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## **PLANNING RURAL TECHNOLOGIES IN THE CONTEXT OF SOCIAL STRUCTURES AND REWARD SYSTEMS\***

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### **ABSTRACT**

Many of the experiences of recent technological change, whether brought about by a process of explicit planning or by default have not contributed to improving the welfare of the poor who live in rural areas.

This paper seeks to understand some of the processes behind recent changes in agricultural and rural technology. It starts by looking at five different levels of rural technology decision making and discusses how these levels are interrelated. Case studies from high population density areas of Asia are used to illustrate some of the reasons for looking at social structures and reward systems at different levels of decision making. Suggestions in the concluding section include the need for rural technology case study research, the use of a rural technology checklist, and the strengthening of national, regional and decentralized research and production systems and a greater emphasis on collaborative work between disciplines when addressing problems of rural poverty.

### **I. INTRODUCTION**

The plans of low income countries and the programmes of international aid agencies frequently have economic growth, poverty reduction, population control and self-reliance as important development goals. Even so, many of the experiences of recent technological change, whether brought about by a process of explicit planning or by default have not contributed to these objectives. These experiences indicate a bleak future for the rural poor unless we understand the processes behind recent rural technological change and learn from these experiences.

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This paper seeks to promote that understanding. Emphasis is placed on looking at how decision-making has influenced rural and agricultural technological change in the recent past.

The basic premise of the paper is that people involved in agricultural and rural technologies are rational decision-makers, and that the decisions they make are determined by the social structures and the reward systems in which they live. Whether they be landless labourers looking for employment, land-owners seeking to cultivate land and maintain possession of their assets, government officials, researchers and university staff wishing to keep their posts and gain promotion, international aid agency personnel trying to find projects and commit funds or university professors and researchers in high income countries teaching skills and values to people from low income countries, all are influenced by their environment.

The thrust of the argument is that if we are interested in promoting technology to benefit the rural poor, it is necessary to examine existing social structures and reward systems under which people make decisions. Without this examination and necessary change, already existing technologies may still not be used and any new technologies suitable for benefitting the poor may well remain idle.

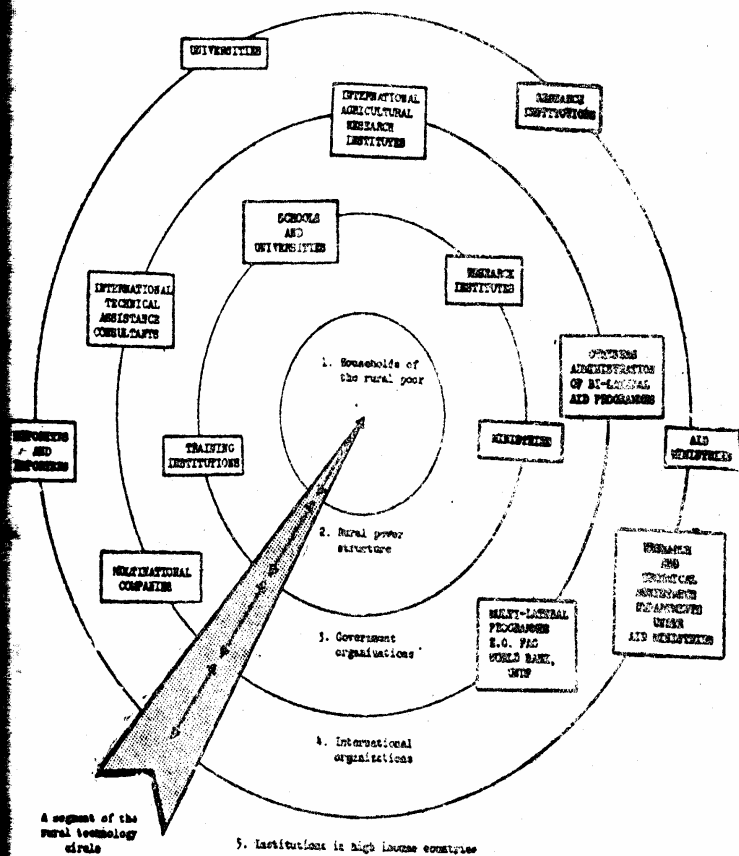
## II. HIERARCHY OF RURAL TECHNOLOGY DECISION-MAKING

Figure 1 is a framework for identifying different levels of social structures where decisions are taken which determine the use of presently known technologies and the creation of new technologies.

### 1. The Rural Poor

In the centre of the diagram (Level 1) there is the household decision-making of the poorest inhabitants of rural areas. Increasingly both planners and researchers are beginning to recognise their ignorance about, and the importance of, many areas of activity within these households. These activities have often been omitted from data used by planners because of the widespread use of national income accounts and official census materials. These procedures use arbitrary classifications which frequently fail to enumerate important agricultural operations and other occupations which are conducted by the rural poor. Milling and food processing are enumerated when performed in mills in rural and urban areas but get overlooked when done by the poorest of rural women. This has led

Figure 1: HIERARCHY OF RURAL TECHNOLOGY DECISION-MAKING



A segment of the rural technology circle

NOTE: Each segment of the circle represents a different technology, e.g. wheat, irrigation, draught power, post-harvest technologies, cholera prevention and treatment methods, contraception methods, house building techniques, etc.

