
The Edge of the Desert: The Problems of Poor and Semi-Arid Lands [and Discussion]

Dharma Kumar, G. Murdoch, J. Swift and N. E. Reynolds

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The edge of the desert : the problems of poor and semi-arid lands

BY DHARMA KUMAR

Delhi School of Economics, University of Delhi, India

Malnutrition and undernutrition are very widespread in the poor countries (l.d.cs) including several semi-arid lands.

Between 1969–71 and 1985 the output of food in l.d.c.s is likely to grow a little slower than their populations, according to the F.A.O.; since incomes will also rise, the total demand for food will rise by 3.6 % p.a. Many countries will find considerable difficulties in importing the food required.

There has been an enormous increase in irrigation since 1949, much of it financed by l.d.c. governments or by international aid. The financial returns to Governments on large scale irrigation works have frequently been very low, because of a deliberate policy of subsidizing farmers, mismanagement or neglect of complementary inputs. Also, irrigation works in semi-arid lands are often built as protection against crop failure, not to maximize revenue.

Instability in agricultural output can be dealt with by technology to stabilize output, the improvement of methods of predicting changes in output, and insurance or relief. Population pressure has closed many traditional sources of protection, such as temporary migration, as a result of growing populations and the change to modern agricultural technologies. Rural public works programmes have been advocated as a remedy but have generally suffered from a shortage of productive projects and the high non-labour content of productive works.

Finally, measures of population control are discussed.

Some 40 of the countries containing semi-arid lands are very poor; their average income per head is less than \$250 per year. In addition, their distribution of income is frequently more unequal than in rich countries. Consequently, large numbers suffer from abject poverty, in particular from hunger and malnutrition. Populations are growing fast, and may grow faster than food production in some countries, mostly in Africa.

After a summary of trends in population and food production, based on the F.A.O., the paper discusses some of the problems facing the governments of poor countries. Most of these countries are largely agricultural, and a basic task is to raise agricultural output. There has been an enormous investment in irrigation, but frequently with inadequate returns to the economy as a whole or the government. In semi-arid lands there is the additional problem of variability of output, and the paper discusses measures to reduce variability or to compensate for the damage caused by it. The paper then considers two long term problems: the growth of unemployment, and the growth of population.

This paper contains little that is not familiar, often tediously familiar, to economists working on rural development, apart from some facts about India, but may be useful to others as a brief and unsystematic survey. My choice of problems and data is doubtless strongly coloured by the fact that the only country I know about in any detail is India; this means that the paper concentrates on the problems of a densely populated country. If I am parochial, at least my parish is very crowded.

The dimensions of mass hunger

It is impossible to be precise about the numbers of people actually suffering from malnutrition. In the first place, estimates of the average daily requirements of any given population are based on assumptions regarding normal body mass, levels of activity, and the age and sex structure of the population, on all of which there may be differences of opinion. Thus estimates of average Indian requirements range from 2373 kcal (9.85 MJ) and 42.74 g of protein to 1789 kcal (7.49 MJ) and 25.9 g of protein (Ryan, Sheldrake & Yadav 1974). India had less than its minimum *total* requirements in 1969–70 by the first estimate, but not by the second. Secondly, figures of average income and food availability are very imprecise (Burk & Mordecai 1976). Thirdly, since income and consumption are very unequal in most countries, the average figures cannot tell us how many people actually got the minimum. Figures of actual consumption are much more difficult to estimate than requirements, and very few poor countries have the data required.

But it is difficult to disagree with the F.A.O.'s statement that 'Each strand of evidence... is far from incontrovertible, but together they point to a conclusion that the problem of food deficiency is extremely serious: one half of child deaths are in some way attributable to malnutrition; there are at least 200 million living child sufferers; and the percentage of population in the developing world subject to food deficiencies ranges to 30 per cent, or even higher in some areas' (Food and Agriculture Organization 1975). The countries suffering most from mal- and under-nutrition include Angola, Somalia, Tanzania and some of the Sahelian countries in Africa; Bangladesh, India, Indonesia and the Philippines in Asia; Afghanistan, Saudi Arabia and the two Yemens in the near East; Bolivia, El Salvador and Haiti in Latin America (U.N. 1975).

Till recently the developing countries have managed to increase food production more rapidly than population. But there are several disturbing facts about the last 20 years. In the first place, the difference between the two rates of growth has been narrowing; indeed there may have been a decline in food production per capita since 1970. And this decline occurred despite government policies to increase food production. Population figures even for the past are subject to wide margins of error, and forecasts of the future are naturally much more uncertain. The F.A.O. forecasts are gloomy, but expected rates of growth of population may be too high.

