TOWARDS RURAL FUTURES: AN APPROACH THROUGH THE PLANNING OF TECHNOLOGIES[1]

by

Robert Chambers

DP 134

June 1978

This paper sets out to open up some apparently neglected aspects of the potential of technological research and development (R and D) for creating rural futures in third world countries, especially in South Asia and Africa. Against the background of forces which deepen and extend rural poverty, it suggests that new technology can either impoverish or, through imaginative R and D, may have a countervailing effect on the forces which tend to impoverish. It reviews some current approaches and then speculates on some gaps which they sometimes leave: R and D on R and D itself; learning from and working with rural people; environment-specificity; a future-orientation. It outlines criteria and a method of planning for identifying desirable new technology and lists types of environment for which the method might be useful. The approach is not put forward as an alternative to current ideas of appropriate technology, but as a possible complement and supplement to them. Like other planning, it has risks. The question posed is whether the potential benefits justify the risks and costs of developing and pilot testing the proposed method.

---

1. I am grateful to many people, too numerous to name, for comments on earlier versions of this paper and for contributing to the ideas in it.

CONTENTS

BACKGROUND AND REVIEW

The background is set by three factors which tend to deepen and extend rural poverty.

The first is population growth. It is a commonplace that most developing countries will have to support very much larger populations in future. It is less widely recognised that, especially in Africa and South Asia, there will be large increases in the absolute numbers of people living in rural areas. According to UN estimates, urban populations in South Asia and Africa will roughly treble over the 25 year period from 1975 to 2000. But in spite of the high rates of rural to urban migration implied by these figures, rural populations are estimated to rise over the same 25 year period by 59 per cent in South Asia and 71 per cent in Africa (UN 1974). For individual countries, especially those that are poorer, the percentage increases in rural populations vary considerably. Taking FAO estimates for this same 25 year period, they range from Egypt (17 per cent) and Sri Lanka (24) through Indonesia (48) and India (49) to Nepal (75), Nigeria (82), Bangladesh (85), Rwanda (96), and Kenya (109).[1]

There is room for disagreement about detailed figures. As aggregates, these figures conceal regional differences within countries: there will within each country be rural areas where increases will be higher and others where they will be lower. But short of a major demographic catastrophe, it seems beyond reasonable doubt that the 'rural' areas of Africa and South Asia will have to sustain very much larger populations during the next quarter century and beyond. The inverted commas are used for 'rural' because the population densities will so thicken in some areas that the rural-urban distinction may become difficult to sustain. In the words of a UN report:

> "In (South Asia), the rural population in 2025 may be almost 800 million larger than the present one and it is hard to foresee how such an enlarged rural population will then be productively employed. More rapid urbanisation might relieve the rural congestion, but ... figures ... suggest also a huge growth of cities, whose further acceleration would likewise encounter formidable obstacles. Simultaneous pressures on the population in both 'urban' and 'rural' localities may conceivably give rise to new forms of settlement of a character which can no longer be described by traditional concepts." (UN 1974:65)

It may be difficult, indeed, thinking conventionally, to see how acceptable livelihoods can be generated for such numbers of people. To look for methods for exposing and tackling this problem is the purpose of this paper.

The problem is exacerbated by the second factor, degradation of rural environments. This takes many forms. Some involve the depletion of

---

1. From estimates supplied by FAO. These were based on data mainly from the early 1970s. Percentages might now be slightly lower, but the orders of magnitude will remain unchanged.

renewable resources - the removal of forests, the cutting of bush for charcoal, or the lowering of rechargeable groundwater. While these processes may diminish the short or medium term potential of rural areas to support population, they are usually reversible. More serious are those processes whcih are irreversible such as some forms of soil erosion and the mining of fossil water. Often there is a grim conjuncture: it is precisely the poorer rural dwellers who live in the most vulnerable environments and who, in order to survive, do the most damage. In many parts of the world poorer people are driven by economic necessity out of the higher potential areas in two directions: up onto steep wooded hillsides; and out onto lower areas of lower potential. In both types of environment, cultivation and grazing very commonly cause erosion and degradation. These poorer people are forced to mine their environments in order to survive. In the short term, this may serve to conceal the extent of the problem of rural poverty. In the longer term it is building up towards a crisis.