The arrows (→) denote dependency relationships, modes of transactions, etc. between levels of decision-making.

to a situation where those involved in development planning have thought it unnecessary to first find out and understand what exists within a rural society, before imposing or inducing far-reaching plans and technological changes.

Some of the activities most neglected have been the work of women and children. However, this situation is changing as social scientists are increasingly undertaking quantitative research on all activities of both male and female household members in rural communities and drawing out the implications for national policies and programmes. For example, Kikuchi *et al* (1977) drawn up detailed economic accounts for rural households in the Philippines. In another situation, White (1976) studies small farmers and landless labourer households in rural Java and shows that women of 15 years and over work an average 11.1 hours per day while men only work 8.7 hours. He documents how children from the age of 6 onwards make a major contribution to household activities, not only by taking care of children, housework, food preparation, firewood collection and shopping but also in what he calls "directly productive work", i. e. working in occupations such as animal care/feeding and handicrafts. One of the themes of this paper is that attitudes towards the number of children a poor family may want (and consequently their interests in birth control methods and techniques) can only be seen in a context of an overall analysis of household income generating opportunities. With employment opportunities and real wage rates very low it is perfectly rational for households to have more children who can be either occupied in "directly productive" work or can take over necessary and essential household activities thereby releasing adults from those activities. Furthermore, with children being the only form of social security for poor older people in most low income societies, it is rational to have a large family because some are expected to die. The implication for rural technologies is that methods which give rise to rural employment and income, as well as those that improve rural health conditions are two of the most important sets of technology for reducing population growth rates. However, the options open to the rural poor for employment are determined in major part by the production and other decisions of the owners and controllers of land and other assets in the rural society i. e. the rural elites.

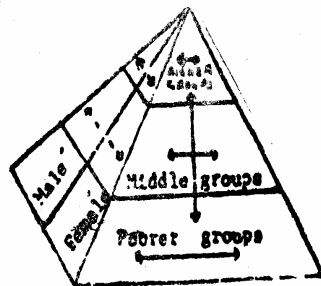
## 2. The Rural Power Structure

The second level of decision-making is that of the rural elites. By making this a level of decision-making we are not implying that members of

the rural elite are in collaboration, although in some situations they may be. Rather, it is to clearly identify that decisions of the powerful members of the rural society determine, in large part, the environment for employment, credit, etc. for the rural poor. This holds not only as a result of the production decisions of cultivators who give employment, but also because richer groups have better access to scarce inputs, and to markets for produce.

As regards the dependency relationships between different socio-economic classes within the rural communities, the pyramid of rural households in Figure 2 provides a useful conceptual framework.

**FIGURE 2 : PYRAMID OF SOCIO-ECONOMIC GROUPS IN A RURAL SOCIETY**



**NOTES :**

Denotes the different relationships between male and female household members in socio-economic classes. Who takes what decisions and why? Who does what work and why?

The vertical lines represent various dependency, patron-client and other relationships between socio-economic classes. These relationships include wage payment systems, share-cropping and other rental systems, consumption and production credit systems and various methods for the re-distribution of food and other income.

The horizontal lines represent within socio-economic class relationships. For example, the mutual exchange of labour and animal draught power between small farmers and the transfer of capital between agricultural and non-agricultural activities within classes.

At the top of the pyramid we have those groups which have land assets, formal education, etc. and at the bottom we have the households of landless labourers and others who have little or no land, assets and formal education. It has been argued elsewhere (Biggs and Burns, 1976) that agricultural technology and modes of transactions (e. g. sharecropping arrangements; labour payment systems; consumption credit systems etc.) are critically interrelated and that the owners of land and other assets have an interest in providing subsistence wages and consumption loans in order to maintain a labour pool and maintain their position at the top of the rural power structure. The "interest" on the part of the rural elite relies upon labour intensive cultivation practices being *the only* production technique available. Transactions of food in this type of society are substantial. In a model which projected the future implications on income distribution of specific types of agricultural technologies, it was found that transactions in kind (food) made up over 20% of total food output (Biggs, 1976).

Although it is interesting to note that similar patron-client systems occur in other parts of Asia (Epstein, 1967) and that practices such as paying labourers a share of the crop for harvesting are found in Java (White, 1976) the critical point to note for an analysis of rural technology is that it is necessary for planners to understand the relationships between technology and social institutions. Many schemes which have promoted labour substituting technologies by their introduction and extension and by favourable price policies, have not taken these realities of life for the rural poor into account. With the result that rural wage rates are declining, unemployment is increasing, and population growth rates are high.

