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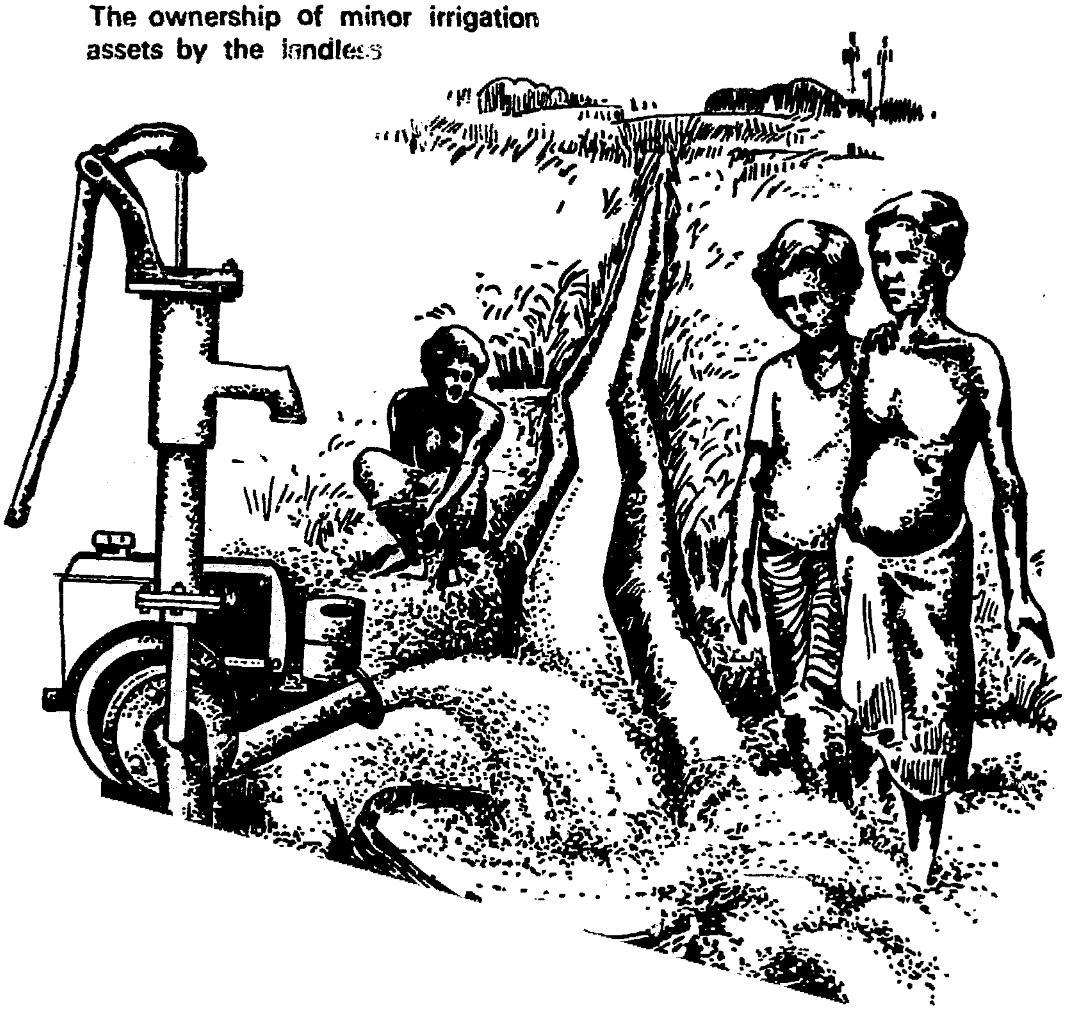
The ownership of minor irrigation assets by the landless



ADAB NEWS Volume X, No. I, January-February, 1983

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ADAB NEWS is a bimonthly journal published by the Agricultural Development Agencies in Bangladesh, a consortium of local and foreign voluntary organisations involved in agricultural and rural development work.

ADAB NEWS contains articles on development issues and offers information on ongoing development projects and programmes undertaken by government and non-government organisations in Bangladesh.

Articles and research papers on any topic related to agriculture or rural development may be sent for publication by any person interested. The papers should not exceed 8000 words. Shorter papers are preferable.

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The Editors appreciate comments and suggestions from the readers of ADAB NEWS

EDITORIAL

Ownership of minor irrigation assets by the landless

Considering the difficulties which are yet to be overcome in initiating a widespread redistribution of land, it is necessary to recognize that rights over non-land assets could provide the landless with significant means for improving their situation and raising their purchasing power. If redistribution of land is an impossibility, agrarian reform measures need to be directed to securing a more equitable distribution of non-land assets.

The government and a number of private voluntary organizations are trying to formulate approaches to facilitate ownership of non-land assets by the landless. In the non-government sector, a significant attempt in this direction has been made in the case of organizing landless groups for irrigation activities. Following government initiatives to develop alternative schemes to involve the landless in the production process, a few NGOs, particularly the Bangladesh Rural Advancement Committee (BRAC) and PROSHIKA started pump ownership programmes for the landless.

In this issue of ADAB NEWS we present papers on the programmes of these two organizations with a view to generate discussions on the problems and prospects of extending the landless irrigation programmes. (See also report on a seminar on the ownership of irrigation assets by the landless, in this issue).

The views expressed in ADAB NEWS are not necessarily those of the Editors or of ADAB's member agencies.

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The Socialisation of Minor Irrigation in Bangladesh

This report prepared by Geoffery D. Wood of the University of Bath, England, and the R. & D. Cell of PROSHIKA, Dhaka, sets out to provide an account of the attempts by some groups of landless and near-landless in Bangladesh, with the support of PROSHIKA, to create and sell irrigation water to cultivators engaged in the production of HYV Boro rice. It should also be noted that other groups unconnected with PROSHIKA but associated, for example, with Bangladesh Rural Advancement Committee (BRAC) and the Grameen Bank have been engaged in a similar exercise. The general conclusion from all the organisations involved is that sufficient success has been achieved to warrant its consideration as a general contributor to rural/agrarian development in Bangladesh. At the same time, problems and failures also exist which need to be carefully examined to see whether they are inherent features of the general principles involved in landless irrigation activity, or whether they can be attributed to specific causes which can be identified beforehand and therefore, avoided in any replication of the programme.

It is probably necessary to explain the background to this programme. The Second Five Year Plan and the Medium Term Food Production Plan had been formulated in principle by the end of 1979. However, there were also concerns within the Ministries of Agriculture and Local Government and Rural Development about both the institutional implications of this strategy in the countryside and the position of the landless whose participation in the supply-side production strategy could, at best, be partial although their numbers were at the same time rising rapidly. The concern within the Ministry was the continued reliance among major donors on a conceptual distinction between growth and equity, accompanied by an unrelenting commitment to the former at the expense of the latter. While formally committed to that overall strategy, the Ministry sought to expose itself to arguments which proposed that growth and equity were inter-related, and that the constraints to production were not technical but social, embodied in the structures of tenancy, money-lending and tied-labour, and the relative problems of effective demand stemming from pre-capitalist forms of servitude.

Since a key element of the Second Five Year Plan involved a rapid expansion of irrigation in rural Bangladesh through minor irrigation technology, it raised the question of water as an agrarian means of production second only to land in significance. The danger of the strategy, as seen by the World Bank, was the concentration of those new, uninstitutionalised water assets in the hands of those who already possessed rural capital either in the form of land or cash and other commercial forms of accumulation. Such a pattern of control over water might ensure that large farmers obtained water to expand their production into another season, but the question was never asked whether the incentives to expand production actually existed for potentially progressive farmers in the absence of any provision to ensure a buoyant rural demand for the produce. According to one World Bank report, during the first half of the 1980's approximately 2.3 million new entrants to the rural labour force will not be able to find gainful employment; and this figure has to be added to the prevailing situation of rural under-employment.

Although the Ministry was exposed to a number of ideas concerning the involvement of the landless and the near-landless in capturing rural property rights other than land, the issues raised concerning water quickly assumed prominence in the context of the major programme to sell minor irrigation technology (LLP's and STW's especially)—initially through the BADC, but eventually through the open-market with the support of an initial 40 million dollar IDA-line of credit, on a private basis to whoever could guarantee the requisite collateral. The Ministry therefore encouraged the efforts to develop an alternative approach to the ownership of minor irrigation assets involving landless groups establishing water rights (or capturing them, in some cases, where contractors had been renting LLP's from the BADC and selling water to farmers usually at high rates which effectively excluded the smaller farmers). In this way, landless groups would not only participate centrally in the new production processes, but they would at the same time contribute to effective demand for the expanded production.

As a result, the Integrated Rural Development Programme (IRDP), with the support of LGRD, undertook to prepare an experimental programme through its newly formed Irrigation Management Cell based on its existing, limited programmes with the landless groups. In the meantime, the Ministry of Agriculture encouraged NGO's like PROSHIKA and BRAC, as well as Grameen Bank to become involved on a similar experimental basis, following the principles of management and organisation which were consistent with their respective organisations. As part of this programme, PROSHIKA, which had already expressed interest in the underlying principles of the approach, presented the ideas to some of the landless groups with which it was involved and got an enthusiastic response from the members who had already been thinking on similar lines.

Objectives of the programme

The objectives of the PROSHIKA programme are:

1. To facilitate the acquisition and use of LLP's and STW's landless groups to enable them to sell water to owners and cultivators of land.

2. To develop a source of income and therefore purchasing power among those groups under conditions where the rates of reward are partially determined by their control of productive assets, other than labour.

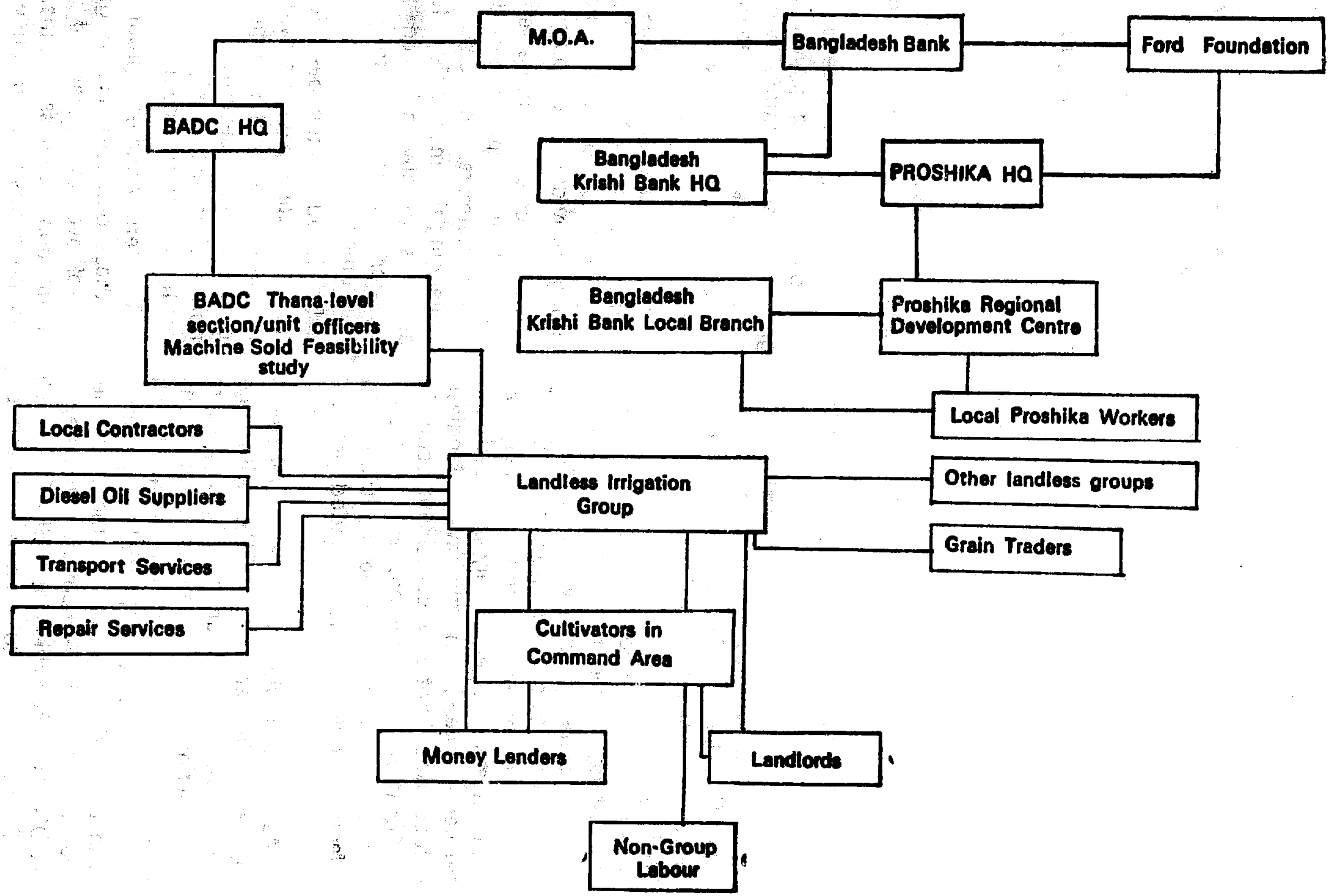
3. To ensure that landless groups share in the benefits from the enhanced productivity of land to which they contribute through providing the source of irrigation.

4. To achieve a more efficient use of water through its wider distribution to smaller farmers, including tenants, by challenging the monopoly of larger farmers/landlords usually achieved through their superior access to the market and government.

5. To add to the basis for the landless groups to participate in a wider programme of non-independent economic activity and to the material security required for any individual to act freely in the democratic institutions of the country.

The term 'landless group' was defined for these purposes as: A group with no control over the means of production or distribution; landless or marginal farmers with no assets; fishermen with no implements; rural artisans who lack working

Diagram 1
Network of Landless Irrigation Programme



capital or raw material ; families who sell their manual labour ; and women of the above groups.

Performance analysis : variables

There are 83 landless groups deploying the STW and LLP technology. These groups are distributed over 11 areas of Bangladesh. Although many organisations have been involved in the network of action, the main burden of innovation has undoubtedly been with the groups themselves. Since the groups are distributed over these 11 areas, they are innovating under very different sets of ecological and socio-economic conditions. As a result, there are many variations in the practice affecting agreements with cultivators, forms of payment, the value of the water fee as a proportion of the crop, size of command areas, irrigation practices, rates of pumping, owner-tenant composition of the command area, numbers of groups themselves cultivating in the command area, prices of paddy sources of finance, and so on.

The nature of these variations could not be predicted at the outset of this work. The range of possibilities could only be learnt by doing—which means that the groups have to identify by a process of trial and error, which particular combination of variables best suits their local circumstances.

The season 1981-82 constitutes the basis for the analysis of the STW and LLP groups, even though it is not actually the first season for a minority of the groups. The data do not represent a fair picture of landless irrigation activity from its opening stages, because although some learning has taken place (crucially around setting a date for the making of agreements, obtaining loan sanctions and a dead-line for the date of installation—especially in the case of shallow tube-well). These are lessons which can be regularly transferred to new irrigation activity. That is to say that some (not all) of our first season problems appear to be genuinely one-off. However, it must also be recognized that in each landless group and in each command area, irrigation practices followed together with rates of pumping and in pricing arrangements for the service.

At this stage, based only on the data arising out of the PROSHIKA programme, the groups' performance can only be compared internally. However, two other kinds of comparison should be recognized and considered as soon as possible. First, a comparison with the experience of other landless irrigation group activity involving other organisations such as BRAC and the Grameen Bank ; and secondly a comparison with the privatised STW programmes in terms of land productivity, rates of fuel use, access for small farmers, employment for the landless, and so on.

The STW groups

In total, there are 51 STW schemes. From the data on the STW groups, a number of key variables emerge which account for the pattern of performance : size of command area ; income per group as well as income per acre ; diesel costs as proportion both of income and operating costs ; rates of diesel use per acre ; forms of agreement (although these usually vary by region rather than performance). There are numerous other variables whose general significance is less clear, although these can be detected in particular cases of strength or weakness. For this reason, not all those variables have been tabulated for the purposes of this report, but examples of such variables would be : one-off first season capital costs ; salaries for group operatives (charged as a cost on income for accounting purposes although it does not accrue as an income to individual members of the group) ; oil and grease ; spare parts, repair services ; payment of fees in advance (thus reducing operating cost loan liabilities) ; and the efficiency of the equipment itself (measured in terms of pumping time per gallon).

Command area size

A strong association exists between command area size and a group's performance. In all areas the successful groups have larger command areas. Successful groups average 14.6 acres, and unsuccessful ones 9.7 acres. Indeed all the regional averages for the command areas of unsuccessful groups are below the lowest successful one of 12.9 acres in Nagarpur. It is interesting that this last figure approximates our original assumption of a minimum of 13 acres as a viable command area size to optimise equipment use and maximise income returns.

Overall, the data on this critical variable is encouraging with an overall average of 13.4 acres achieved. It has to be remembered that out of the 51 STW schemes, 34 are in their first season with a total command area acreage of 446.9 acres (Bhairab, Chatalpur and two in Madaripur are in their second season), giving an average of 13.7 acres per group. This represents a highly significant learning factor from the experience of the first season (especially in Bhairab) when delayed dates of boring and equipment installation resulted in sub-optimal command areas in the 80—81 season. For the 81—82 season, groups entering the programme for the first time were informed of this problem via PROSHIKA workers, workshops, etc., and a dead-line was established for installation and tested capacity date beyond which the purchase and operation of equipment would not proceed for the 81—82 season. In this way, the farmers could be certain that the irrigation facility was available, therefore justifying investments in HYV seedbed preparation, digging field channels, etc. Where tube-well irrigation is new to a locality (whether owned and managed by the landless or not) the risks for farmers is as high as for equipment owners, so that developing confident expectations about regular and adequate water supply is crucial. The size of the command area for the 34 first season groups certainly demonstrates that with correct timing, a scheme does not have to creep towards its optimal command area over a period of years.

