ECONOMIC INCENTIVES FOR SUSTAINABLE PRODUCTION

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Abstract

Appropriate economic incentives for millions of households, farmers, and small producers are needed in the Third World to channel development activities into sustainable patterns that preserve the productivity of natural resource assets. Incentive problems now arise both from market failures, such as externalities and common property problems, and from policy failures, such as price distortions. Many opportunities are available to improve policies in ways that promote resource conservation, reduce environmental damage, and simultaneously raise economic productivity, decrease government budget deficits, and ameliorate rural poverty. Revising inappropriate pricing policies for agricultural output and such purchased inputs as pesticides and fertilizers would help. Reforming irrigation finance would improve the performance of public systems and promote better water use. Changing inappropriate forest revenue systems and incentives for the use of forest resources could discourage wastage of forest resources.

I. The Need for Incentive Reform

The serious degradation of natural resources taking place in Third World [13, 14] stems not primarily from large projects, but from the cumulative effects of many small agricultural operations that cannot be reached by environmental impact assessment or regulation. Remedies, therefore, must also include changes in economic policies and incentives to promote sustainable resource use by large and small enterprises and households, and to channel economic and demographic growth into activities that provide rising incomes while preserving important natural resources.

Some incentive problems arise from market failure. For example, people borrow against the future by destroying renewable resources because they lack options. Small farmers on marginal soils around the world, for example, plant subsistence crops although the cost in erosion is high.[1] They persist in using

[1]For further discussion of interconnections between poverty and environmental degradation see [30].

inappropriate technologies because they lack the knowledge and resources to adapt. They ignore future consequences because institutions deny them a secure stake in the future yield of the resources they exploit. Solving these problems demands changes in incentives, so that people respond appropriately to true costs and opportunities. Market failures must be corrected, a difficult problem even in highly developed societies.

However, problems of resource degradation stem both from market failure and from market distortions. Numerous government policies not only fail to reflect the true opportunity cost of resource use, they perversely encourage more rapid and extensive degradation of soils, water, and biota than market forces alone would. Many current policies, including subsidies, taxes, and market interventions, artificially increase the profitability of activities that result in serious resource degradation. Changing these policies would often reduce economic losses, and also reduce long-term environmental degradation. Typically, these changes would also reduce fiscal burdens on government and eliminate important sources of inequity within the economy as well.

Eliminating these market distortions has large payoffs. Instead of trading off growth for environmental quality, these changes promote both, and thus command broad support. And, unless they are eliminated, investments and other programs that seek to enhance and protect natural resources will have little chance of overall success—their efforts will be swept away by the expanding pattern of unsustainable resource use. Usually, adjusting prices, tax rates, and other existing policy instruments is administratively simpler than constructing entirely new institutions or regulatory systems to cope with problems of market failure. So, such actions are important and feasible early steps toward better resource management.

II. Agricultural Output Prices

Governments intervene in many ways in agricultural markets. The broad effect in developing countries is to turn the internal terms of trade against agriculture [29]. Depressing agricultural profitability in this way reduces the derived demand for farmland, labor, and other inputs not supported by offsetting government subsidies. Since farmland can't shift massively into other uses, these policies keep land prices lower than they otherwise would be. Consequently, returns on investment in farmland development and conservation are depressed. Farmers are discouraged from levelling, terracing, draining, irrigating, or otherwise improving their land. The loss of land productivity through erosion, salinization, or nutrient depletion is less costly relative to other values in the economy. In general, depressing agricultural prices depresses farmer incentives for soil conservation.

Of course, prices are not the only incentives farmers respond to. Security of tenure is vital to rural households considering long-term investments, in soil conservation works or tree plantations, for example. Many countries have found that ensuring secure rights to land, improvements, and tree stocks induces significant increases in household investment in them.[2]

Within the agricultural sector, differential rates of implicit taxation among commodities can strongly influence cropping patterns and land uses.

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[2]For a recent collection of studies on common property and related tenure issues, see [19].