Representing the distribution of rural households in a pyramid reminds us that different cultivator groups have different resource endowments. Technology which is "appropriate" to the needs and production problems of the people at the top i. e. those who have plenty of land and other assets and have to employ labour at the market rate, can be very different from policies that address the problems of smaller farmers, artisans etc, who have little land or other assets but plenty of household labour with few alternative productive uses. In most countries the majority of rural households are near the bottom of the pyramid. Promoting technology which is labour substituting may solve the production problems of small and large cultivators but increase the state of poverty of the landless. In this context we might note the limited usefulness of a "small farmer" strategy as a method for long-term egalitarian rural deve-

lopment. Such programmes have the inherent weakness of not addressing the problems of the growing numbers of rural landless. In fact, even distributional land reform measures which might create a few less landless labourers and a few more small farmers in the short term will be of limited use unless there is a major political commitment to using national resources efficiently and to effectively channeling other assets and resources to the smallest farmers. In the long run cooperative farms or collectives may be the only way of consolidating holdings to gain economies in the use of energy and water and ensure that capital is not substituted for labour unless there is an increase in overall productivity to the cooperative.

In this context it is interesting to note that where land has not been brought under collective control, but western styled cooperatives have been used in Asia, either for breaking down "lumpy indivisible" technological inputs (e.g. large capacity deep tubewells) or for distributing credit, fertilisers, seeds, etc. this transfer of a western organisational structure (in conjunction with new technologies) has only resulted in the indigenous social structure—as portrayed by the pyramid—distributing benefits in its traditional unequal way. The benefits have neither trickled down nor have the poorer groups had access to the government supplies of inputs.

The male and female dimension is given to each socio-economic group of the pyramid to emphasise that the decision-making, the problems, the roles played by, and the work done by females in various groups is very different. For example Cain (1977) shows how females are engaged more in household activities as family wealth increases and how the female members of poor households have a greater need to seek wage employment.

Finally, as regards the linkages between agricultural production and the effective demand for food, the pyramid reminds us that unless the rural poor have jobs there will be an insufficient demand for food grains. In this situation food grain prices will decrease and land will be either switched into other uses or be used less intensively.

### 3. Government Organisations in Low income Countries

The third level of decision-making is in government organisations in low income countries. These are the ministries that decide on prices, taxes, imports of machines and the seeds of high yielding varieties, etc. and thereby affect the type of technology promoted or prevented in rural areas. At this level



also we have national research institutes, universities and schooling system. The structures and reward systems which set priorities of work and reasons for promotion, etc. in institutions at this level crucially determine whether people make decisions which promote technologies that reduce rural poverty. Decisions made at this level change the whole environment for people living in rural areas.

When looking at the behaviour of people and institutions at this level it is essential to look at the relationships between socioeconomic groups in rural areas and those who control the institutions of the government. Many studies have described the price responsive behaviour of farmers, the work of extension agents, etc. but most have failed to analyse the way in which the elites of the rural society influence and control government organisations. It is not by chance that institutions and technologies are introduced into rural areas which are of benefit mostly to the rural elites (Wood, 1976).

#### 4. International Organisations

The fourth level of decision-making is that of international organisations. We have at this level such organisations as the World Bank, the International Agricultural Research Centres, FAO, and other U. N. organisations. There are many different ways in which these organisations can support and strengthen national, regional and decentralized research and development programmes in low income countries by projects and outreach programmes. However, what are the most effective ways of strengthening these local systems? Have we looked closely enough at the outcomes of past programmes and seen what type of programme leads to the best allocations of scarce resources? We also have at this level the overseas offices of bilateral donor programmes. This latter group of organisations are put at this level because the perception of problems, decision-making, priorities, etc. of local offices of bilateral programmes frequently differ from the priorities, perceptions of problems, etc. found in the headquarters in high income countries. Also at level four we have some of the international technical assistance agencies and the multi-national firms.

In different ways the behaviour and decision-making of institutions at this level can determine to a larger or lesser degree— depending on the objectives and strengths of national governments— the options and possibilities and behaviour of decision-makers at level three and below.

### 5. Institutions in High Income Countries

Finally, at level five, we have the institutions in high income countries. At this level we have the more obvious considerations that staffing patterns, promotion criteria, degree of multidisciplinary analysis, etc. in aid ministries directly influence aid policies and the ability of rich country aid programmes to effectively analyse and address the needs of the rural poor. In addition, we have other institutions in high income countries whose behaviour has an even greater impact on whether the issues of rural poverty are addressed in low income countries. These are the universities and research institutes where much technical and social science manpower has been trained and research undertaken in the past, and where it continues to take place. Are these institutions, the training they give and the professional standards they impart relevant to meeting the present and future problems of the rural poor in low income countries? As regards publications, we still have the situation where it is more prestigious to publish articles in international journals than to circulate information in low income countries where it would have more influence on policy and strengthen local analytical capacities. In respect of the supervision of Ph. D. dissertations, we also have situations where professors in high income countries feel it unnecessary, or treat it as an imposition, to be in direct contact with the Director of the low income institutions about the types of courses, dissertation topics, field work, etc. of trainees. Surely this is not the way to back-up and strengthen institutions in low income countries.