The population of what the F.A.O. calls the developing market and I shall call the poor non-Communist countries, is expected to grow by 2.7% per annum between 1969–71 and 1985; this is indeed the U.N.'s 'medium' projection. The F.A.O. assumes that the rate of growth of food production will remain stable at the past rate of 2.6%, or a little below the rate of growth of population. The effective demand for food will also rise, as incomes rise. Assuming that incomes per head will continue to grow at the same rate as in the past, the demand for food will rise by another 0.9%, or by a total of 3.6% per annum. On these projections, poor non-Communist countries will have a deficit of nearly 85 million tonnes (Mt) in 1985, as against an annual average deficit of 17 Mt in 1969–71, which was itself difficult enough to finance. Indeed if one excludes the cereal exporters, the deficit in a normal year might amount to 100 Mt, and in a bad year to 120 Mt or more; in 1973–4 the cereals deficit (excluding the exporting countries) was 52 Mt. World production is expected to be able to meet this deficit; the developed countries are expected to increase their production by 2.4%

per annum, and although their per capita consumption will rise, their populations will only increase by 0.9 %, leaving them with substantial surpluses. But not all poor countries will be able to buy the food they need, nor is food aid likely to cover the deficit. In terms of the gap between output and population, the problem is most severe in Africa: between 1969–71 and 1985 its population is expected to grow by 76 %, the output of food by 45 %. In terms of sheer numbers, of course, the Asian problem is the worst.

The economic structure

The policies required to increase food supply – by increasing domestic output of food, or of exports to buy food with, or aid – will vary with each country's economic structure and resources. Most of these countries are still largely agricultural: agriculture typically accounts for between one-third and one-half of the gross domestic product, and provides employment for two-thirds or more of the labour force. There is, of course, considerable variation even among the poor semi-arid countries. In Zaire, agriculture accounts for 8 % of the g.d.p., and in Rhodesia for 16 %, but in India for 45 % and in Gambia for nearly 60 % (table 1).

The proportion of a country which is semi-arid also varies enormously, from 5 % in Pakistan to 100 % in Rhodesia and several other countries of Africa. 54 % of India is semi-arid; some 1.7×10^6 km² support 261 million people, or over half the total population of the semi-arid tropics. The semi-arid regions of India (with a man–land ratio of 1.54 people to the hectare) are the most densely populated of all the semi-arid regions. In general, the man–land ratio is much higher in semi-arid Asia (1.33) than in Africa (0.13 south of the Sahara, 0.03 in the Near East and NW Africa) (table 1). There are similar variations in the density of animal populations: in Asia there are 1.36 cattle and buffaloes per hectare of arable land, in Africa south of the Sahara 0.89.

In some of the sparsely populated countries much of the population is nomadic. In Somalia 75 % of the human population is nomadic and in Sudan 30–40 % (Grigg 1974). The proportions are much smaller in other countries but many of them, even countries as densely populated as India, contain large nomadic and semi-nomadic populations.

Where there is settled agriculture, the dominant mode of cultivation is small-scale peasant farming. But the land is very unequally divided: in the states in India containing large proportions of semi-arid lands, over half the households cultivated holdings of less than 1 hectare, and occupied only a little over 5 % of the total area; over half the area was cultivated by less than 10 % of the households, though even they were small enough: holdings over 20 ha are rare. There was little difference, in fact, between these and other states in India. The all-India figures exaggerate the extent of true inequality in that farm size is inversely correlated with proportion of land irrigated; this is probably true of semi-arid states also.

The all-India figures show that 45 % of all farms have some irrigated lands; figures are not separately available for semi-arid areas. Again, in India, even in the smallest size group, up to 0.19 ha, the average farm has 1.63 fragments; the number increases with the size of the farm, and farms over 20 ha contain over 11 fragments on average (Ryan 1974). Fragmentation has obvious disadvantages; it is often wasteful of land and time; it may make the use of certain agricultural techniques, including the full use of irrigation water, difficult. But it also has some less obvious advantages: farmers often like to hold fragments of different types of land to spread risk, spread labour over the year, and for ease in selling and mortgaging small amounts of land (Kumar 1975). In arid lands the risk factor may be especially important, since rainfall is so erratic.