Despite the significance of the command area size variable in distinguishing between our general categories of performance, it is less significant in determining the extent of success. When distribution of command area size and average return per group and per acre are compared, it is seen that the successful groups in Shibganj, with the highest average command area of 16.6 acres, achieve an average return of Tk. 1852 per group and Tk. 112 per acre. Successful groups in five other areas with lower command areas are achieving a higher rate of success, including the successful groups in Nagarpur with the lowest command area average of 12.9 but with an average net return of Tk 4129 per group and Tk 319 per acre.

Nor has the command area variable entirely determined the income receipts per group. The Shibganj successful groups with the highest average of 16.6 acres are ranked 6th (with gross receipts or Tk. 18,185 pergroup) out of the seven regions in which there are successful groups. This is actually lower than for the unsuccessful in Nagarpur with an average gross income per group of Tk 19,081 and an average command area of 11.25 acres. The successful groups in Ghior, on the other hand, with an average command area of 13.2 acres (the second lowest) are receiving an average gross income per group of Tk 29,707 (the second highest), although Ghior achieves the highest average income per acre of Tk 2263.

Form of payment

The first variable which limits the significance of the command area is the form of payment between the sellers and the purchasers of water. Twenty of the 51 STW groups receive payment in the form of a 33 percent share of the standing crop. Fifteen out of these 20 are successful, but, more significantly, the extent of their success is greater than for successful groups receiving other forms of payment. These 15 groups are in Saturia, Ghior, Nagarpur and Madaripur which are the most successful groups whether measured by gross income per group, gross income per acre, or net income per group and per acre.

In all cases where a 33 percent crop-share payment has been made, the agreement includes an insistence that the cultivators perform the full related package of cultivation practices (weeding, fertilizer and pesticide application). Only in one other scheme has this provision been included (Serial No. 19 in Bhairab where the water fee is a cash payment, with the farmer supplying the diesel). At this stage in the programme, under current conditions of paddy prices, etc., this 33 percent crop-share fee seems to be the most beneficial for the groups, since other forms of payment—even including the unsuccessful groups—all result in lower incomes per acre.

Using Tk 130 per maund as the basis, the income per acre figure for successful groups in these four regions suggests a range of per acre yields from 42-52 maunds. We do not have reliable comparative information on yields, but it is likely that for the first season command areas this is the top end of the yield range for STW schemes. If this is the case (and it has to be investigated further), then the implication would be that this 33 percent crop-share fee arrangement also provides the greatest incentive for the cultivators to maximise the productivity of their land. (Such a conclusion would certainly lend strength to the argument that crop-share forms of exchange are not always inefficient, and depend upon or take their meaning from the conditions and relationships which surround them).

Other forms of payment are not yielding the same amount of income or return for the other 23 successful groups. The 10 (out of 11) successful groups from Shibganj with fixed cash arrangements record low incomes per group, low incomes per acre, and low net returns per group and per acre. Leaving aside the one successful group from Chatalpur, only Bhairab is worse. The 14 groups in Bhairab (now in their second season) are involved in different fee arrangements: seven are receiving 25 percent crop-share; five fixed cash; and two fixed kind payments. Of those seven, five are successful by the criteria we have been using, although it should be recorded that three of those 'successes' are very marginal (benefitting from the 'without depreciation' criteria); three out of the five fixed cash are successful, although all three are marginal; and the two fixed kind payment groups are successful, though diesel is paid by the farmers in both the cases.

Taking Bhairab as a whole, the net return position is clearly unsatisfactory, even after the attempts to improve it from the first season and recognizing that our cost/return data have been based on the interacting variables in the better second season only. Levels of income are clearly the main problem since the command areas broadly conform to our assumptions, and rates of diesel use are the second lowest for all the STW groups after monitoring the high per acre fuel consumption in the first season. This impression is reinforced by the fact/that diesel costs nevertheless represent 31 per cent of income. If the STW programme is to continue in Bhairab (or even expand as other groups are requesting), then the water fees have to be raised. This might be linked to agreements where farmers pay for diesel in advance since the two most successful Bhairab groups follow this practice combined with a fixed kind payment. Certainly, the groups have responded well to

TABLE : 1.

SUMMARY OF LANDLESS GROUPS DEPLOYING STW TECHNOLOGY BY REGION

Region	No. of Gr.	Group Members		Size of Command area		No. of Cultivators in Command area (In Group Members)		Average irrigated area per cultivator (Acres)	Net return (After Depreciation)		Net loss After Depreciation		Net return without Depreciation		Net loss without Depreciation		Water fee Arangement
		No.	Av.	Total	Av.	Total	Av.		No.	%	No.	%	No.	%	No.	%	
1. Mirzapur/Tangail	5	73	15	59.76	11.45	157	31	·36	3	60	2	40	3	60	2	40	F/Cash
2. Chatalper/Comilla	1	9	9	6.0	6.0	24	24	·25	0	0	1	400	0	0	1	100	F/Cash
3. Bhairab/Myn.—D	14	234	17	183.09	13.07	421	30	·43	4	29	10	71	10	71	4	29	50%-25%share 36% cash 14% kind
4. Saturia/Dhaka—D	4	83	21	53.0	13.25	149	37	·36	3	75	1	25	3	75	1	25	33% share
5. Ghior/Dhaka—D	3	79	26	39.76	13.25	80	27	·5	3	100	0	0	3	100	0	0	33% share
6. Shibgonj/Bogra—D	11	293	27	176.46	16.08	402	36	·44	8	73	3	27	10	91	1	9	F/Cash
7. Nagarpur/Tangail-D	8	232	29	98.08	12.27	202	25	·49	5	63	3	37	5	63	3	37	33% share
8. Madaripur/Far.—D	5	86	17	68.0	13.6	167	33	.41	2	40	3	60	4	80	1	20	33% share
Total/Average	51	1089	21	684.75	13.4	1602	31	·44	28	55	23	45	38	75	13	25	

the criticisms made in the previous season by extending the command areas and controlling diesel consumption more closely.

Rates of fuel use

Diesel expenses for the engines represent the largest proportion of operating cost. The rate of fuel use was therefore always expected to be a significant variable in determining success or failure. However, the variable is complicated by different rates of machine efficiency and of course variations in soil types with clay demanding less water than sandy soils, with loam somewhere in between. Many command areas combine these soil types in different proportions, and although we have collected data on predominant soil characteristics which do clearly explain different rates of pumping (hours per acre and gallons per acre) in some cases it is difficult to be precise with respect to soil type. However, it has been possible to record diesel costs and hours of pumping.

Within each region, there is a clear correlation between diesel cost as a proportion of income and diesel used per acre (a standard price of Tk 25 per gallon has been used to convert gallons into cost, average pumping per acre and performance). Since the pattern of variation between diesel as a proportion of operating cost, and performance (an overall average of 25 percent for successful groups and 23 percent for unsuccessful) is not so clearly and regularly differentiated, we can assume that it is the relationship between income and diesel cost which accounts for performance. Saturia and Ghior (where six out of seven groups are successful) have the highest average net return per acre (over double their nearest successful rivals in Nagarpur), but the lowest diesel cost/income ratios of 18 percent and 22 percent respectively. This relationship is further reinforced by considering groups with the highest negative net returns in, for example, Chatalpur, Madaripur and Saturia, where the diesel cost income ratios are, respectively, 65 percent and 52 percent.

Scope for improvement

There is obvious scope for improvement in the performance of the STW groups, especially as the average net return for the ten groups in Bhairab designated by the 'without depreciation' criteria as successful actually amounts to Tk 1.4 per group and 10 paisha per acre. And it has also to be remembered that the groups in Bhairab are actually engaged in their second season of irrigation activity so that problems cannot merely be attributed to learning issues, late installations and below optimum command areas.

However, the extent of innovation required by this technology from water sellers and farmers alike must also be recognized. By definition at this stage of the introduction of STW's in Bangladesh, there has been little experience in any locality of irrigated, HYV boro rice cultivation. New command areas and new concepts of water management, field operations and applications of inputs have to be brought into an optimum combination for the specific conditions obtaining in any locality. Local knowledge has to interact with the technical specifications of the equipment and new varieties. It is unrealistic to expect a high rate of initial success.

LLP groups

The analysis of the performance of the groups using LLP technology is complicated by a distinction between purchased and rental schemes. Of the 32 LLP group schemes, eight are rental and these are concentrated in Chatalpur.

The inclusion of subsidized rental schemes, in the 32 LLP groups of this programme has not significantly distorted the over-all picture of performance. Rented schemes represent 25 percent of the total with successful and unsuccessful schemes at 24 percent and 28.6 percent of their respective subtotals.

Chatalpur, where the rented schemes are concentrated, is a single winter crop area with an approximately 15-year history of low lift pump irrigation with individual entrepreneurs/contractors renting equipment from the BADC. In such are[illegible] familiar with mechanised irrigation, it [illegible] been important that landless groups sh[illegible]gin the process of capturing water rights during the phasing out of rental arrangements (i.e., having the insecure period subsidized during which the landless are establishing their rights) to lay a viable foundation both in command areas and in confidence among farmers in their capacity to deliver an irrigation service prior to the period when the landless groups have to commit themselves to the purchase of equipment. Indeed we had hoped that landless groups would have been able to participate in the rental arrangements over a longer period of time (i.e., involving a delay in implementation of the government's privatisation of minor irrigation) to enable them to accumulate capital for subsequent purchase under the favourable conditions of subsidy.

Unsuccessful groups

A total of 78 percent of the LLP groups are successful and 22 percent are unsuccessful. It is interesting to note that the LLP groups in difficulty are primarily concentrated in one locality (four in Ulania out of a total of seven unsuccessful groups) revealing an incompatibility between precise choice of technology and the local condition. In other words, a mistake was made among elements of the programmes network and can be corrected. Such a mistake constitutes an example of action research/learning by doing methodology for rural change.

Before describing it, the wider point to emphasize is that LLP technology, unlike STW, has not generated common problems for all group users irrespective of particular conditions. An example in the case of STW's is the small scope for error in securing a satisfactory command area size to deploy a STW in a financially viable way. Optimism concerning the use of LLP by the landless is justified on this basis. The problem in Ulania is the local average command area size per group of 16.6 acres. Even the successful groups where two out of three have marginal negative net returns (Nos. 23 and 24) and are assisted into the 'successful' category by removing the depreciation element from the calculation, have an average command area of 19.3 acres.

The constraint in securing an optimal command area size was technical rather than social or political. The area is tidal and the significance of this had not been appreciated for the capacity of LLP to be installed. Pumping could only occur when the tide was in and functioning to maintain acceptable levels for pump extraction in the down-flow rivers and canals. At the same time, these levels were insufficient to maintain the rate of water extraction demanded by the capacity of 2 cusec machines. As a result, these machines were underutilised, with command areas naturally shrinking to a size consistent with the availability of water rather than the potential of the equipment.

The two unsuccessful cases in Chatalpur (Nos. 30 and 31) are surprising in that the pump-sets were rented. The two cases are not identical in their combination of problems, but both had small command areas (35 and 33.5 acres) compared to the other schemes in Chatalpur. However against this, No 34 was also a rental scheme with a command area of 36.5 acres. The average income per acre Nos 30 and 31 is Tk 569—the equivalent of 4.4 maunds of paddy per acre (at Tk 130 per maund). However, the rate for No. 34 is Tk 1040 per acre, the equivalent of eight maunds of paddy per acre.

It is not easy to explain this varia-

TABLE : 2

SUMMARY OF LANDLESS GROUPS DEPLOYING LLP TECHNOLOGY BY REGION

Region	No. of Gr.	Group members		Size of command area		No. of cultivators in command area (In Group Members)		Average irrigated area per cultivator (Acres)	Net return (after depreciation		Net loss after depreciation		Net return without depreciation		Net loss without depreciation		Water fee Arrangement
		No.	Av.	Total	Av.	Total	Av.		No.	%	No.	%	No.	%	No.	%	
1. Ulania/Barisal-D	7	113	16	115.94	16.50	185[1]	31	.52[2]	1	14	6	86	3	43	4	57	F/Cash
2. Chatalper/ Comilla—D	8	442	55	427.47	53.43	691[4]	86	.62	6	75	2	25	6	75	2	25	7 Fixed kind
R																	
P	2	26	13	100.0	50.0	23.6	118	.42	1	50	1	50	2	100	0	0	F/Cash
,,	10	468	47	468	47	527.47	52.25	.57	7	70	3	30	8	80	2	20	7 kind 3cash
3. K. jury/Myn-D	12	233	19	455.02	37.9	480	40	.95	12	100	0	0	12	100	0	0	11 kind 1 50%share(3)
4. Kalkini/Far.-D	3	44	15	53.0	17.66	83	28	.64	2	67	1	33	2	67	1	33	F/Cash
Total/Average	32	858	27	1151.43	35.93	1675	52	.69	22	69	10	31	25	78	7	22	

Notes :
1. Details of one Command Area missing, so $\frac{183}{6}=31$
2. Calculated without 19 acres of CA where cultivators details are missing
3. Command area in khas land, 15 acres, occupied by all 51 of group members.
4. In 2 of these rented schemes, 2 lip one used. In one case the CA is 120 acres with 200 cultivators, 156 from groups.

tion in rates of income but a plausible account is suggested from the proforma data. The groups 30 and 31 are small, with 10 and 11 members respectively.

The group members were not sufficiently strong in the bargaining over price with large number of non-group customers whose own margins on production costs were very tight. There is also the possibility (as we learn from the previous season) that, since this is an area where LLP irrigation had been managed for up to 15 years by individuals, contractors and entrepreneurs renting equipment from the BADC, the landless groups had to offer a low price for water as part of their strategy for capturing the asset.

In one scheme, Tk 7000 costs were incurred for spare parts for machine which was rented. Corroborative evidence of machine difficulty is provided by the low (though not the lowest) machine efficiency rate of 1.3 hours per gallon of diesel. This suggests that the group was allocated an old machine by the BADC. A closer investigation is necessary, for this phenomenon does direct us to a potentially more common problem in later years as purchased equipment requires repairs more frequently through age and the question of liability for repair and spare parts cost has to be raised.

The final unsuccessful case to consider is in the Kalkini project area of Faridpur District. The command area is very low at nine acres, while the rate of pumping is very high at nearly 144 hours per acre and 30 gallons of diesel per acre. The command area consists uniquely and entirely of sandy soil where, of course, water absorption is high so that higher rates of pumping per acre should be expected.

The difficulty however, cannot be attributed to the high fee only, since pumping had been interrupted during the season, thereby affecting crop yields. These interruptions were not only mechanical, since a rich man had also interfered and tried to stop the scheme. More details on this are needed, but it is evident that some competition was taking place for rights over command areas in the locality and this might explain the small command area. The Kalkini scheme might have been inappropriately encouraged because of such difficulties and the sandy soil; or it may be necessary to regard this as an example of the need to 'fund' a group during its attempts to capture or assert its rights over the provision of irrigation water in particular localities.

Successful groups

The main areas of success are in the Khaliajuri project area of Mymensingh District and Chatalpar in Comilla District. Khaliajuri is all the more impressive as all the equipment was obtained through purchase rather than rental. The average net return per group after one season was Tk 16,287, vastly exceeding the other LLP (purchased) group projects. Because of the purchase factor, we should concentrate upon trying to establish a pattern to the success in Khaliajuri and learn from it either for expansion there or in other project areas. However, we are the first to appreciate that experience in one region cannot be merely replicated elsewhere. Much depends not just on physical variables but on the systems of landholding patterns of land distribution and the history of struggles between rural classes in a locality. With such caveats, let us investigate the Khaliajuri groups more closely.

First it must be recognised that most of the groups have schemes in the Haor area or just on the edge of it. It has therefore predominantly been a Boro single-crop area well-used to irrigated rice cultivation using mainly *dhon* techniques. As a result, the value of irrigation water has all along been accepted by landholders. In some of the areas of the edge of the Haor where the ground is higher, broadcast Aman (April to November/De-

Table 3

Summary of financial position of STW groups

With depreciation Allowance	No.	%	Gross return	Av. retrun	Without deprec. allow. No.	%	Gross return	Ave. return
Successful	28	55	143225	5115	38	75	133895	3524
Unsuccessful	23	45	—79162	—3442	13	25	—69841	—5372
	51	100	64063	+1256	51	100	64063	+1256

Table 4

Summary of financial position for LLP groups

With deprec. allowance	No.	%	Gross Return	Av. Return	Without Deprec. allow. No.	%	Gross Return	Av. Return
Successful	22	69	204047	12575*	25	78	260916	10872
Unsuccessful	10	31	43059	4306	7	22	39928	5404

cember) can, with irrigation, now be replaced by a Boro—T Aman rotation. Such a rotation has a much higher labour demand, and the implications of this will be discussed below.

Second, the main effect of this history of irrigation (either through traditional methods on small areas of land, or during the last 15 years with individual entrepreneurs renting LLPs from the BADC) has been the apparent willingness of farmers to commit their land to command areas and themselves to agreements. The average size of command area is 27.9 acres per scheme, and all agreements run for five years with 2 cusec. pumps. This average acreage might indicate some under-utilised capacity which could be absorbed in subsequent seasons.