Whereas many development analysts see poverty as a problem to be analysed in developing countries, many of the problems for the rural poor are perpetuated as a result of inappropriate institutions, as well as training and research in high income countries. Are we as careful and objective as we might be in analysing these issues?

Finally, in rich countries there are the interests of organisations concerned with imports from developing countries and those which supply goods and services to developing countries (sometimes as part of aid agreements). Of course, the objectives and behaviour of these private and government organisations need to be taken into account when seeking to explain why technologies for benefitting the poor have been promoted or not in rural areas of low income countries. Although there is a growing literature by macro and international economists on the roles and activities of multi-national firms, there is plenty of room for more agricultural

economists to become involved in these issues which affect people in rural areas.

In a nut-shell, it is the structures and reward systems in institutions at different levels of decision-making which are important. It is these social systems which order priorities, establish incentives, identify constraints and opportunities. These need to be in the right direction in order to give rise to the use or creations of agricultural and rural technologies to benefit the rural poor.

### III RURAL TECHNOLOGY CASE STUDIES

In order to illustrate our approach to the planning of rural technologies, we take three examples. In the first we see why agronomy and agricultural engineering research should be given priority and the implications of this for research and price policy. In the second we suggest why past irrigation technology in Bangladesh has been inappropriate for either productivity or equity goals. In the third example we see how the welfare of rural women has been neglected in rice mechanisation programmes.

#### 1. Agricultural Production and Employment in Bangladesh

In spite of an aid commitment to Bangladesh of over 1 billion U. S. dollars per year, there is a chronic lack of empirical analysis of present agricultural and rural activities, ( by all household members over all the year ). In a recent study Clay and Khan (1977) estimated that between 76% and 81% of the total labour force were employed in agriculture in 1975-76 and that this labour force will grow over the following decade at 2.1% per year. Using a simple model they projected the 1985/86 demand for labour. They used 31 separately defined crops, various assumptions about growth rates in crop production, and a national objective of food grain self-sufficiency. Some of the disturbing results indicated that : (a) empirical employment elasticities (the ratio of the percentage change in employment to the percentage change in yield) for switching to high yielding varieties are 0.5 but generally lower. These are significantly lower than earlier Planning Commission estimates of 0.8. (b) some switches in cropping patterns would give negative employment elasticities. For example, a switch from broadcast Aman (deep water) rice and winter mustard to HYV Boro (Winter) paddy using modern capital intensive irrigation techniques gave a 5.5% reduction in employment and a 27.7% increase in yield and therefore an employment elasticity of -0.20. (c) the absolute level of unemployment and under-employment will increase

by 2.2 and 3% a year over the next decade. They see rural works programmes as an important component of any future employment generating mechanism. For us one of the immediate technological implications is that high priority should be given to research on labour intensive forms of multiple cropping, intercropping and other agronomy practices in order to find and create crop production technologies which will use abundant agricultural resources (such as labour) and at the same time reduce rural poverty. This means an emphasis on improved labour intensive agronomy practices because much of the presently known yield potential of rice, wheat and other crops is nowhere near fully exploited. Such a labour intensive crop production programme would be totally complementary to rural works programmes for the expansion of irrigation, flood control measures and the development of rural infrastructure.

Unfortunately, agronomy and agricultural engineering in low income countries receives little attention and are often less prestigious and lower paid occupations for scientists than those of plant breeding, entomology, pathology. Agricultural engineering is often a poor brother to other types of engineering. In addition, it is rare for plant breeders, agronomists and engineers to carry out farmer surveys in order to determine research and production priorities. However there are notable exceptions. For example, the important small survey of on-farm wheat seed storage methods in Bangladesh by a wheat breeder (Ahmed). This orientation is not easy. It requires a pragmatic knowledge about how crops grow under a wide range of different conditions; working in rural areas with cultivators, labourers and rural artisans; being inventive and working in villages with applied agricultural economists, development anthropologists, extension personnel and administrators. It requires responding to practical problems rather than to problems that might seem academically challenging. Finally this type of work involves a high risk on the part of a professional researcher, because it takes that person out of the safe confines of a traditional career structure.

The important question is: How can research priorities and reward systems be changed so that agronomy and agricultural engineering become a priority subject and incentives are given for research and analysis in this area.

The second problem is that price, credit and tax programmes must be implemented to promote rural technology to benefit the poor. Even if we have excellent agronomy and agricultural engineering research to provide information for planners, it will "sit on the shelf" unless these other policies were not implemented in the past.

## 2. Irrigation in Bangladesh

Perhaps the most important engineering technology in Bangladesh is that associated with irrigation. The careful and timely irrigation of crops is the *sine qua non* for increasing agricultural production.

