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Attacking Undernutrition and Poverty: Some Issues of Adaptation and Sustainability

Michael Lipton

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ATTACKING UNDERNUTRITION AND POVERTY: SOME ISSUES
OF ADAPTATION AND SUSTAINABILITY

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I shall try to do three things in this lecture. First, I shall review the definitions and evidence around the subject of poverty, undernutrition and hunger, and the links among definitions, and among the different types of evidence. Second, I shall discuss the relevance of individual adaptations to low energy intake relative to apparent energy requirements; the issue of sustainability is normally thought to be one for aggregates and environments, but a good deal of our concern about sustainability of solutions, in the area of nutrition and agriculture, in fact relates to adaptations at individual and household level. Only when these have been considered can we usefully discuss sustainability of adaptations at the level of a group, or the environment or system from which a group draws sustenance. It is here that issues of common property management, and of the relationship between State action and the preservation of the financial and ecological resource bases, have to be faced.

DEFINITIONS AND EVIDENCE:
POVERTY, UNDERNUTRITION AND HUNGER

My concern today is with absolute poverty, not relative poverty. On some definitions, the (relatively) poor are always with us as a matter of logical necessity. The worst-off one-third of persons or households must, by definition, always exist. There are less self-confirming and more respectable definitions of "in relative poverty," such as the once-popular "earning less than one-third of national average GNP per person" (although "spending less than one-third of national average real consumer outlay per adult equivalent" would be preferable). However, there are two reasons for not treating relative poverty here.

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First, it is really an aspect of inequality, not of poverty. There are some measures of inequality, such as the Atkinson [1976] measure, which systematically “weight up” income distributions unfavorable to the very poor, and therein catch the notion of relative poverty. Poverty and gross inequality are both evils, but they are different evils, though connected. Second, we are interested in poverty partly so as better to allocate resources to alleviate it; here, relative poverty often gives the wrong signals. In Bangladesh, a much larger proportion of the population is “absolutely poor” than in Brazil, but a smaller proportion is “relatively poor”; the poorest and next-poorest quintile of households in 1981-2 in Bangladesh enjoyed 6.6 percent and 10.7 percent of household income respectively, as against 2.0 percent and 5.0 percent in Brazil in 1972 [World Bank, 1988, p. 272]. An absolute-poverty indicator would suggest that aid resources go to Bangladesh rather than Brazil, surely correctly. A relative-poverty indicator would suggest the opposite. Similar arguments apply to resource allocation for anti-poverty purposes among areas within a country.

These two objections to the relative-poverty concept are related. If we use it to allocate resources in anti-poverty programs, we reward inequality, but do not necessarily (or normally) concentrate those resources where they can do most to alleviate need. Indeed, the Kuznets hypothesis suggests that “relative poverty” is systematically more in middle-income than in low-income countries.

So it is absolute poverty that we need to concentrate on. How should we define it? Much effort has been devoted to counting and adding up the number of persons or households below some “poverty line.” Ingenious and sometimes convincing methods of combining the incidence of poverty and its severity into a single measure have been devised, most notably by Sen [1981]. However, for this process to make much sense, we

need to have some reason for putting the poverty line where it is, in other words, some definition of absolute poverty.

Unweighted lists of attributes of the poor, for example “basic needs” some or all of which persons defined as “poor” do not meet, do not commend themselves. Nor do scalars that represent weighted sums of the elements of an alleged “vector of poverty,” such as the physical quality of life index or PQLI [Morris, 1979]. There are at least three reasons why these attempts fail.

First, the items included in, or excluded from, any given list or vector of characteristics of poverty are arbitrary. Second, so are the weights attached to these components (including the equal, but nonetheless arbitrary, weightings given to the three components of Morris’s PQLI). Third and most important, policymakers require to know where some of these needs, or components, are adequately handled and others not: which region is literate but unhealthy, which has high infant mortality rate but low adult mortality, and so forth. In lumping these matters together in a single index, or simply giving the number of unmet “basic needs” as a poverty indicator, we needlessly lose information.

This is apart from the fact that none of these lists of need indicators, or weighted sums, corresponds either to an intuitive notion of “absence of poverty,” or to a typical economist’s notion of “lack of command over resources.” For that very reason, these indicators cannot distinguish between primary and secondary poverty [Rowntree, 1901]: that is, between lack of resources available to a person or household, and inadequate capacity to turn those resources into well-being, whether as total consumption or as acceptable levels of components of it such as nutrition, health, literacy, etc.

To an economist, a definition of primary absolute poverty based on **either** income or expenditure does commend itself. Such a definition

assumes that most of the time most people will dispose of income or expenditure in a way that maximizes long-run expected utility. Of course that approach is problematic: there exist public goods, sometimes provided to individuals and sometimes to groups, often free and often unpredictably; even for private income, maximizing utility for head of household, for parental couple, and for the household as a whole are different things, not all obviously definable; and (as Rowntree [1901] and, if in a different way, Auletta [1982] implicitly recognized) such factors as addiction and mental disturbance can intervene decisively between income (or expenditure) and capacity to maximize utility.

One way of evading these and other problems, which recommends itself as a temporary way-station in a search for operationally useful definitions of the poor, is to define, at the level of a household of a given size and composition by age and sex, some level of income or expenditure at which that sort of household, spending the way such households typically do, manages exactly to satisfy some bundle of needs. The relative prices of "satisfactions" must be the same for each household, and independent of the amount of spending that any household does to satisfy any need, for this to work really well. However, it should, for example, be feasible to specify the level of income or expenditure at which a household of two adults, one thirteen-year-old, and one four-year-old—if it allocates outlay among foods, and between food and nonfood, in a way typical of its demography and total income or outlay—gets as much of all the basic nutrients (including of course dietary energy) as it requires.¹

There are of course still problems with any such definition of

¹This is much better than a least-cost-diet approach, as was in fact used by Rowntree. Such an approach seeks to establish the minimum income required to purchase some artificially inexpensive diet. This, however, in many cases will not be available, "cookable," digestible by weanling children, or otherwise acceptable.

poverty. Publicly provided goods, common property resources, capital-type windfalls, and price variations all present problems, though manageable ones. Most seriously, we shall have to come to terms with the question of valuing, against one another, the various alleged requirements which an income or expenditure bundle, if just adequate, will precisely meet. However, all these items are manageable. (I shall return to the last later, trying to justify the view that “adequate dietary energy” usefully summarizes the things that advocates of a basic-needs bundle are trying to get at.) For the moment, I want to deal with a more difficult definitional problem.