Many countries severely discriminate against export crops relative to domestic food crops such as cereals, as Table 1 shows for Sub-Saharan Africa. Although many environmentalists argue that overemphasis on export crop production exacerbates soil degradation and ecological disturbance, their view is not valid as a general proposition. First, most developing countries discriminate against export crops. Second, export crops, with some exceptions (such as groundnuts and cotton), tend to be less dangerous to soils than basic food crops. Many export crops grow on trees and bushes that provide continuous canopy cover and root structure: coffee, cocoa, rubber, palm oil, and bananas are quite suitable for the hillsides where they are often grown. Table 2, for West African conditions, illustrates that these crops, with grasses growing underneath, typically result in rates of erosion two or three times less than those for such staple crops as cassava, yams, maize, sorghum, and millets. Also, established pasturage results in relatively low erosion rates.

Differential agricultural taxation can have a substantial effect on cropping patterns and land uses. Although many heavily taxed crops are perennials, ample evidence shows that over time farmers respond strongly to differential incentives [4]. In fact, they respond more to differentials among crops than to overall discrimination against agriculture (because it is easier to shift land and other resources from one crop to another than to withdraw from agriculture altogether) [5, pp. 8-22]. Evaluation of agricultural price policies should not be divorced from land capability assessments and considerations of soil conservation.

III. Agricultural Input Subsidies

A. Pesticides

Agricultural pesticide use involves serious health and ecological risks, especially in Third World countries [15]. Farmers, farmworkers, their families, and consumers are extensively exposed—in the field, or by using contaminated containers, or consuming contaminated food. Acute poisonings are common, and little is known about the effects of chronic exposure on people with such common health problems as anemia, liver abnormalities due to parasitic diseases, or reproductive disorders. Pesticides' effects on the immune system may exacerbate health problems in populations in which infectious diseases are prevalent [20, pp. 20-25]. Intensive pesticide use also creates significant ecological problems. Fish in irrigated rice paddies, ponds, and canals have been destroyed. Throughout the world pest populations have resurged and new pests have emerged as pesticides have killed off their natural predators. More than 400 pests have become resistant to one or more chemicals, and the number is growing exponentially [11].

Few Third World governments have been able to put in place effective systems of pesticide regulation, enforcement, farmworker training, and public education to ensure safe and effective use. Nonetheless, many Third World governments continue to subsidize pesticide sales to farmers heavily.[3] Table 3 shows that in a sample of nine developing countries, subsidies range from 15 to 90 percent of full retail cost, with a median of 44 percent. In large countries these are costing governments hundreds of millions of dollars per year, and the

[3]For a fuller discussion of this issue, see [22].

TABLE 1

INDEX OF NOMINAL AND REAL PROTECTION COEFFICIENTS FOR CEREAL AND EXPORT CROPS IN SELECTED AFRICAN COUNTRIES, 1972-83 (1969-71=100)

	Cereals				Export Crops			
	1972-73		1981-83		1972-73		1981-83	
Country	nom. index	real index	nom. index	real index	nom. index	real index	nom. index	real index
Cameroon	129	90	140	108	83	61	95	75
Côte d'Ivoire	140	98	119	87	92	66	99	71
Ethiopia	73	55	73	49	88	71	101	66
Kenya	115	94	115	98	101	83	98	84
Malawi	85	79	106	100	102	94	106	97
Mali	128	79	177	122	101	83	98	70
Niger	170	119	225	166	82	59	113	84
Nigeria	126	66	160	66	108	60	149	63
Senegal	109	79	104	89	83	60	75	64
Sierra Leone	104	95	184	143	101	93	92	68
Sudan	174	119	229	164	90	63	105	75
Tanzania	127	88	188	95	86	62	103	52
Zambia	107	93	146	125	97	84	93	80
All Sub-Saharan Africa	122	89	151	109	93	71	102	73

Note: The nominal index measures the change in the nominal protection coefficient with border prices converted into local currency at official exchange rates. Data for Ghana are not available.

Source: World Bank, World Development Report 1986, Washington, D. C., 1986, p. 86.