The potential for irrigation is especially great in the dry winter season (rabi) when it is thought that sufficient surface water is available to irrigate about 20% of the available crop land (Thomas, 1975) and water stored within 25 ft. of the surface is thought to be sufficient to irrigate a further 15-20%. In addition, almost all of the remaining cultivable land can be irrigated from deep aquifers.

Table 1 gives some characteristics of irrigation methods in Bangladesh and it can be seen that the great bulk of public investment went into deep tubewell schemes, while very little went into promoting labour intensive methods to utilise surface water or water stored near the surface. The deep tubewell schemes have produced little irrigation and the utilisation of equipment is very low. Although water and capital are a scarce resource to Bangladesh, the government has been subsidizing irrigation water from public pumps to the tune of 66 to 100% (i. e. free in some situations to those farmers who can obtain it). On the other hand, local indigenous labour intensive techniques still irrigate nearly 50% of the country. They are not subsidized, they are an efficient use of capital and suitable to the prevailing conditions of plot fragmentation.

In addition, because there is competition between techniques for water it is not unlikely that the promotion of publicly owned low lift pumps and deep tubewells—with the complementary institutional programme of farmer irrigation cooperatives—may have resulted in the unnecessary substitution of capital for labour and a shift of irrigation water away from small farmers who use labour intensive techniques to larger farmers who monopolise the water from the cooperatives.

Because of these apparent inconsistencies between development goals and irrigation investment it seems pertinent to look for explanations for why this happened.

The answers to these contradictions are to be found not so much in an ignorance of irrigation technologies; or a lack of ability to carry out social benefit cost analysis; or a lack of knowledge about how cultivators respond to input and output price incentives; or even a lack of knowledge about

Table 1 Some Characteristics of Methods of Irrigation in Bangladesh

Method	WATER SOURCE			SURFACE WATER				GROUNDWATER				TOTAL	
	Dhone <sup>(5)</sup>	Swing <sup>(6)</sup> Basket	Low Lift Pump (LLP)	Gravity Canal	Dug Well	MOSTI <sup>(1)</sup>	Shallow Tube Well (STW)	Deep Tube Well (DTW)					
1. Estimated Actual National Coverage, 1977													
— thousand acres	1,200	47	1,000	100	10	25	70	135	2,540				
— %			40	4	—	1	3	5	100				
2. Motive Power (Diesel/Electric/Manual)	M	M	D/E	D/E	M	M	D	D/E	—				
3. Discharge (cusecs)	0.4	0.5	2	—	0.01	0.02	0.5	2	—				
4. Pumping Height from water level/ water table (ft.)	X	X	X	X	X	X	X	X	—				
			X	X	X	X	X	X	—				
			X	X	X	X	X	X	—				
			X	X	X	X	X	X	—				
5. Capital Cost ( taka )	200	30	30,000-60,000	—	60	800	15,000	75,000-225,000	—				
6. Working life ( years )	5	2	7	25+	1-5	7	7	7-15	—				
7. Annual Capital Cost ( taka ) (2)	60	20	11,000	—	30	200	3,600	30,000	—				
8. Command Area : Max. ( acres boro paddy ) : Actual	( 1	( 0.3	60-100	—	( 0.3	( 0.5	15,20	60-80	—				
	(	(	20- 40	—	(	(	5-15	20-40	—				
	(	(	140	—	(	(	200	430	—				
9. Annual Capacity Cost : Min. Actual per acre ( taka )	( 60	( 60	370	—	( 90	( 400	560	1,000	—				
10. Government subsidy or tax as % of capital cost (3)	—	—	866%	8100%	—	140%	115%	88-100%	—				
11. Public sector allocations — FFYP (million taka)	NIL	NIL	740	433	—	50	210	1,821	3,354				

Foot Notes : Next page.

the way in which rural power structure channels irrigation and other benefits of development to existing wealthier groups. The answers are to be found more in an understanding of the social structures and reward systems in government organisations and donor agencies.

In an analysis of decision-making on deep tubewells, Thomas (1975) describes the reasons for why non-optional choices were made. It appears that the visiting World Bank appraisal mission had only very limited time to familiarise themselves with conditions in Bangladesh and carry out their analysis. From their standpoint they favoured a "medium-cost" technology because it used "reliable, imported technology" in spite of the fact that the rates of return were lower than on "low-cost" technology. More time for their analysis and familiarity on their part with Bangladesh conditions, irrigation technologies and readily available reports by Bangladesh researchers, might have shown them that the low-cost technique using local technology would have been a better alternative. Thomas maintains "the role of the aid donors was particularly influential and undoubtedly contributed to the choice of medium-cost technology."