This is the problem that, in defining and analyzing absolute poverty, people mean two different things. An ultra-poverty line can be drawn at the level of expenditure where—with the spending patterns between foods and non-foods (and among foods) typical of the normal or average household with a given expenditure-per-month, size and age and sex composition—it is just possible to meet the energy requirements or work and health, and to maintain full physical and mental functioning (including undiminished prospects of survival and wellness). The second and usually much higher moderate poverty line occurs at a level of expenditure where, similarly given typical spending and demographic patterns, a household can just avoid taking financial decisions that imply physical or human disinvestment, i.e. sale or mortgage of physical or financial assets, or reduction of outlay or time currently being devoted to acquiring educational capital.²

The ultra-poverty line and the moderate-poverty line define the

²(a) It has to be assumed that neither the “assets” nor the “outlay or time” are (in some sense) “very large.” Misers, or (employable) Perpetual Students, are making choices, not being resource-poor. (b) “Moderate poverty” in this sense, of course, occurs at a “poverty line” that would rightly be regarded in the West as a place of appalling material inadequacy (of shelter, clothing, etc.).

borders of zones of individual or household sustainability. Below the ultra-poverty line, a household cannot sustain basic human functioning for long unless it cuts the activity level; changes the household size or structure (for example by joining with another household to exploit economies of scale in consumption [Lazear and Michael, 1980] or by “shedding” some small child to a relative who can look after it); or else accepts noticeably higher risks of death or disease. Between the poverty and ultra-poverty lines, the household cannot sustain the value of physical assets and/or of human educated capital for long, without some fundamental adjustment. Of course, a household can move in and out of the ultra-poverty and moderate-poverty zones, either as it moves along the life-cycle (and changes the child/adult ratio or the access to potential inheritances), or with individual or group accidents or windfalls, whether of a medical or agricultural nature.

We still need to tackle the problem of just what this “normal household expenditure for a given household demography and spending pattern” has to be able to purchase, in order that either poverty or ultra-poverty can be avoided. I have argued that a list, or even more a weighted vector sum, of necessary levels of “basic needs” is arbitrary and unsatisfactory, but what else can be done? There is a strong case for using “food adequacy to meet normal requirements” as an indicator of absence of poverty, and also for saying that “energy requirements” are in this sense a good proxy for all requirements taken together. This sounds like an absurd statement. Man does not live by bread alone, or even food alone; if he did he would need more than just calories. So what is the justification?

Let us start from the other end. We are looking for, in the first instance, an “ultra-poverty line” that will sharply separate those who do not have enough capacity-to-spend to meet basic requirements, from those

who do have enough. We hope to find discontinuities in behavior, as between those below and those above that line. There is evidence [Lipton, 1983] that the ultra-poor are those who, though spending more than 80% of outlay on food, still meet less than 80% of the dietary energy requirements suggested by FAO/WHO/UNU [1985] for their age, sex and activity group. Empirically, this identifies perhaps 10-15% of households in low-income countries, containing 15-20% of populations and 17-25% of pre-schoolers, in a typical year. These percentages are considerably lower than those normally quoted as falling below nutritionally-defined "poverty lines" (in other words, the level of expenditure at the ultra-poverty line, per adult equivalent, is considerably below expenditure and the normally quoted poverty line).

What is the nature of the evidence for these statements? Surely it is not being said that those who can meet 80% of dietary energy requirements, but no more, are in any sense not really poor?

First, let me rehearse the reasons for looking at a food measure in general, and an energy measure in particular. The food measure, as suggested here, is not simply the amount of food going into a body. It is the energy adequacy of that food relative to requirements. In other words, if a household is less healthy and therefore needs to use up more dietary energy to fight infections or parasites, or if a household has much energy stress owing to employment (or job search) or domestic work, then the expenditure and income required, to obtain enough food to avoid ultra-poverty, increase. Going further afield, if mothers receive no post-primary education and have little chance of modern employment—or of educating their children for long—then their preferences will lead to large families of small children and high infant mortality rates (as well as many pregnancies), again increasing energy requirements and therefore income and expenditure required to satisfy them (or 80% of them). Thus a food-

related “ultra-poverty level of income or expenditure” is at worst a metaphor, at best (and I believe this is achievable) an accurate summary, of all the factors that determine whether income suffices for full physical functioning.

But why energy rather than total food in some other sense? Again I summarize what will be familiar to an audience of nutritionists. Protein deficiency (despite recent revisionisms) has been shown to be fairly rare, and where it occurs to be usually removed when energy intake rises, so that protein foods need no longer be “burned up” for energy purposes. Micronutrient deficiencies are of course a large and genuine problem, not so readily cured by increasing energy intake (especially not for vitamin D deficiency, or iodine deficiency); but (especially in these two cases) extra income and expenditure are extremely weakly related to improved nutrient status. So, if we are looking for a poverty-linked food indicator, then it had better be dietary energy intake relative to requirements. Such a food indicator, after all, needs to be (a) highly sensitive to the level of economic resources at the disposal of a household (which micronutrient adequacy is not), and (b) highly prevalent among people with inadequate economic resources (which protein deficiency is not, especially not independently of energy deficiency).

“Ultra-poverty,” then, can usefully be defined as “inadequate household resources, given normal demographic and spending patterns, to obtain even 80% of dietary energy to meet such a household’s average requirements.” It turns out that households in this sad condition are normally spending at least 80% of outlay (including consumption of any foods produced on the home or farm) for food alone. It is also these households—and the strongly overlapping group at risk of severe undernutrition, as anthropometrically indicated—that suffer sharply raised risks of infant mortality, of impairment of intelligence and capacity to

learn, and of inadequate adult physical performance as a result of undernutrition in childhood. Since the evidence for this was presented in [Lipton, 1983], the attempt in the large, multi-country CRISP project to define similarly convincing indicators of damage from mild to moderate undernutrition (MMU) does not appear to have succeeded, while various aspects of the work of the Dunn Nutrition Unit, not only on pregnant and lactating women [Dunn, 1985], have strengthened the evidence that energy requirements have in the past been overstated.