The third factor is the tendency for those who are already better off to benefit most from programmes and from social change, while those who are worse off benefit less, or do not benefit, or lose from the process. The "talents effect" as Andrew Pearse has called it, (1977: referring to the biblical parable of the talents), is widely documented and is a powerful force. It is complemented and reinforced by urban bias which Michael Lipton (1977) has identified, the tendency for towns to siphon off wealth and skills from the countryside. These tendencies should not, however, distract attention from successes or from opportunities. Real wages for agricultural labourers have sometimes risen. Settlement projects have sometimes raised the levels of living of some of the poorer people. The talents effect and urban bias must be reckoned with in any design for rural development but they should not induce despair. They are powerful forces, not inexorable laws.

If these three factors - rural population growth, degradation of the environment, and the talents effect combined with urban bias - can be seen to operate to deepen poverty, the weight given to them must be judged against the tendency for views of the future to have their own cycles. The alarm and pessimism associated with the rise in oil prices and the food shortages of recent years are easing. Optimism is rare but there is now perhaps a little less lack of confidence about mastering the problems of population, environment, food and poverty. It is salutary therefore to recognise that even without considering future trends, present poverty is an outrage. Even if it was expected that rural populations would decrease, that environmental degradation would be replaced by enhanced potential, and that the talents effect and urban bias would be weakened, there would still be a need for widespread and imaginative initiatives. As it is, given that the three factors are operating dynamically to hold down and depress the levels of living of the rural poor, the prospect is the more intolerable and the problem more intractable. In many rural environments anything that could reasonably be described as 'social justice' seems remote.

The gloom deepens when one considers past failures and future difficulties. With the partial exceptions of Kerala and Sri Lanka, land reform in South Asia has been a farce. Initiatives to help the poor have been perverted to benefit the better-off. Improving the management and operation of government agencies may only be a promising line of attack where there is a powerful and persistent political will to secure a more equitable distribution of resources, and this is usually lacking. Inflation in food prices and shifting terms of trade intermittently inflict great but largely unseen privation on millions of dispersed rural people. The green revolution turns not red, but brown. Family planning, it is believed, will not catch on before there is social and economic progress, and social and economic progress for the poorer people becomes less possible as family planning fails to catch on. Revolution, and the Chinese model, are debated but often seem remote, and attempts to achieve them might generate more suffering than they relieved. And meanwhile, the population continues to grow and the prospects become more, not less, daunting.

In seeking ways forward, one line of attack,[1] to be explored in this paper, is through future-based planning with an initial emphasis on R and D for rural technologies. It is a commonplace that mechanical and biological technologies have marked effects on the distribution of income and on social relations. Big expensive irrigation pumps may help the more prosperous rural people to appropriate communal groundwater at the expense of their less fortunate neighbours. Modern Rice Mills, as introduced into South India, have, if they work at capacity, a potential for denying employment in the traditional hulling sector to hundreds of the poorest people for each Modern Rice Mill installed (Harriss 1974, 1977a).[2] Tractors sometimes displace labour, or exacerbate the exploitation, indebtedness and dependence of the small farmers who must hire them (Harriss 1977b). Various green revolution packages tend to favour those with access to credit and reliable water, and these are usually those who are already better-off. By studying and exposing phenomena such as these, social scientists have, it is true, performed a useful function, but the outcome has sometimes been a rather negative and pessimistic view of social changes which are influenced by changes in technology.

It is useful to note two partial explanations for this negative and pessimistic view.

First, social scientists excel in criticism and are weak in prescription (Chambers 1977). They are often drawn towards problems and failures. It is also often at the earlier stages of new departures in rural

---

1. There are of course many others, including measures which should be taken by the richer nations of the world; and what is suggested here is not a panacea, but rather one possible weapon in the armoury that is needed.

2. The observer may be excused for some puzzlement at the decision to introduce three more Modern Rice Mills into Tamil Nadu (MIDS 1977:99) since recent work at IRRI on the small Kiskisan huller has led to an outturn as good as that of the Modern Rice Mill, and the three new mills will either prevent employment or displace employment for hundreds of very poor people.

development that most attention is attracted. But it is precisely then that most problems are likely to be encountered. Thus it can be argued that in their differing ways, the shortcomings of settlement schemes in tropical Africa, of cooperatives in many countries, and of the seed/fertiliser/water technologies of the green revolution, have all been exposed at just the time when some of the most important lessons had been learnt, some of the teething troubles were over, and there was a chance of better performance. To criticise is, however, a safer activity than, on the basis of criticism, to prescribe feasible ways of achieving that better performance.