FOOT NOTES (Table 1) :

- (1) MOSTI—Manually operated shallow tubewell for irrigation.
- (2) The annual capital cost is calculated by depreciating the initial cost over the working life at 15% per annum.
- (3) In the case of low-lift pumps and deep tubewells hired out by the Bangladesh Agricultural Development Corporation (BADC), a rent is charged which reduces the subsidy to 66% and 88% respectively. In the cases of gravity canal water and deep tubewells under the control of the Bangladesh Water Development Board (WDB) the subsidy is 100% as no charge is, in general, levied for water. MOSTI and private shallow tubewells are taxed as a result of import duties.
- (4) Includes all other manual methods.
- (5) Dhones are like pivoted canoes with one end open. They are generally operated by one person to lift water about 1 metre.
- (6) Swing buckets have ropes attached to each side. Two people swing the bucket to lift water.

Source : Biggs, Edwards and Griffith (1978)

In an early version of this table we listed down the side a large number of characteristics associated with each type of technique. Such things as suitability for fragmented plots; suitability for benefiting small farmers, dependency on imported spare parts, contribution to rural industries, etc. We found this a useful way to get an overview of past and future irrigation methods and to sort out the interrelated technical, economic and institutional relationships. Similar matrices could be drawn up for the analysis of other areas of rural technology, e.g. draft power, post-harvest operations, transport, house construction, contraceptive methods.

In analysing the role of the relevant Bangladesh Ministries, Thomas stresses the importance of seeing how specific ministries are often in a bargaining position with respect to aid donors and that both seek to find a project which is a "satisfactory" solution from their narrow point of view rather than concentrating on solutions which are more consistent with overall national development goals. As Thomas says "unfortunately, most of these organisational factors were implicit, not explicit. Most of the participants in the decision-making process contended they were acting only on the basis of development goals and administrative feasibility. The evidence seems clear that they were not. The result was that there was no conscious effort to weigh all the real considerations and the trade-offs among them."

In another study, Ahmed (1976) describes how the specific Ministry in charge of water resources and the way in which the government was organised prevented the consideration of other low cost techniques. However, this still leaves the question of why foreign donors took no interest in supporting a whole range of low cost irrigation techniques. Here again it is likely that organisational issues such as who was responsible for which jobs; the type of training of their professional staff; and the terms of reference for various tasks were responsible in large part for this situation.

While millions of dollars have been committed for irrigation projects, virtually nothing comparable has been done for building up the necessary integrated research and development system; a system involving universities, research institutions and planners. In fact the way in which planning documents and reports of foreign donors and governments are often marked "restricted" or "not for public" has only helped to prevent the build-up of a local analytical capacity.

A number of recent reports suggest that this situation is changing<sup>1</sup>. Even so it would seem that one of the major ways of supporting these new trends would be to bring the structure, promotions and other types of rewards in the administration and in the engineering and social science profession in line to favour such multi-disciplinary policy oriented research. No easy task but perhaps one of the most essential ones if Bangladesh's educated manpower is to be used efficiently for promoting irrigation and other rural technologies which accord with the national objectives of reducing rural poverty. Obviously changes are also needed in aid agencies in order to back-up such changes.

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1. For a list of some of these reports see Biggs, Edwards and Griffith (1978).



### 3. Rice Milling in Java

In Java small mechanical rice processing facilities have spread very quickly and over three or four years have replaced traditional handpounding. In a study of this change Timmer (1974) argue that the spread was totally in keeping with prevailing input and output prices and available technologies<sup>2</sup>.

What is particularly disturbing about this is the apparent lack of prior analysis of the consequences for rural income distribution of the government price and technology policies which encouraged the spread of small rice mills (SRMs). For example, the foreign consultants who produced a report for the government completely ignored hand-pounding in their rice storage, handling and marketing study, and certainly did not review the impact on employment and income distribution in rural areas. In analysis based upon information from village level studies, Collier and colleagues later show that it is particularly hired labourers and especially women who lost jobs as a result of the new innovations. They consider that the number of jobs lost was more like 1,200,000 as compared to Timmer's estimate of 100,000. They also show that hand-pounding capacity of women estimated by Timmer was 5 times above their empirical estimate of 5.0 k.g. of paddy per hour per person. As one would expect, this change makes the economic viability of hand-pounding all the less favourable for larger farmers and/or rice traders who used to employ labourers to process rice<sup>3</sup>. As Collier and colleagues indicate, there is a very urgent need for programmes to provide productive employment for women in Java, especially as this type of mechanisation programme is actively putting women out of work. Unfortunately, resources and technical skills allocated to rural public works programmes and other means to gainfully employ rural people are inadequate for the need. Let us hope in Bangladesh, where the milling of rice is still done mainly by poor rural women, that the lessons from Java and the recent analysis by Harris (1978) will be used before programmes are implemented which have such a negative impact on women.

This case study highlights (a) how rapidly mechanical technology can spread, (b) the negative effect of technology on rural women when insufficient attention is given to their problems, (c) the reason why empirical village level

2. Their comments are included in the back of the article by Timmer (1974).

3. It is interesting to note that in Sierra Leone the foreign consultants involved in analysing rice processing made a similar mistake over the hand-pounding capacity of women. In addition they also were not directly concerned with the negative impact on the welfare of rural women (Spencer *et al*, 1976).

studies on specific technological topics are needed for macro analysis. (d) the work of foreign consultants can have a major influence on the welfare of the poor.