It is really at the level of ranking of groups or areas, with respect to the incidence and severity of the phenomena, that we find a very strong overlap between the rankings achieved by various indicators: proportions with energy intake inadequate to support 80% of requirements; proportions spending over 80% of outlay on food; evidence of sharply raised risks of infant mortality, or physical or mental impairment; and severe or upper-moderate anthropometric shortfalls. These linkages are less strong at individual and household levels, due to interpersonal variations in requirements (exposure to disease, as well as level of activity).

Even at individual levels, however, several strong links emerge among these indicators, reflecting discontinuities in economic behavior around the ultra-poverty line. It is the ultra-poor, not the poor, who as income in the household rises do not significantly reduce the proportions spent on food, nor the proportion of food outlay that goes for starchy staples [Bhanoji Rao, 1981; Lipton, 1983; Edirisinghe et al., 1983]. This suggests that decisionmakers in ultra-poor households, but not elsewhere, believe that "empty calories come first" as a priority use of any extra resources available. Further, there are strong behavioral links between ultra-poverty and labor market behavior; it is only the ultra-poor who do not raise age- and sex-specific participation rate in the labor force as poverty presses harder, presumably because there are health/nutrition

reasons for not doing so [Lipton, 1983a]. Indeed the success of the Employment Guarantee Scheme in the Indian state of Maharashtra in attracting ultra-poor participants, compared with the relative failure of the National Rural Employment Program to do so, is probably attributable to the fact that the former scheme, but not the latter, supplies “food first” to participants in the work programs, and locates its activities near each village, so that a long walk to work is not required from people with little or no energy to spare.

Most of this evidence—especially the strong evidence relating severe undernutrition to observable functional damage, and the very weak evidence for other forms of undernutrition—was fully discussed in [Lipton, 1983] and has been supported by further enquiries since. A number of enquiries among the moderately poor show remarkably low, though clearly positive, responses of energy intake, especially among preschool children, to household income per adult equivalent; these will be reviewed in Dr. Behrman’s lecture in this series, and support the line of reasoning given here. Although the income-elasticity of food expenditure is quite high, the income-elasticity of calorie intake is rather low for these moderately poor people—they are seeking improved, varied, pleasanter diets, rather than more empty calories.

However, we need to react to recent suggestions that, we need to react to recent suggestions that, even for very poor people, income-elasticity of demand for dietary energy may be extremely low. Very careful econometric work by Bouis and Haddad [1988] on data from Bukidnon, Philippines, suggest that for these extremely poor people a rise in household income of 20% leads to a rise in a dietary energy intake of only 1%. Behrman reaches similar conclusions for India, using them to suggest that income and outlay, on the one hand, and calorie intake or adequacy, on the other, are “loosely linked not tightly meshed.”

David Hume remarked that “it is not contrary to reason, to prefer the destruction of the universe to the pricking of my little finger.” It is not, either, contrary to reason (i.e. to logic) for poor and desperately hungry people, when consumption rises 20%, to increase dietary energy intake by only 1%. However, common sense suggests that something has gone wrong somewhere, even if not with the logic or econometrics. What is it?

The jury is still out, but in my judgement, what is happening is that we are looking at dietary energy intake alone as income changes. We ought to be looking at dietary energy intake relative to requirements. If people get substantially better off because of a remittance, or a higher wage-rate, then—especially if their level of energy expenditure is already very high—they may well respond by cutting work input, and therefore their requirements for food. Under these circumstances, a rise in income and expenditure would not be associated with a large rise in dietary energy intake absolutely. It would, however, be associated with a substantial rise in intake relative to energy requirements. Admittedly these are hard to measure, but there are a number of indicators from ongoing IFPRI work that this may be what is going on in the Philippines and Kenya cases (in both of which positive, but surprisingly weak, responses of energy intake to higher household income, even among very poor people, were observed).

However, it is almost true by definition that, if a group of households is so poor as to be able to afford only 80% of the dietary energy that “it needs,” then a significant increase in income will bring about a significant increase in dietary energy intake. The reason that the earlier studies of Rao, Edirisinghe, and myself were able to find this, presumably, was that, as the ultra-poor groups we looked at got better off, they did not significantly reduce their energy expenditure, and did therefore use extra income and outlay to finance increased energy intakes.

In the Behrman and Bouis/Haddad data sets, extra income may have gone along with reduced energy expenditure, which indeed would then have been chosen as a form of leisure preference along the lines of Robbins [1930].

A second interesting possibility, when we find a group of people that appears to be ultra-poor but does not raise energy intake substantially when income and outlay rise, is that the average weight of these people (or the adults among them) may be rather small. After early adolescence, there is little or no health or other advantage in increasing energy intake in order to support some "standard" or "reference" body weight, say, 10-12 percent higher than the weight one actually has, unless one proposes to increase one's energy expenditure subsequently. For instance, in the Philippines data set, mean adult weight in the Bukidnon sample was 8% below the standard assumed correct for the Philippines [Bouis, pers. comm.]. So 5-7% fewer kcals consumed, and therefore outlay on kals, than standard energy "requirements" data (based on reference weights) suggested, would have been required to ward off serious undernutrition. These adults were shorter than average; therefore they required less food to maintain a given weight-for-height (or indeed to avoid hunger).

A third possibility is deduced by Ravallion [1988] from data for rural East Java. These data suggest that many households comprise people "crowded" either just above or just below the norm, the point at which (with outlay used as it typically is) energy intake exactly meets requirements.³ If so, a very small income-elasticity of demand for calories (around the norm) (a) is consistent with a very large effect of income change on the proportion of persons enjoying caloric adequacy, (b)

³This very precise concept of a "subsistence income" can, as Ravallion shows, be modified to allow for some forms of interpersonal and intrapersonal variations, and even adaptations, in energy requirements.

represents a rational response—with those just below the norm, when income or outlay rises, needing only a modest responsive increase in calorie-intake so as to dispel undernutrition (and hunger?); and with those just above the norm, when income or outlay falls, avoiding more than a tiny responsive decrease in calorie-intake, so as to minimize undernutrition (and limit severe hunger).