TABLE 2

VEGETAL COVER FACTORS (C) FOR EROSION IN WEST AFRICAN CONDITIONS

	C. representative annual value
Bare soil	1.0
Dense forest or culture with a thick straw mulch	0.001
Savannah and grassland, ungrazed	0.01
Forage and cover crops: late planted or with slow development	
First year	0.3-0.8
Second year	0.1
Cover crops with rapid development	0.1
Maize, sorghum, millet	0.3-0.9
Rice (intensive culture, second cycle)	0.1-0.2
Cotton, tobacco (second cycle)	0.5
Groundnuts	0.4-0.8
Cassava (first year) and yams	0.2-0.8
Palms, coffee, cocoa, with cover crops	0.1-0.3

Source: E. Roose, "Erosion et ruissellement en Afrique de l'Ouest--Vingt années de mesure, en petite parcelles expérimentales," ORSTROM/IITA., Paris, 1977, p. 51.

TABLE 3

ESTIMATED AVERAGE RATE AND VALUE OF PESTICIDE SUBSIDIES

Country	Rate: percentage of full retail costs	Value ($U.S millions)	Per capita of-total population ($U.S.)
Senegal	89	4	0.7
Egypt	83	207	4.7
Ghana	67	20	1.7
Honduras	29	12	3.0
Colombia	44	69	2.5
Ecuador	41	14	1.7
Indonesia	82	128	0.8
Pakistan	negl.	negl.	-
China	19	285	0.3

Source: World Resources Institute, Paying the Price· Pesticide Subsidies in Developing Countries (December 1985)

fiscal burden is growing. These policies were put into place in the early years of the Green Revolution to induce small farmers to adopt an unfamiliar technology, but continue fifteen years or so later, even though the technology is by now familiar and the bulk of the subsidies go to large commercial farmers. Few, if any, governments have seriously investigated whether these funds could be better spent in research, training, extension, or regulation to promote better pest management practices.

Rational pest management balances risks of crop losses against pest control costs. Using chemicals excessively is as irrational for the farmer as using none, especially because excessive use induces pest resistance and creates new pest problems. Most experts advocate integrated pest management (IPM), which relies on a balance of biological and chemical controls, along with changes in cropping patterns, irrigation timing, and other practices [10]. Pesticides are used only at key stages of the life cycle of pests or crops, or when damages to crops reach a predefined threshold. However, by lowering pesticide costs to farmers, subsidies artificially depress this threshold and encourage prophylactic applications. Subsidies also artificially lower the costs of chemical use relative to other control methods: planting resistant varieties, destroying infected plants, altering planting dates, etc. Thus, they distort on-farm operating decisions and undermine the very approaches agricultural agencies are promoting. Removing these subsidies may often be an opportunity to obtain economic, fiscal, health, and ecological benefits.

B. Fertilizers

Similar issues arise from chemical fertilizer subsidies, although less acutely. The rapid growth of fertilizer use in developing countries, a four-fold per hectare increase since 1970, has contributed to higher yields. Many developing countries have subsidized chemical fertilizers heavily since the 1960s. Even in the 1980s, according to the World Bank, "Rates of subsidies...were rarely below 30 percent of delivered costs and were in some countries 80 to 90 percent (in Nigeria, for example). Rates of 50 to 60 percent are common" [29, p. 95].

On close examination, many of the economic arguments for large, continuing subsidies are shaky [6]. After decades of experience, farmers should not need large subsidies to induce "learning by doing" or to overcome faulty perceptions of risk. If farmers are slow to adopt chemical fertilizers, it may be because of problems of distribution, extension, or availability of complementary inputs, not because of price. In parts of Africa and other regions of low population density, fallowing might restore soil fertility more economically. Fertilizer subsidies only partially offset explicit and implicit taxes on agricultural output, and are often captured by those who don't really need them (large commercial farmers of irrigated land) and those for whom they are not intended (producers and distributors).