These three case studies have illustrated how planning decisions have had far reaching effects on the rural poor. It can be seen that contemporary technological change is certainly not guided by a "hidden hand". People and institutions take definite actions to promote one type of technology rather than another. In the next section we make some suggestions which might help in directing this process towards benefitting the rural poor.

#### IV IMPLICATIONS AND SUGGESTIONS

##### 1. Case Studies of Rural Technologies

The first suggestion is that case studies be undertaken of recent technological change. These studies should take a specific technology (e.g. HYV wheat, hand-tillers or a specific medical technology) and see how the structures and reward systems at different levels of decision-making led to actions which resulted in the spread of that specific rural technology. This type of analysis is represented by a segment of the decision-making circle in figure 1 and links together micro, macro and international analysis. These studies should determine which groups have been the beneficiaries of the technological change and the reasons for these outcomes. We should look at "success" and "failure" case studies and draw lessons for planners who are drawing up programmes which include rural technologies to benefit the poor.

##### 2. Rural Technology Check-List

In order to ensure that important questions are raised at the project<sup>4</sup> identification stage and at other stages as projects are monitored, modified and re-planned, we suggest the use of a rural technology check-list as given in the Appendix. The questions are self-explanatory. In part 1 under Knowledge and Skills we ask "have the experiences and written reports of local researchers, administrators, etc. been searched out and taken into account?" It is remarkable how often visiting "experts" do not feel that this is a necessary part of their work. The check-list would help to rectify this situation. Under Alternatives and Processes of Change, we have put: "If this is a labour substituting technology,

4. This includes production projects, research projects and institution building projects.

have labour intensive programmes been included elsewhere (e.g. rural works programmes)?" It seems that in many situations employment and income distribution problems are "somebody else's problems" or there is an attitude of "it does not matter if a certain operator is mechanised because efficiency is increased and the displaced labour will be absorbed in urban areas or somewhere else in the economy." The problem for agricultural and rural development planners is that this easy assumption is generally incorrect and improvements in employment and in income distribution has to be effected at the same time as productivity is increased. There is no evidence to show that this cannot be done. The fact that it has not been done in many high population density areas is another matter. In part 3 a whole range of possible beneficiaries from various decisions on rural technology are included. They range from rural poor females to employees of aid agencies. This matrix of beneficiaries is given because considerable pressures, and all types of arguments, are put up by ministries, aid donors, professional people, etc. for various rural and agricultural projects. However, even a quick use of part 3 of our checklist might reveal that the rural poor would not necessarily be assured of benefits while people and organisations at higher levels of decision-making might obtain employment, prestige, status and perhaps meet their targets for identifying projects and committing funds. This is not to say that the objectives of several groups—including the poor—may not coincide on some occasions. However, it is important to recognise that conflicts do exist. Generally it is not the rural poor who are in a position to exert pressures and have their cases heard. I agree with Carruthers and Clayton (1976) and Chambers (1977) that the sensible application of check-lists is more useful in many policy-making and planning situations than more complex types of analysis.

### 3. National Planning and Research Capacities

The third ring of Figure 1 denotes policy-making, planning, research, extension agencies of government organisation in low income countries. We saw in our discussion of irrigation in Bangladesh that little had been done in the past to integrate and strengthen these local capacities for policy analysis, plan formulation and the establishment of a viable local system of irrigation research and analysis. National capacities at this level of decision-making are essential if countries are to decide for themselves what types of rural technologies, aid projects and other programmes are relevant to their national goals. Greater attention should be given

to ways and means by which aid programmes, professional dialogues and other methods can lead to supporting the development of these local capacities. One of the most important components for strengthening systems at this level is that promotions and organisational structures encourage an ongoing dialogue and exchange between poor rural households, researchers, planners and the administration.

For social scientists, engineers and other professionals and consultants working in developing countries this means that more of their time and funds are spent in local training, local research, improving local communications, and in other ways to support the build up of local institutional capacities, and less time on production projects only for aid agencies or for the publishing of results for an international audience.

#### 4. Collaborative Research

It is easier to talk about, and write about, collaborative research and planning than to do it. Working with technical scientists, administrators, rural households, etc. on identifying the problems of the poor and on establishing technological research priorities and drawing up feasible programmes is always time away from contacts with one's professional colleagues. In addition, are agricultural economists trained in such a way that is conducive to collaborative work and given skills which enable them to make a substantial contribution to this type of on-going practical decision-making? Generally the answer is no. If we think collaborative research, analysis and planning are necessary at any level of decision-making then we have to change the norms of our profession so that rewards are given for doing this type of work.