Probably, all three effects are at work. Requirements (not just intakes) vary with income or outlay per AE; mean requirements are in fact below norms suggested by “reference weights”; and many people are crowded close to the norm. What is not plausible is that hungry and undernourished people, when income or outlay rises, do not seek to alleviate their hunger and undernutrition.

It will be a long time before economists and nutritionists, jointly, have sorted these difficult matters out. At present, we have a lot of evidence for discontinuous changes in behavior around an ultra-poverty line as defined above. The indications of very weak response of energy intake even relative to requirements to higher household income or outlay, in my judgement, are convincing only in countries such as Nicaragua, or generally in circumstances, where energy requirements were in fact largely met before income rose and where upper-moderate or severe anthropometric indicators of undernutrition are extremely rare. If really poor communities (whether in cross-section or in time series) appear to exhibit such low energy-intake response, we shall usually find special explanations, particularly that energy expenditure is going down as income or outlay rises, so that energy intake relative to requirements is in fact strongly related to household resources, although absolute energy intake may be related very weakly.

Anyway, the essence of my argument is that the ultra-poor, but not the moderately poor, behave in both food markets and labor markets, and

respond in respect of health, in ways that indicate that their main priority is extra dietary energy. It should be noted that this claim, that the moderately poor and the moderately undernourished can normally adapt in a sustainable fashion without impairment to capability and functioning, does not rest on the controversial Sukhatme-Margen [1978] hypothesis about metabolic adaptation. There is strong evidence that average requirements are overstated in the developed countries, further overstated by transference to tropical environments (with slack seasons workwise), and substantially modified by interpersonal variations in requirements and intakes, in particular by the fact that, at a given level of outlay, spending pattern, and demography, a household with low energy requirements (e.g. low weight and height among its members, or low BMR's) will also choose a level of dietary energy intake below the average for its outlay/demography/activity group [Lipton, 1983]. If all such low-intake households are counted as undernourished, we have an overestimate. Anyway, there is a wide range of reasons for believing that most of the moderately poor, obtaining 80-100% of FAO/WHO/UNU intakes, are not in fact at increased nutritional risk, even to full capability and functioning.

Two important new bodies of knowledge have emerged since my last review [ibid.]. First is the evidence about low requirements and successful adaptation among pregnant, lactating, and other women [Dunn, 1985]. Second are the glimmerings of evidence that working efficiency and immune response may be related to intakes other than simple energy, including zinc, iron, and perhaps some vitamins. Adequacy here will depend more on social than on private income sources, and will again disrupt the link between moderate poverty and undernutrition or functional damage.

All these modifications plainly do not apply to those at risk of severe undernutrition. Because the poorest have the largest families—to

replace infants who have died, to compensate for the effects of sib crowding, and to insure against old age—a significant proportion of children, well over 25% in Bangladesh, are at substantial risk of severe undernutrition on account of household ultra-poverty: even more in bad years. There is little danger that a realistic definition of the scale of nutritional risk, and of the ultra-poverty related to it, will downgrade nutrition to the level of “too small a problem” to engage politicians as a claim on resources.

Does this mean leaving out the moderately-poor from any account of food priorities? Since the moderately poor are almost certainly in most cases shorter (and have shorter children) on average than the non-poor, would not such a policy deny them their “genetic potential” in terms of height? I believe these questions get cause and effect the wrong way round. The correct causal sequence is that, as people get better off, there is a simultaneous rise in discretionary activity, demand for dietary energy, child height, and ultimately adult height (there is some considerable doubt whether this applies to East Asian populations, however). Those such as Beaton and Martorell, who have argued that stunting in a population (even if moderate) is a marker of poverty in that population, are clearly right. Those who would use that argument to infer that non-wasted, mildly stunted individuals (or even populations) are as such at greater risk, however, are very probably mistaken. The moderately poor, who tend to have experienced mild to moderate undernutrition at least in childhood, probably very seldom suffer significant or lasting damage or functional impairment. However, one cannot simply see this problem at individual level. Supposing we could perfectly measure “nutritional adequacy relative to requirements,” we could construct a distribution function for it. Suppose that, in any population, mean energy intake fell (with mean requirements constant). The distribution would usually shift

to the left, and the number of mild-to-moderate undernourished would increase over time. If that were all, there would probably be little cause for alarm on purely health grounds. However, if the whole distribution is shifted leftwards, then the numbers of severely undernourished also increase. That obviously is very worrying.

However, if there is a policy option—use resources to reduce ultra-poverty, and in the process shift severely-undernourished persons into mild or moderate undernourishment; or use similar resources to reduce moderate poverty, thereby pushing the mildly/moderately undernourished children into “100% adequacy”—the former policy seems clearly preferable. The distinction is important precisely because so many World Bank and other projects have missed the poorest (at risk of severe undernutrition), while reaching many of the moderately poor.

It is not the case that, for individual children who are mildly stunted, not wasted, and (mostly) in moderately poor households, “more dietary energy intake and nothing else” will normally help. What happens to such children in adulthood? If physical activity does not increase and income does, they may well become somewhat poor but fat, a problem receiving growing attention in developing countries (as also among some impoverished populations in the USA, notably poor black women) [Stunkard et al., 1972; Arteaga et al., 1982; Ross et al., 1983; Okeke et al., 1983; on the mechanism, see Payne and Dugdale, 1977]. If adult activity goes up and income does not, the children “rescued” from the anthropometries defined as “mildly undernourished” will, in adulthood, be poor and hungry—and may replace their earlier, pre-rescue expectation in adulthood (mild stunting) with a much more dangerous one (wasting, at a taller height). If the typical activities of developing agricultures—involving much body translation and rather little lifting of weights—increase, then even if income increases the larger adults would be

in important ergonomic senses less efficient than before.