Fertilizer subsidies contribute to the low application efficiencies, probably well under 50 percent, typical of developing countries. Imprecise timing, placement, careless use of irrigation water and other complementary inputs, and careless cultural practices, such as weeding, contribute to low application efficiencies, and can be improved substantially at some additional labor and management cost. Fertilizer subsidies distort these on-farm decisions. The result is waste of costly inputs, and increasing pollution problems as chemicals run off into water bodies.

More fundamentally, these subsidies artificially lower the cost of

maintaining and restoring soil fertility, and so reduce farmers' incentives to practice soil conservation. Loss of fertile topsoil and depletion of desirable properties in the soil can be offset to some extent by adding chemical fertilizers. If they are heavily subsidized, farmers do not realize the true costs of misusing their land.

Specifically, subsidies induce a substitution in favor of chemical fertilizers and against organic manures. Acreages under leguminous manure crops have fallen as chemical fertilizer use has expanded. In Taiwan, one of the few countries where data are available, use of organic manures and crop residues dropped from 17.3 m.t. in 1962 to 7.1 m.t. in 1981, and the acreage of green manure crops fell from 200,000 hectares in 1948-53 to only 18,000 hectares in 1981. Meanwhile chemical fertilizer use rose fivefold [3, p. 92].

Organic and chemical fertilizers are not perfect substitutes. While the latter provide cheap concentrated sources of certain nutrients, organic manures also provide a variety of micronutrients and improve soil structure. In sandy soils, they increase water retention and prevent nutrients from leaching out. They buffer soils against increases in acidity, alkalinity, and other toxicity. In clayey soils, organic matter makes the soil more open and porous, so that water infiltrates, reducing run-off and erosion and preventing soil baking and hardening. Root development is improved, and biological activity is greatly stimulated. For these reasons, numerous studies show not only that yields comparable to those produced by chemical fertilizers can be maintained through organic manuring, but also that organic manures improve yields when used with chemical fertilizers, offsetting the sharp declines in marginal returns to chemical fertilizers that most South and Southeast Asian countries have experienced [17].

Heavy fertilizer subsidies have become an enormous fiscal burden with uncertain benefits and substantial environmenal costs both on and off the farm. Becau e soil productivity is so vital to the development of most developing countries, these issues deserve more attention than they hve received in the past.

C. Irrigation Water

In current prices, $250 billion has already been invested in Third World irrigation, and $100 billion more will be spent this century to create more capacity. The benefits, in expanded farm output, have been substantial. But, there are serious economic and environmental problems, especially with large public systfems.[4] Costs have been much higher and agricultural benefits lower than projected when investments were made [12]. Operation and maintenance of completed systems are often deficient. Environmental impacts have been extensive. In India and Pakistan alone, over 20 million hectares have been lost through waterlogging, and at least 30 million arfe seriously affected by salinization [16, 28, p. 92].

Impounded waters and canals have provided breeding grounds and habitat for carriers of malaria and schistosomiasis. They have displaced whole communities and flooded valuable crop and forest lands, threatened critical ecosystems and wiped out anadromous fish populations. River hydrology downstream has been disrupted, with large impacts on erosion and sedimentation, estuaries, and even deltaic fisheries [21].

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[4]This section is based on a longer study by R. Repetto. See [23].

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The environmental and performance problems of irrigation systems are connected. More efficient use of water would reduce risks of waterlogging, and would also reduce the apparent need for additional, large-scale, increasingly costly expansions, and the environmental effects of further river impoundments.

Irrigation is heavily subsidized, especially in public sector systems, and has become an enormous fiscal drain.[5] Revenues in most countries don't even cover operating and maintenance costs. Charges are also small relative to water's value to farmers, especially in peak period, so that excess demand is chronic and water has to be severely rationed. Farmers almost always strongly desire additional water supplies, since they bear few of the costs, and enjoy most of the benefits.

This financing system undermines performance. Neither farmers, local governments, irrigation agencies, or for that matter, international banks, are financially at risk for the success of irrigation investments, and so pressures for new capacity lead to a proliferation of projects, many of them of dubious worth. Benefit-cost analysis of such long-term investments is inherently speculative, and easily becomes overly optimistic when strong political pressures are at work [9].