#### 5. Village Level Surveys and Research Trials

One of the areas where collaborative research is necessary is at the village level. Increasingly it is being recognised that surveys of farmer's problems are a necessary input for the establishment of technical research priorities—both for on-farm agronomy trials and for research under experiment station conditions. On the agricultural engineering side a similar approach is needed in order to start addressing the problems faced by rural artisans, landless labourers and those in industries.

#### 6. High Income Country Research

We have argued that the rewards and organisational structures of international agencies and institutions in high income countries affect the rural poor in low income countries. Studies should be undertaken to look into these questions. The pay-offs for the rural poor will be greater from this kind of work than from yet another study to document that farmers in low income countries are price responsive. Often we have looked at the institutional structures and reward systems in villages and in low income countries without an introspective look at similar influencing factors from high income countries. This has meant that we are not adequately equipped with the insights which would enable us to understand the determinants of rural poverty and analyse what change is necessary or desirable. In addition, if young professionals are being trained to work in aid organisations and ministries, then even an elementary exposure to the different objectives of these organisations, the way in which such institutions operate and to management techniques should be a fundamental component of their training programme.

#### CONCLUSION

The elimination of rural poverty is one of the biggest and most difficult problems in the world today. The challenge for development planners is whether they can affect social structures and reward systems so that existing and new technologies are used to address the problems being faced by the rural poor.

**APPENDIX RURAL TECHNOLOGY CHECK LIST**

**PART 1. TECHNICAL CRITERIA**

	YES	NO	DON'T KNOW
1. RESOURCES :			
— Is there a high use of relatively abundant resources ?	—	—	—
— Is there a low use of relatively scarcer resources ?	—	—	—
— If labour is abundant, are labour intensive methods used ?	—	—	—
— Universities and Research Institutions and Schools— Are they involved ?	—	—	—
USE OF RESOURCES			
2. KNOWLEDGE AND SKILLS :			
— Local "non-formal" rural skills and knowledge : Is there a high use of the skills, etc. of cultivators, artisans and other rural people ?	—	—	—
— Local "formal" skills and written reports : Have the experiences and written reports of local researchers, administrators, etc. been searched out and taken into account ?	—	—	—
1. TECHNICAL :			
— Are the genetic, chemical and engineering relationships adequately known and/or defined ?	—	—	—
— If not, are the uncertainties clearly shown ?	—	—	—
— Are programmes included for obtaining missing or new technical information ?	—	—	—
RELIABILITY OF PROJECTION			
2. INSTITUTIONAL :			
— In relationship to this technology and programme, are the structures and reward systems of decision-making situa-	—	—	—

Cont.

	YES	NO	DON'T KNOW
tions at the household, rural economy, national and international level taken into account ?	—	—	—
—If not, are the uncertainties clearly show ?	—	—	—
—Are programmes included for the timely collection and presentation of monitoring and replanning information ?	—	—	—
1. MAJOR ALTERNATIVE :			
—Has a broad scenario been presented which places this technology in a context of overall rural development ?	—	—	—
2. PROCESS OF CHANGE :			
—Has a description been given of how, in the context of existing rural society at the village level, this technology will change the society from one state of development to another ?	—	—	—
3. ASSOCIATED PROGRAMMES FOR EMPLOYMENT :			
—If this is a labour substituting technology have other associated labour intensive programmes been included elsewhere ( e.g. rural works programmes ) ?	—	—	—
4. DO NOTHING ALTERNATIVE :			
—Has a brief description been given of the implication of not promoting this technology ?	—	—	—
5. AN ALTERNATIVE ;			
—Has a brief description been given of an alternative technology and how its implications are different from major alternative ?	—	—	—
6. INFORMATION :			
—Have copies of reports, articles, analysis been circulated and deposited in a local library, where it is readily accessible ?	—	—	—

ALTERNATIVE  
AND  
PROCESSES  
OF  
CHANGE

PART 2. DISTRIBUTION CRITERIA ( Long-Term )

	less unequal	more unequal	NO CHANGE	DON'T KNOW
—Distribution of land	_____	_____	_____	_____
—Distribution of human skills	_____	_____	_____	_____
—Distribution of non-land rural assets	_____	_____	_____	_____
—Attitudes in rural areas	Self-Reliance increased	Dependency increased	_____	_____
—Location of Decision-Making	Decentralised	Centralised	_____	_____
—Level of information and Communications	Increased	Decreased	_____	_____
—Capacities of local multidisciplinary research and development systems	Increased	Decreased	_____	_____
—Capacities for local training for agricultural and rural development	Increased	Decreased	_____	_____
—Workable local planning process	Supported	Undetermined	_____	_____
—Rural Investment from a Rural Surplus	Promoted	Not Promoted	_____	_____
—Rural population growth	Increased	Decreased	_____	_____
—Rural Industrialization	Promoted	Not Promoted	_____	_____
—Economic Stability	Increased	Decreased	_____	_____
—Other	_____	_____	_____	_____

A tick (✓) in each line





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