TABLE 1.^a SELECTED SOCIO-ECONOMIC DATA ON SEMI-ARID TROPICAL COUNTRIES^b

	portion of country semi- arid %	semi- arid area 10 ³ km ²	semi- arid popu- lation 10 ⁶	semi- arid popn/ land ratio people/ ha	popu- lation growth rates ^c %	per caput g.d.p. ^d \$ U.S.	agric. as percent- age of total g.c.p. ^c %	net food supplies per caput per day		
								energy kcal	MJ	protein g
Asia										
Burma	25	170	7	0.41	n.a.	92	34	2010	8.42	44
India	54	1700 ^e	261 ^e	1.54	2.2	99	45	1990	8.33	49
Pakistan	5	40	3	0.75	n.a.	136	38	2410	10.2	55
Thailand	60	308	25	0.82	2.7	176	29	2210	9.25	51
sub-total or average	36	2218	296	1.33	2.45	106	37	2013	8.43	49
Africa South of the Sahara										
Angola	60	748	3	0.04	n.a.	201	n.a.	1910	8.0	40
Botswana	100	569	1	0.02	2.8	n.a.	43	n.a.	n.a.	n.a.
Cameroon	25	119	1	0.08	n.a.	162	50	2230	9.33	59
Cent. Af. Rep.	50	311	1	0.03	2.2	131	31	2170	9.08	48
Chad	40	514	3	0.06	2.3	69	48 ^h	2240	9.37	78
Dahomey	80	92	2	0.22	2.5	24	36	2170	9.08	52
Ethiopia	50	611	12	0.20	1.8	72	52	1980	8.29	66
Gambia	100	10	1	1.00	2.1	123	59 ^h	2320	9.71	62
Ghana	50	119	4	0.34	3.0	260	n.a.	2070	8.67	43
Guinea	70	172	3	0.17	2.2	106	n.a.	2060	8.62	45
Kenya	90	524	10	0.19	3.1	135	31	2200	9.2	68
Madagascar	50	294	4	0.14	n.a.	107	30	2240	9.48	51
Malawi	75	88	3	0.34	n.a.	58	48	2400	10.1	63
Mali	60	721	5	0.07	2.1	77	48 ^h	2130	8.92	68
Mauritania	25	258	1	0.04	2.2	211	42 ^h	1990	8.33	73
Mozambique	50	376 ^e	4 ^e	0.11	n.a.	228	n.a.	2130	8.92	40
Namibia	30	247	1	0.04	2.0	n.a.	n.a.	n.a.	n.a.	n.a.
Niger	40	507	4	0.08	2.7	91	51	2170	9.08	78
Nigeria	75	693 ^f	42 ^f	0.61	2.5	97	49	2290	9.58	50
Portuguese Guinea	100	36	1	0.28	0.9	n.a.	n.a.	n.a.	n.a.	n.a.
Rhodesia	100	389	5	0.13	3.3 ^g	225	16	2550	11.4	73
Senegal	100	196	4	0.20	2.4	209	33 ^h	2300	9.62	64
Somalia	50	319	2	0.06	2.3	70	n.a.	1770	7.41	57
Sudan	60	1491 ^e	15 ^e	0.10	2.8	137	32	2090	8.75	59
Tanzania	60	752	10	0.13	2.6	77	34	1700	7.12	43
Togo	80	45	2	0.44	2.5	138	43	2210	9.25	51
Upper Volta	100	274	5	0.18	2.1	46	44	2060	8.62	70
Zaire	10	234	2	0.09	4.2	n.a.	8	1040	4.35	33
Zambia	100	753	4	0.05	2.9	399	6	2250	9.41	69
sub-total or average	65	11489	157	0.13	2.5	123	38	2155	9.02	60
Southern and Central America										
Bolivia	20	220	1	0.05	2.6	197	19	1760	7.37	46
Brazil	12	1036	20	0.19	2.8	422	13	2820	13.92	67
Paraguay	60	244	1	0.04	n.a.	250	33	2540	11.3	65
sub-total or average	31	3326	58	0.17	2.7	469	19	2670	12.5	67
Near East and Northwest Africa										
Arab Rep. Yemen	20	39	1	0.26	2.7	61	n.a.	1910	8.0	57
Peoples Rep. Yemen	10	29	—	0.17	3.0	113	n.a.	2020	8.45	67
sub-total or average	12	611	2	0.03	2.9	303	13	1997	8.36	58
Oceania										
sub-total or average	34	19565	512	0.26	2.5	159	29	2132	8.42	54

In many dry farming districts, markets are very undeveloped. But debt is common. In their survey of West Rajasthan, Bose, Malhotra, Johory & Sen (1965) found that while the cultivators could finance the kharif crop themselves, they borrowed for the rabi or winter crop, repaying after the harvest 1.25 kg in grain for every kilogram taken.

Those designing Government policy or scientific research must bear in mind that they are dealing with very large numbers of small farmers; a large proportion of these do not own sufficient land to occupy them for more than six months of the year or to feed their families satisfactorily, especially in bad crop years. Again, although the number of landless labourers is generally lower in semi-arid areas than in the more densely populated humid areas, there still are several millions (Sundaram 1975).

Increasing agricultural production

Most Governments rely largely on irrigation to increase agricultural output in the semi-arid zones – and in many countries, irrigation in these areas is the condition for any expansion in the total cultivable area. There are various problems in interpreting international data but even so it is certain that there has been an enormous increase in irrigation since the Second World War: in 1949 the total irrigated acreage in the world was 107.7×10^6 ha; in 1964 the irrigated arable lands alone amounted to 175×10^6 ha (Baumann 1975). A large part of the new irrigation projects has been financed by Governments; in India about half the total irrigation is provided by Government. In particular, a substantial percentage of the revenues of developing countries and of international aid has gone into large scale irrigation projects. But there seems to be a growing feeling that many of these investment decisions were mistaken.

Much of the criticism of large scale irrigation appears to be based on evidence that the return on existing schemes is low. Wollman (1970) has asserted, but without providing evidence, that 'For most of the countries in the arid zones of the world, the scattered and incomplete evidence that is available indicates that output could be doubled or tripled with the same water base if better farming methods were adopted'.