These distortions tend to generate their own momentum. Areas that have not benefitted also want heavily subsidized projects. Even in project areas, farmers in the head reaches, which are more favorably located to divert water and are often finished first, typically establish water-intensive cropping patterns and capture a disproportionate share of available capacity. Because water is then chronically short in the tail reaches and less than promised to those constituencies, strong demands for additional supplies are perpetuated [26].

Operation and maintenance are also undermined by the excess demands generated by this system of financing. When funds for O&M depend on collections from irrigators, a vicious cycle of dissatisfaction, declining collections, and declining performance can ensue. When funds are allocated from general revenues, agencies don't feel themselves as accountable to users to provide an optimal service, but as allocating a resource of which there is not enough to go around [7].

So, operators are susceptible to pressure, inducement, and influence. However, when farmers' trust in the impartiality of the system is destroyed, they are less willing to abide by its rules or contribute to its upkeep. The fundamental problem lies in the financing system, which creates huge economic rents for those able to obtain water from public systems, and chronic excess demands. Were beneficiaries financially responsible for the costs of the system, and water charged at approximately what it is worth to the users, these pressures would be much reduced.

Further, the current system generates few incentives to farmers to use water efficiently. For a few, water supplies are ample and cheap, and are used rather lavishly. For the many, supplies are uncertain, irregular, and inadequate, discouraging complementary investments to make the most effective use of water supplied. Changes in financial incentives, in combination with management and physical improvements, would promote more efficient patterns of investment in irrigation, of operation and maintenance of existing systems, and of water use on the farm.

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[5]For additional evidence, see [23], and additional reference cited therein.

D. Other Input Subsidies

1. Mechanization

Developing countries promote agricultural mechanization through favorable tax and tariff treatment, liberal allocations of rationed foreign exchange, cheap credit, and highly subsidized diesel fuel. Where governments take a large direct role in farming, parastatals use access to budgetary resources to create highly mechanized operations, and typically run them at a loss.

Such direct and indirect mechanization subsidies are at best unnecessary and at worst inefficient and inequitable. When using machinery is economical, farmers will do it without subsidies, if there is a reasonable supply system. If subsidies promote mechanization even when it is uneconomical, rural employment is reduced. Large landowners benefit, while smallholders with fragmented holdings derive little benefit and suffer a competitive disadvantage. Since smallholders derive considerable income from seasonal wage employment, they suffer further from labor displacement. Mechanization subsidies entail significant economic welfare losses.

In addition, they may result in severe damage to natural resources. For example, using heavy equipment for land clearance in tropical regions instead of traditional methods has sometimes devastated the soil. Nutrients in the biomass have been lost, thin topsoils have been scraped off, the ground has been compacted so that water cannot infiltrate, and erosion rates have risen enormously. Even in less vulnerable soils, heavy equipment used inappropriately has compacted soils, with reduced porosity and increased susceptibility to erosion. When left exposed and plowed against the contour, erosion rates are much worse than under minimum tillage [18, p. 162ff].

In general, therefore, eliminating subsidies for agricultural mechanization is another good example of a complementary policy change, which serves the objectives of economic welfare and natural resource conservation.

2. Credit

Subsidized agricultural credit programs are at least as widespread in developing countries as fertilizer and other input subsidies, and even more questionable on economic grounds [1]. Their implications for natural resource management are not obvious, at least in the long run, but may be significant.

Special loan funds with interest ceilings, usually discounted by the lending institution with the monetary authorities, are often set up for (a) purchasing particular inputs, (b) growing particular crops, (c) acquiring particular assets, such as cattle or tractors, and (d) developing land, by clearing forests or constructing irrigation structures. In inflationary economies, real interest rates on these credits can be well below zero, and default rates are usually high, because the lending institutions are largely absolved from risk.