This is not to advocate hunger among children! The sequence has to be that, in moderately poor households especially, activity and income rise together. This leads to less selection against persons with high energy requirements. Then, height and weight increase, faster than in earlier generations, through adolescence to adulthood. Possibly, even then, the ceiling height and weight of some major populations, East and perhaps South Asians, may fall below European, African and North American ceilings. If so, so what? Achievement of genetic potential in terms of intelligence is a human right. But the genetic potential to grow as tall as George Bush rather than Michael Dukakis, whatever one's preferences between them, seems unimportant, except perhaps in professional basketball.

We have reached the point of presenting reasons to define, as ultra-poor, nutritionally at-risk groups comprising 10-25% of populations in low-income countries (almost always more in rural than in urban areas, and among large than among small households). How do some of these people, and many more among the moderately poor, adapt to periodic or lifetime levels of dietary energy stress (relative to requirements) that for most of the ultra-poor, and a few of the moderately poor, can cause real damage? Are the adaptations harmful, neutral, or perhaps even beneficial? It is to these issues that we turn in the next section.

ADAPTATION AND INDIVIDUAL SUSTAINABILITY

Ultra-poverty, then, is incapacity to afford outlay per consumer unit—although spending about 80% of total household outlay on food—sufficient to avoid serious risks from dietary energy stress, and as a possible consequence (although the correlations are not terribly good) anthropometric states involving severe or perhaps upper-moderate

undernutrition. Energy stress, whether for a short period or integrated over a lifetime, is best seen as part of a sequence: source, stress, strain, and damage [Payne and Lipton, 1988]. A typical source is a drought that cuts a subsistence farming community's access to food, or a disease or busy season that increases a household's requirement for food although it is already near the ultra-poverty line. The stress that results from such a source can take the form of reduced (or, by acceptable standards, "low") energy inputs; raised ("high") energy expenditure; or reduced ("low") conversion efficiency of inputs into expenditure, for example because energy absorption or utilization has been impaired, or energy excretion increased, in schistosomiasis [Stephenson, 1986]. Strain is the detectable, and possibly but not necessarily damaging, response of the body to stress, for example a reduced rate of child growth. Damage is impairment of mental or bodily condition, subjective wellness, or task performance, arising from strain. "Adaptation," being a response to stress, is obviously a sort of strain. By accommodating the body-brain system to stress, it contributes to survival and reproductive fitness within the new stressed environment.

What adaptations, then, are "acceptable?" Presumably, those that do not lead to functional harm or pain. On the whole, people who are poor but not ultra-poor, and who are receiving dietary energy intake between 80% and 100% of FAO/WHO/UNU [1985] requirements for their age, sex, and activity level, have achieved adaptations that are not only sustainable but acceptable, although many have child height-for-age (or adult weight-for-height) characteristic of "mild to moderate under-nutrition." However, even if moderate adult stunting is "acceptable" in the sense of causing insignificant functional harm or pain, the path towards it—via child hunger, and delayed recovery from some forms of illness—plainly is not "acceptable" (although there is no clear damage

from the end result, nonextreme adult stunting). The most cost-effective way to remove this “unacceptable” phenomenon is frequently to improve the health environment, rather than to increase child food intake.

Also, the poverty which prevents populations from avoiding a path, which for many of them leads to mild to moderate undernutrition and 80-100% “calorie fulfillment,” is clearly not “acceptable,” in particular because it pushes the left end of the distribution (of households by energy-per-adult-equivalent) into circumstances that involve risks of severe undernutrition. However, it is wrong to infer—from the widely agreed judgements that neither the children’s growth path, nor the underlying poverty (and the resultant distributions of persons by energy-intake relative to requirements, or by height for age), is acceptable—that the adaptation (mild to moderate adult stunting without wasting) is itself not acceptable. Life expectancy, physical performance (at least per kilogram of body weight, which is usually what matters), and mental performance do not appear to be impeded. At the risk of paradox one might even argue that, given available food, moderate stunting is beneficial because it reduces the risk of wasting, a more seriously risky condition. Martorell [1982] is quite right to say that such stunting is healthy only in the sense that scar tissue is healthy. The burning that causes scar tissue, like the dietary energy stress (and associated hunger) in childhood that selects persons likely to develop into mildly or moderately stunted adults, is undesirable; but the response to a burn of scar tissue, or to undernutrition of mild-to-moderate stunting, is surely healthier than available alternatives.

The source-stress-strain-damage sequence is sometimes rather useful in looking at these matters. Whether a particular form of strain, as a response to stress, is likely to succeed, or to be “acceptable” if successful, may well depend on the source of stress. A given rise in energy

requirement relative to energy intake may require response A for successful and acceptable adaptation if the source of stress was the need to work longer and harder, but B if the source of stress was an increase in the price of dietary energy (other things equal).

A wide range of possible responses, maybe adaptive, to strains exists; they can be classified into biological and behavioral (would-be) adaptations. Following Payne and Lipton [1988], biological adaptations include: (1) a reduction in growth rate in children; (2) reduction in fat and lean in roughly similar proportions; (3) a reduction in lean mass relative to fat, and hence in the total basal metabolic rate of the body; (4) a reduction in the specific metabolic rates of tissues, including, but not only, a possible shift under energy stress toward more efficient metabolic pathways in the sense suggested by Sukhatme and Margen [1978]; (5) energy-saving changes in the reproductive cycle, later menarche, earlier menopause, less frequent menstruation, or fewer births—given all the above. Behavioral adaptations, rightly stated by Ferro-Luzzi [1986] to be much more important, although they are much less analyzed and discussed, add to the list (6) selection of tasks to reduce energy expenditure given the length of the working day, (7) reduced length of work, (8) greater ergonomic efficiency (usually brought about by slower work—walking a mile uses slightly less energy than running it); (9) reductions in child play (“acceptable” only if psychomotor development is not impaired); and (10) more intensive mother-child interaction to reduce damage as a result of children’s energy stress (“positive deviance” [Zeitlin et al., 1987]).