There are two separate questions: the returns to the economy as a whole, and the returns to Government on public irrigation works. Before independence, water rates for Government irrigation works contributed to public revenues in India; since independence there has been a steadily mounting loss (Ministry of Irrigation and Power 1972). This is partly because the rates were very low – a fraction of what farmers were prepared to pay private owners of

NOTES TO TABLE 1

^a Taken from Ryan (1974); Ryan gives data for all countries, but here countries with a per caput g.d.p. above \$250 have been excluded, except for Ghana which is a marginal case. Most of the data relate to the late 1960s.

^b Semi-arid areas and populations were estimated by using Troll's (1966) map for climatic regions of the world by estimating the regions V_3 and V_4 (dry savanna and thorn savanna) in each country and examining population densities in these areas as contained in *Hamond Incorporated Atlas* (1972). n.a. denotes data not available.

^c Source: United Nations (1973).

^d Source: Food and Agriculture Organization (1970).

^e Excludes the areas irrigated from major government irrigation schemes.

^f The 1973 Census in Nigeria puts the population of Northern Nigeria at 51 million, the area at 730 000 km and the population/land ratio at 0.7. Source: Kassam, Dagg, Kowal & Khadr (1974).

^g Southern Rhodesia only.

^h Source: Curtin (1974).

ⁱ Figures in parentheses are estimates of Paiva, Schattan & de Freitas (1973).

^j Estimated g.d.p. per caput for northeastern Brazil as contained in Schuh (1973, p. 4).

tube-wells. (There are legal provisions for the collection of betterment levies, but in most States these are ignored.) There is no justification for such low rates which amount to a subsidy to a minority of farmers, frequently the better-off. Raising the rates would not decrease water use (Ansari 1968). In fact keeping rates so low that they do not even cover maintenance costs leads to waste and over-watering both in India and Australia (Clark 1970). But several Indian States have raised water rates steeply in recent years.

On the other hand, even with low rates, the water from large irrigation schemes is sometimes underutilized. Data on utilization of irrigation have to be interpreted with care, particularly where the water is also used for power. It takes several years and considerable investment in feeder channels, ground levelling, etc., to make full use of irrigation facilities. Marketing facilities for inputs such as fertilizers and for agricultural produce may have to be developed. If farmers are used only to dry farming, it may take additional time to switch to wet farming, which needs more labour and capital per hectare. So in a period of rapid expansion of irrigation, such as the last 30 years, statistics of underutilization may reflect largely the problems of adjustment. (In fact the intensity of utilization has risen from about 60 % at the end of the First Plan, in March 1956, to 83 % by March 1972, Ministry of Irrigation and Power 1973.)

But there are other problems which will not be cured merely by the passage of time. Waterworks may be mismanaged (Wade 1975). Farmers buy fertilizers and other inputs, and the only source of credit may be the village moneylender or rich farmer, whose own resources are limited, and whose rates of interest are high. The fragmentation of holdings may make it uneconomic for an individual to build feeder channels; the social structure of the village may not encourage cooperation. Sometimes even large farmers do not make full use of irrigation facilities: it may pay them to rent out the land to others willing to undertake the necessary expense and labour, but they are afraid of losing the land permanently under present land laws.

In the belief that farmers on their own cannot make full use of irrigation facilities, the Government of India has assumed the responsibility not only for on-farm development, including the provision of credit, but also for building roads, marketing, providing inputs and extension services. The Command Area Development Programme is only a few years old; only a few C.A.D. authorities have actually started working, management problems are still unsolved, and it is too early to judge the success of the experiment. The Government of India is even considering a bill which would empower State Governments to regulate the kind of crops farmers can grow and the period of sowing on land irrigated by Government: if this involves detailed administration, experience suggests that it is unlikely to be successful.

The financial returns on Government irrigation works in India have been low, first because the price charged for the water has been low, diverting a part of the benefits of the investment in irrigation to the farmers. This is true of many other developing countries (Duane 1975). Secondly, the return to the direct users of the water has also been below potential because of mismanagement in the distribution of water, lack of infrastructure, etc. There is a third important reason for the low social returns which is to some extent a matter of deliberate choice. Irrigation works have been built in semi-arid areas as a measure of protection against failure of crops. If the Government could concentrate only on maximizing total output it might locate irrigation projects differently, but it has to consider problems of regional balance.

Protection against uncertainty

The variability of output is one of the main problems of rain-fed agriculture. The semi-arid regions of northern Africa and western Asia are particularly prone to very sharp declines in output. In India too the dry areas are the major source of instability. The main reason is rainfall: the coefficient of variation of rainfall is inversely correlated with mean rainfall.

The F.A.O. (1975) has calculated 'instability indexes' of food production for 125 countries, or the coefficient of variation from the trend rate. Comparing the indices for the two periods 1952-62 and 1962-72, the F.A.O. found no significant trend; for the world as a whole the instability index was 4. But the overall index for developed countries was 6, whereas that for the l.d.cs was 3; the output of the d.cs is thus twice as unstable as that of the l.d.cs. To some extent this may have been brought about by Government policies, such as support schemes for agriculture. But the literature is full of references to the uncertainty of l.d.c. agriculture; presumably in order to stress the fact that its variations are much more uncontrolled than in the developed countries, and also that they are much harder to bear in l.d.cs.