Second, conservative disciplinary specialisation limits the range of concerns. The methodologies in which people are trained may determine what they examine and what they see as relevant. Thus, for example, studies of communication and of extension education have sometimes been almost obsessed with methodology and statistics and have tended to ignore the fact that the advice generated by agricultural research, and proferred by extension agents, is often against the interests of the farmers who are advised. Such studies sometimes culminate in unreadable treatises based on dubious data analysed to two places of decimals, when perceptive research should have led much more quickly than it has done towards research on the agricultural R and D process itself. Or again, social anthropologists have their own lore and approaches to rural research in villages: they live in villages and study villages; but it is rare indeed to find a social anthropologist who has spent time on a research station, and studied the perceptions, values and behaviour of those engaged in scientific R and D. Quite often, social scientists seem to find it easier and safer to follow in well-worn ruts, and this means that needs and opportunities which lie, as it were, between the ruts are not explored and exploited. With rural technologies this is liable to mean that R and D opportunities are not perceived.

The alternative and positive view is to see in work on rural technologies a potential for creating rural futures which will be better than they would have been. For example, small irrigation pumps can be developed and introduced instead of large; traditional rice hullers can be improved instead of introducing Modern Rice Mills; new seed-fertiliser technologies can be scale-neutral, for example through enhancing biological nitrogen-fixation; and tractors can be introduced only selectively. But a positive orientation such as this immediately raises questions concerning choices of modes of intervention.

Those who take this positive view advocate several types of initiative. These include reviving, adapting, inventing and improving technologies (Hoda 1976:150-152); the assembly of data on intermediate technologies, its effective communication, and field application (McRobie 1976); upgrading traditional methods, scaling down and redesigning high-cost technologies, and new product design (McRobie and Carr 1971); preparing a catalogue of alternatives which people in the field can work with (van Bronckhorst 1975:167); institutionalised screening and choice of technology, and direct learning from poor people themselves (Reddy 1976); changes in the allocation of research resources and in research priorities in agriculture (Arndt _et al_, 1977 _passim_), and in particular, allocations among crop and livestock research systems, choices of emphasis within a farming system and among geographic regions, and selection of disciplines to carry out research (Mellor 1977:484 ff).

Examined more closely, these and other approaches and initiatives concerned with developing rural technologies divide up in various ways. Sometimes they are specific to one quite narrow technology, such as one source of power for one purpose or one crop. Or they may be specific to a discipline, especially where there are professional conferences of engineers or agriculturalists concerned with rural technologies. Most commonly, however, they appear to be specific to a technological sector. Thus the ILO in Employment, Growth and Basic Needs (1976) stresses choice and innovation with food processing, solar power and other small-scale sources of power, simple modes of transport, the development of equipment for lifting and moving water, and brickmaking and other building materials. Similarly, the Intermediate Technology Development Group (ITDG) has advisory panels on such fields as building materials, chemistry, ferro-cement, forestry and forest products, homestead technology, nutrition, power, and so on (McRobie 1976:4 ff). The Science and Technology section of the perspective plan for Tamil Nadu (State Planning Commission, Tamil Nadu, 1973) is based on the work of 15 task forces which considered sectors such as agriculture and allied activities, forestry, veterinary, fisheries, irrigation, minerals and so on. Starting from above and outside the rural situation, it is logical to divide up sectors in this way: they coincide with technologies, institutions and disciplines and provide the most obvious and easiest approach.

FOUR GAPS

There is no intention to belittle or undervalue these approaches, but following what is commonsense, or more obvious and easy, is liable to leave gaps: gaps between disciplines, between technological sectors, between institutions, and between sources of information. Different observers might identify different gaps. To this observer four appear particularly obvious and important. They are:

(i) R and D on R and D itself;

(ii) learning from and working with rural people;

(iii) environment-specificity;

(iv) future-orientation.

Combined, these will lead us to a proposal for what may be a new approach.

(i) R and D on R and D itself

A preliminary scanning of the literature reveals a lack of analysis of the R and D process for rural technologies. This may be in part because technical literature is inbred and not concerned with the types of issues which would seem important to social scientists; and in part because social scientists have not been either inclined or encouraged to examine what goes on in, say, seed breeding or on agricultural research stations or in engineering works. Studies by sociologists, social psychologists or social anthropologists of processes of R and D for rural areas do not come readily to hand. (The writer knows only of one - Howes forthcoming). Since the outcomes of these processes have had, and can be expected to continue to have, profound effects on rural life, R and D on R and D itself appears a priority if R and D is to be improved.