These credit policies undermine financial institutions serving rural areas, which cannot offer deposit rates high enough to attract rural savings. Their institutional capabilities are subverted by credit rationing, their ability to pass risk along to the monetary authorities, and freedom from competition.

Inevitably, subsidized credit schemes in rural areas, even those specifically designed for smallholders, are quickly captured by larger farmers, who are better risks, more influential, and less costly to serve. The distribution of subsidized rural credit is typically even more skewed than the distribution of land.

Since credit is fungible and lenders cannot readily ensure that directed credit actually increases the flow of resources to the activities they intend to subsidize, the allocational effects are less clear-cut. So too, therefore, are the impacts on natural resources. Only when loans are tied to verifiable activities, such as the acquisition of specific assets that might otherwise have been marginally attractive, are credit subsidies likely to have a significant impact on the allocation of resources. For example, several Latin American countries have provided highly subsidized credit for the acquisition of livestock and the establishment of ranches, often in forested regions. The economic prospects for some of these livestock operations have been risky, to say the least. Carrying capacity is low, and much of the pasturage under minimal management has deteriorated within a few years through loss of soil fertility and invasion by weeds. Yet, credit at negative real interest rates has increased demand for the assets, pasture land and cattle, that can be used as collateral, leading to extensive deforestation in some countries.

The implications of credit subsidies on natural resource management have to be evaluated in each case. However, in general, to the extent that credit and machinery subsidies promote capital-intensive forms of agriculture with significant economies of scale, such as ranching, they displace farm labor [8]. Since rural populations are still growing in most Third World countries and employment problems are acute, labor displacement puts marginal lands under even greater pressure.

E. Overview of Agricultural Input Subsidies

Subsidies have been backed up by government research, extension, and marketing services to promote a "linear" agricultural technology that draws heavily on natural resources for inputs and discharges wastes and residues as unwanted byproducts. This farming system diminishes soil productivity and the self-regulating capacities of agricultural ecosystems, compensating for these losses with chemical inputs. It imports large amounts of water and exports huge quantities of chemicals, minerals, and sediments in surface and underground run-off. Vast quantities of organic residues are exported outside the farm sector as wastes and pollutants. With farm output doubling about every 20 years, this linear technology increasingly depletes and impairs natural resources.

Alternative agricultural systems rely more heavily on interspecies population balancing, nutrient recycling, and sustained productivity with a minimum of external inputs.[6] Even in the U.S. and other industrial countries, where purchased inputs are relatively cheap, farms using alternative technologies are close to commercial viability, and would probably be competitive were the external costs of chemical run-off and soil erosion internalized into farm production costs. In the Third World also, agricultural systems involving multiple cropping and integration of tree, animal, and crop production are capable of sustained high productivity with fewer external inputs.

The current policy framework discriminates massively in favor of the dominant linear technology, by heavily subsidizing inputs of chemicals, capital, and water, and by failing to charge to users of this technology the substantial external costs that "exported" residues and wastes imply. Even when an

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[6]The ecological principles of such agricultural systems are set out in [2, 27].

alternative approach would be more productive and stable in the long run, it is unlikely to emerge in the face of the overwhelming policy-induced bias in incentives against it. Therefore, one of the first and most fundamental steps policymakers can take to promote more self-regenerative patterns of agricultural production is to reduce the pervasive incentive bias against them. If this step is not taken, special programs to promote more ecologically sound agricultural technologies are unlikely to make much headway in the field, because their long-term economic value will not be apparent to the farmer.

IV. Sectoral Issues

A. Forests

Every year more than 11 million hectares of forests are cleared for other uses, and in most developing countries, deforestation is accelerating. Already in this century, Third World forest area has fallen by half.

The environmental consequences are severe. In the tropics, much forest clearance leaves only degraded soils unsuitable for sustained agricultural production. In watersheds, deforestation increases erosion, flooding, and sedimentation. In semi-arid areas, it robs the soil of essential organic matter and shelter from wind and water erosion. Moreover, in the tropics, loss of forest area threatens the survival of uncounted species of animals and plants [31].