I have not been able to obtain the F.A.O. calculations for each country (assuming that they were made for each country) but it is probable that the output of the semi-arid regions is more unstable than in the rest of the developing world.

The lack of markets increases instability. Thus the Indian farmer grows bajra, because he needs cereals, even though it is less stable than alternatives, such as kharif pulses (Jodha & Vyas 1969).

There are three lines of attack on this problem. First, one can try to alter the techniques of production so as to make output less variable and less uncertain, by irrigation, mixed farming and research into drought resistant varieties. In the past, scientific research has often neglected those crops most useful to poor countries, but this imbalance is being rectified; research is in progress on the cereal grains and the grain legumes of the semi-arid lands. The latter are the cheapest source of protein even at the very low current yields.

Secondly, one can improve one's method of predicting changes in output. Agrometeorology is still in its infancy; also, meteorologists, like all other valuable resources, are very unequally distributed (F.A.O. 1975). International action such as the proposed world agrometeorological watch should reduce uncertainty.

Thirdly, where risk is unavoidable, one can devise ways of reducing its impact on those who cannot or should not bear it. In India famine relief has always been one of the responsibilities of the Government, and under the British an elaborate system of famine relief evolved, ranging from the remission of land revenue to the setting up of public works and relief kitchens. Since independence, the expenditure on relief has grown enormously. Since relief was genuinely urgently required it was sanctioned hastily and actual expenditure was not sufficiently scrutinized. 'It would perhaps be no exaggeration to state', the Planning Commission Report on Integrated Agricultural Development in Drought Prone Areas remarked, 'that there is no other activity in which demands are processed as perfunctorily, funds of large dimensions allocated so easily and expenditure is incurred with such inadequate planning and scrutiny as in the case of relief operations' (Planning Commission 1973).

Several writers have described the waste and corruption of the Indian drought relief programmes (Jodha 1975), but as usual suggestions for improved systems are rare. Indeed it seems to have been the experience of these recent drought prone areas programmes that led Morris

(1974) to suggest that relief is frequently not necessary. He argues that the population of semi-arid areas 'have worked out mechanisms for coping with climatic instability'; these include the building up of inventories in good years, which can be drawn down in lean years, and migration when the rains fail. 'Why in a modern nation should regions susceptible to drought suffer more than areas with less volatile weather cycles? The answer is that they probably do not; they only suffer differently.'

There is an important truth in this statement, that the inhabitants of drought prone areas are not necessarily the poorest in the country, even in years of drought, whereas in normal years they may be better off than the inhabitants of densely populated areas (Chatterjee, Sarkar & Paul 1974). The Governments of poor countries are poor, and have to make hard choices between poverty relief programmes for different regions and groups. The survivors of dramatic disasters are frequently overcompensated, though less so in poor countries than in rich. But this still leaves a number of questions unanswered.

In what sense is India 'modern' – after all, part of the problem is precisely that transport and markets are underdeveloped. Were traditional methods of coping with instability ever particularly 'efficient', however one defines efficiency? They have not prevented deaths in the past. Nor is famine a good agent of natural selection of farmers. Since inhabitants of semi-arid lands *do* suffer differently, special measures may be needed. Is instability of output increasing as a result of population pressure? Can traditional measures continue to be used?

Jodha (1975) has described in more detail the measures with which Indian farmers traditionally meet droughts and famines. As soon as a crop failure is expected, labour is used more intensively in cleaning the fields and weeding, collecting rough fodder, processing chaff before feeding it to the animals and so forth. Once the crop failure occurs farm families immediately restrict their consumption. Inventories are run down and assets mortgaged; in extreme distress jewellery, land and cattle are sold. Farmers migrate from drought stricken areas as a last resort. Sometimes only a man or two from each family moves to nearby towns or irrigated areas in search of temporary employment, sometimes whole families with their livestock may travel several hundred kilometres in search of employment for human beings and pasture for animals. Some indication of the extent of migration is provided by the fact that three million inhabitants of the arid zone in India alone migrate every third year in India (Planning Commission 1973).

But no modern government should be satisfied with these traditional responses to scarcity. The sharp curtailment of consumption leads to the enfeeblement and deaths of humans, especially infants, and animals. Farmers who sell their land and cattle during famines, when prices are low, find it difficult to buy them back in normal times, when prices have risen: Jodha has reported that the droughts have increased inequalities in rural areas. But it is not clear to what extent this is cumulative; as we have seen, land is generally not more unequally distributed in dry areas than in wet.

The pressure of population is closing many of the traditional sources of protection against scarcity. The traditional system of rotational grazing is being abandoned, pastures are being ploughed up, and sub-marginal lands are being cultivated. In these areas crop yields have fallen, so that it is difficult to stock food and fodder even in good years. Again, while the need to migrate has increased, farmers have to go further, and Jodha reports that since 1956–7 or so, the councils of some villages to which the people of Rajasthan traditionally migrate charge increasingly heavy taxes. (Compare this with the problems of international boundaries faced

by migrants in the Sahel.) Also, the migration of cattle often involves over-grazing: since the owners of the herds have little interest in preserving the pastures there has been extensive destruction of natural pastures along traditional routes in India. There is clearly need for a well-worked out policy of famine or drought relief. The question of relief works overlaps with the wider problem of maintaining employment.