(ii) Learning from and Working with Rural People

Rural people often have a rich knowledge and understanding of their environments (Howes, 1978). From this point of view they can be seen as sources of insight and as living data banks. But scientists and social scientists have often been primitive in their failure to recognise the potential of this resource. Biases of class and of professionalism, urban life styles, preference for comfort and the familiar, and pressure of work, all various disincline those engaged in R and D from direct contact with rural people and especially the poorer rural people and from listening to them and learning from them. There are signs of change and notable exceptions. Agricultural researchers in Western Darfur in the Sudan have worked as labourers on farmers' fields in order to learn and understand (Personal communication, David Gibbon). A social scientist, John Hatch (1976), has written an account of the operations involved in smallholder maize farming in Peru based on his experience as a labourer being taught by farmers. In India there has been a widespread movement for linking urban institutions with villages. For example, under the village adoption programme of the University of Madras, the intention has been for the University's science and technology resources to be applied to villages, for village work to become part of students' curricula, and for it to be "the rural community which is helping the university/college community by making the learning and research process complete ..." (Adiseshiah 1977:133-134). The reality may lag behind the rhetoric but the direction of the intended change is clear. For the future, perhaps village residence and a village-based research project relying on local knowledge and understanding should be part of the training of every natural scientist or social scientist whose professional life is to be concerned with rural development. And those who as scientists pioneer methods of learning from rural people should describe and analyse, for the benefit of others, their experience and methods in this underpractised, underdeveloped and understudied activity.

(iii) Environment-specificity

This gap is surprising.

To be sure, it must be recognised that much research and R and D is in some senses environment-specific. It is, for example, obvious that R and D for a particular crop is by definition environment-specific since any one crop will only grow in certain environments; and it is particularly agricultural scientists and others who analyse agricultural research who put the case for environment-specific work (e.g. de Castro and Schuh 1976:517; Mellor 1976:494-5; Okigbo 1976:164). Indeed, de Castro and Schuh (1976) take an important further step in arguing for regional research in Brazil on the grounds that research should be adapted to relative factor endowments. It is also true that there is a species of book which consists of conference papers contributed by writers from different disciplines, usually on different topics, but which all concern one fairly homogenous environment such as the Kalahari desert in Botswana or the Dry Zone in Sri Lanka (Peries 1968). It is also true that in Sri Lanka and elsewhere, there are often agricultural research stations for different agro-climatic zones. It is again true that there have been attempts to carry out multi-disciplinary research on zones, such as that undertaken, albeit in a loose fashion, on the elephant grass or coffee-banana zone in Uganda (Hall 1973).

The gap is, then, not a lack of research that is specific to environments. What appears to be missing is an approach to R and D for mechanical and biological technologies which simultaneously does all of the following:

(i) concerns a socio-ecological environment (defined in terms of a degree of homogeneity of social and ecological parameters);

(ii) involves the several most relevant disciplines (agronomy, economics, rural engineering, sociology, and others as needed);

(iii) takes account of relative factor endowments in the environment;

(iv) derives, from the above, prescriptions for R and D, including priorities.

(iv) <u>Future-orientation</u>

The fourth gap is a future-orientation. There is, of course, a sense in which all R and D is by definition future-oriented: it takes time and it is only in the future that its benefits can be realised. The gap is that rural R and D appears to be largely or entirely based upon perceptions of the present rather than projections for the future in which the R and D may bear fruit. If factor proportions were constant and likely to remain constant, this might make sense. But as we have seen they are often changing especially in two respects. First, populations in many rural areas of Africa and South Asia will increase by between 50 and 100 per cent during the next 25 years. The implications are unnerving. In North Arcot District, in Tamil Nadu, for example, the ratio of landless to those with land has already changed from 2 to 11 in 1895 to 9 to 11 in 1975, and will, at projected rates of population increase, rise to 18 to 11 in 2001 unless land is subdivided (Harriss 1976). Second, resources are being depleted. The lowering of water tables by overpumping as in parts of Tamil Nadu (Madduma Bandara 1977), or by using fossil water in deserts, and the destruction of arable or pasture potential through soil erosion are examples where productive potential is diminishing. In circumstances such as these, piecemeal R and D following one's nose into the future may not be adequate. If there is a currently poorly endowed rural environment which will have to support, say, twice the population in 30 years' time on half the soil and water resources, that future will be so different from the present that adequate livelihoods may only be achieved through a quite different and new technological repertoire.