There are also more direct economic losses. While some forest conversion is to be expected, especially in richly endowed countries, the actual process of conversion has been highly wasteful, sacrificing significant potential benefits to the local economy, and has probably been pushed too fast, too far [25]. Rich public forests have been mined as exhaustible resources, and most of the proceeds have been needlessly relinquished to foreign interests. They have been opened for harvesting more rapidly and extensively than government forest agencies could manage, and on terms that virtually ensured short-sighted wasteful exploitation. Moreover, as the result of government supported programs, huge forest areas have been sacrificed to cattle ranches, agricultural settlements, river impoundments and other uses that have proven to be inferior uses of the land and other resources, or have failed outright.

The "stumpage value" or economic rent in mature virgin tropical forest timber is very substantial. Many governments have offered timber concessions to logging companies on terms that capture only a small fraction of this rent in royalties, taxes, and fees, leaving most of it as supernormal profits for private interests. Table 4, derived from detailed country case studies, illustrates this fact. Governments typically lease timber lands not through competitive bidding, which would give them a larger share of the rents, but on the basis of standard terms or individually negotiated agreements. Potential investors are thus led to rush into (aptly named) concession agreements before others take the most favorable sites, setting off "timber booms."

Other policies ensure rapid exploitation. Political instability, pressures from local partners, irregularities in the contracting process, and risks that one-sided agreements will be re-negotiated, all lead concessionaires to realize their profits as early as possible. Host governments often require lessors to begin harvesting within a stipulated time, and limit leases to periods much shorter than a single forest rotation. Moreover, by basing royalties and taxes on the volume of timber harvested, not the volume of merchantable timber present in the tract, governments encourage concessionaires to take only the stems of greatest value,

TABLE 4

GOVERNMENT RENT CAPTURE IN TROPICAL TIMBER PRODUCTION
(in $U.S. millions)

(1) Country and Period	(2) Potential Rent from Log Harvest	(3) Actual Rent from Log Harvest	(4) Official Government Rent Capture	(5) 4 3(%)	(6) (4 2(%)
Indonesia 1979-82	4,958	4,409	1,654	37.5%	33.0%
Sabah 1979-82	2,065	2,064	1,703	82.5%	82.5%
Ghana 1971-74	----	----	29	38.0%	----
Philippines 1979-82	1,504	1,001	141	14.0%	9.4%

(1) Potential rent assumes that all harvested logs are allocated to uses (direct export, sawmills, plymills) that yield the largest net economic rent.

(2) Actual rent totals rents arising from the actual disposal of harvested logs.

(3) Rent capture totals timber royalties, export taxes, and other official fees and charges.

Source: Chapters 2, 3, 4, and 7.

opening up a large forest area and damaging or destroying many of the trees not deemed worth harvesting. Reform of forest revenue systems can conserve forest resources and increase the benefits to the host country.

Reforming incentives for local wood processing industries offers similar opportunities. Log exporting countries have struggled to establish local processing industries against the discriminatory policies of industrial countries by waiving or reducing export taxes on processed wood, and banning log exports. These industrialization incentives often promote local employment at a heavy cost. Mills established in many countries in response to such inducements have been small and inefficient, needing many more logs to produce the same output. Thereafter, governments are reluctant to reduce the mills' supplies of raw materials, whatever economic or ecological reasons there might be to reduce the log harvest.

In forest-poor countries, a critical problem is that woodlands, although nominally government property, are treated in practice as open access common property resources. Individuals lack adequate incentives to preserve tree stocks for future use, or to plant and maintain new stocks that might be harvested or destroyed by others. In addition, in many Third World countries, individuals can still obtain title to forest lands by occupying and "improving" them, which means clearing at least part of the holding for agricultural or industrial use. Especially in Latin American countries, where existing agricultural lands are distributed very unequally, and in African countries, where population growth is extremely rapid, these laws and traditions obviously promote rapid deforestation.