However, there appear to be three main constraints on expending the command area size further. Most of the command areas are in effect extensions of existing Boro land which has been *dhon* irrigated or low enough to retain sufficient moisture. These areas resemble very shallow not necessarily circular bowls (dishes, saucers) and mechanised irrigation is required for the 'sides' away from the low 'centre'. But the size of these shallow depressions impose a natural limit to feasible irrigation. Also, these areas can be remote from villages and landholders, making the supervision of a farmers' investment sometimes precarious. This also explains why sharecroppers in the command areas are more frequent than in other project areas. Finally, the quality of soil is a limiting factor. Six out of the 12 command areas have a clay constitution which facilitates irrigation over a wider area of less permeable soil for a given rate of pumping. In these six command areas, the average size was 41.6 acres compared to an average of 34 acres for the command areas consisting of the more permeable sandy/loam mix.

Third, it is actually noticeable that the hours of pumping per acre are also lower for the command areas with clay (Nos 45-49 and 56) at 15.6 hours per acre compared with 22.8 hours per acre. There also appears to be a strong correlation between this clay soil/pumping/diesel-use variable and the net return per group. Groups with command areas averaging 41.6 acres, with clay soils and 15.6 hours per acre pumping rate have an average net return of Tk 21,032.6. Groups in the other category (leaving No. 53 out of this calculation due to lack of data) have an average net return of Tk 10,592.6.

Social relations

Throughout this report, so far, the terms successful or unsuccessful have been used specifically to measure performance as a positive or negative net return. The analysis has concentrated upon the rather narrow but crucial criteria of financial viability despite the broader structural objectives of the programme. This emphasis has been intentional since financial viability is a necessary, though far from sufficient, condition for continuing and expending this approach to agrarian reform. Such concern, we feel, is justified as an initial consideration in a programme which seeks to generate the conditions of material independence or strength amongst landless classes. In this sense, the net return is unavoidably an index of this material independence in the process of breaking down erstwhile relations of dependence by the landless and near-landless upon landlords, money-lenders, and employers.

However, financial viability is by no means a sufficient condition of such independence and may indeed disguise the truth of such relations. The measurement of 'success' in these terms can only show that in principle a group can honour all the new financial obligations incurred as a result of participating in rural production in this way so that relationships of financial dependency are not actually being increased. The existence of 'acceptable' net return in 75 percent of the STW groups and 78 percent of the LLP groups cannot therefore be the basis of complacency.

A positive net return might be complete meaningless, if it is merely reflecting a relation of employment activity or if it is immediately absorbed in the partial honouring of usurious debt obligations. This section of the report must therefore consider the structural implications of the rural landless owing and deploying minor irrigation assets and it must include within this assessment, the constraints, both technical and social which the groups have faced and are likely to face in reproducing and expanding the activity in later seasons.

Of course, maintaining group solidarity under pressure is never easy with individual group members in personal situations of precarious dependency and subservience to dominant families in a village. If those families have land in the command area, the pressures on individual group members are even more complex. Group members are also faced with conflicts of loyalty between *bari* or wider kin relations and their obligations to fellow group members.

One case was reported from Bhairab in the first season where a non-group landholder with kinship links to a member had attempted to obtain a reduction in his water fee by promising to split the difference with his kinsman in the group.

Debt and mortgage relations exist between individual Samity members and rich landholders with land in the command area. Attempts by those landholders to subvert the agreements were reported by the group.

Threatening deals have to be expected all the time, so that the solidarity and consciousness of groups based on a sense of common interest which outweighs competing loyalties and obligations becomes an important selection criterion for participation in the request of the landless for rents from water and other non-land rural means of production.

Organisational innovation and the socialisation of irrigation

The groups themselves have evolved organisational responses to reinforce or even maintain the solidarity and resolve of their members under pressure. There have been considerable variations from the initial assumption of one group (of e.g., 15-30 members) per scheme, especially in the case of LLP schemes. At present, STW groups are mainly operating independently of other groups, but in four schemes, two or more groups have joined together for irrigation. In another instance in Bhairab, a STW group received the support of other non-participating groups in a dispute with some of the farmers in the command area. However, for the STW groups, the command areas are small and so, therefore, are the numbers of farmers with whom the group has to negotiate over prices, crops, cultivation practices and water distribution.

The situation is different for LLP schemes. The size of the command area is much larger and consequently so too is the number of non-group cultivators receiving irrigation. Under these conditions, different units or levels of operation have emerged: an implementing group (possibly just a reference to the appointment of a driver or lineman from a group); a group signature for a loan from the BKB and other groups (sometimes in the form of a village committee) which in effect collectively commission the activity and to which profit ultimately accrues from the activity. These distinctions particularly emerged during the first season in the Aurail projects which are not included in the formal data for this report. However, the experience is worth relating because of its relevance to the practices of groups elsewhere, now and in the future.

Several reasons emerged for this network of organisational arrangements. First there is the issue of collecting water charges from a large number of farmers, for which a wider expression of landless solidarity is requred than a single group can display. The highest number of non-group cultivators in this year's LLP schemes was 105.

Recalcitrant farmers using delaying tactics to avoid payment then have a larger village committee with which to contend. In one Aurail scheme last year, fee collection itself was not undertaken by the group or individuals who are actually responsible for distributing water. This had the advantage of preventing a further round of negotiations and arguments at the time of payment over whether sufficient and timely water had been delivered.

Second, with the large command areas associated with LLPs, possession and management by a single group would effectively excude other groups in the *para* from ever gaining access to or benefits from this activity. There cannot be enough command areas to distribute between all the groups of a locality, especially when several pump units are involved in one scheme.

Third, the political implication of different patterns of ownership is important. There is a danger, to our philosophy at least, (especially at the higher rates of net return) of small group ownership of irrigation assets reproducing the notion of private property along with petty commodity perceptions, perhaps leading to divisions within those groups if aspirant contractors emerge. With a larger number of groups involved under the conditions noted above, the ownership of these assets is socialised at a wider level, strengthening the themes of collective economic activity and united political consciousness.

There are other advantages to such organisational flexibility: economics of scale on drain construction and maintenance, fuel provision of services such as fertilizer procurement and application; profit can be more easily diverted into other activities; and scheme functionaries (driver, lineman, manager, etc.) can be more adequately supervised by wider, collective pressure.

The capture of water rights

So far, the problems of solidarity of groups have been discussed on the assumption that command areas have been established and that the conflicts concern the effective implementation of agreements. However, the conditions under which groups secure water rights vary according to cropping patterns; class relations in prior irrigation arrangements; class alliances with state institutions such as the BADC, the courts, District Development Committees and local government; attitudes of different classes of farmers in the potential command area; and employment patterns.

In Madaripur and some of the Bhairab STW areas, problems with the BADC have been dominant. Some farmers over previous years have tried unsuccessfully to obtain STW's from the BADC but they had been overcome by delays, requests for bribes, etc. Therefore, despite the current supply of equipment, farmers made no attempt to organise and purchase a STW from BADC. Instead they had been watching with scepticism to see if the groups could succeed where they had not. This does, of course, raise issues for subsequent seasons where contractors or groups of richer farmers in the locality of a landless irrigation initiative may be encouraged to compete for command areas, employing their traditional relationships of access to the BADC.

With LLP command areas, the problem has often been to enter an existing market for irrigation water which, under rental conditions has been dominated by large contractors and rich farmer/petty landlords. Since the rates of return to contractors under rental arrangements have been potentially very high, the power of patronage of BADC Thana Unit Officials (and upwards) has been considerable. Large sums of money have therefore changed hands in those transactions at the time of

TABLE 5

Distribution of Tenants in the command areas, as a proportion of total cultivators

LLP GROUPS	Non-Group Leasing on CA % Total Cultivators	Group Leasing in on CA % Total Cultivators	Total Leasing in on CA. % Total Cultivators
Location			
Ulania	55	17	72
Chatalpar	5	2.6	7.6
Khaliajuri	17.5	1.25	18.75
Khalkini	11	11	22
TOTAL	15	4.4	19.4
STW GROUPS			
Mirzapur	10	1.3	11.3
Bhairab	4	1.2	5.2
Chatalpar	—	—	—
Saturia	15.4	8.7	24.1
Ghior	—	—	—
Shibganj	9.2	31	40.2
Nagarpur	—	—	—
Madaripur	15.6	9.6	25.2
TOTAL	7.4	10	17.4
TOTAL	11.3	7.1	18.4

SOURCE : PROFORMA DATA.

application with command area cultivators as the ultimate source of it.

In areas where rental arrangements have until now been retained, such as Chatalpar in Comilla District, the landless groups as discussed before, had to make competitive applications to the BADC (based on evidence of farmers' willingness to contract with the water-seller) by driving down the rate of the water-fee to farmers. This is why the income of those projects was not very high (about 5 maunds per acre), while the net return was higher because costs were lower and more heavily subsidised. This is also why two rental LLP schemes were 'unsuccessful' by these criteria. However, those rental arrangements have provided a subsidised basis for landless group entry into the water/irrigation market.

As suggested above, a continuation of rental arrangements for landless groups in their first two seasons of irrigation service could be a vital policy initiative, provided that once entry is established and purchase becomes necessary, the water-fee can rise to a level consistent with the costs of running purchased equipment (i.e., an economic cost). The problem with this bidding down strategy of entry is that, initially at least, the beneficiaries of these subsidies are clearly the farmers—especially the larger ones. Some of this subsidy (approx. 30 percent of total cost) will be maintained for LLP's under purchase conditions. In these circumstances, it is imperative that the groups quickly move to re-establish and raise their share of the agricultural products as soon as the farmers are convinced of their access to water under the groups' management.

There is a further implication of the shift to 'purchase only' conditions for LLPs related to the capturing of water rights. In an open market situation without any formal, state organised zoning controls from season to season (except that enshrined in long-term contracts which can be broken anyway), rights of prospective water-sellers to command areas remain insecure and constitute a continual object of competitive bids. This changes the nature of the current race between classes to secure these assets under World Bank inspired liberal supply conditions. Presumbly if a non-LLP owner presents a water service proposal to the farmers of a command area which, through its acceptance, effectively displaces the existing owner of the LLP previously supplying the same command area, then LLPs will be continually bought and sold in the countryside over the next few years, long after this urgent period of sale through the BADC and other dealers. To some extent, the same possibility applies to STWs as well.

This means that the period in which landless groups must acquire water rights is not finite. Groups may fare better than individuals in the water-selling business as they can perhaps apply more pressure and sanction in the collection of water fees. Also, they can more easily ensure fair and regular allocations of water to the plots of different cultivators (different in the sense of class and *bari* status) in the command area.

Relations with small farmers and sharecroppers

It was always recognised that the socio-economic basis for this programme did not consist of a simple antagonistic division between the landless and cultivating farmers. It is well-known that there are many rural families in Bangladesh which can be described as 'marginal' or 'small' farmers in addition to the near landless category already discussed. And of course this picture is further complicated by the presence of tenants and sharecroppers leasing-in land as a supplement to their own holdings or as their only access to cultivation.

An objective of the landless irrigation programme is to improve the access of such small farmers to irrigation, on the assumption that their status and weak political position in the community invariably discriminate against them in the community in the competition for allocations of water from private contractor/large land-holder sources. In the 51 STW schemes, 32.5 percent of the owning cultivators and landlords (group and non-group) have total holdings (inside and outside of the command areas) of less than 1 acre; 54 per cent have less than 2 acres. In the LLP schemes, corresponding figures are 43.5 and 59 percent respectively.

Two kinds of benefits to small owner cultivators are apparent. First in the new command areas, this additional season, with potentially high yields, has some impact upon the total availability of their holdings making them less dependent upon joining the local supply of labour themselves. Secondly, in the older, more-established, command areas (in LLP areas) where there has been a bidding down of the price for water, the economics of their winter cultivation is being transformed. In both cases, the particular problem of access to water is being managed by the groups, with whom the small farmers can interact on more equal terms.

We must also be concerned with the effect of irrigation upon tenancy. There are general issues here which apply to the whole minor irrigation strategy in Bangladesh, particularly whether the enhanced value of land through irrigation functions to displace sharecroppers. This can only be assessed over a longer time period. A second issue refers to the effect of irrigation upon share agreements between tenants and landlords. Three main types of landlord-sharecropper production/cost share arrangements have appeared in the context of a water fee. These are shown below in Diagram 2.

Without independent data on yields, it is difficult at this stage to compare any effect of these types of landlord-tenant arrangements upon sharecropper incomes. Yields can only be derived where the water fee to the group is in the form of crop share, and this only applies to Saturia, Madaripur, and some of Bhairab and Mirpur in Diagram 2, as no sharecroppers are recorded for the other crop share/water regions of Ghior and Nagarpur.

An experimental calculation based on a fixed assumed yield of 40 maunds per acre would actually suggest that sharecroppers under type Ia (Diagram 2) in Saturia would be worse-off with gross income (after water fee) of 13.33 maunds. But it is recognised that this is an unrealistic calculation, as the actual production in Saturia, based on a mutiple of average income per acre, reveal a yield of approximately 46 maunds. Furthermore, it is assumed that a 33 percent crop share as payment for water has a positive effect on farmers' cultivation practices and pushes up the yield per acre relative to other forms of payment.

Bearing this in mind, Type 3 (Diagram 2) is probably the most unproductive relationship. This speculation seems to be supported by the evidence from Chatalpar (with low rates of fixed payment in kind and therefore the lowest average income per acre at Tk 696). Closer, special investigation of the implications of these arrangements for productivity and sharecroppers' incomes are clearly required.

As far as this programme is concerned, perhaps the final point to note on tenancy is its high incidence, first in Ulania and then is Shibganj, compared with the other regions. In Ulania, this can be attributed to the same phenomenon which caused the mislocation of the 2 cu. sec. pump sets. The former are char lands, newly available for cultivation and yet precarious with salinity problems, in an area which for those reasons has a long history of landlord domination with hungry people keen to cultivate marginal and unstable land. Absentee landlords are common in such difficult and remote terrain. Shibganj in Bogra represents a slightly different history of landlord-tenant relations and polarisation of landholding. Significant in this

Diagram 2

Distribution of Landlord-Tenant Crop Share and Water Fee arrangements.

Type Location	1 Bhairab Khaliajuri Shipganj	1a. Saturia	1b. Mirzapur	2 Ulania Madaripur	3 Chatalpur
Water Fee	50/50 landlord S/cropper	33% Product.	25% Product.	S/cropper	S/cropper
other Inputs	S/cropper	S/cropper	S/cropper	S/cropper	S/cropper
Net. Production	50/50 landlord S/cropper	50/50 landlord S/cropper	50/50 landlord S/cropper	33% L/lord 66%S/cropper	50/50 L/L S/cropper

Source : PROSHIKA WORKER REPORTS

context is the high incidence of group members (31 percent of total cultivators in the command areas) cultivating as sharecroppers.

With this high incidence of small farmers and the existence of a significant proportion of sharecroppers, will a landless irrigation programme bring the landless groups, small farmers and sharecroppers together, or will it highlight their separate interests and be divisive ? The participation of small farmers from the groups has already been noted. Furthermore the distinction is not so sharp in dynamic historical terms, since there is a regressive career of becoming landless so that small farmers, sharecroppers and wage labourers are at different points on a moving line.

Certainly, if small farmers gain better and regular access to irrigation then their holdings will become more viable, perhaps arresting their downward fortunes. Whether it will offset the effects of multiple inheritance in the long-term is the problem with all 'small farmer programmes' under Bangladesh conditions. However, any continuation of small farmer fortunes would be dependent upon their access to irrigation in these areas, thus for expediency alone, the conditions for an alliance between these classes in any locality should exist.

There is a further dimension to this issue, where 'landless' groups associated with PROSHIKA (and other organizations) are collectively sharecropping land, or becoming receivers (temporary or permanent of mortgaged land, cultivating it collectively along with other sharecropper land. As a process, this activity functions to divert land away from the richer peasant/money-lending predators on the land of precarious families, to make it more possible for small farmers to get back their land ; and finally to create more possibilities for alliances between the groups and the small farming families.

The above is a brief version of the report entitled "Socialisation of Minor Irrigation Assets" prepared by Geoffrey Wood and the R & D Cell of PROSAIKA. Readers interested in the fuller text should enquire at PROSHIKA, GPO Box 3149, Dhaka-2.

Irrigation Projects for the Landless in Rural Bangladesh

Izzeddin Imam

A review of the rationale and experiences of a BRAC-organized landless groups in irrigation projects involving shallow tube-wells.

A programme for making minor irrigation assets such as Shallow Tube-wells (STW's) and Low-lift Pumps (LLP's) available to landless groups has been discussed and considered for some time now and has actually been put into practice by a few organizations. Bangladesh Rural Advancment Committee (BRAC) was one of the earliest. The theoretical and general structural implications for the rural political economy of such a programme has been adequately considered elsewhere, and this report will deal mainly with a description of the initiai experiences and obstacles encountered during its actual implementation. However, it is still necessary to start with a brief consideration of why such a programme has been undertaken by BRAC and how its genesis is related to the interpretation of its early experience.

Supporting the disadvantaged

The above irrigation assets are being made available under substantial government subsidies. However, they are normally purchased only by those farmers who own considerable amounts of land and have the investable surplus necessary to acquire this sort of asset. Thus, the benefits of a state subsidy are being enjoyed only by the wealthier section of the rural community while the poorer, landless peasants are completely by-passed.