A PROPOSAL

The proposal is to try to fill these gaps by developing an environment-specific future-based approach to rural planning. Institutionally this might take several forms but the core might usually be a small multi-disciplinary team of natural and social scientists. They would examine an environment which posed problems of poverty and impoverishment. They would assess current resources, knowledge, and values, especially the knowledge and values of the rural people. They would make forecasts of factor endowments, especially of land, water, energy and people, for some future date, perhaps within the range of 10 to 25 years ahead. They would then sketch alternative future scenarios and identify the changes and technologies necessary for them, specifying the characteristics of technologies which might link the factors, given their relative proportions, in ways which would provide adequate and acceptable livelihoods for the people. They would then think backwards from these futures to the present and engage in a process of search and iteration between existing R and D and the alternative futures. One output would be the specification of technologies which might not yet exist, but which might lie within the range of possiblity, and which would support one or more of the scenarios.

Criteria for Technologies

This process would, of course, be far from value-free. Technology is not value-neutral. A critical part of the process would be agreeing criteria for desirable futures and future technologies.

A personal list is:

(i) productivity. Enhanced productivity of resources in relation to their relative scarcities. In order to appraise this, the relative factor endowments at the future date have to be assessed. The further definition of productivity leads into the linkages between ecological energetics and political economy (where there may be a nascent subject to be called political ecology or economic energetics). For working purposes, however, the concept of productivity may not present serious problems.

(ii) equity. More equal rather than less equal distribution of and access to resources and income. This criterion leads into political philosophy. It may be more difficult to gain agreement on an operational definition (how equal? and who may be how much more equal than who else?), than to agree on the way in which the criterion in general applies in particular cases. Ideas of minimum levels of living and of basic needs are relevant here.

(iii) net livelihood-intensity. Livelihood-intensity is the extent to which a technology would generate or sustain livelihoods at or above an acceptable level. It is not the same as labour-intensity. The livelihood-intensity of a technology is not constant; it is specific to an environment. It depends among other things on the relative factor proportions and seasonalities. For example, the introduction of a labour-intensive technology into a labour-scarce environment might have a low or zero net livelihood-intensity; whereas its introduction into a labour surplus environment would have a positive and high net livelihood-intensity. Seasonality is also likely to be very important in assessing livelihood-intensity. For example, a technology which provides food or income flows for poor people during the lean periods of the year and thus supplements their income so that they rise above a minimum acceptable level, may in that environment have a very high net livelihood-intensity. The net livelihood-intensity is specified since a new technology often displaces an old one. If the net livelihood-intensity of new technologies were always estimated, some, like the Modern Rice Mills, would register heavy negative scores.

(iv) environmental stability. The physical and biological environment should be more rather than less stable and self-renewing.

Even taken together, these four criteria for desirable technologies are not comprehensive. Whether explicitly or implicitly, most people probably have value systems in which something best described as the quality of life is important. In the writer's values, the implicit paternalism of the application of these four criteria should be tempered by giving weight to what is valued by the rural people who are likely to be affected.

Together, these criteria may provide parts of a framework for a view of human existence which combines ecology with political economy. There may be a need here for the reuse of an old word, or the invention of a new one, to describe the combination of a balanced but evolving relationship between man and his physical and organic environments, and an equitable and continuous flow of benefits to families and to individuals.

Suitable Environments

In any pilot exploration of this approach, the choice of environment is important. The benefits from the approach may be greatest in environments which are critical or likely to become critical in terms of livelihoods. These will often be where population is pressing on resources, where resources are diminishing (through soil erosion, through removal and use of forest, bush and vegetation, through depletion of underground water resources, through secular climatic change), where population is increasing rapidly, and where inequalities are marked and/or becoming more marked. A reasonable initial data base is also important since orders of magnitude in factor proportions have to be established in order to be realistic about alternative futures.

Examples of suitable environments might be found in:

(i) Hill or mountain areas where population pressure is associated with the removal of forest, the cultivation of steep slopes, overgrazing, erosion, and/or declining water supplies. Examples include parts of Nepal, India, Sri Lanka, Thailand, Kenya, Tanzania, Ethiopia and Peru.

(ii) Arid or semi-arid areas where increases in human and livestock populations, in cultivation, in the removal of vegetation, and sometimes in human in-migration are associated with declining primary productivity, erosion, and other forms of degradation. Examples include the Sahel zone, and parts of Eastern Africa.

(iii) Areas of dense human settlement with irrigation where the scope for outmigration is limited and population is rising fast. Examples include the riverine and delta areas of the Nile in Egypt, and parts of Pakistan, India, Bangladesh, Sri Lanka, Thailand and Indonesia. Included here are areas where there is a net long-term depletion of groundwater resources.

(iv) Areas with sharp seasonal crises, especially (but not only) where seasons are monomodal, and agricultural activities are tightly confined to a short period. Examples include parts of West Africa, the Sudan and Bangladesh.