Rural public works

In most l.d.cs there is already a large amount of surplus labour, if one includes besides the openly unemployed those who work only part of the day. In India, nearly 70 % of the work force is in agriculture, subsistence farming predominates; open unemployment is small, and estimates of disguised unemployment vary. Mehra (1966) estimated that in 1956-7 about one-third of the workforce in agriculture could be removed without reducing output. Under-employment was not closely correlated with climatic conditions: some semi-arid states, such as Rajasthan, Punjab and Madhya Pradesh had high rates of disguised unemployment; Gujarat, Andhra Pradesh and Maharashtra not (Mehra 1966). Unemployment has almost certainly declined in Punjab and Haryana, but trends in the rest of India are not clear (Sundaram 1975). Other semi-arid tropical countries also suffer from open or disguised unemployment, 60-70 % of the rural work force in the Maghreb according to one estimate (Tiano 1973).

Since the population of l.d.cs has been growing rapidly over the last 15 years, the labour force over the next 15 years at least is bound to grow too. An estimate made in 1971 predicted that the labour force would increase by 2.3 % between 1970 and 1980 (Turnham 1971); in many l.d.cs the proportion of the population that is openly unemployed will increase.

The scale of the problem of unemployment is unprecedented. Neither in Europe nor in Japan did the labour force grow by over 1.6 % per year during the period of development; the United States experienced a rapid growth in the labour force between 1850 and 1914 but it had resources to match. It is worth stressing this point since some economists argue that the l.d.cs of today should learn from the advanced countries who relied on labour-saving technology during their period of industrialization (Robinson 1975).

The population in the rural areas is growing rapidly in most l.d.cs; if rural employment could increase at the same pace, the costs of urbanization would be saved. But there is a growing disquiet in the literature on the effects of introducing modern agricultural technology on employment, both in agriculture and in the economy as a whole (Raj Krishna 1974; Singh & Day 1975). To illustrate, Raj Krishna has calculated both the direct and indirect effects on employment of a 5 % growth in output, with technological change of the type experienced in wheat cultivation in the Indian Punjab between 1968/9 and 1973/4. He finds that with technological change total employment will only grow by 2 % because agricultural employment grows very slowly, mainly as a result of the mechanization of threshing and the shift from bullock driven to power driven irrigation. Without technical change a 5 % increase in agricultural output increases total employment by 4.7 % (the increase in non-agricultural employment is much smaller in the second case). Unless further, more detailed, calculations alter these findings very sharply, Governments must consider the possibility that the growth of certain types of 'modern' agriculture will stimulate growth in output and employment in the rest of the economy, but at a rate insufficient to absorb the increase in labour force that is likely.

If spontaneous developments in agriculture cannot provide the additional employment required, can Government do so? The real issue seems to be not whether it should or should not, but whether it can. One can argue that it has in its favour resources of money, organizational skills and technology; or that it alone can remove certain obstacles to agricultural development – it can enforce consolidation of fragmented holdings or redistribute land. Also, the rapid growth of agricultural output should make it possible to operate public works on a large scale; workers can be paid indirectly out of the increase in food supply. Unfortunately, the experience in India and other countries with public works schemes, such as Algeria, Morocco and Tunisia, has so far not been happy (Lewis 1972; Tiano 1973). The evaluation reports submitted to the Government of India and numerous reports make the same accusations: bad planning, inefficient implementation, red tape, waste and corruption. Many roads and earthworks were washed away by the first rains while contractors made huge profits. But the search for ways of improving public works schemes rightly continues.

An interesting experiment in new institutional structures for increasing rural employment is the Labour-cum-Development Bank set up by the Government of Kerala. This Bank finances small quick yielding labour intensive rural projects; the beneficiaries have to repay the loan within three years. A special feature of the scheme is that labourers are paid two-thirds of the market wage in cash, the balance is withdrawable after three years, with 9% interest; an anti-inflationary measure. The Bank has only been in operation since 1973, but it has already found a shortage of properly processed schemes; also, while it was originally planned that the labour content of the projects would be 80% of the total cost, in the three schemes it has financed so far, wages amount to less than 60% of the cost (State Planning Board, Kerala 1974). These have been the recurrent problems of nearly all rural works programmes in India: the shortage of productive schemes ready for implementation, and the high non-labour content of those schemes which are productive.

There is clearly no shortage in theory of socially productive public works: irrigation channels, drainage, roads, village schools and hospitals, storage facilities, housing, the list is endless (Lewis 1972). (Many of the semi-arid districts of India were once centres of great civilizations and the repair of the monuments they have left behind them would be very useful, even from the narrow viewpoint of tourism.) The problem is the cost of the non-labour inputs, a good problem for technology to solve, especially since the provision of employment ranks high amongst national objectives in India and elsewhere. The State of Maharashtra already operates an employment guarantee scheme under which in every district manual work is to be provided to all who want it, if possible within 5 km of their homes. Wages are based on output at a rate enabling the average worker to earn Rs. 3 for a seven-hour day, a rate which compares favourably with the current daily wages of field labourers. Nearly 80% of the expenditure incurred so far has been on irrigation works (Planning Department, Government of Maharashtra 1975) as in nearly all the other employment schemes in India. Unfortunately no study has been published of this scheme, which has been in operation since 1972.