This is clearly an unsatisfactory situaation since it implies a state-privilege being granted in a way which further exacerbates the problems of inequity. Does it not, therefore, seem imperative that a programme which diverts the benefits of this subsidy towards the landless and the disadvantaged should be sup-

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ported? At least, such a programme would impart the correct bias to a government effort to protect the poorest rural sectors from the hardships of the marketplace. This is much more worthy of support than a programme whose net effect is to provide cheap assets to the rural upper and middle-classes.

Participation of landless

The provision of these particular assets under subsidy is part of the government's drive to increase agricultural production. The participation of the landless in this drive has the consequence of giving them an actual stake, for the first time, in increased productivity. Since the irrigation water is supplied for a fee, which is a prearranged share of the total yield, an increase in the yield directly benefits those supplying the water. This leads to more than the immediate benefits of landless participation in greater productivity. It reduces one of the great obstacles to higher agricultural production: lack of effective demand.

With the landless groups supplying irrigation water for a few, there is a more equitable distribution of the surplus being thus produced and a consequent enhancement of the landless peasants' buying power. This rise in effective demand itself turns into a spur of increased agricultural production, while at the same time avoiding the usual problem of equity associated with most growth models.

Economic activity

Another benefit of the proposed scheme is, of course, the greater economic activity being generated, particularly of the type which benefits the landless and other disadvantaged groups. More employment opportunities are presented for agricultural labour, while the scheme itself is an opportunity for the group members to avail themselves of new forms of supplementary income. Those might eventually include the delivery of a complete package of inputs and services to farmers, such as fertilizers, appropriate seeds, pesticides, processing and maintenance facilities, etc. Moreover, this is being done through the mobilization of a new resource which is gaining increasing prominence as one of the means of production.

Until now the chief non-labour means of agricultural production has been land and this has, of course, been concentrated in relatively few hands. With the harnessing of water resources, however, water will itself become another vital agricultural input and it is important that its control is not taken over by the same land-owning classes. This programme provides an opportunity, therefore, for the landless to assert control over a newly emerging resource and has important implications for the rural political economy in general.

Improving bargaining position

A successful involvement of the landless in water delivery services would lead to an improvement in their bargaining position in every other form of exchange relations that exists between the landless and land-owning classes. This is a very significant area of concern in the rural economy, covering such crucial issues as agricultural labour wages, sharecropping terms and local money-lending rates. Thus, the political as well as social benefits of such a programme to the landless could be of incalculable importance and could lead to an important transformation in the structure of rural socio-political relations.

Cooperative alliances

Another advantage, in terms of structural relations between the different rural classes, may be obtained through the creation of cooperative alliances between the landless and the marginal or small farmers. The marginal farmers normally do not

When landless groups undertake irrigation activities they enter into new and untested forms of commercial relationships with farmers. It is necessary that these groups have a strong sense of commitment and internal solidarity to withstand any external pressures and criticisms.

have access to water on favourable terms from STW's owned by the larger landownes and would thus be more than willing to obtain water from landless groups on more favourable terms. The possibility of a favourable bargaining position and more equal exchange relations would encourage greater cooperation between these two groups and a greater realization of any common interests. This is a strategic goal to pursue from the point of landless interests and as a means of breaking their isolation from the production process.

These goals are ambitious ones at this stage and are dependent on a successful and economically viable implementation of a landless irrigation scheme.

Irrigation project

It is important to realize that a successful implementation of a scheme to organize the landless and involve them in an irrigation project is dependent not only on cost considerations but also on the ability of the landless to organize, negotiate, reach agreements and extract timely payments from farmers. These are skills which are acquired slowly by landless groups and are the results of many years of experience. BRAC has been helping to organize and has been working with many such groups since 1972, in different parts of the country.

It was in one such group in BRAC's Manikganj project in 1976 that discussions first arose about the possibility of undertaking an irrigation scheme. This was first attempted by renting a low-lift pump from the government. However, the attempt failed because the pump was stolen and arrangements with the farmers were not made on a satisfactory basis. This taught valuable lessons, however, and it became obvious that the first landless groups undertaking such activities would be entering into new and untested forms of commercial relationships with the farmers. It was necessary that these groups should have a strong sense of commitment and internal solidarity to withstand any external pressures and criticisms. They would have to negotiate vigorously for favourable terms from the farmers, extract regular payments and ensure that the STW operations ran smoothly.

Mode of operation

Initially, only four groups undertook irrigation activities. The internal planning and organization tasks were carried out by the group members themselves, while BRAC provided support services and management advice. The groups started their initial round of contracts with the potential receivers of water to gain firm, written commitments.

Here they met their first dilemma—a crucial one for the initial stages—the problem of credibility among the farmers. The Bangladesh Agricultural Development Corporation (BADC) would only supply the STW's to the groups if they could show signed guarantees that the farmers were willing to receive water on a long-term basis. On the other hand, the farmers were unwilling to undertake any such commitment until they were assured that the landless group would actually receive and instal a pump. They were sceptical of the landless groups' ability to do this and wanted to actually see the pumps before they would sign.

The groups were able to extricate themselves from this vicious circle only through intense negotiations with the farmers. These discussions were carried on exclusively between the group members and the farmers, while BRAC provided an assurance of mediation in case of conflict. Finally, a breakthrough was made. Farmers owning a total of approximately seven acres of land within the command area of the pump agreed to sign contracts.

These contracts committed the farmers to receiving water for a period of at least five years during which time they would pay rent of one-third of the crop yield for dry season irrigation (to cultivate HYV Boro crops) and one-quarter of the crop yield for wet season, highland irrigation. The farmers also agreed to take water for at least two crops per year. Once these contracts were signed, the paper-work necessary for the BADC sanctioning of the STW was set into motion.

Credit

Arrangements were also made to open a credit line with the Bangladesh Krishi Bank (BKB). It should be pointed out here that this is the part of the project which proved most difficult and frustrating for the groups and in which the BRAC support staff had to provide the greatest amount of help. The paperwork involved for BADC and BKB processing is very cumbersome and requires the expenditure of a great deal of time and money which the landless members can hardly afford. For instance, signatures are required of each owner of the plots involved, yet these owners are often not local residents and have to be tracked down in Dhaka or other distant places.

Furthermore, the landless members often feel too intimidated to assert themselves in government offices and feel that they are not given due attention and consideration: their cases are left pending so that the sowing of their crops is unreasonably delayed. In fact, it seems clear that much of the processing of their cases would not go through without constant pursuing from BRAC staff and this may prove to be the one major area of weakness for the landless groups' organization of this project.

Financing

The financing of the project is undertaken in two different ways by the BRAC groups. In the Manikganj project, the financing is arranged through BKB. The groundwork for this was laid in consultations between senior BRAC and BADC officials in Dhaka. Under the agreement arrived at, BKB decided to make Taka 17 lakhs available for a total of 50 STW's from BADC.

Of this amount, about Tk. 10 lakhs would be available for purchase of the STW's, while the rest would be available for operating cost loans. BRAC would stand as guarantor for these loans and would deposit with BKB funds worth 50 percent of the loans advanced to individual groups. The remaining 50 percent would be covered by hypothecation of the tube-wells purchased out of the loans. The repayment schedules, usually over 5 year's would be worked out individually with the groups concerned. In BRAC's Rural Credit and Training Project, the financing would be undertaken through BRAC loans to the landless at commercial interest rates.

First season results

Following the first year of operations, some preliminary conclusions can be drawn regarding the experience. The scheme was undertaken by four Manikganj groups in the winter of 1980-81 and by 12 groups in the following year. Once the siting of the well was approved by a BADC surveyor, STW was installed and the channels to the fields were constructed using the group members as labourers. Thus, some extra employment was generated out of the scheme. The first season of water was provided and water management did not present any serious problems. A field rotation system for order of water delivery was agreed upon and maintained by the tube-well operator who is hired by the group for the duration of the irrigation season. He also maintains the pump and motor and calls in a mechanic if repairs are needed.

Some repair and spare parts expenses seem to be incurred in every season (Tk 475 for spares and Tk 360 for repairs in the first season for one particular group), but this could be kept to low levels if the machines were maintained properly. The major problem with repairs is not the expense so much as the delays it causes in the irrigation pattern, particularly when mechanics are unwilling to cooperate without some inducement.

The single major expense is, of course, the fuel costs for operation. This amounts to about 50-60 percent of the total costs of operation. In this regard, efficient water management may help to minimize this cost.

Revenues

Revenues are dependent on the total acreage covered under the command area. The first two of these variables (which are the only ones under the direct control of the irrigation scheme) were very poor due to the credibility problems mentioned earlier and the delays incurred before the implementation of the scheme could begin. However, cost estimates can help us to set minimum levels for these two variables in order to ensure that the scheme breaks even or makes a profit. Our calculations show that the minimum levels would be a coverage of 13 acres and a yield of 35 mds./acre.

Fortunately, the early experience shows that these are both attainable targets, provided adequate early preparations are made before the start of the project. This optimism is further justified if we consider that the initial costs are higher than the operating costs in subsequent years, since the main irrigation channels and sheds (for the protection of the tube-well) do not have to be completely re-constructed.

The main factor to watch out for in the future is fuel costs. At present, diesel motors are being used and the price of diesel has been rising steadily over the years. Perhaps, other types of motors may be explored, particularly electric motors where electricity is available.

The goals

It seems clear that the schemes are economically viable and this is being proved so by the increasing numbers of BRAC groups undertaking similar schemes. However, problems still remain. They involve not only credit facilities and other economic features but also the willingness on the part of the rural community at large to give credibility and support to the landless groups in this effort.

These projects represent a new level of involvement for landless groups in the mobilization of new rural resources. A successful operation at this stage will have important consequences for the establishment of the landless groups as an active participant in the rural political economy.

Soil of Bangladesh—IX

Hugh Brammer

The fertility of individual general soil types is described and discussed below in the order in which the soils were described in the four previous issues of ADAB NEWS: First, floodplain and piedmont soils; then terrace soils (i.e., those on the Madhupur tract and the Barind tract); and, lastly, hill soils.

Fertility of general soil types

Floodplain soils

Calcareous Alluvium may be infertile when it is newly deposited, especially where it comprises a thick layer of sand or of raw, wet silt. However, within a few years, this material can become highly fertile, unless it is very sandy, the topsoil is constantly being buried by new deposits of raw silt it lies in depressions which stay permanently wet, or it is saline.

Young Calcareous Alluvium contains moderate or small amounts of lime, so the soils are alkaline. This implies that phosphorus and zinc may be relatively deficient, and that the nitrogen in urea fertilizer will quickly be lost by volatilization unless the fertilizer is quickly mixed into the soil.

The content of organic matter in new alluvium is low, which means that nitrogen and phosphorus contents are low. However, the actual nitrogen and phosphorus availability can be strongly influenced by the seasonal flooding (which makes the topsoil neutral in reaction, makes phosphorus more available to plants and provides biological nitrogen) and by the cultivation of nitrogen-fixing legumes in the dry season (or *dainchya* in the monsoon season).

In part, the fertility of Calcareous Alluvium on older char areas is due to the good moisture holding properties of the predominant silty soils. On river charland, the soils produce good rabi crops without fertilizer use. On estuarine charland, the silty soils are easily puddled to hold water for transplanted Aman cultivation, again mainly without the use of fertilizers.

Noncalcareous Alluvium differs in fertility from Calcareous Alluvium mainly in the fact that it does not contain lime. Deep sandy alluvium and new, raw, silty alluvium are infertile, but silty alluvium which is more than about 5-10 years old often provides soils with a high reputation for fertility. As in the silty Calcareous Alluvium, that reputation is based mainly on these soils' good moisture holding capacity in the dry season and on the seasonal flooding which provides ample nitrogen and makes phosphorus more easily available.

Very young soils have an alkaline topsoil in the dry season. Such soils might be deficient in zinc, and it is particularly important to mix urea fertilizer quickly into the soil after application. Topsoils in somewhat older soils are neutral or slightly acid in reaction in the dry season.

Nancalcareous Grey Floodplain Soils generally are fertile. Silty soils on the Tista and Jamuna floodplains and non-saline tidal clays are regarded as particularly fertile. That reputation is based on their high moisture holding capacity and the nutritional benefits which they derive from seasonal flooding. Light textured soils on higher floodplain ridges and clays on the Surma-Kusiyara floodplain are regarded as less fertile, mainly because of their lower mositure holding capacity in the dry season.

All the soils respond normally to nitrogenous and phosphatic fertilizers. Deeply flooded soils also benefit considerably from the addition of biological nitrogen. Although these soils have high contents of potash, responses to potash fertilizers are obtained on dryland crops and sometimes on rice. Recent fertilizer trials have revealed sulphur deficiency on soils used intensively for HYV paddy cultivation. Zinc deficiency has also been reported, and both zinc and sulphur deficiencies may be expected to spread with the time as intensive, irrigated, HYV paddy cultivation expands.

Noncalcareous Dark Grey Floodplain Soils differ from their grey cousins mainly in having a slightly higher content of organic matter, especially in basin soils. Deeply flooded soils on the old Brahmaputra and old Meghna floodplains are regarded as particularly fertile, reflecting their superior moisture holding capacity in the dry season and the benefits they derive from seasonal flooding. The benefit derived from biological nitrogen often is conspicuously demonstrated by the vigorous dark green appearance of deepwater aman grown without use of fertilizers on these soils.

All the soils respond normally to nitrogenous and phosphatic fertilizers. Despite high potash contents, potash fertilizers also give responses on dryland crops and sometimes on paddy. Both zinc and sulphur deficiencies have been identified on sites where irrigation keeps soils used for HYV paddy cultivation wet for most or all of the year.

Calcareous Dark Grey Floodplain Soils on the Ganges river floodplain include soils that contain lime in the topsoil and some that have moderately to strongly acid topsoils (in the dry season : all topsoils have a neutral reaction when flooded in the monsoon season). Deeply flooded soils benefit greatly from biological nitrogen fixation, and they generally remain moist during the cool winter months. Higher soils tend to be more droughty, especially in the pre-monsoon season, and they benefit less from biological nitrogen fixation (except on fields where leguminous crops are grown, as is common on such soils).

Soils where the topsoil is calcareous may need special fertilizer treatment. Nitrogen from urea is quickly lost to the air or water if the fertilizer is not quickly mixed or buried in the soil. Phosphate fertilizer applied when the soils are not submerged may be quickly coverted into a form which plants cannot use. Powder TSP should not be used on these soils, therefore, and granular TSP should preferably be applied in concentrated bands between crop rows, not broadcast over the soil surface. Slow acting hyperphosphate also is a useful fertilizer for these soils. The addition of organic manure can increase the effectiveness of phosphate fertilizers on such soils, although such manures provide relatively little phosphorous themselves.

Calcareous topsoils also are likely to be zinc deficient. Evidence of this has been reported in soils growing local paddy varieties as well as in those used intensively for HYV paddy cultivation. Sulphur deficiency has also been reported.

Soils with seasonally acid topsoils, which cover most of the area on old floodplain land, respond normally to nitrogen and phosphorus fertilizers, and sometimes to potash also. Both zinc and sulphur deficiency have been reported on irrigated land used for intensive HYV paddy cultivation.

Calcareous Grey Floodplain Soils

have not been studied separately. These minor soils are likely to have similar fertility problems to those described above for calcareous dark grey soils, aggravated by the fact that the soils become saline in the dry season.

Grey Piedmont Soils are less fertile than Grey Floodplain Soils. For corresponding soil textures, piedmont soils have a lower moisture holding capacity than floodplain soils. This is aggravated by the hard, puddled condition of the topsoil in piedmont soils used for transplanted aman, as the majority of such soils are. Piedmont soils generally are moderately to very strongly acid in reaction, and have much lower weatherable mineral reserves than soils on the Tista, Brahmaputra, Jamuna, Ganges and Meghna floodplains. Many suffer also from flash floods.

These soils respond normally to nitrogenous, phosphatic and potash fertilizers. However, kharif crops may need relatively high amounts of nitrogen, applied in frequent top-dressings, to off-set the rapid leaching caused by the heavy rainfall of the areas where these soils occur. Sulphur and zinc deficiency have been reported near Comilla on intensively cultivated soils.

Acid Basin Clays apparently present no special fertility problems, unlike the Acid Sulphate Soils described later. The main agricultural problems on these soils arise from the deep and rapid flooding to which most are subject, and the heavy texture of their topsoils. Deepwater aman and boro crops grown on these soils benefit greatly from biologically fixed nitrogen.

Peat soils in Bangladesh are much less fertile than such soils generally are believed to be. Apart from their difficult physical properties when wet, such soils may be deficient in sulphur and copper, and have toxic amounts of iron and possibly manganese. These problems would be difficult (or costly) to remedy.

Acid Sulphate Soils either already are so extremely acid that plants cannot grow, or they have the potential to become extremely acid if they are artifically drained. In addition, most such soils are saline. The reclamation of such soils for cultivation can be very expensive, involving embankment, flushing out of the salinity and acidity, liming and strict drainage control after reclamation.

Calcareous Brown Floodplain Soils are moderately fertile where they are deep and loamy. Shallow loamy soils over sand, on the highest ridges, are relatively infertile because of their low moisture holding capacity and low content of organic matter.

These soils share the problems of all soils with a calcareous topsoil : rapid loss of nitrogen from urea fertilizer, unless it is quickly and deeply mixed into the soil ; rapid immobilization of phosphatic fertilizer, especially if applied as a powder ; and a high probability of zinc deficiency (and probably iron deficiency, also).