(v) Areas of high rainfall and dense and rising population where population pressure on land is a problem with limited scope for outmigration. Examples include high rainfall areas in Kenya, Tanzania, Rwanda, Burundi, Sri Lanka and Indonesia.

(vi) Areas with an existing project or programme and a good data base. Especially for pilot testing of the proposed approach, such areas may have a comparative advantage since relatively little administration or data-collection may be required in order to carry out the exercise; and some or all of the staff needed may already be on site or available without additional expenditure. Examples include the Integrated Rural Development Programme districts in India; zones or districts in any country for which resource inventories and social surveys have been completed or where comprehensive multi-disciplinary research has been carried out; areas for which evaluation base-line surveys have been undertaken; areas where multi-disciplinary rural development project teams are or will be at work; and areas where the work of social anthropologists provides insights. This category, (vi), crosscuts the first five categories.

This is an illustrative, not a comprehensive list.

The size of environment selected would depend on several considerations including:

(i) the areas for which relevant data are available;

(ii) social homogeneity (including population density, social groups, in and outmigration, agricultural systems, etc.);

(iii) environmental homogeneity (geomorphology, soils, climate, vegetation, water availability and sources, etc.);

(iv) the environment-specificity of the types of technology likely to be considered.

The optimal degrees of homogeneity and variance will be matters for judgement and for learning from experience. A socio-ecological zone could conceivably, at one extreme, be a village or a group of villages; or at the other extreme, an extensive geographical area like the Gangetic plain in India, the Kenya Highlands, the Dry Zone or the Wet Zone in Sri Lanka, or the Nile Valley in Egypt. Usually, however, it might be intermediate between these two.

Preliminary Explorations

Preliminary and largely non-numerate explorations of this approach to the planning of technologies have begun to identify some of the problems and potential. Some of the main points emerging are:

(i) the importance of slack communal resources at the micro-level. Resource inventories which deal in aggregates may miss vital potential in micro-environments, such as seasonal standing bodies of water (in dambos in tropical Africa, in village tanks in South Asia) or wasteland which can grow fuel crops. One question which immediately arises is whether the potential of communal resources can be reserved for and allocated to those who are poorer.

(ii) the likelihood that some of the future technologies will derive from fundamental and/or high-capital research. This point is not antagonistic to the current view about technologies that small is beautiful and local is lovely. There are many good reasons for supporting that view and developing that approach (benefiting from local knowledge and satisfying local needs, low capital requirements in R and D, low risk in R and D, widely dispersed benefits, and avoiding the creation of dependence). But the question is, environment by environment, whether that approach, though necessary and desirable, will be enough; whether other technologies might be invented and developed which would enable the poorer people in those environments to move further and faster towards the achievement of at least their basic needs; and whether (as with solar pumps), those technologies will be developed anyway, and will very likely, unless there is deliberate intervention, have characteristics which will worsen rather than improve the lot of the poorer people.[1] This danger is

1. For example, the two institutions developing solar pumps in India have both been working on a 5HP model (Bhushan 1976:6) yet in North Arcot District 5HP pumps are precisely those owned by the richer farmers and used by them to appropriate communal groundwater at the cost of their less well-off neighbours and at a high long-term social cost in lowering the water table.

the greater because so much of the relevant R and D is taking place and will take place either in the richer industrialised countries, or in the urban-industrial milieu of the poorer countries. By way of illustration of these possible technologies, three speculative prescriptions from preliminary conjecture have been (a) small-scale solar pumps for groundwater lift for North Arcot District in Tamil Nadu, (b) an energy- and livelihood-intensive technology for converting lignin and/or cellulose into usable or edible products for the Himalayan foothills, and (c) livelihood-intensive methods for storing solar energy for use in tractors in the Sudan.

(iii) the value of plotting paths to future scenarios. Attempts to identify feasible paths to future scenarios immediately raise questions variously of the economic viability of technologies, and of measures for the control of technology which have political implications. These are considerations which necessarily impinge on decisions taken in the R and D process.

(iv) the critical importance of assumptions about asset distribution and access to resources within the society. If no conceivable technologies could at the future date generate adequate livelihoods for all the population, then this will lead iteratively to specifying the redistribution necessary, and the rewriting of scenarios accordingly.

