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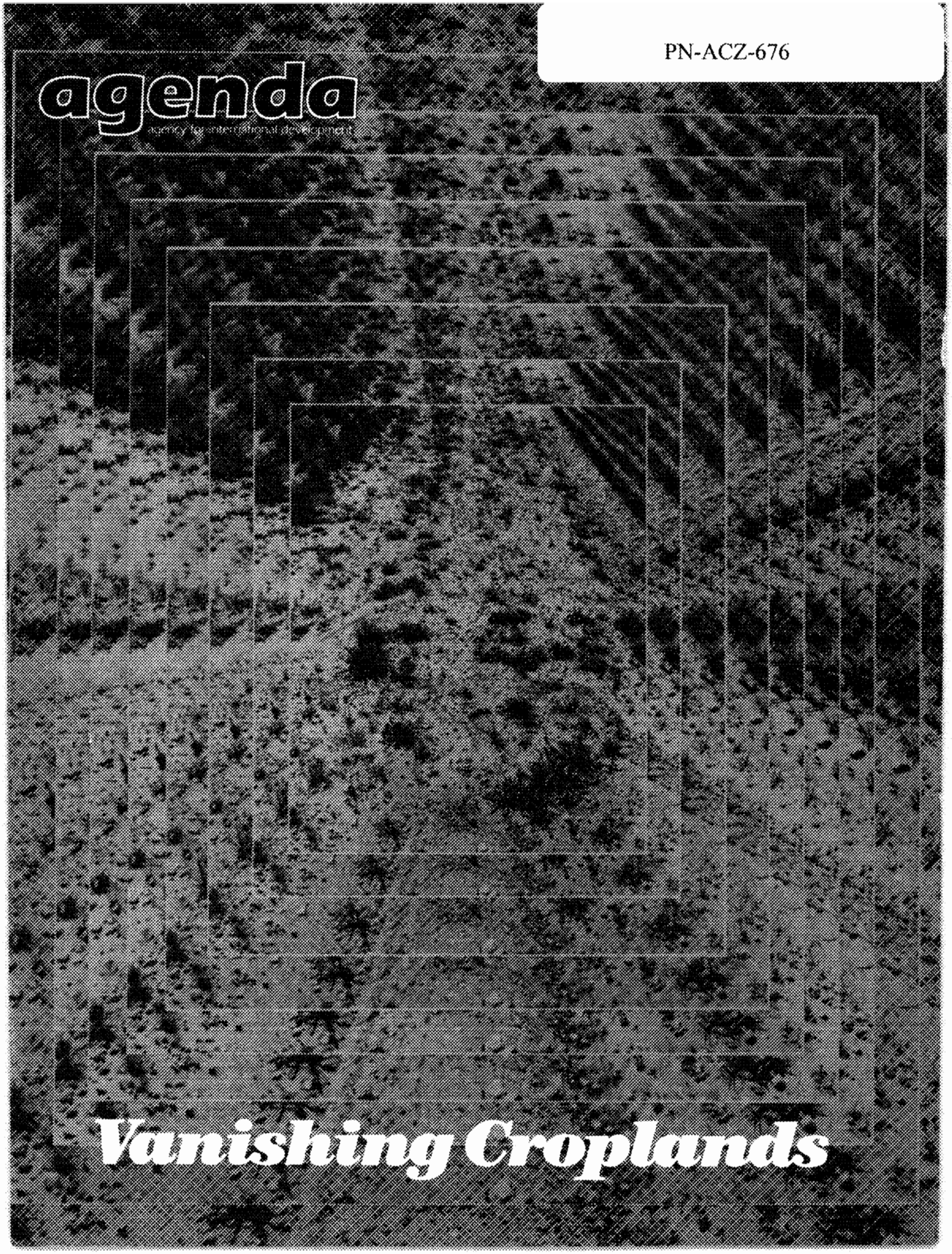