In addition, the rapid permeability of these soils means that nitrogen is quickly leached by heavy rainfall or heavy irrigation. Also these soils benefit much less from biological nitrogen fixation than floodplain soils which are seasonally flooded. Therefore, relatively large amounts of nitrogen need to be added for high crop yields ; and for most crop, this should be given in split doses. The addition of large amounts of organic manure on these soils would be an advantage, both to increase their moisture holding capacity and to improve the availability of nitrogen, phosphorus and other nutrients.

Noncalcareous Brown Floodplain Soils suffer the same problem of rapid leaching of ntirogen as their calcareous, and shallow soils over sand are similarly infertile because of low moisture holding capacity and low organic matter content. On the other hand, extensive areas of deep soils on the Himalayan Piedmont Plain in Dinajpur District have a moderate content of organic matter and they store moisture relatively well.

These soils provide no particular fertility problem, except that nitrogenous fertilizers should be given in split doses to reduce nitrogen losses, and additional amounts may need to be given after heavy rainfall and irrigation. Additional potash may also need to be given to off-set leaching by heavy rainfall, especially in shallow soils. Sulphur may also be needed, for the same reason.

Black Terai Soils have a relatively high organic matter content. None-the-less, they are not regarded as fertile soils. The reason for this is not yet fully understood. Because of their rapid permeability, nitrogen, potash and possibly sulphur are easily leached by the heavy monsoon season rainfall. However, it seems probable from laboratory analyses that some other nutrient limits fertility—possibly calcium deficiency or manganese toxicity—but field studies still are needed to identify specific fertility problems and to suggest practical measures for their correction.

Deep Red-Brown Terrace Soils are popularly regarded as infertile. Yet, with the provision of irrigation, such soils can become highly productive if the soils also are properly fertilized.

Without irrigation, the fertility of the soils is limited by their relatively low moisture holding capacity. That makes shallow rooted crops quickly susceptible to drought in the pre-monsoon and when dry spells occur within the monsoon season. Cultivated soils also are low in organic matter, which means that nitrogen and phosphorus are relatively deficient in these soils, which do not benefit from seasonal flooding. Potash also seems to be deficient. Sulphur and other micronutrients may prove to be deficient under intensive irrigated cropping.

The rapid permeability of these soils means that nitrogen is rapidly leached by heavy rainfall or excessive irrigation. That needs to be off-set by the use of additional nitrogen, given in split doses. Preferably, a large amount of organic manure should also be used.

The use of organic manure would also alleviate the other fertility problem encountered on these acid soils; namely, phosphate fixation. The latter particularly occurs where red subsoil material has been exposed by deep cultivation, land levelling or erosion. The other antidote for phosphate fixation is to apply granular TSP or hyperphosphate in concentrated bands between crop rows.

In general, liming to correct soil acidity is not recommended for red soils of this kind. That is because it can upset the balance of micronutrients and so create new fertility problems. A better approach is to grow acid tolerant crops where feasible, to use as much organic manure as possible and to use rock phosphate or hyperphosphate as a phosphate fertilizer.

Shallow Red-Brown Terrace Soils generally are not cultivated. Their fertility is low because of their shallow depth, low moisture holding capacity and, in some soils, their wet subsoils during the rainy season.

Brown Mottled Terrace Soils are broadly similar in fertility to Deep Red-Brown Terrace Soils. Their natural fertility is low: nitrogen is easily leached; and phosphate is easily fixed. Moisture holding capacity is even lower than in the red soils. On the other hand, they become waterlogged following heavy monsoon season rainfall.

Deep Grey Terrace Soils also are low in fertility. During the period when they are shallowly flooded, they apparently benefit from additions of nitrogen by biological fixation; phosphate also is made more readily available during this period. At other times, nitrogen is easily leached, and phosphate may become unavailable. Potash also seems to be deficient in these soils; sulphur and possibly zinc, may also become deficient under intensive paddy

(Continued on page 46)

Traditional vs. semi-intensive fish culture

Remarkable difference in pond fish production

Four farmers' ponds in the Raipur Thana were studied to determine the difference in production between traditional (unmanaged) and semi-intensive fish cultivation (predator control prior to stocking, feeding and fertilising). Computed fish production of 265 kg/ha for the traditionally managed pond increased to 3100 kg/ha/11 months with semi-intensive fish cultivation - an eleven fold increase. These results are in agreement with consensus data on traditional fish farming and data presented on semi-intensive fish cultivation in a paper which will appear in the next issue of ADAB NEWS. The present study was conducted by the Fish Pond Study Group of the Department of Zoology, University of Dhaka, and Mr. A. R. Bhuiyan, S.O., Raipur Fish Hatchery and Training Centre, Noakhali, and Mr. C. H. Davis, Adviser, IRDP/DANIDA, Noakhali.

The average fish production in Bangladesh is estimated to be 270 kg/ha pond area/year (3 maunds/acre) when farmers follow traditional fish farming practices. The ponds are generally unmanaged, with farmers following the practices listed below.

—Weed and predator fish are not killed before stocking fry.

—Inputs are not provided regularly or at all. It is left to nature to provide food for the fish.

—Farmers do not harvest the fish regularly each year. When required, they catch a few big fish for their own consumption or sale. The farmers do not realize that fish farming is like any other farming. One has to sow the seeds, tend the crop, and harvest it regularly to bring a good income. It is difficult to convey that regular fish harvest is an integral part of good fish farming.

The traditional method of farming can be regarded as 'subsistence fish farming' or 'extensive culture'. Production compares most unfavourably with that in neighbouring countries which have better semi-intensive) management of fish cultivation. In China, the average production in pond fish culture is reported to be 2.5 tons/hectare, the maximum being 7.5 tons/hectare.[1] Lam (1982) gave a table showing the total area under cultivation and the total amount of production in freshwater pond culture in ASEAN countries.[2] Computation from this table gives an average production of 2.25 tons/ha in Indonesia, 1.31/ton/ha in Malaysia, 1.89 ton/ha in Singapore. There were two estimates for Thailand : 5.83 tons/ha given by Thailand Fishery Department in 1978 and 4.33 tons/ha given by Varikul and Sriton 1981.[3]

What are the reasons for the comparatively low productivity in Bangladesh, given the favourable climatic conditions for fish cultivation ? The following preliminary study quantifies differences in fish harvest and production when farmers use traditional and semi-intensive methods for fish cultivation.

The study ponds and management

The group selected four ponds in two villages (Kerua and East Lach) of Raipur thana, Noakhali District, belonging to local farmers and situated adjacent to their homesteads. In each village, one pond was managed in the traditional manner and the other adopted semi-intensive fish culture. Monthly observations were taken from 17th September (stocking) 1981 to 29th May 1982 (final harvest). These samplings included detailed studies on water quantity and fish biology. However only the differences in total harvest are mentioned in this paper.

i) Traditional fish cultivation-two ponds.
 Kerua village 0.16 ha (0.40 acre)
 East Lach village 0.16 ha (0.4 acre)

It was planned that traditional management would be followed for these ponds. In one case this was not followed so results are only available for Kerua village

ii) Semi-intensive fish cultivation-two ponds.
 Kerua village 0.18 ha (0.45 acre)
 East Lach village 0.14 ha (0.35 acre)

Semi-intensive fish cultivation

Semi-intensive fish cultivation implies that certain basic fish management procedures were followed for fish production. The procedures were rather simple and easy for farmers to understand : These included the following : a) All fish in the ponds were killed by using 'Rotenone' before new stocking with fish fry. b) Regular inputs in the form of compost, cow dung, T.S.P., and urea were supplied at intervals to augment production of planktonic organisms, which constitute food for the fish. c) Regular feeding with rice bran (Kura) and oilcake was omitted because the farmers were reluctant to follow a fixed regime. In any case, the experiments were not meant to maximize production but show to the farmers the difference in fish harvest between traditional and 'semi-intensive fish farming'.

'Harvest' means the actual total wet weight of the catch at the end of the observation period. 'Production' means total harvest minus the initial weight of the fry stocked in a pond.

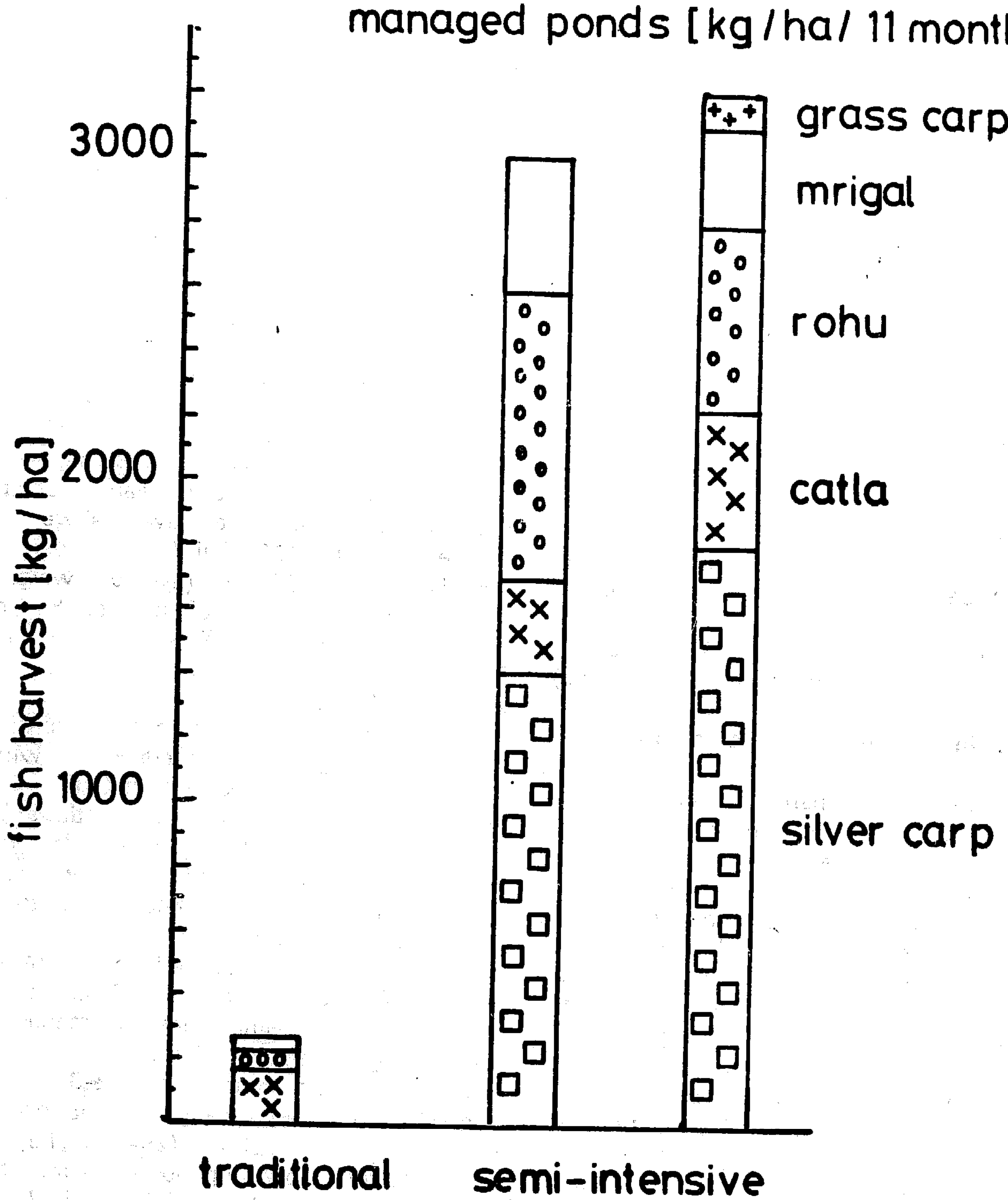
Remarkable differences

The results are discussed on a village basis because the farmers' reaction to the local "demonstration effect" gave a different story at Kerua and East Lach villages.

Kerua Village. The production estimates of the two ponds in this village showed rather clearly, as was expected from theoretical considerations, the remarkable difference in production between traditional and semi-intensive ponds. In this village, the traditional pond had only 82 big fish, which were stocked 2-3 years earlier. These included 58 Catla (average weight a little above 1 kg), 18 Rui (average weight 0.84 kg) and 6 Mrigel (average weight 1.5 kg), making the total harvest 85 kg in 0.16 ha pond area. This would mean 530 kg/ha in 2 years (may be 3 years ?) or 265 kg/ha/year.

Wild and predator fish in the semi-intensively managed pond were killed with rotenone prior to stocking with 5,500 fry per hectare (silver carp 2,200, catla 550, rui 1650, mrigel 1100). Initially, the fry weighed 5-10g and 88 percent were harvested some 8½ months later. The total fish production was 415 kg (harvested 422 kg) from the pond, which is equivalent to 2270 kg per hectare. Thus, production from the semi-intensively managed pond in 8½ months at Kerua was more than four times the harvest from 2-3 years' harvest in the traditionally managed pond. In Figure 1, production (2940 kg/ha) is computed for a growing period of 11 months to allow for prepatation of pond (one

Fig 1 Computed weight of fish harvested in traditional and semi-intensively managed ponds [kg/ha/ 11 months]



month) prior to the restocking of the ponds.

Village East Lach. The story of this village is rather disheartening. Nevertheless, there is a brighter side to it, also. Data obtained from the traditionally managed pond were not according to plan because the farmer gave additional, unscheduled inputs. The sequence of events was as follows.

Earlier nettings showed that there were only a few big Catla (belonging to previous years' stock) in the pond. But samplings in May showed big-sized fish of other species as well. These appeared very well fed also ; the pond owner would not harvest the fish as was designed. He would rather continue to stock the pond, as is the normal practice in traditional fish farming in Bangladesh. Thus, it was not possible to estimate the production in the pond.

Nevertheless, the probable reasons for the farmer's reactions were probed. It transpired that, by seeing and comparing the condition of the fish in the adjacent 'managed' pond, the owner had decided to improve his stock of fish by feeding them a large amount at one time. He put in all the rice bran from a cart-load of milled paddy. He also put a load of oil-cake in the pond (amount undisclosed). This was in violation of a verbal agreement that he would manage his pond in the traditional manner till the end of our observations. We also came to know that the owner of the 'unmanaged' pond stocked his pond with good-sized (300-500 g) fish from neighbouring ponds.

We also experienced difficulties with the semi-intensive pond at East Lach. The pond was stocked with 6880 fry/ha. each weighing 5-10 g. with the following species : silver carp 2820 ; catla 710 ; Rui 1760 ; Mrigel 1240 ; grass carp 350. The sampling proceeded for only eight months, when most of the fish were found dead and floating on the surface in May, 1982, after a partial harvest the previous day.

It was alleged that 'rotenone' poison was possibly present in the net used for partial harvest and that this was the cause of the death of the fish in the pond. The net was reported to have been used in a rotenone-poisoned pond the previous day. The exact reason for the deaths could not be ascertained as the fact became known to us two weeks after the incident when we went for the monthly sampling. The local Supervisor, however, recorded the average weights of the different species of dead fish. The surviving few fish were harvested on 29.5.1982. Therefore, the total harvest in the pond was calculated from the average weight and the number of dead fish and from those actually caught on 29.5.1982. Total calculated fish production from the pond was 345 kg in 0.14 ha or 3150 kg/ha in 11 months (Figure 1).

The bright side of this story is that it showed once again the effectiveness of demonstration ponds in moulding the fish farmers' attitude. They have great motivation value. It proved the adage 'to see is to believe'.

Incredible waste of resources

This study clearly demonstrates that fish harvest can be increased significantly with simple management practices and feeding. The traditionally managed pond yielded 265 kg/ha compared with a mean of 3100 kg for the two semi-intensive ponds, an eleven-fold increase in production.

Are the general trends in these figures realistic compared with other data for traditional fish farming in Bangladesh ? It is surprising that primary data for fish production are not readily available, considering how simple it is to obtain them. An estimate of 270 kg/ha used here is obtained from a general consensus of opinion of various fisheries staff. Harvest from the traditionally managed pond of 265 kg/ha/year in this study is close to the estimated national average and therefore represents a realistic sample.

Given the production with semi-intensive fish cultivation, it is worthwhile to examine some of the reasons for farmers not realising this potential. In a survey of social factors affecting the potential use of the aquatic system at Joydebpur, Bangladesh, Gill and Motahar pointed out six main constraints identified by the farmers.

In order of frequency of reply the constraints mentioned were as follows:

—poor supply of fry
—inadequate financial/credit facilities
—lack of consensus with multiple ownership of ponds
—lack of knowledge
—insufficient excavation of ponds
—poor growth of fish

During 1982 the Raipur Hatchery sold about 100kg of hatchlings (43 ml) and 3.4 ml fingerlings. We don't know the survival rate, but if it was 90 percent for hatchlings/fingerlings and 50 percent for fingerlings to market fish, this could produce about 12.5 million fish (5150/ha pond) in the Chandpur Irrigation and Flood Control Project. Fingerling production can be supplemented by diversification of fry production, especially nursing hatchlings to fingerling size by the farmers. In this way, the full potential of the hatchery could be realised, income generated, as well as risks spread over a wider area. At least in the Raipur area, the hatchery has contributed significantly to the supply of fingerlings but it will take a long time to develop the personnel and infrastructure to satisfy national requirements.

Problems of credit, concensus and distribution of benefits can also be overcome, given sufficient organisational inputs. One example of this is the NIRDP-DANIDA landless fish pond cooperatives in which a total of about 1000 members have leased 22 old government ponds. The performance is encouraging, with substantial accumulation of capital, reserves (in cash or fish) and fish production of up to 1500 kg/ha.