Further, in many forest-poor countries where planting rates would have to be increased many times over to balance sustainable yields with domestic demands, prices for trees harvested from public lands are set far below their economic replacement cost. License fees, stumpage trees, and other charges for harvesting wood amount only to a minor fraction of the costs of planting new stocks and tending them to maturity. Higher fees might provide forest agencies with budgetary resources for forest maintenance and afforestation programs, and encourage private farmers to establish woodlots on their holdings. There is no reason why forest products harvested from public lands in countries facing severe wood deficits should be sold at far less than their replacement costs.

Although current concerns about deforestation in Third World countries have focussed on population growth, tenurial issues, and investment needs, it is clear that both in countries with abundant forest resources and in others, government policies have been important factors behind resource depletion. Policy changes can do much to promote conservation and simultaneously raise the economic benefits countries glean from the forest sector.

B. Livestock

Most of the world's rangelands have deteriorated and are losing productivity. Desertification commonly results from overstocking with homogeneous herds that selectively graze preferred grasses, exposing and compacting bare soil, and letting less nutritious and palatable species take over. Water percolation decreases, soil erosion intensifies, water tables decline, and hardy shrubs replace grasses. Over 70 percent of Third World rangelands are now moderately or severely desertified [13, Ch. 5].

Many governments and international agencies have supported range development and livestock services. Where this has taken place without adequate control over herd sizes, stocking rates have typically risen to exceed

range carrying capacity in years of low rainfall and forage production. Managing an intrinsically communal rangeland resource to limit overgrazing is critical. Various proposals have been made to finance infrastructure investments and livestock services through locally administered grazing fees and head taxes, to discourage excessive growth of herd sizes. These proposals have been difficult to reconcile with local political and cultural traditions.

Beyond support for livestock services, governments, especially in Latin America, have offered generous fiscal and financial support: subsidized credits, tax holidays and exemptions, and export incentives. While pasturage is an appropriate land use over vast areas of Latin America, these inducements, together with the skewed distribution of land ownership, have probably kept many large holdings in livestock production, a land and capital intensive operation, instead of crop production. This has reduced agricultural employment opportunities and increased cropping pressures on smallholdings for income and food requirements. On marginal lands, increased cropping intensity aggravates soil erosion and losses in soil fertility.

Moreover, generous fiscal inducements have led ranchers to convert large forested areas to extensive pasture, in the Amazon region, for example. Under minimal management without adequate fertilization, many soils have deteriorated after conversion through leaching of nutrients and invasion of weed species, so that within a few years, productivity declines and pasture is abandoned. Nonetheless, such operations may still be privately profitable because of the policy incentives to investors.

A recent analysis based on a sample of large government supported ranches in the Brazilian Amazon showed, for example, that the typical ranch was intrinsically uneconomic, because of low productivity and relatively high establishment costs, and could be expected to lose more than half of its invested capital over the lifetime of the project. Nonetheless, the investments were still highly profitable for the private investor, tripling his own equity input [24]. In the late 1970s (and continuing to the present for approved projects), such investors were eligible for income tax holidays, write-offs of operating losses against other unrelated taxable income, accelerated depreciation, tax credits for investments in approved Amazonian projects, and subsidized credit at negative real interest rates.

With these inducements, the Brazilian government effectively financed by far the greater share of approved livestock investments, covering many millions of hectares of forest land, through foregone tax revenues and loan capital that could be repaid in inflated currency. The government also bore a substantial share of operating losses. Private investors could shelter outside income by acquiring cattle ranches in the Amazon with very little equity investment, and take advantage of rising land prices for an ultimate capital gain. Such policies run the risk of promoting economically and ecologically unsound investments, at substantial fiscal cost to the government. Policy change can help to ensure that livestock investments are made in regions and in technologies that offer a reasonable prospect of success, both economically and in their use of land and water resources.

V. Conclusion

Although environmental problems in development are widespread and serious, much can be accomplished by taking advantage of opportunities to establish policies that promote better resource management and conservation,

and, at the same time, reduce fiscal burdens on government and improve economic productivity. By and large, among countries heavily dependent on their natural resources for sustained income growth, there is no conflict between good resource management and sound development policy.

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