Population growth

In many developing countries and certainly in Asia, a reduction of the rate of growth of population would ease the problems of unemployment and low economic growth, and it is clearly preferable to achieve this by lowering the birth rate, and by voluntary means. Nearly all poor societies already practice various traditional forms of birth control (Cowgill 1975;

Mandelbaum 1974) though their efficiency can doubtless be improved upon. There are two types of actions Government can take to encourage a decline in fertility. There are direct family planning programmes providing information, free contraceptives and positive incentives (from tax relief to free radios and subsidized houses) and disincentives (such as jail or compulsory sterilization). Indirect measures would work upon the motives for having large families, such as support in old age.

The influences on fertility are still imperfectly understood (Schultz 1976). Economists have put forward two main economic reasons for large families in poor rural societies. One is that after the first five years or so, children can add to the family income, by doing work on the family farm, cattle herding and so on. This is the aspect Robinson stresses:

‘One very clear reinforcer for high fertility is the traditional rural family life-style with its great need for family labour.... To sum up, the traditional peasant family unit is labour intensive and of high fertility and the two characteristics interact and reinforce one another. Any policy which encourages labour-intensive techniques may also be unwittingly striking a serious blow at any hope of getting a small family accepted’ (Robinson 1975).

But he ignores the second economic reason: the need for security in old age. It is likely that fertility is also determined by the need to ensure that at least one son will survive to support the family (Mandelbaum 1974).

Public schemes for support in old age might therefore reduce the demand for sons. One could even argue that widespread and prolonged unemployment would increase fertility, if families took as given the probability distribution of employment, but these speculations can hardly be tested. And social security measures in India, such as the Tamil Nadu old age pensions scheme, or the Maharashtra Employment Guarantee Scheme, have not lasted long enough to have significant effects on fertility.

There is evidence both from Pakistan and Bangladesh that an increase in female labour force participation leads to a decline in fertility; in Bangladesh this was true of women working in agriculture (Chaudhury 1974; Shah 1975). As far as I know, no one has discussed the effect of modern agriculture on fertility via female participation rates – for instance weeding is a largely female occupation but herbicides supersede human weeders. Bardhan (1974) has speculated on the effects different systems of agriculture have on death rates: female children may be more neglected in arid hilly areas than in the irrigated areas, especially those growing rice, where women are needed for weeding, harvesting, and threshing.

If he is right, female children will be neglected in the plains too, as female labour is displaced!

Apart from its intrinsic interest, a deeper understanding of the motives for bearing children would improve the efficiency of family planning programmes and the effects of other measures increasing employment, income and social security, on family planning. But one need not, of course, wait for large changes in the economy: a survey of rural communities in Maharashtra during 1953–66 found that the birth rate had declined, even without significant improvements in income, education or health facilities, as a result of a vigorous family planning campaign, in particular sterilization camps (Dandakar & Vaijayanti 1975).

Several developing countries have already succeeded in reducing their birth rates significantly: American Samoa, Chile, Costa Rica, Egypt (from 43 in 1960–4 to 35 in 1971), Fiji, Guadeloupe, Jamaica, Martinique, Mauritius, Puerto Rico, Reunion, Sri Lanka, Trinidad and Tobago and Tunisia (from 46 to 35). Fertility has also declined in parts of Brazil (U.N. 1974). In contrast, in some countries of Africa fertility, already high, may have risen as the incidence of

debilitating diseases has fallen. But the expectation of life in Tropical Africa is still the lowest in the world: between 41.3 (in West Africa) and 44.5 (in East Africa). It is hopeful too that measures which seem to be most important in bringing about a fall in fertility are good in themselves; better health facilities, better education, especially female education, more social security.

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Discussion

G. MURDOCH (*Land Resources Division, Ministry of Overseas Development, Tolworth Tower, Surbiton, Surrey*). I would like to comment on the advantages of fragmentation of cultivated holdings. The risk that is spread relates less to atmospheric moisture distribution than to soil moisture contents and seasonal water-table levels. In years of high rainfall a farmer's upland fields do well though crops on his patches of hydromorphic soil are waterlogged. When rains fail and his well-drained soil yields poorly, adjacent low-lying sites can be relied on reasonably often to produce rations sufficient to avert total famine. In the Swaziland Lowveld a distinctive name – *tihubodla* – is given to arable patches in valleys where relatively high watertables facilitate 'insurance' cropping of this kind.

J. SWIFT (*I.S.I.O., Sussex University, Falmer, Brighton*). I take issue with Kumar's support for a policy of benign neglect in drought and famine areas, a policy which is based on the assumption that peasants and pastoralists have their own adaptive responses to such conditions and can cope better on their own.