Will adaptive responses succeed in given circumstances? This depends mainly on three things. The first is whether the organism can sustain the strain for long enough, which in turn depends on the severity and duration of the stress which is causing the strain (and on the

reversibility of the strain, once the stress eases). The second is the decomposability of response into several small, low-cost, additive strains, each perhaps reducing requirements relative to intake by only 50-80 kilocalories per adult equivalent per day, but together easily "saving" the 300-400 kilocalories necessary to get "close enough" to energy balance. The third factor, determining the prospects for success and acceptability of an adaptive response, is that desirable adaptation should not be occluded by other, less desirable, forms; for example, if I reduce my level of activity by resting more during energy stress (and thus earn less and increase the risk of a downward cycle in the wellbeing of my household taken together), that action occludes the possibility of increased ergonomic (or perhaps metabolic) efficiency in doing given tasks with less food, because I am cutting down the tasks that I do, and thus not allowing such increased efficiencies to express themselves.

SUSTAINING GROUP ADAPTATIONS: STATES AND RESOURCE BASES

Better sustainability of adaptation by individuals can make sustainable adaptation more difficult for groups. For example, it is probably the case that a larger proportion of adults are stunted in many developing countries today than ever before, because children who would once have died from severe undernutrition-infection synergisms now receive extra food or treatment, suffer only MMU, sustainably adapt to it, and grow to a short-statured but otherwise unimpaired adulthood. At the level of the group, however, such public health support is linked to the fact that many of the mechanisms with which small communities used to sustain the well-being of weak individuals have gone. However, the replacement "sustaining mechanisms," provided in the rich countries of the North by social security systems and other forms of State action, are limited by the poverty of governments in developing countries.

Nevertheless, publicly-mediated schemes for school and preschool feeding, public works, and (to a lesser extent) asset redistribution have increased sufficiently in much of South Asia to balance the decline in traditional community provision for the very poor. In Sub-Saharan Africa, this is generally not the case. Kwame Nkrumah said, "Seek ye first the political kingdom," meaning that economic issues were secondary to political freedom and self-government. It is perhaps unfortunate that so few countries in Sub-Saharan Africa have been under sufficiently powerful pressures to seek the political republic, the *res publica* in the Roman sense: the feeling—strongly prevalent in much of South and East Asia, even among members of élites who are in other respects far from wholly admirable—that the provision of some sort of emergency reserve, usable by the poorest in time of extreme stress, is a community responsibility requiring effective State overview; that, if "the truest index of a society is how it provides for its most vulnerable members" [Gup, 1988], the State has increasingly to secure the means to that end.

There is no doubt that the micro-community, as both markets and populations grow, is decreasingly effective in providing group-mediated adaptations to energy (or other) stresses affecting the very poor. In South India, Epstein [1973] contrasts "Dalena," a modernizing and commercializing village where average incomes have risen but traditional forms of mutual protection have broken down, with "Wangala," a more traditional wet-rice village with lower average incomes, more mutual support, and almost certainly less unequal income distribution. Plainly, in developing countries as a whole, Dalenas are displacing Wangalas. The importance of this transition for policies to improve sustainable food security among rural groups is great. In particular, as labor markets modernize and integrate, we must expect a sharp decline in the proportion of rural communities where larger farmers as employers, in order to

guarantee labor when they want it under conditions of uncertainty, offer local workers job preference and some security in bad seasons or years. Concomitantly, we must expect an increase in the proportion of villagers facing free labor markets [an excellent discussion of the contrast in the context of empirical material from West Bengal is Bardhan and Rudra, 1980].

The consequences of this commercialization for food security are not only mediated through the decline or privatization of common property resources—always much more used by the poor than by the rich, but sharply less available to both, as population increase raises the incentive to “enclose,” and also the costs of policing common property use [Jodha, 1983; Lipton, 1985]. Private quasi-charitable contributions to food security also become diverted to formal markets, as in the case of buttermilk, formally given by larger cattle-owners to poor and hungry people but increasingly sold by them in organized urban milk markets [Dasgupta, 1987]. In general the increasing mobility of labor, and rising availability of workers per acre, reduce the incentive for wealthy people, especially in a particular village, to provide reserve food security for the poor. When labor is in increasingly excess supply, only charitable considerations, not economic advantage, will induce employers even as a group to take action maintaining the physical status (let alone the reproduction capacity) of the workforce—unless, as in efficiency-wage theory, employers retain particular workers or even their children for many years, and therefore reap the benefits if particular members of the workforce are better fed and produce labor of a higher quality (of course a higher quantity is in these circumstances not very important). However, formal labor markets, and even formal screening devices, render such “attached labor” unlikely to occupy more than a small proportion of the food-insecure, even in rural areas.

Hence there is a growing requirement for State organs to provide food security, if the managers of those organs feel a duty to do so (the issue of the *res publica* again) or perceive an interest in doing so, either to preserve the security of the State or to satisfy domestic or foreign pressures upon them. Suppose the State does act as if it recognizes such a need. This generates a problem of sustainability through finance. In the traditional community, village “big men” sometimes felt that it paid to finance the nutrition, in bad times, of working families and their children. Where are the comparable pressures on the State to sustainably finance the maintenance and reproduction of the labor force, or (even more) of infants who will not be in the labor force for 10-20 years, let alone old people suffering food insecurity and unlikely to do much work in future? (The latter group is of course a growing proportion of the ultra-poor in many developing countries, though still a small one in most.)

Food security, sustainably financed by the State, raises several issues. One is democracy: can the ultra-poor (and their friends and relations) put pressure on the State? Is it “one person, one vote” or “one dollar, one vote?” Without a democratic-liberal polity, market liberalization alone can generate dire consequences for the unorganized, food-insecure ultra-poor, especially the rural poor who cannot effectively engage in riots. A second issue is that of free-riding: obviously taxpayers prefer other taxpayers to meet the costs of providing food security. In a small community there is mutual observation and constraint among taxpayers, limiting free-riding because of the power of “custom” and the wish to be seen to observe it [Akerlof, 1980]. In a large and diffused State, avoidance of taxes and social-security contributions, and hence destruction of sustainable financing for food-security schemes, through free-riding is more difficult to control than in a small village.