The poor growth of fish and lack of knowledge reported by the farmers are possibly related factors. This study has shown how fish harvest can be increased with simple inputs and management. This points to the need for training schools and/or demonstration ponds designed for illiterate or semi-literate participants. In either case, training would be more structured and effective if 'face to face' extension material such as flip charts and teachers' guides were used.

Conclusion

Two important and striking facts came out of our preliminary study.

1. Substantial increase in fish harvest from traditional methods can be obtained with semi-intensive fish culture. This includes killing predator and wild fish prior to stocking with a mixture of non-competitive and desirable species, and minimal but regular feeding and fertilising of ponds.
2. A positive effect of demonstration ponds although the observation was casual and not incorporated in the experimental design.

We recognise many of the constraints for fish cultivation by farmers, but we are confident that fish production can be increased several-fold with semi-intensive fish cultivation. Details will hopefully be given in the forthcoming issue.

Acknowledgements

We are thankful to the former and the present Chairmen, Department of Zoology, Dhaka University for the facilities provided and permission to do the work. The work was financed entirely by DANIDA through the DANIDA-DU Department of Zoology Fish Pond Study Project. We record our thanks and deep appreciation for this support. We sincerely thank Mr. A. Q. Choudhury, Project Director, Raipur Fish Hatchery and Training Project and its staff for local facilities and accomodation during our visits to Raipur.

Notes :

1. Hae-Ren, Lin. 1982. Polyculture system of Freshwater Fish in China. Can. J. Fish. Aquatic Sci. 39 (1) : 143-150.
2. Lam, T.J. Fish Culture in Southeast Asia. Can. J. 1982. Fish. Aquat. Sci. 39(1) : 138-142
3. Gill, G J. and Motahar, S.A. (1982) "Social factors affecting the use of the aquatic system in farming in Bangladesh". Workshop proceedings. Maximum Livestock Production from Minimum Land (in press).

A combined digester and gasholder PVC plastic tube biogas unit

C.H. Davis & T. R. Preston

This paper describes a 5.88 m^3 PVC tube biogas unit which costs only Tk 890 including expenditure on gas pipe line, stove, light and labour. This unit is expected to produce 1.7 m^3 of gas per day or 5½ hrs cooking from the dung of 2-3 adult cattle.

Tube biogas digesters have been operating in other countries. They are generally cheaper than the fixed and floating gasholder types and solve design problems present in the tent model. These digesters could be constructed by small-scale industry using a hot clothes iron to join the P.V.C. sheets. Further testing of plastic material is required.

A biogas unit constructed as a complete polyvinylchloride (PVC) plastic tube could overcome problems associated with flooding, anchorage and leakage with the PVC tent model. These problems and various modifications of the design were discussed in detail in the Nov-Dec. 1982 ADAB NEWS. Major faults with the tent design are shown in Fig. 1. The width and specifications of the tent model were determined by the dimensions of locally available PVC sheets because a sample method of glueing or welding (joining) the sheets together was not known.

Construction of a combined digester and gasholder PVC tube biogas unit requires joining plastic sheets. This article describes results from December 1982 to February 1983 to develop simple methods of constructing tube biogas digesters so that they could be manufactured by small scale decentralised industries.

Construction of PVC tube

Various thickness and grades of PVC are available from old Dhaka in rolls, generally 138 cm (54 inches) wide and 50 metres long. By joining sheets into a tube, a digester of any capacity can be constructed to match the availability of dung etc. or the gas requirements for an individual household or community. Three biogas units have been constructed. The method used is shown in figures 2a-c.

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a) Joining sheet together (Fig. 2a)

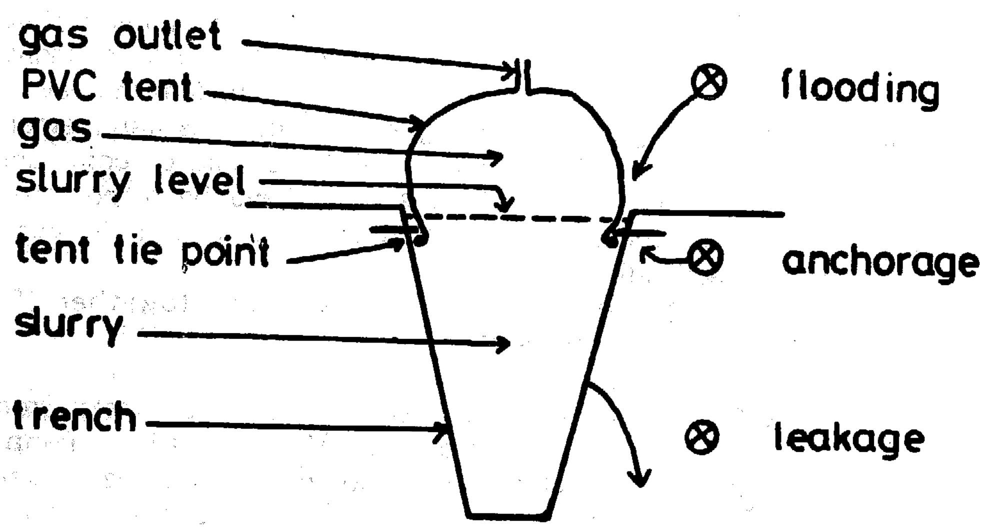
The first step is to decide what size of digester is required. Data from a 15m^3 red mud PVC digester[2] with inputs of cow dung and water have been used to calculate Tables I a and I b and provide a guide for the length and width of the sheet.

The PVC is rolled out and the edges overlapped and joined together to form one big, flat sheet. End pieces are then cut from half a circle so that the circumference is equal to the length of the sheet (diagram 2a).

Formulas

Circumference of circle $= \pi \times$ Diameter, for half circle

Fig 1 Tent model biogas - mäjor problems



$$\text{Diameter } (d) = \frac{2a}{\pi} = 0.637\ a.$$

where a is width of sheet.

v) **Constructing tube (Fig. 2 b)** The next step is to join the circumference of the half circle to end of the plastic sheet (a to a in Figure 2). Initially, you may think that this is impossible! Try with a piece of paper, and you will see that it is necessary to fold the sheet into a cylinder and the end half circles in to a cone before they will match. A circle (hoop) made from split bamboo will help to hold the plastic in position. The seam along the cylinder and cone is then joined with the cylinder in a collapsed or flat position

By using this method, the unit will have an even shape with the end cones joined to the cylinders, and the inlet and outlet pipes connected to the cones. All joins will be strong because they are overlapped.

After the unit is constructed, it is advisable to test for faulty joins or small holes in the plastic. This can be done by inflating with a motor exhaust (motor cycle/vehicle) attached to a length of old bicycle tube and pipe. Alternatively, use your lungs! Check for leakage by sound smell and bubbles, using soapy water. Keep the tube inflated as a guide for digging the trench.

c) **Complete digester (Fig 2c)** Two-thirds of the volume of the tube is now placed in the trench so it fits neatly and there are no sharp roots, stones, etc. to puncture the sheet. This is equivalent to 0.687 of the circumference (approx. 2/3), leaving one-third ballooned above the trench. It is important that the trench supports the plastic tube when it is filled with dung/water so it is only acting as a water proof membrane and not giving physical support. Thinner and cheaper plastic can then be used. A few centimeters of mud on the botton of the trench will also help to fill any irregularities in the trench.

The gas outlet is fitted at any convenient place on top of the tube. Threaded elbow and coupling PVC plastic fittings are available and these can be used to clamp glued washers on the inside and outside of a small hole in the tube so as to give a good gasproof outlet.

Reinforced concrete cement pipes are secured for the water/dung inlet and slurry outlet. A 6 ft. 4 in. diameter pipe can be cut at about the 2½—3½ mark and secured to the ends using nylon rope or strips of bicycle inner tube. The inlet must be higher than the outlet so that 'each charge' displaces slurry to the outlet end. Final adjustments to the slurry level can be made after the digester is filled by altering the level of the outlet pipe.

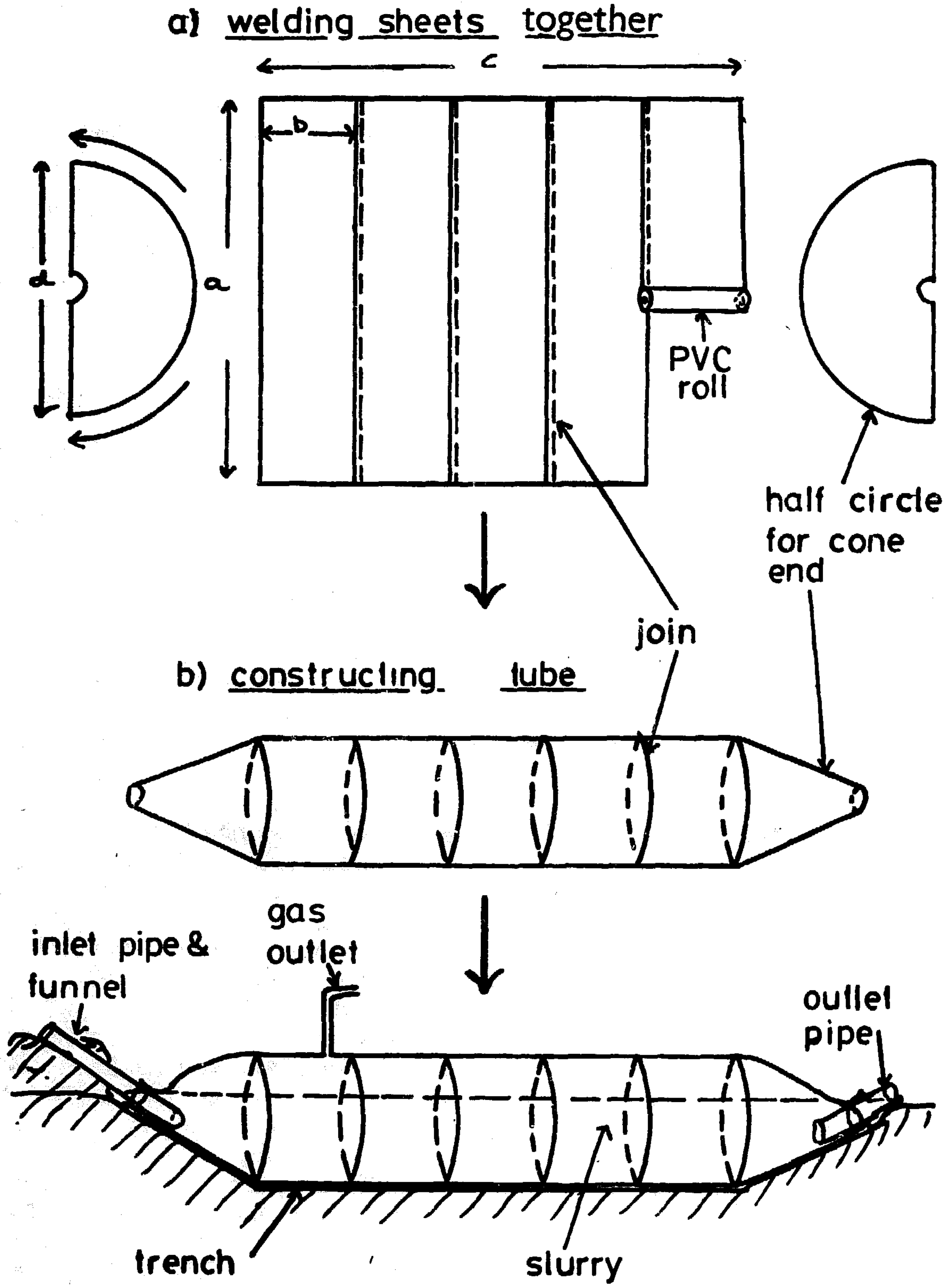
An inlet funnel can be made from mould of earth and scraps of plastic, remaining after cutting the end 'half circle'. During rain, this can be folded over the inlet pipe to prevent water entering the digester.

Joining PVC sheets

a) **Glueing**. The best glue we have found is 'Combined Bond' Colle de Contact, from Combined Chemicals Co., (H.K.) Ltd, with the sole export agent of Fairlite Mfg. Co., P.O. Box 79350,, Mongkok, HongKong. It partially 'melts' PVC whilst leaving a tough rubbery adhesive substance between the sheets. This is ideal for any repair work and securing the gas outlet. It costs approx. Tk 400/- for 3 kg, and 100g (Tk 13/-) would be sufficient for any minor repair work.

b) **Hot clothes iron**. A hot clothes iron will melt PVC and give a very strong join, provided the temperature is adjusted properly. We use a Chinese 'Red heart' (Tk 415) iron with a setting between rayon and silk with excellent results. Two layers of PVC are placed on a flat, 4-inch drive belt with newspaper on top and ironed until the paper is just singed (brown) and the plastic melted. The weave pattern of the flat belt comes through, so the plastic

Fig 2 Construction of tube biogas digester



is not completely melted and weakened. A hot clothes iron is the preferred method at this stage.

High frequency welding. This machine (approx. Tk. 50,000) is used for making plastic hand bags, edges of folders, etc., in old Dhaka. It has given good results with heavier, reinfored plastic.

d) **Hot air welding.** A hot air welding machine (similar to a hair dryer) and used in foreign countries has not been tested yet.

Assumptions used for Table 1

1) **Volume of tube.** The volume in the end cone pieces has not been included in the calculations to allow for a safety factor. The width of the trench is determined by the diameter of the tube. To allow for complete digestion, each charge of dung/water should take 40 days to reach the outlet end. Although we don't know the optimum ratio of diameter to length, a long narrow tube would possibly give a better digestion because there is less chance of dung/water 'short circuiting' between the inlet and outlet pipes.
2) **Digester volume**. The digester (dung/water) volume occupies two-thirds of the total tube volume. This gives a gas storage space for about 18 hrs production.
3) **Expected gas.** This is calculated as 45% of the digester volume. In San Domingo, a mean value of 49% was obtained from biogas of a similar design, so a small safety margin is included.
4) **Cooking time**. Gas consumption from a single burner will obviously vary depending on the flame strength. The allowance of 300 litres/hour is 50% higher than San Domingo figures.
5) **Daily loading**. The key figures used are 5% Dry Matter (D.M.) in the input, 20% DM in fresh cow dung and a retention time of 40 days. The input is achieved by mixing 1 dung/3 water, which is weaker than normal. By using this mixture, the unit at San Domingo has been operating for over two years now without stirring or problems with scum formation.
6) **Total liveweight of cattle.** Assuming a DM feed intake of 3% of liveweight, a digestibility of 50% and total collection of dung. The total liveweight could be composed of combinations of well fed cows, bulls, calves etc.

Tube biogas unit at Noakhali. Three tube biogas units have been constructed to-date. The first was made from heavy duty, nylon reinforced PVC (as used on some open-sided buses) and delivered on 12 November 1982 for installation and testing at the Bangladesh Agricultural Research Institute. Information is not available at Maijdee on installation date, performance, etc. The second was installed at the Gandhi Ashram, Joyag, on 27 Nov. 1982. A major problem occurred when the tube was placed in an existing trench which was too long. When it was filled with dung/water, the soft, fresh soil packing broke away and the plastic tube was torn. This has resulted in intermittent and annoying gas leakage because the tear occurred in a position which is difficult to repair without emptying the dung/water.

The third unit was constructed at the artificial insemination station Maijdee on 3rd Feb. 1983 and it is now operating.

Details are shown in Table 2.

2) Pottery stove.
A pottery model obtained from the Environment Pollution Control (E.P.C.) Dhaka, is cheaper and more efficient than the metal domestic Titas Gas types.
3) Assuming that a successful light can be developed, with components manu-

Table 1(a)

Volume (m³) of tube digesters with various length and widths of sheet in meters (see figure 2 a)

Width of Sheet	Diameter of Tube (m)	Length of Sheet (c) 4 m.	6 m.	8 m.	10 m.	12 m.
2 m.	0.64	1.27	1.91	2.55	3.18	3.82
3 m.	0.95	2.86	4.30	5.73	7.16	8.59
4 m	1.27	5.09	7.64	10.19	12.73	15.29
5 m.	1.59	7.96	11.94	15.92	19.89	23.87

Table 1 (b)

Calculated inputs required and gas production obtained from digesters of various sizes. (Data from San Domingo, Ref 2)

Volume of tube (m³)	Digester volume (m³)	Expected gas (m³)	Cooking time (hrs)	Daily Loading (kg) Fresh dung	Water	Total Liveweight of cattle required
1	0.67	0.30	1	4	13	56
2	1.34	0.60	2	8	25	112
3	2.01	0.90	3	13	38	168
4	2.68	1.21	4	17	50	224
5	3.35	1.51	5	21	63	279
10	6.70	3.02	10	42	126	559
15	10.10	4.50	15	63	188	837
20	13.40	6.03	20	84	251	1117

Table 2

Specifications and construction costs for the tube biogas unit at Maijdee

Specifications			
Volume of tube		5.88 m^3	(205 cft)
Digester volume		3.9 m^3	(135 cft)
Daily input	dung(fresh)	25 kg	(28 Srs)
	water	75 l	(16 gallons)
Expected gas		1.7 m^3	(61 cft)
Cooking time		5.5 hrs	5.5 hrs.
Costs			**(Tk)**
Plastic 24 yds x Tk 21			504
Inlet and outlet RCC pipe (6ft)			50
Welding[1]			100
Labour 3 man days			75
Pottery stove[2]			60
Gas tap			6
Gas pipe line (Tk 1-50 ft) plus fittings			60
Gas light[3]			40
			890

Notes

1) Welding using a hot iron and flat drive belt. One man-day is assumed, but it would be quicker with experience, giving a margin for small scale industry.

factured from pottery.