Vanishing Croplands

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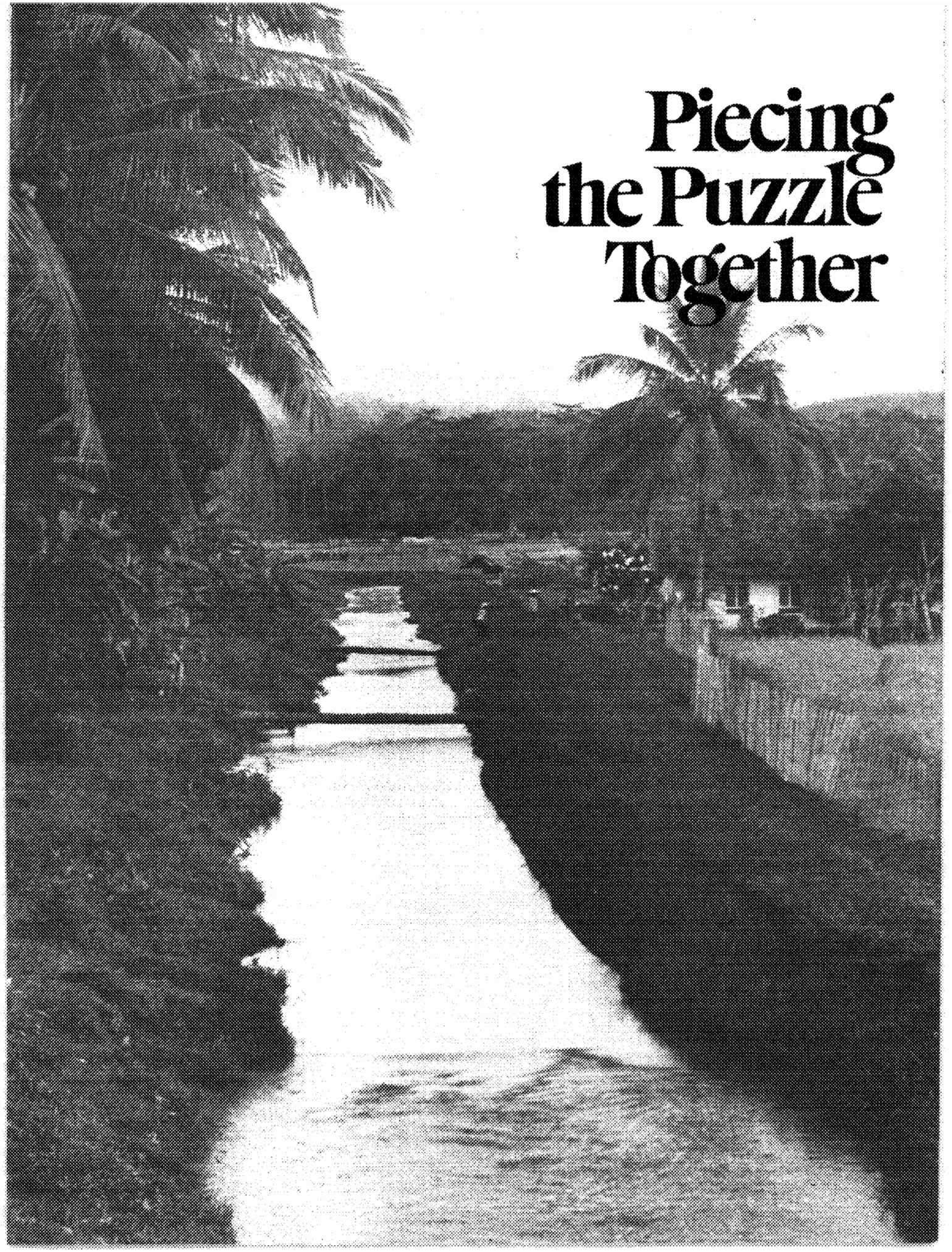
John J. Gilligan, Administrator
James W. McCulla, Director
Office of Public Affairs
Press and Publications Division
Office of Public Affairs
Agency for International Development
Washington, D.C. 20523
(202) 632-7978

Edward R. Caplan, Division Chief
Laura L. Kreuzer, Editor



Piecing the Puzzle Together

Area development is like a military advance along an entire front. Instead of the traditional method of separate actions to improve each sector, an area plan seeks to improve them simultaneously so that a gain in one sector will stimulate or support improvements in other sectors. This approach is being tried on the Indonesian island of Java.