There is of course some truth in this assumption; the traditional reactions of peasants and pastoralists to drought and famine did give them some protection. But these responses have long ago been modified in ways that are impossible to reverse, even were this desirable. Indeed it is becoming increasingly clear that famine conditions are at least partly man-made, a result of the economic and political relationships between peasant and pastoral societies on the one hand, and a wider market economy and a central political power on the other.

The Sahelian and Ethiopian famines provide an example. In these regions there has been increasing integration of traditional peasant and pastoral economies to the market economy, resulting in declining food production for own consumption, and increasing production of cash crops for marketing; combined with declining terms of trade between agricultural and pastoral products on the one hand, and manufactured goods on the other, this has led to increased susceptibility to famine in such societies.

In these conditions a policy of benign neglect with regard to famine relief would not mitigate these long-term economic trends.

At the same time, the increasing commercialization of subsistence economies, and the increasingly centralized bureaucratic political power which has replaced previously diffused political power, has progressively deprived people of responsibility for and control over their own land. So an increased susceptibility to famine has been accompanied by increased environmental destruction, which in turn magnifies the famine risk.

D. KUMAR. Swift's first paragraph stating that I support a policy of 'benign neglect' is completely baseless; see the section on protection against uncertainty pp. 483–485, especially the concluding sentences: 'There is clearly need for a well-worked out policy of famine or drought relief. The question of relief works overlaps with the wider problem of maintaining employment.'

His other comments raise issues beyond the scope of the paper, which dealt with questions of Government policy. The effects of commercialization and integration into a market economy require much more analysis than is possible here.

N. E. REYNOLDS (*The Ford Foundation, 55 Lodi Estate, New Delhi 110 003, India*). There have been a number of references to agricultural research, most in an expectant vein. Some speakers have praised the work being done at I.C.R.I.S.A.T. I am familiar with the latter and in no way wish to detract from the compliments paid to it. Nonetheless, there is a danger that these expectations will be disappointed in practice and the reasons for this being so should be recognized. On a popular level there is an expectation that agricultural breakthrough will occur in an orderly progression; from wheat, to rice, to cotton and then, due about now, to the coarse grains, oilseeds and grams that form the bulk of crop agriculture in semi-arid lands. Breakthroughs have and will occur. What must be realized is that the environment for research on and for its adaptation by farmers in the semi-arid areas is much more difficult. Firstly, there is the underlying factor that much, if not nearly all, farming is of a subsistence nature which alters farmers' perceptions from those of researchers and policy makers as to the real value of purchased inputs. The risks attendant on crop agriculture are higher in these regions than in the wheat and rice belts. Much of the farming is already on marginal lands due to population pressures, environmental destruction and a resultant more extensive approach. There is, in most areas, a continuing spread of cropping onto technically unsuitable soils with a heightened

erosion threat. Parallel to the last point, the common lands which have traditionally provided a vital flow of nutrients, fuel and power (through traction) – the forest and grazing lands – into crop agriculture have suffered in some areas close to the point of no return. As a result the farming systems are becoming increasingly fragile and exploitive of soil wealth. Under such conditions new crop technology, while offering a chance, can only transform agricultural stability and production if the environmental tissues are also tackled – land use, community relations to resources, physical flows of nutrients, fuel and power into crop agriculture.

A further complication is that, at least in countries with a varied agricultural base, agricultural research constituencies will have arisen or will arise first in the other areas – e.g. with wheat, rice, cotton and sugar in India. As poor countries are able to marshal only limited financial and manpower resources, the capacity of agricultural research to handle all the demands placed on it will be limited. Breakthroughs in the crops named above and the growth of strong commercial interests around those crops will produce strong lobbies. Threats to new production gains, as pest and disease, will demand, and most likely get, the attention of the research establishment. Hence long term, well supported research efforts for the coarse grains, oilseeds and grams by national research organizations may suffer from a series of competitive claims. What this scenario suggests is a mixed approach. Research, yes. But also a serious attempt to grapple with the land-use question and the nutrient and other flows from marginal (and usually common or state lands) into crop agriculture. This complex of issues is largely institutional, market and price in nature and is hard to achieve without strong leadership. Alongside the latter, improved seeds (i.e. good seed not necessarily h.y.v.), improved husbandry practices and improved services and marketing, even on a humble level, will help to lay a foundation upon which farmers can accept the newer risks the use of new technology will involve.

Professor Kumar referred to the wastage surrounding relief expenditures. From her paper and from earlier discussion one might claim that ‘community’ emerges as the key element in the management of resources. One could add that nowhere, to my knowledge, has the idea of a budget for a village or an area (to cover several years and embodying government expenditures under all heads) been tried whereby government could negotiate a contract with the community. Such a procedure would help elicit greater involvement by the community and build the institution of community – contrary to the common effects of popular government. It would also be an educational tool to raise awareness of alternatives, of short- and long-term trade-offs and of the value of sequential decisions and investments. At the same time it should produce a measure by which government’s performance can fairly be measured, in the process providing it with advance information as to the rôles it must be able to play. Then a format would exist upon which larger funds could be expended as a relief measure, disciplined by the budget and the negotiated and contracted plan.