Discussion

We believe that locally produced P.V.C. tube biogas units can overcome problems with the tent biogas design and the high costs associated with floating (Indian) or fixed (Chinese) gasholder digesters constructed from bricks/cement and metal. The design is not new; such units have been developed and operating in Taiwan and other places for a number of years. The experiences presented in this article on welding PVC could allow the units to be manufactured by small scale industries.

Further work is required to test different types and grades of gas-proof sheets and refine the relationships between capital cost and the expected life of the unit. In the short term, suitable plastic sheet could be part of commodity assistance to Bangladesh, while the proposed gas-based petrochemical industry could meet requirements in the longer term.

Although it is beyond the scope of this article, biogas could form a key component of village renewable energy, nutrient recycling and sanitation. Particular emphasis could be placed on using the effluent for fish farming or vegetable cultivation given the good returns from these enterprises. Community-based tent-model, biogas latrines are already operating at a hospital in Rangpur District. The potential for individual or village based latrines, even if the gas was only initially used for lighting, cannot be underestimated.

References

1) Dhar, S. K., Stevenson, P. D., Davis, C. H. and Sarwar, G.1982. "Evaluation of a gobar gas plant incorporating a plastic PVC sheet gasholder and trench digester". ADAB NEWS, IX (No. 6) 2-13.

2) Pound, B., Bordas, F. and Preston, T. R. 1981. "The characterisation of production and function of a 15m³ red-mud PVC biogas digester." Tropical Animal Production 6, 146—153

Private, non-profit trades schools in Bangladesh

Donald Becker (c.s.c)

After the War of Independence, many voluntary organisations and church groups began development work in Bangladesh. Among the permanent projects started were trades schools, of which about 30 are now operating in all districts of the country. The government of Bangladesh itself has been putting emphasis on vocational training with the aim of encouraging industry and of providing jobs for the numerous unemployed of the country. All realize that the economy of the country should not depend upon land holding. If only one person per rural family were to be a non-agricultural wage-earner, the family could be somewhat assured against poor crops or other disasters.

The Government plan for vocational training is an ambitious one, and many of the districts now have either a vocational school or a theoretical school for preparing foremen and supervisors. There is a plan to establish small vocational schools in each thana and at present about 54 have been started. Recently, the government has rearranged its technical training organisation, with the technical schools (with mainly theory based courses) remaining under the Directorate of Education, while the vocational schools have come under the Bureau of Manpower and Labour.

The majority of the skilled work force of the country, of course, are still trained as apprentices to masons, carpenters, mechanics, machinists, welders, fabricators and the like, in small shops or on the job. But the training is rather haphazard for the illiterate or near illiterate trainees. The skilled workmen fear that trainee apprentices will eventually take over their jobs and treat them poorly, and the amount of training given depends a great deal upon the aggressiveness of the apprentice. Generally, the workmen are not themselves well-trained and there work is of a low standard resulting from poor work habits, careless-

NAME OF THE SCHOOL	LOCATION	RESPONSIBLE ORGANISATION	COURSES TAUGHT	LENGTH OF COURSE	PARTICULAR POINTS
1. Bolla Technical School	Bolla Island	Swedish Free Mission	Mechanics, Me.al work		to train poor boys
2. Boyra Technical School	Boyra, Khulna	Yavarians	Mechanics, Metal Work,	3 years	For poor boys who cannot complete their schooling.
3. Christ Church Trade School	Bokultola, Jossore Town	Church of Bangladesh	Auto Mechanics, Metal Work, Welding-Fabrication, Carpentry, Electrical Repair	3 years	For orphan boys and poor boys
4. Christian Industrial Center	Faridpur Town	Baptist Mission	Auto Mechanics, Machine Shop, Welding	2 years	For poor boys who cannot complete high school
5. Dhammara Sika Budhist Orphanage Trade School	Bashabo, Dhaka	Buddhist Society	Metal Work, Printing, Carpentry, Mechanics	2 years	for poor Buddhist boys
6. Families For Children	75 Indira Rd., Dhaka	Families For Children, Canada	Metal work, Carpentry, Sheet Metal Work, Electrical, mechanics,	1 year	for orphan boys
7. Miriam Ashram Technical School	Fazilkhar Hat, Chittagong	Kalida Fishing Project, Brothers of Holy Cross	Diesel engine repair and maintenance, metal work, electrical, welding	2 years	Trains fishermen to operate and maintain fishing fleet
8. Mirpur Agricultural Workshop and Training School (MAWTS)	11½ Mirpur	CARITAS BANGLADESH	Mechanics, Machine shop, Welding and Fabrication	3 years and also short term	To train poor boys to produce and repair agricultural machinery
9. NCCB Vocational training Institute	395 New Eskaton, Dhaka	National Council Churches, Bangladesh	House wiring, Radio/Television, Airconditioning/Refrigeration, Welding	6 months	Short Term courses for students
10. Nevara Technical School	Suihari, Dinajpur	Pime Fathers and Brothers	Carpentry, Auto Mechanics Electrical, Metal Work	3 years	For poor boys who cannot complete high school
11. Ratanpur Technical School	Ratanpur, Khulna	Church of Bangladesh Social Service Program	Carpentry, Mechanics, Welding, Metal Work		To train poor boys to serve local agricultural and industrial needs.
12. St. Joseph School of Industrial Trades	32 Shah Sahib Lane, Dhaka	Brothers of Holy Cross	Machine Shop, Sheet Metal/Welding, Electrical, Electronics, Carpentry	3 years	To train poor boys who cannot complete their high school education.
13. St. Joseph Technical Program	St. Joseph H.S., Mohammadpur, Dhaka	Brothers of Holy Cross	Lathe, Welding, House Wiring, Small engine mechanics	1½ years	for poor boys, especially Biharis
14. Seva Sangha	7 Brickfield Rd. Chittagong	Foundation Trust	Machine Shop, Tailoring Welding, Electrical, Auto Rickshaw, Carpentry	3 years	For poor street urchins and orphans
15. UCEP Technical School	UCEP 2 Mirpur, Dhaka	UCEP—Bangladesh	Carpentry, Electrical Tailoring, Jute work, Engine mechanics Welding,	2 years	For strcet urehins

ness poor tools, and lack of theoretical knowledge.

Trade schools

The private, non-profit trades schools fill a real need in the country, and though the basic aim of all private schools is the same (namely, the training of poor boys so that they can enter the job market) each school has its own particular target as well. Many of these schools offer admission only to those who are very poor and totally illiterate, poorly motivated and who can scarcely afford the time, the transportation costs to attend the school, or the other small expenses incurred in receiving training.

Other schools take in average students who are partly educated and can benefit from more thorough training. These boys can be turned into better craftsmen than the first group, but enough time must be given to the training of all of the boys to overcome the handicaps of not having grown up with mechanical gadgets and tools. The boys are intelligent, however, and their technical abilities can be developed. Some of the schools offer literacy lessons along with their vocational training.

Most of the private, non-profit trades schools stress practical training in their trades to help the student develop good skill and ability. Besides giving formal organized skill training, most of these schools use production and repair work as a means of giving 'on the job' training. This allows the boys to develop their skills in an actual work situation and, at the same time the boys develop confidence in their own ability.

The instructor in this type of school must have a thorough knowledge of his trade and have a high degree of skill. The theory training lessons are about one-third of the practical training lessons. This enables the boys to have a working knowledge of their trade and read drawings, make sketches and make their own calculations on the job. The production and repair work for outside customers serves as an income for these trades schools so that they can cover their running costs, since training is provided by most of these schools free or almost free to poor students.

Association of trade schools

All the private, non-profit trades schools have to confront common problems, such as supporting their recurring expenses, keeping skilled workers and teachers and maintaining a high standard of training. Fifteen of the existing private, non-profit, trade schools have joined together in an association, in an attempt to find solutions to their problems and for giving mutual advice and encouragement. Purely commercial trades schools, which are springing up everywhere to meet the needs of people wanting training to take jobs in the Middle East, do not qualify for membership of the association and are, in fact, barred by the constitution of the association. Those schools are profit-making for their owners and are poorly equipped to impart a high standard of training.

Voluntary agencies may find it useful to take advantage of the trained personnel coming from the trades schools, and the schools could certainly use to full advantage any production work given to them by various agencies. Income is badly needed to maintain the schools and each school would do its best to do the work well.

The office of the Association For Private, Non-profit, Trades Schools is located at St. Joseph School of Industrial Trades, 32 Shah Sahib Lane, Dhaka. A list of the member schools is given below, along with pertinent information.

Asia Tech

New Ideas

This column will provide information on products and processes originating in the Asian and Pacific region. The Regional Centre for Technology Transfer (RCTT), an institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), which is collaborating with ADAB NEWS in featuring Asia Tech, will help you contact the source of the product/process. For further information, write to the Reginal Centre for Technology Transfer. P.O. Box 115, 49 Place Road, Bangalore 560 952, India.

Australian Ethanol from Sugar

The CSIRO Division of Chemical Technology has devised a new method of fermenting sugary crops to make ethanol. The new process called 'solid phase fermentation' is relatively simple. The crop is pulped and fed directly to the fermenter without prior extraction of the sugar. No water is added. The crop, with the help of a dose of yeast, brews its own juice.

The process is very economical in producing 1 to 5 megalitres of ethanol/year. By contrast, a conventional distillery requires a capacity of the order of 50 megalitre/year to achieve efficient operation. A solid phase plant would cost much less to install than a conventional plant and its operating cost is also lower.

New Zealand Sorghum Ethanol

New Zealand is concentrating on sorghum plantations on dairy farms to provide the raw material for fuel ethanol production. Sorghum harvest and processing fall in the slack milk production period so ethanol fermentation could be an off-season activity for dairy farmers. The plan devised by New Zealand's Ministry of Agriculture and Fisheries calls for sorghum cropping on land previously reserved for sillag. and and hay.

Preliminary cropping and processing studies show that ethanol yields of around 3,000 litre/hectare for a single April harvest are possible. Sugar extraction was done with a small three-roller mill. While the extraction efficiency of this mill was lower than that of other conventional methods, it provided more appropriate feeds for cattle than conventional milling procedures. It thus fits the requirements of an integrated dairy farm—ethanol manufacture operation.

Philippines Green Charcoal

Mr. Gonzalo Catan of the Philippines has developed a method of producing green charcoal biomass like grass, twigs, sea-weeds, saw dust and other cellulosic material. When mixed with coal or charcoal and briquetted, it yields a fuel with a calorific value of 10,000-20,000 BTU.

Cellulosic material is first gathered, sprayed with water and allowed to decay for 3-4 days. The partially decayed material is cut and ground. The ground biomass can then be mixed with coal if desired, and briquetted. One of the advantages of this process is that briquetting does not require the use of an external binder. Lignin available in the biomass is itself used as a binder. 'Green' charcoal is claimed to be easy to ignite and is said to burn with a low, clean flame.

Bangladeshi Solar Food Dryer

The United Mission based in Nepal has developed a culturally acceptable, economically attractive, efficient and safe solar food dryer for use in rural Bangladesh. The dryer is constructed of panels made of a 5 cm. thick sandwich of woven bamboo sheets and rice straw. The internal surfaces of the dryer are coated with a mixture of resinous tree gum and powdered charcoal or boiled wheat flour and powdered charcoal. Woven bamboo cane is used to make the removable food trays. The open top is covered by a sheet of 6 micron thick low density polyethylene film which costs 5 percent of the price of sheet glass in in Bangladesh. The drying of fruits and vegetables takes from six hours to two days depending on the initial water content and product thickness.

Indian Portable Biogas Plant

Mr. Arvind Pandya of Ahmedabad has developed a portable biogas plant which is a 1.83 m (6 foot) cast iron plant capable of daily conversion of 10 kg of cow dung to 2-2.8 m³ (70-100 ft) of gas. The 178 cm (70 inches) diameter vessel has a feeder mechanism to receive the dung. The plant costs about US $ 500 and does not require any cement for consideration.

(Continued from page 29)

cultivation. Iron toxicity could occur in soils kept continously wet by irrigation or seepage.

Fertility improvements can be achieved by providing irrigation in the kharif season; adding more organic manure; mixing urea and phosphate fertilizers deeply into the topsoil; giving frequent, small doses of urea as top-dressings; and by giving potash, sulphur and possibly other fertilizers, if proved necessary.

Shallow Grey Terrace Soils have low contents of organic matter, nitrogen, phosphorus and potash, but they are relatively more fertile than their deep cousins because their heavy clay subsoil reduces leaching losses and gives them higher moisture holding capacity (at least for paddy cultivation). Seasonal flooding within fields provides biological nitrogen and makes phosphorus more readily available for kharif crops. Irrigation may provide similar benefits for boro paddy if the soils are kept continuously submerged.

For intensive HYV cultivation, normal doses of urea, TSP and MP are needed. There is evidence in some areas that zinc and sulphur may also be needed.

Grey Terrace Valley Soils are broadly similar in fertility to Deep Grey Terrace Soils. They are similarly low in organic matter, nitrogen, phosphorus and potash, and they are equally easily leached of nitrogen. They benefit similarly from biological nitrogen and phosphate availability in the monsoon season, especially in the lower parts of valleys where seasonal flooding lasts longer. On the other hand, they are more prone to iron toxicity, especially along valley margins.

For intensive HYV paddy cultivation, normal doses of urea, TSP and MP need to be given. Urea should be well mixed into the soil, especially in higher valley soils which may not stay submerged continuously during the kharif season. Rapid leaching of nitrogen, either vertically through the soil or laterally by overflow of water from field to field, needs to be off-set by giving frequent, small top-dressings of urea following deep mixing in of the basal dose. Slow-release forms of urea would also be useful.

It is probable that sulphur and zinc may eventually need to be given. Iron toxicity needs to be corrected by providing intercepter drains along valley edges and by ensuring that the soils can dry out for a time each dry season.

Report

Ownership of irrigation assets by the landless

Recently, ADAB organized a seminar on "The ownership of irrigation assets by the landless" with a view to facilitate open discussions between the Bangladesh Rural Advancement Committee (BRAC), PROSHIKA and members of other organisations on the problems and prospects of extending the landless irrigation programmes. Representatives from over 30 government and non-government organisations participated. The seminar was adressed, amongst others, by Mr. Anthony Bottrall of the Ford Foundation, Mr. Izzeddin Imam of BRAC, Mr. Farooq Ahmed Chowdhury of PROSHIKA and Mr Geof Wood of the University of Bath. Dr. Hugh Brammer, FAO Agricultural Development Adviser, chaired the seminar.

Introduction

Introducing the topic, Mr Anthony Bottrall said that the issue of ownersip of irrigation assets by the landless had to be viewed in the context of the increasing landlessness, unemployment and marginalisation of the rural poor. He said that, in the absence of any significant redistribution of land, one of the approaches has been to look for ways in which the rural landless might acquire assets other than land. Irrigation water is a very valuable resource, especially in the winter season and also as a supplement to the Aman and Aus crops. It is still a relatively unexploited resource. Less than 20 percent of the cultivable area is irrigated during the Rabi season and there is still a lot of scope for expansion, specially through the development of ground water. This has aroused interest in several NGOs and among some sectors of the Government (in the Ministry of Agriculture and the Ministry of Local Government and Rural Development) to embark on the development of support programmes to landless groups which would enable them to acquire pumps and sell irrigation water to cultivators, concentrating wherever possible, on contracts with smaller farmers. Similar opportunities for the landless appear to exist in other related fields, e. g., in supplying farmers with complementary inputs (fertilizers, pesticides) or moving into the rapidly expanding market for pump repair and maintenance, spare parts, and so on.

So far, several organisations have had experience with landless pump groups on an experimental/pilot project level. In some cases, these programmes have grown out of other more general programmes for small landless groups, with group members deciding to move on to the acquisition of a pump after having built up some savings and mutual confidence through other smaller activities with lower capital requirements. In other cases, programmes have started out with the primary objective of pump group formation. So far, the bulk of activity in this field has been undertaken by NGOs, though there has been some limited experience in one government sponsored programme, the ASAARD programme for small farmers and landless—near Comilla and Bogra (and IRDP is planning to start a pilot programme shortly).

Referring to the ensuing discussions on the topic, Mr Bottrall said that special attention ought to be paid first to the prudence of adopting the pump strategy: is it a desirable strategy or is it wrongly conceived? Secondly, there are major questions relating to government policy in the field of irrigation development generally. As already mentioned, there are opportunities for the landless to move into this still relatively open field, but many aspects of the present government policy are not helpful to the expansion of the landless programme. One could argue that, in some respects, the government's privatisation policy could be of help to landless in as much as, by reducing BADC's role in pump distribution and maintenance (planned but not yet implemented), it is likely to open up new opportunities for them in the sphere of support service activities.

This may, therefore, be a particularly promising area for the landless groups to move into in the future. On the other hand, in the area of irrigation, it is apparent that certain government policies, particularly with regard to subsidies on pumps and on credit, tend to favour rich individuals rather than the landless. It therefore seems that, if the landless pump strategy is to be expanded, significant policy changes may need to be considered.

Thirdly, there are questions about how to design and manage landless pump programmes, even within the constraints of the present government policies. There ought to be discussions on alternative approaches to the organisation of pump groups, the relationship between pump groups and cultivators, and the activities of the support agencies—not only those immediately involved but also the banks and input supply agencies.

Finally, Mr Bottrall said that, having reviewed the strengths and weaknesses of the programmes so far, participants might also wish to reserve a significant part of their discussion time to consider the most promising lines of advance for the future. Some of these might well involve preparing landless groups for movement into new areas of activity altogether, where there is little or no previous experience to draw upon.