By James McCulla, Director AID's Office of Public Affairs.

Mike Thomsic is 67 years old.

No matter. He was scrambling up the steep hill faster than men 40 years younger, including the wiry Indonesian farmers who have wandered around it all their lives.

At the top the younger men were puffing hard. But Thomsic was bursting with enthusiasm.

"This fella here," he said, motioning to a grinning Javanese farmer, "All he wants is to make a little more money. That's why he's going along with this project."

The project could be seen clearly from the hilltop vantage point, which looked down on a small valley near the village of Panawagan on the island of Java. The farmer and his neighbors had carved terraces into the hillsides. Soon they would be green with rice, corn and cassava.

The scene was centuries old, as familiar as a southseas travel poster. But close inspection disclosed a radical innovation.

Javanese farmers traditionally construct a level terrace. Sometimes it has a lip to contain water for wet rice cultivation. But such a terrace will not hold up under heavy, prolonged rain. The cascading water rips off the edges, carrying rich topsoil to the valley floor. In few days, the hillside is in a shambles, delaying food production for months, if not years.

Thomsic had the farmers tilt the floors of these terraces into the hill so the excess water flows to a rear ditch. Then narrow rock or bamboo-lined spillways were run from the top of the hill to the valley floor, intersecting the ditches. Excess rain water is channeled to the spillways and rushes harmlessly to the creek below.

Thanks to this new approach, land prices are rising and most farmers are willing to try high yield seed, fertilizer and chemicals required to boost production and profits.

Panawagan is a demonstration project, created by the government of Indonesia with help from AID. Thomsic, a veteran of the U.S. Soil and Conservation Service, is part of the U.S. technical assistance team. The idea is to bring other Indonesian farmers here so they will see the benefits of adopting the new practices.

What impresses most farmers is the dollar-and-cents logic. But some of them also realize that re-making their modest valley has greater purpose. Panawagan is a vital piece in a large and complex puzzle. If all the pieces can be fitted together, a 1,720 square mile area of south-central Java will achieve an economic stability it has never known before and a better life for its 2.8 million inhabitants.

The area is the Citanduy River Basin.

Other pieces of the puzzle are levees to halt flooding, weirs to divert water down new canals, new irrigation ditches to guarantee adequate water for rice paddies, new roads to haul crops to market, and credit unions to finance seed and fertilizer. There are plans for small scale industries and improved health and education systems.

Citanduy is an area development project. To date the U.S. has committed $13 million in low interest loans to the Citanduy and the Indonesians have supplied matching funds.

Area development is like a military advance along an entire front. Instead of the traditional approach of separate actions to improve agriculture, or health, or roads, or power, an area plan seeks to improve them all simultaneously in such a way that a gain in one sector will stimulate or support an improvement in another.

It is not an easy route to go, even in a developed country. Here it is being attempted in the face of 50% rural illiteracy, social institutions attuned to traditional approaches, inexperienced administration and a disturbing level of farm debt.

Because of population growth Indonesia can no longer feed itself and must import food. A drought in Southeast Asia would wreak havoc in Indonesia. Massive unemployment plagues the 30 million Javanese who own no farmland as well as those who do own small amounts — one acre is the average. The level of child death and adult disease is high and life expectancy is only 47 years in rural areas.