Costs and Benefits

This proposed approach to rural and technological planning might be tested and developed in several different ways. It might be best carried out by a small group of natural and social scientists from key disciplines. Ideally, they would be creative lateral thinkers, open to ideas, prepared to contemplate and explore the apparently absurd, and above all not narrowly disciplinary or defensive. They should be well-informed about R and D directions and potentials in their fields. Ideally they should, through language and cultural affinity, be able easily to establish rapport with and learn from the people living in the chosen environment. Work might initially involve a matter of weeks rather than months, with the possibility of subsequent follow-up.

The costs, both financial and in terms of the time of the persons involved, need not be high.

On the benefit side the outcomes might be:

- a better understanding of the problems and complementarities in multi-disciplinary collaboration, especially between natural and social scientists;

- a better appreciation of directions and options in problem rural environments;

- specifications of desirable but non-existent technologies which might be presented to those responsible for R and D priorities;

- adjustments in current R and D programmes at the regional level and below;

- the development of a method of environment-specific future-oriented R and D which would be replicable.

If this form of planning for future rural technologies has already been tried, it is important to learn from the experience; and if it has not, the question is whether, and if so where and how, it is worth giving it a try.

References

Adiseshiah, M.S., 1977, 'The Role of the University in Integrated Rural Development', (extracts from a paper for the Association of Indian Universities, Coimbatore, January 17-19) in Bulletin, Madras Development Seminar Series, 7, 2, Madras Institute of Development Studies, February.

Arndt, Thomas M., Dalrymple, Dana G. and Ruttan, Vernon W., 1977, Resource Allocation and Productivity in National and International Agricultural Research, University of Minnesota Press, Minneapolis.

Bhushan, Bharat, 1976, 'Solar Energy as a Decentralised Source: a Case Study of the Solar Water Pump' (draft report), mimeo, Science Policy and Management Research Unit, Administrative Staff College of India, Hyderabad.

Chambers, Robert, 1977, 'Challenges for Rural Research and Development', in B.H. Farmer, ed.

Congdon, R.J. ed., 1975, Lectures on Socially Appropriate Technology, Committee for International Cooperation Activities, Technische Hogeschool, Eindhoven, Netherlands.

de Castro and Schuh, 1976, in Arndt et al eds.

Farmer, B.H. ed., 1977, Green Revolution? Technology and Change in Rice-Growing Areas of Tamil Nadu and Sri Lanka, Macmillan, London.

Hall, Malcolm, 1973, 'Agricultural Development Research in the Coffee-Banana Area of Southern Uganda', in S.M. Mbilinyi, ed.

Harriss, Barbara, 1974, 'A "Which" Guide to Appropriate Rice Processing Technologies in South Asia', Centre of South Asian Studies, University of Cambridge, December.

Harriss, Barbara, 1976, 'Piecemeal Planning: the Effects of Partial Intervention in Food Grain Marketing in an Ordinary District in South India', mimeo, paper to the seminar on Accelerating Rural and Agricultural Development, Reading University, September.

Harriss, Barbara, 1977a, 'Paddy-milling: Problems in Policy and the Choice of Technology', in B.H. Farmer, ed.

Harriss, Barbara, 1977b 'Tractors, Profit and Debt in Hambantota District, Sri Lanka', in B.H. Farmer, ed.

Hatch, John K., 1976, The Corn Farmers of Motupe: a Study of Traditional Farming Practices in Northern Coastal Peru, Land Tenure Center Monographs No. 1, Land Tenure Center, University of Wisconsin, Madison.

Hoda, M.M., 1976, 'India's Experience and the Gandhian Tradition', in Nicolas Jequier, ed.

Howes, M.T., 1978, 'The Uses of Indigenous Technical Knowledge in Development', mimeo, background paper for the workshop on indigenous technical knowledge, Institute of Development Studies, University of Sussex, 13-14 April.

Howes, M.T., forthcoming, 'Research Strategies in Thai Sericulture: Determinants and Implications'.

Hunter, Guy, Bunting, A.H. and Bottrall, Anthony, eds., 1976, Policy and Practice in Rural Development, Croom Helm, London.

ILO, 1976, Employment, Growth and Basic Needs, International Labour Office, Geneva.

Jequier, Nicolas, ed., 1976, Appropriate Technology: Problems and Promises, Development Centre of the OECD, Paris.

Lipton, Michael, 1977, Why Poor People Stay Poor: Urban Bias in World Development, Temple Smith, London.

Madduma Bandara, C.M., 1977, 'Hydrological Consequences of Agrarian Change', in B.H. Farmer, ed.

McRobie, George, 1976, 'Intermediate Technology in Action', mimeo, Intermediate Technology Development Group Ltd., 9 King Street, London WC2E 8HN, autumn.