BRAC landless irrigation project

Talking about BRAC's landless irrigation programme, Mr. Imam said his organisation took up the programme with a view to improve the bargaining position of the landless *vis a vis* the larger landowners. He said that as minor irrigation assets were available on government subsidies, BRAC felt that the landless should be involved in irrigation projects so that the state subsidy is not enjoyed only by the wealthier section. The participation of the landless in irrigation would complement the government's strategy to involve the landless in increasing production. With water becoming an increasingly important agricultural resource, the participation of the landless in irrigation programmes would effect a more equitable distribution of assets and would provide them with an alternative source of employment and income.

BRAC became interested in the programme in 1979. It started the landless irrigation project in Manikganj with four landless groups in the first season (1980-81) and 12 in the second. Realising that the groups undertaking such a project would necessarily come under pressure, and would have to negotiate and interact with local government agencies and extract payments out of the recipients of the irrigation facilities. BRAC selected group which were cohesive and well-united.

The first problem that emerged was in establishing the credibility of the landless both with the farmers and the BADC. Farmers had to be convinced that the landless group would be able to provide them with water, and that the BADC would sanction the equipment. On the other hand, the farmers could not approach the BADC for the equipment unless they could present to the BADC signatures of all the farmers who were willing to receive water from the landless group. After many rounds of discussions a breakthrough was made. Some farmers, owning a total of about seven acres of land, signed contracts which committed them to receiving water for at least five years, in return for one third of the crop-yield in the dry season and one-quarter in the monsoon season.

A credit line was established with the Bangladesh Krishi Bank (BKB). Since the landless could not provide collaterals, they had no access to credit. BRAC became the guarantor and deposited with BKB funds amounting to 50 percent of the loans given to the landless. The assets were hypothecated to BKB to cover the other 50 percent. (In a second landless irrigation project, started under BRAC's Rural Credit and Training Project, loans were given directly by BRAC at commercial interest rates.

Commenting on the financial viability of the project, Mr. Imam said that the profitability was high. The revenue in the first season was about Tk. 20,000 and the operation cost was Tk 1500-1600. The first year was a difficult year, but the yields increased with time. Returns depended on the total acreage covered under the command area of each pump. BRAC found that a command area of 13 acres and an yield of 35 mds/acre was the financial break-even point. Operation costs decreased in the second year as costs for makings drains, sheds, etc. were not necessary. The major cost involved was in fuel and lubrication. Careful monitoring is necessary to see how this affects returns.

In conclusion, Mr. Imam offered the following recommendations, which he said emerged from discussions with the landless group members and field workers.

1. The interaction between the landless and the local government agencies takes up a lot of time. Delays are caused in installing pumps and often the problems arising between the two parties cannot be solved without the intervention of BRAC. There is a need to ensure better cooperation from the government agencies.
2. As the first year is the most problematic, loan repayment should be made easier. It could be suggested that the first year be considered a grace period and repayment be made from the second year onwards.
3. It is often difficult for the landless to obtain signatures of all the farmers who wish to receive water from them. All the owners may not be living in the same area ; and the problem becomes even more serious when absentee landlords are involved. The procedure should be streamlined.
4. It is necessary to ensure availability of spare parts.
5. It is felt that water management training would help the landless to conduct their programmes more efficiently.
6. Landless irrigation projects are important not only from a financial but also from a social point of view, and cooperative alliances can be formed between different rural classes. (For a detailed view of the BRAC Programme, see article by Mr Imam in this issue).

Proshika

Describing the PROSHIKA landless irrigation project, Mr. Farooq Ahmed Chowdhury said that, as the main thrust of PROSHIKA was in building landless organisations and undertaking schemes for the landless, PROSHIKA became keenly interested in starting irrigation projects for such groups. PROSHIKA first tried this scheme in the 1980-81 Rabi season with a few groups. In the subsequent Rabi season (1981-82), 83 landless groups, distributed over 11 areas of Bangladesh joined the scheme. Of these, 51 entered into STW projects and 32 into LLP projects.

The PROSHIKA landless irrigation programme started with the following objectives.

1. To facilitate the acquisition and use of low lift pumps (LLPs) and shallow tubewells (STWs) by the landless, and enable a more equitable distribution of agricultural assets.

2. To develop a source of income, and therefore, purchasing power among those groups.

3. To ensure that landless groups have a share in the benefits from enhanced productivity to which they also contribute.

4. To achieve a more efficient use of water through its wider distribution to smaller farmers (including tenants).

5. To enable the landless to participate in a wider programme of non-development economic activities.

Mr. Chowdhury said that the landless irrigation programme was an experimental programme, developed through a process of action research. The 11 regions in which the experiment had been conducted had very different ecological and socio-economic conditions, and there were many variations in local practices. He said that the groups had to identify, by trial and error, the particular combination of variables most appropriate for their local conditions.

Taking the 83 groups operating in the second season as the basis of his discussion, Mr. Chowdhury said that, in evaluating their performance in the 1981-82 season, it was found that 75 percent of the STW groups and 78 percent of the LLP groups were financially successful. There was little experience in the cultivation of HYV Boro rice in any of the STW localities and it would be unrealistic to expect a high initial rate of success. However, the results were encouraging. The average command area for successful STW groups was 14.6 acres. Overall, the average command area size was 13.4 acres. The command area size had been significant in determining the extent of the success, but the forms of payment between sellers and purchasers of water often limited the significance. The groups receiving payment in the form of a 33 percent of the standing crop fared best. These groups obtained the highest income per acre. This also provided the cultivators the greatest incentive to maximize productivity. Other forms of payments—including fixed cash arrangements, and 25 percent crop share—have brought relatively low net returns.

Of the 32 LLP schemes, 8 groups rented their equipment and 24 groups worked with purchased machines. In future, concern should be focused on the viability of the purchased equipment since the highly subsidized rented equipment is being phased out under the privatization strategy. It was expected that, financially, the LLP groups would be more secure than the STW groups because rented and purchased LLP's were both more highly subsidized than STWs; farmers in single-crop LLP areas were more dependent on and familiar with irrigated rice production and the search for a command area was more flexible as it was not necessary to site the equipment permanently. Despite such factors, the success rate of LLPs was only three percent higher than that of STWs. This indicated that LLP schemes are not necessarily the easier option for landless groups.

Seven of the 32 LLP groups were unsuccessful. The problems were location specific. Four of the seven unsuccessful groups were in Ulania, Barisal. The problems there were technical. The area is tidal, and pumping could only occur when the tide was in. Command areas were therefore very small. Two groups in Chatalpar, Comilla, were unsuccessful because of low income per acre. The groups were weak in bargaining over the price with large numbers of small non-group cultivators whose own margins on production costs were tight. The seventh group had a low command area resulting partly from sandy soil and partly from interference by a 'rich man'.

The main areas of success were in the Khaliajuri area of Mymensingh District and Chatalpar in Comilla District. The success of the Khaliajuri groups has been credited to the facts that:

(a) schemes were either in or on the edge of haor areas where cultivators have been accustomed to Boro irrigation and with irrigation, broadcast Aman could be replaced by a Boro-T. Aman rotation; and

(b) past history of irrigation has made cultivators willing to commit land to command areas and themselves to long-term agreements.

In conclusion, Mr. Chowdhury enumerated five issues which required further research in relation to the ownership of irrigation assets by the landless. He said:

(a) the employment implications of this programme, as well as of the minor irrigation strategy generally, should be researched more carefully over a longer period;

(b) a comparision should be made with the experience of landless STW groups involving other organizations besides PROSHIKA; this should include a comparison with the privatised STW programme;

(c) some follow-up analysis is required to see how individual members utilize the profit from their irrigation activity;

(d) closer investigation is required of the implications of different types of land lord-tenant arrangements for productivity and sharecroppers' incomes; and,

(e) it will be necesary to study possible ways of increasing returns from the group's irrigation activities by increasing double-cropping and supply of supplementary water during Aus and Aman seasons or for wheat. It may be possible to enter into non-irrigation activities such as milling or other irrigation-related service activities.

(See also paper on PROSHIKA's programme in this issue).

Discussion

Mr. Geofrrey Wood of the University of Bath, commenting on the PROSHIKA landless irrigation project, said that much of the success of the irrigation programmes depended on being able to install the pumps by November. It would be better not to proceed if that deadline could not be met. Training in water management would greatly enhance the efficiency of programmes. Such training was also necessary for the cultivators, who could learn to use the water more efficiently. In Mymensingh, one problem was the lack of information among pump owners and cultivators regarding the correct quantity of water needed and the quality of the soil. In some area, it may not be altogether possible to undertake such programmes because of unfavourable soil conditions.

Mr. Wood said that in the LLP areas, people were more familiar with irrigation, but problems arose regarding the capture of rights to this resource by the landless. There was competition and conflicts between various groups, and often rates of water fees had to be brought down and varied in different areas. In the event of negotiations between the landless and farmers, the status of the landless in the community is a very crucial issue. It is necessary for the landless to gain a standing in the community to be able to assert themselves in dealing with the landowners and the richer class. When the landless undertake irrigation activities (particularly when both STW and LLP areas are brought under a scheme), the landless have a large commercial issue in their hands. A very large number of farmers are involved and the form of relationship between the two groups is vital. Political and social issues are brought into the forefront. It has been seen that, often, a particular landless group will involve another group to collect its water fees in order to prevent problems with landowners. The socialisation and promotion of the ownership of irrigation assets by the landless is therefore a very important factor.

Later, Mr. Wood replied to a comment that, in the absence of any strong policy base which could facilitate the ownership of irrigation assets by the landless, PROSHIKA and BRAC were perhaps going a little 'overboard' with the projects. He said that given the circumstances, it would be defeatist on the part of voluntary workers to sit back and wait for desirable policies to be implemented. The landless programme will not be successful unless there is public support and unless the landless work for it. There is no point in creating a protective barrier around the landless. Voluntary workers are not nurse-maids, and the landless have to strive for their own support. Mr. Wood maintained, however, that a key element in the success of the volags groups had been the care taken in initially identifying such groups and building them up before they were ready to undertake pump purchase and operation. If government assisted programmes were to achieve similar levels of success, it would be essential for them to pay the same kind of attention to preparatory group formation.

Group discussions

In the second session of the seminar, the participants were divided into four discussion groups. ADAB offered the following six points as guidelines for discussions. Group members were asked to choose the issues they considered most suitable.

1. Non-land property rights and the policy environment. Agrarian reform can be achieved by recognising that other non-land assets and services to agriculture such as water, engine maintenance and delivery of inputs can be owned and undertaken collectively by those without land instead of being concentrated in the hands of those who are already well-off. At the same time, this can raise the purchasing power of the rural population for agricultural and industrial goods, with the same level of resource provision as contained in present privatisation policies. Should present policy therefore be reconsidered or at least adjusted to make room for such alternatives ? How do current pricing (including energy) and subsidy—withdrawal policies affect this ? Does the IRDP-KSS form of ownership still function to concentrate the benefits in a similar way to privatisation ?

2. Access and administrative costs. Landless and near-landless have acute problems of access to credit, information, training (management, book-keeping, machine maintenance), inputs (machinery, diesel fuel, spare parts, fertilizer, etc.) and services (machine repairs, boring, feasibility studies, advice). What have been the administrative costs in trying to overcome those problems ? Does the assistance of an intermediary such as BRAC, PROSHIKA, etc.. decline rapidly after the first season ? Do new groups learn from and gain assistance from neighbouring groups with experience ? What are the implications of these questions for expansion and replication of the strategy ?

3. Water management and command areas. Where there are problems of profitability, can these be resolved through improving water management practices ? And how can this be achieved ? The analysis of experience so far is based on a net *boro* paddy command area, but command areas can often be (sometimes partially) double-cropped, including the provision of supplementary irrigation for *T. Aman*. Command areas can be temporarily extended to irrigate wheat in plots adjacent to land where *boro* paddy will be planted later. How widespread are those opportunities? Regarding management, is water over-provided, are soils always appropriate, is there leakage, is the lay-out of drains too sensitive to political influence rather than technical considerations? Experience includes all these problems: what are the costs of providing adequate water management support for the sellers *and* the consumers of water? Does the landless strategy involve problems over and above the privatised system?

4. Exchange relations between sellers and consumers. The forms of payment vary between a share of the crop (the share is itself a variable), a fixed quantity of crop (with straw and wet/dry variations) and fixed cash payment. Sometimes payments are made at harvest, sometimes during the growing season, sometimes preceding the season, or partial combinations of these systems. Sometimes farmers purchase the diesel oil directly. These variations affect the scale of advance operating capital required; they reflect power relations between landless sellers and the landowners in the command area; they affect the degree of control a group can exercise over water distribution practices; and they affect the quality of small farmers' access needs for credit to undertake HYV production: what are and what should be their sources? Finally, which form of exchange and agreement has the most impact on raising the productivity of land?

5. Related activities. The machines can be used for other purposes, such as a power source for milling, lathes for workshops, pump drainage. This creates other opportunities for employment and landless involvement in small scale rural industry. Also, the irrigation programme (whether landless—collective or privatised) requires services such as maintenance, overhaul, repair, spare parts, fuel delivery. Those are all areas for landless involvement, but they require recruitment, training, capital for holding stocks, and setting up workshops. A related set of services in providing inputs (fertilizer, pesticide, seed) can be organised on similar principles. There are specific and practical policy implications here.

6. Social effects. The strategy obviously has employment implications: more local opportunities affect seasonal migration patterns, influencing the potential for raising wage rates and reducing the dependency of marginal farmers on the labour market. Effects on status in the village are reported: with more landless participation in decision-making there is less harassment. Will the landless be in a stronger position to resist moneylending and mortgaging practices? What organisational innovation among them is emerging, and how should it be encouraged and sustained? Do the landless and marginal farmers have joint interests in this strategy? Are we witnessing a socialisation of this means of production in this strategy, or the development of conventional attitudes to property owning and profit?

Recommendations

The following ideas and recommendations emerged from the group discussions.

1. Policies are needed to assure ownership of assets by target groups. Assuming that a system of preferential distribution of the pumps to the target group is desirable, the government should help create an effective demand for water. In the absence of supportive government/legal policies concerning public water rights, private organisations should work towards facilitating access to this crucial agronomic input for the disadvantaged.

2. The need for a facilitating intermediary does decline, although not rapidly. It is important first to build up the integrity of the group before handing over the management and ownership to the landless. This would also strengthen the banks and BADC's confidence in the group. Expansion of this scheme, may, therefore

require sufficient lead time to form workable groups.

3. Better management of delivery and use of water should be ensured. Crop insurance should be emphasized. Cultivators should be encouraged to double crop the command areas (where feasible) and extend irrigation for wheat cultivation.

4. Involvement in other activities, e. g., provision of other agricultural inputs, will necessarily require higher levels of group fund investment and management. Some groups in PROSHIKA even preferred using the pump for other activities e.g., milling because of larger profit margins. Some measures may be needed to assure that this does not upset the agreement between farmers and other groups.

5. The bureaucratic procedures involved in obtaining pumps should be simplified. It is also necessary to train landless groups in handling such procedures along with training them in water management pump maintenance, making contracts with farmers, etc.

6. Access to spare parts and workshops must also be ensured.

A federation of water management groups might eventually be able to run workshop and supply depots.

7. Neither the volags nor the government should now rush in with a widespread programme for the landless on this model. That would be premature and its failure would kill the programme.

Conclusion

Summing up the seminar and offering his views, the Chairman, Dr. Hugh Brammer, made the following comments.

1. BADC is likely to be eliminated from pump sales as a result of privatisation. However, some agency will still be needed to control the location of irrigation devices. This will be an increasingly important function as competition for water increases. Eventually, this regulatory function might have to be taken over by local government.

2. Water management (appropriate cropping patterns; rotational water distribution, etc.) and repairs will be major problems until the quantity and quality of support services can catch up with the numbers of pumps being distributed: (in this year alone 55,000 shallow tubewells are due to be distributed). This is an area of opportunity for landless groups to exploit.

3. Thought needs to be given to insurance against risk of loss. This cannot be done through conventional crop insurance since the premiums for small farmers would be far too high. The solution may have to be sought through other means, e. g., extension of the period of credit repayment, both to pump groups and to individual cultivators.

4. A key-objective of the programme should be to ensure that the groups become self-sustaining and that they develop in such a way as to prevent their being taken over by ambitious individuals, whether from inside or outside the group. In this connection, it is not clear at present how and over what time-span the voluntary agencies will seek to disengage themselves from their present level of supervision and assistance to the groups. If landless pump groups are successfully developed under the IRDP programme, they will presumbly have the TCCAs to look to for long-term back-up support; but from where will the groups initially assisted by the voluntary agencies obtain such support?

In conclusion, Dr. Brammer said that the voluntary agencies in their current programmes are performing a pioneering role by demonstrating that such an approach is feasible. The objectives were clear: to provide the means for a more equitable distribution of assets, incomes and political power. However, he reminded the participants that the work is still in an Action Research phase. There is a long way to go yet before one could say to government: 'We have a viable project for investment.'

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June	19-28	Mobilisation and Organisation of Landless
July	03-6	F.E. Refresher's Course
July	24-31	Leadership and Social Change
August	07-22	Functional Education Teacher's Training
September	04-15	Trainers Workshop
October	02-10	Entrepreneurship Development in Rural Development perspective
October	23-31	Mobilisation and Organisation of Landless
November	08-21	Project planning and Management in the perspectives of rural development
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