Panawagan is necessary for the Citanduy's success. The problem is erosion. It has increased so much in the last few years that levees, ditches and canals already built are rapidly being clogged by silt from the uplands.

But there is a larger consideration. Because of an incredible rate of erosion some ecologists fear that Java, a lush tropical island today, could become a desert in 30 years. Other scientists may not go that far, but they do foresee an island of barren mountains surrounded by a treeless savanna.

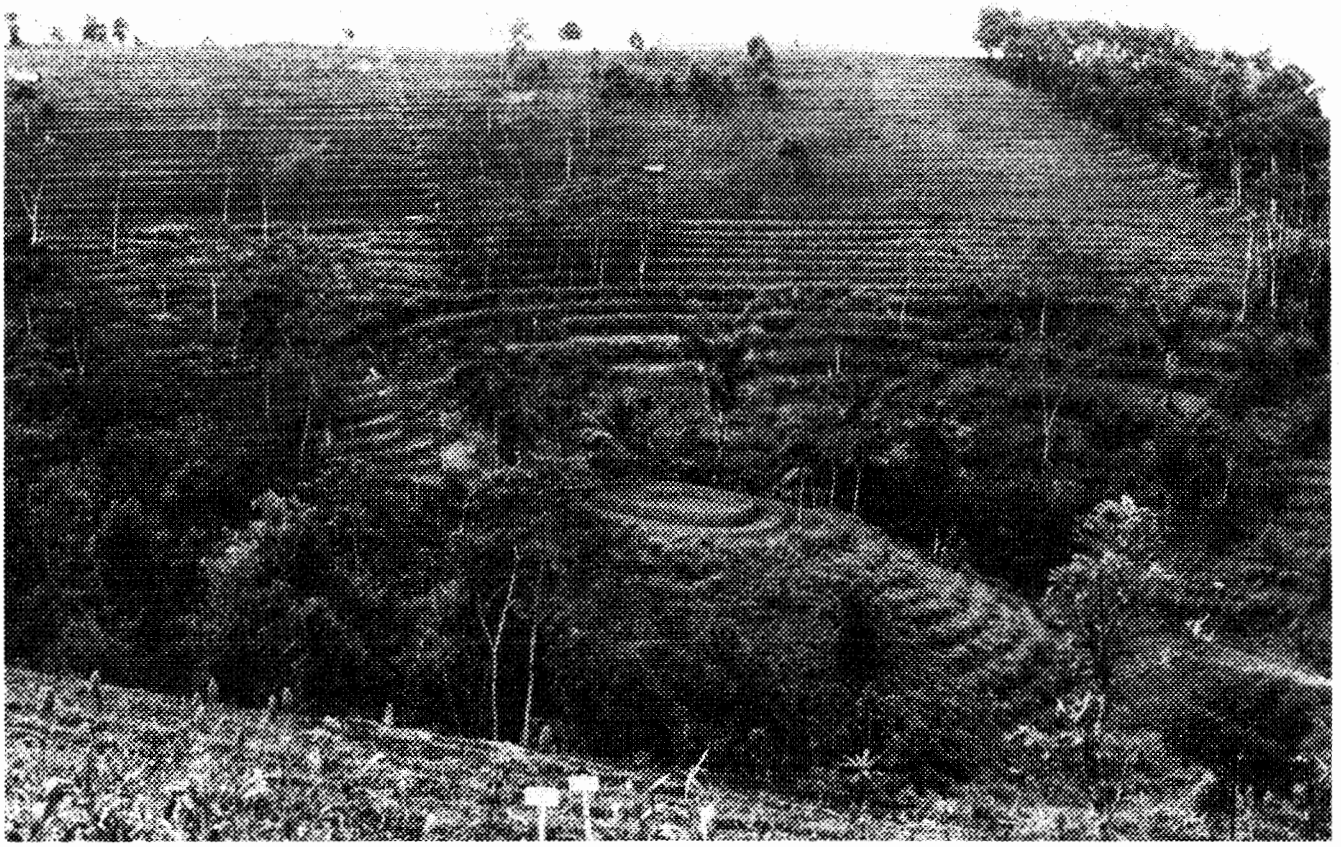
Population pressure is the big reason for erosion. Java is the size of Louisiana, which has 3.8 million people. Java has 85 million. Constant, massive population growth has forced people to move up the mountainsides. There they strip away the forests and ground cover for fuel and farm land, leaving nothing to hold the topsoil in place.