These are far from theoretical issues, even in large countries with

democratic "pressures from below" and no obvious and acute debt or fiscal crises. Consider India: in Tamil Nadu, the Chief Minister's Noon Meals Scheme for child feeding is in serious financial difficulties; a similar large scheme in Andhra Pradesh was withdrawn in 1985 for financial reasons [Heaver, 1988]; in another State, Maharashtra, the Employment Guarantee Scheme is also in some cash difficulties. Where democratic pressures are less than in India, and especially if public expenditure has to be cut during a stabilization process, the pressures towards disproportionate cuts in expenditures orientated towards food security are severe, as the evidence on health and social-services spending during structural adjustment demonstrates [Cornia and Jolly, eds., 1987; Pinstруп-Andersen, 1988].

Does this mean that people concerned with food security need also to help developing countries (a) in building efficient and sustainable institutions of taxation or social-security contributions for those who are food-secure; (b) in building acceptable institutions of debate and pressure that will include the food-insecure, even if the government or the State may reject formal or multi-party liberal democracy? Such difficult involvements may not be necessary if, as in South Korea or Taiwan, (c) the potentially food-insecure have obtained access to assets such as farmland following a radical redistribution; and/or (d) there is a rapid and labor-intensive growth process. Otherwise, however, strategies of food security (and more generally of "adjustment with a human face"), if they are to be financially sustainable under stress, probably need to address such issues directly.

Failures of sustainability at individual level are characterized by exhaustion of individual or household stocks or savings (from fat in the body, through grain in the store, to money in the bank or saleable assets) while the source of stress persists. Such failures at group or community level are at present characterized by a sense among many wealthy persons

that is no longer worth meeting the costs of keeping individual laboring families adequately fed and safely bearing children, because excess labor is substantial and increasing. At State and Government level, non-sustainability of provisions to ease adaptations to energy stress is typically due to financial failure, whether based on domestic deficits or on foreign indebtedness. Jointly these last two circumstances represent an incapacity to mobilize adequate resources collectively, because the better-off no longer feel a sufficient combination of (a) moral-economy, *res publica* inducements, and (b) private-advantage incentives, given the extent of (c) neighborly overview among the better-off to prevent free-riding, and hence no longer provide support for the poor in circumstances of food insecurity.

In the industrial North of the world, this transition was essentially overcome by a growing labor shortage, plus concomitant pressures towards voting power for the poor; the overcoming process involved major food insecurity for the poor, for example in England in 1815-48. One does see such a transition from communally-mediated to publicly-mediated food security at work in several countries today, including India and China. However, in many African countries there is as yet little sign of it. Both Africans and outsiders are understandably, and in part rightly, fixated on supply-side remedies to food insecurity, but unfortunately at a time when much of Africa, because of a growing proportion of laborers among the food-insecure and ultra-poor, needs to pay careful attention to the demand-side, entitlements [Sen, 1981] considerations as well.

Discussing the circumstances of the food/health-insecure poor in England in the 1840s, Carlyle [1842] drew attention to infectious disease, specifically cholera, as a tragic but perhaps necessary means of alerting the well-off to their self-interest in the food/health security of the ultra-poor. This mechanism works better where the ultra-poor are largely urban, and mingle with non-poor, food-secure people in ways making it difficult for

the latter to avoid infection or contagion, so that they must instead seek to improve the food/health security of the poor as well as the rich. While these pressures have some force in much of the developing world today, as reactions to the recent near-epidemic of cholera in North Delhi indicate, we should not expect them often to work very well. The ultra-poor and food/health-insecure are far more rural and dispersed, and the better-off are more insulated and better able to protect themselves against infectious illness. What is required, rather, is a morality, almost an aesthetic, which deters the food-secure from accepting a food-health nexus that substantially increases the rates of death and impairment among the food-insecure. And this brings us back once again to open debate and pressure, liberal democracies, and sustainable tax systems.

It would be nice to think that something significant can be done by returning, to food-insecure individuals or small groups, the capacity to insure their own food security. The aftermath of partial breakdown of community systems would then be managed, not by a centralizing and powerful State, but by “empowered” poor families themselves. Obviously whatever can be done to encourage this, from home gardens in urban Djakarta and Kinshasa to hand-operated irrigation-pumps in rural North Bangladesh, is desirable. However, while it is necessary for international agricultural research to pay much more attention to the interests of deficit and near-subsistence farmers, it would be self-delusion to imagine that the trend, for a growing proportion of the world’s food-insecure to be marketing their labor and purchasing their food, will be reversed.

The question, then, is how State and quasi-State organs (I admire the work of NGOs but it cannot provide the basis of a solution) are to take over, from traditional community systems, residual responsibilities for sustainable food security. Handling this problem efficiently, in a time of financially induced “public squalor” alongside fashionable State

minimalism, will strain to the utmost the intellectual resources of such nutritionists, political scientists, and public-finance economists as are concerned with the sustainable food security of the extremely poor.

I am much more worried about whether this transition can be managed, than I am about the normal sense of "sustainability" in matters of food and agriculture: the long-run capacity of "the environment," generally in a loosely-defined sense, to support a given series of short-run "solutions" to the problems of the food-insecure. Nevertheless, especially during rapid population growth, tendencies towards what might be called "nutritional resource mining" need to be taken seriously. For example, one is worried about the attempt to spread high-yield, low- or zero-fertilizer cassava in West Africa, especially under circumstances of already-shortening fallows, degrading or eroding soils, and dwindling yields. The extra NPK for plant yield increases, if it does not come from fertilizers or manures, may well come from soil-mining, impairing future poor farmers. To a somewhat lesser extent, the "low-input, high-output" strategy of CIAT gives rise to similar concerns. Such approaches are well motivated, seeking to provide high-yielding varieties to farmers who cannot afford fertilizer, or cannot rely on timely deliveries or credit. However, this attempt to reach the potentially ultra-poor with a cheap food source in the short run may well further degrade their long-run capacity to sustain themselves.