McRobie, George and Carr, Marilyn, 1977, 'Mass Production or Production by the Masses?',mimeo, ITDG, May.

Mbilinyi, S.M. ed., 1973, Agricultural Research for Rural Development, East African Literature Bureau, Nairobi, Kampala and Dar es Salaam.

Mellor, John, 1976, 'Relating Research Resource Allocation to Multiple Goals', in Arndt et al, eds.

OECD, 1974, Choice and Adaptation of Technology in Developing Countries: an Overview of Major Policy Issues, Development Centre of the Organisation for Economic Cooperation and Development, Paris.

Okigbo, Bede N., 1976, 'Fitting Research to Farming Systems', in Guy Hunter et al, eds.

Pearse, Andrew, 1977, 'Technology and Peasant Production: Reflections on a Global Study', Development and Change, Vol. 8, No. 2.

Peries, O.S., 1968, The Development of Agriculture in the Dry Zone, Ceylon Association for the Advancement of Science, Colombo.

Reddy, Amulya Kumar N., 1976, 'The Transfer, Transformation and Generation of Technology for Development', paper for the Working Meeting on Human and Social Development, United Nations University, Tokyo, 6-11 June.

State Planning Commission Tamil Nadu, 1976, Science in the Battle Against Poverty: a Plan for Science and Technology 1974-1984, Madras

UN, 1974, Concise Report on the World Population Situation in 1970-75 and its Long Range Implications, Population Studies No. 56, Department of Economic and Social Affairs, United Nations, New York.

van Bronckhorst, Ir B., 1975, 'Appropriate Production Systems - a Conceptual Framework', in R.J. Congdon ed.

Appendix: Some Rural and Urban Population Projections (millions).

	1975		2000		% increases 1975 - 2000	
	Rural	Urban	Rural	Urban	Rural	Urban
Algeria	8.4	8.4	10.7	26.0	27	210
Bangladesh	68.7	5.0	127.0	17.3	85	246
Botswana	0.6	0.1	1.0	0.4	65	459
Brazil	44.5	65.3	50.3	162.2	13	149
Colombia	9.9	16.0	11.1	40.4	12	152
Costa Rica	1.2	0.8	1.7	2.0	43	150
Cuba	3.6	5.8	3.8	11.4	5	96
Egypt	19.6	17.9	23.1	41.5	17	132
Ethiopia	24.8	3.1	42.2	11.4	70	265
Fiji	0.4	0.2	0.4	0.5	6	111
Ghana	6.7	3.2	10.2	11.0	53	242
Honduras	2.2	0.9	4.2	2.7	90	220
India	481.5	131.8	717.3	342.0	49	160
Indonesia	109.8	26.2	162.8	74.7	48	185
Iran	18.3	14.6	25.8	40.8	41	180
Jamaica	1.1	0.9	1.0	1.8	-14	93
Jordan	1.2	1.5	1.6	4.3	34	185
Kenya	11.8	1.5	24.6	6.4	109	328
Malaysia	8.4	3.7	12.1	9.9	43	172
Mauritius	0.5	0.4	0.4	0.8	-4	86
Mexico	21.8	37.4	28.7	103.6	32	177
Namibia	0.4	0.3	0.5	0.8	16	190

(cont. overleaf)

(Appendix cont.)

	1975		2000		% increases 1975 - 2000	
	Rural	Urban	Rural	Urban	Rural	Urban
Nepal	12.0	0.6	20.9	2.2	75	271
Nigeria	51.5	11.4	94.0	40.9	82	259
Pakistan	51.6	19.0	84.6	62.3	64	228
Philippines	28.4	16.0	44.1	45.6	55	185
Rhodesia	5.0	1.2	10.1	5.1	100	309
Rwanda	4.0	0.2	7.9	0.8	96	403
Sri Lanka	10.6	3.4	13.1	8.2	24	143
Sudan	15.9	2.4	30.0	8.9	89	271
Tanzania	14.4	1.0	29.8	4.25	107	307
Thailand	35.1	7.0	62.2	23.4	77	236
Upper Volta	5.5	0.5	9.2	1.7	67	244
Vietnam	36.1	7.4	53.5	22.3	48	202
Zaire	18.1	6.4	26.0	23.4	44	266
Zambia	3.2	1.8	4.6	7.0	44	280

Notes

1. Source: FAO based on data a few years old. More recent figures would probably generally show slightly lower percentage increases, but without affecting the general orders of magnitude.

2. Percentages are based on the original figures which were in thousands, and which have here been rounded to millions to one decimal place.