However, we must be careful. It is not the environmental stability of a particular area's capacity to produce food or food-exchangeables that is at stake, as some of the more naive interpretations of the concept of "carrying capacity" (especially in the field of cattle management) suggest. It is not necessarily wrong if a particular piece of land reverts to scrub or otherwise goes out of use. What matters is the capacity of a society and an economy to produce and distribute livelihoods in a sustainable fashion,

not the capacity of a piece of land to produce output, let alone to produce a particular sort of food. If new livelihoods are being found elsewhere and/or the rate of population increase in an area is being reduced, then agricultural techniques or strategies that impair the sustainability of cultivation on a particular piece of land may be perfectly justified.

For instance, when the British Royal Corps of Engineers in the 1850s and 1860s commenced the development of the "Canal Colonies" in what is now the Pakistan Punjab, they prepared maps predicting quite accurately when each large area would become saline. This was not a wicked attempt to destroy food-producing capacity. Instead it was an intelligent appraisal that, by the time that these lands became saline (unsustainable), other employment and income opportunities would have opened up, locally or more probably elsewhere, for the farmers or workers who were displaced and that in the interim these people and their children needed the food that only irrigation, for all its long-run threats to the sustainability of particular pieces of land, could provide.

In dealing with the environmental sustainability of livelihoods, therefore, it is necessary to avoid the trap of using mechanistic concepts of carrying capacity. Even if technology were static, rather than adjustable as the person/land ratio rises (or indeed inevitable as this happens in the longer term [Boserup, 1965]), the maintenance of carrying capacity of any particular set of resources has no validity as a policy indicator. The question is whether income gains (and population decelerations), while the carrying capacity of a particular piece of land is being reduced, can restore the land, develop new lands or other income sources elsewhere, and so on. Of course, it is crucial whether such processes in fact maintain livelihoods, i.e. it is a critical question whose land and incomes are being developed, out of the surpluses generated by the "mining" of sustainable carrying capacity on a particular piece of land.

There is another trap, more or less the opposite of the carrying-capacity trap. It is to argue that rural markets are good enough (and that rural income distribution is also acceptable enough, or has sufficiently few or small market consequences) for the rate of interest to be a satisfactory guide to the allocation of resources, for food security or anything else, between livelihoods-for-now and sustainability-for-later. A more sophisticated version of this fallacy is to argue that benefit-cost analysis can select, using an "appropriate" rate of interest, the technology that could "optimally deplete" a given environmental resource. At least three things are wrong with this. First, even if the rate of interest is much the same as the (loanable-funds-weighted) rate of "time preference" for present income over future income, it is the rate of time preference now that determines interest rates between now and the future; but income levels, distributions, and preferences now have no moral or logical precedence over such preferences later on, when the chickens come home to roost and find that their feed can no longer be grown. (Indeed, idealists and moralists have always perceived the safeguarding of future generations' interests to be the first duty of politicians!)

Second, especially in very poor communities, the observed rate of interest is greatly bid up by consumer lending, high local administrative costs for small loans, and in some cases near-monopoly in informal credit supply combined with severe competition among poor demanders of funds. This would rule out environment-preserving technologies, if such "artificial" (and current-preference-orientated) interest-rates were taken to correctly reflect social preference between present outcomes and future sustainability.

Third, and of special importance for those who would construct social policy entirely out of individual market decisions, it is noteworthy that even the very poor—almost wholly without access to markets in

which they can borrow long-term funds—show behavior revealing a strong preference for preservation. They seek to hand on tiny parcels of land in good shape to their children, or even to recontracting landlords. They often have several children at substantial cost for several years, in order to obtain food security for a distant old age. Yet these same people, when borrowing short, must pay a very high rate of interest. One can conclude from this that people, through their actions, reveal a preference for long rates (in markets in which they cannot transact) that are very much lower than the short rates that they must pay in the credit markets where they can and must transact to survive from season to season. Hence the social rate of time preference, in respect of environment-preserving decisions, is much lower, more sustainability-orientated, than observed rates of interest might appear, to economists affected by what Pigou termed “myopia,” to suggest.

Nutritionists need tools, in order to assess the environmental sustainability of food security in an economy. These have to be much better tools than those based on physical carrying capacity, and almost without any indicators of incentive or scarcity, used in its projections to 2000 by FAO [1981, 1987]. These tools will certainly involve the assessment of the impact, on population and child/adult ratios in at-risk groups, of alternative paths of agricultural innovation, “green revolution,” and perhaps above all crop-mix. A critical issue here is that the sets of innovations, required to use and pay food-insecure laborers and improve their conditions in the short term, will raise fertility—the biological supply of children as mediated by the physical condition of mothers and also the pressure on couples to produce children with good chances of employment—before lowering it [Easterlin and Crimmins, 1985]. Many of the functions, measuring the impact of various forms of human improvement on fertility, are inverse-U-shaped. A little education, female employment,

urban contact, better chances for jobs for the young, or income may actually raise the number of children born to a woman in her life; a lot of these benefits will bring that number down. The policy implications are that fertility-reducing measures are probably needed to complement labor-using growth and employment patterns, if short-run poverty alleviation is not to run into problems of long-run environmental sustainability as populations grow. Female education above the primary level, modern female employment, and primary health care creating confidence that infant and child death rates will come down, are all likely to help bring about a rapid fertility transition.

All this sounds fine but is expensive. A second consequence, therefore, of the fact that fertility is inverse-U-shaped in its response to increases in income and its major correlates (with the top of the inverted U somewhere slightly above the ultra-poverty level), is that there exists a sharp conflict between equity (i.e. equal treatment of persons in the same relevant circumstances, for example with identical income but in different regions of a country), on the one hand, and forms of poverty alleviation or nutritional improvement that are sustainable in the environmental-demographic sense, on the other hand. The well-being and nutritional security of the ultra-poor will need, given its large costs, to be raised for biggish regional groups one at a time, rather than raised somewhat less for all persons at risk in all regions at once. The latter strategy will lead to much more population growth and a slower fertility transition than the former, and except in poor countries with large external resource inflows may prove both environmentally and financially unsustainable.

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