Getting the Citanduy off the ground has been a lesson in the

civics of a less-developed country. Many LDCs became independent only a few years ago and were not administratively prepared for it. Indonesia, which won a war of independence against the Dutch in 1949, then underwent a bloody revolutionary period in 1965 and 1966, is no exception.

The AID mission in Jakarta, the capital, commented on the difficulties in a recent report to its Washington headquarters:

"Among the problems of public administration commonly shared by most Indonesian institutions, the lack of adequately trained and motivated manpower is probably the most pervasive. Closely following would be: (a) Inadequacies of coordination, cooperation and communication between agencies and levels of government (lack of horizontal integration); (b) Overcentralized and insufficiently clear delegation of authority; (c) Inability to link plans with action, particularly long-range with project implementation; (d) Inadequate participation in the processes of development by both local government agencies and the rural population; and (e) A reliance on obsolete or unwieldly bureaucratic systems and administrative procedures."



The Citanduy experience brings the abstractions of the report to life.

During the early planning stages it became evident that the central government's Department of Public Works would have to play a major role because of the amount of construction involved, although it was clear even then that the Citanduy was basically an agricultural project. But Public Works had no authority to make budgetary or other commitments for the Department of Agriculture. And that department pointed out that the higher authority had not authorized it to pledge any resources.

Bappenas, the national planning agency, contended that it did not have the capability to monitor major, multidimensional projects like this throughout the country. Then there were the provincial (state) and district governments to factor in, not to mention the village fathers. They may prove the most important factors of all when the bottom line is drawn.

The U.S. role in the Citanduy development process has moved far beyond merely providing money and technical know-how. AID officials have helped Indonesian administrators make their first difficult journey through the labyrinth of a complex undertaking that can succeed

only with considerable coordination, cooperation and courageous individual assumption of responsibility.

The sensitive and crucial educational process involved a number of AID mission personnel, from the director, Thomas C. Niblock, on down. Niblock, who was assigned to Indonesia in 1975, played a major role in transforming the project from a relatively simple water resource development effort into its present all-sectors approach.

Much of this responsibility fell on the AID Citanduy project officer of the last 2½ years, Gerrit H. Argento. He arrived in Indonesia five years ago bearing a doctorate degree in economics.

The Citanduy has yet another goal. Its importance was underscored when Thomsic took Argento and a Washington visitor on a tour to inspect some older irrigation construction.

It was not encouraging. One bank of the canal was caving in. That would destroy the profile necessary to keep the water moving fast enough to maintain silt in suspension. No one was maintaining the canal. Why not?

The answer is not clear. Perhaps people in the area felt it was the responsibility of the national government, which built the canal. On the other hand irrigation systems traditionally are maintained locally. Argento pointed out that size is another possibility. The new irrigation systems — unlike traditional systems — transcend the boundaries of village political and social units and are not under the control of a single national agency.

The Citanduy grand plan appeared to anticipate such problems when it established administrative reform as a goal. Implementation will not be easy because the people must create new management and social institutions, acknowleding interests and responsibilities beyond their villages and valleys.

Every age and society has its "modern men" — people who grasp quickly specific innovations and the system of thought that leads to them. The Citanduy has uncovered a few, some of whom also posses an ability to motivate people — a rare commodity in any society.

Mr. Rachlan — he uses only one name like many Indonesians — is one of these men. A school teacher until noon, he works until late in the night as planning chief for the district that includes Panawagan.

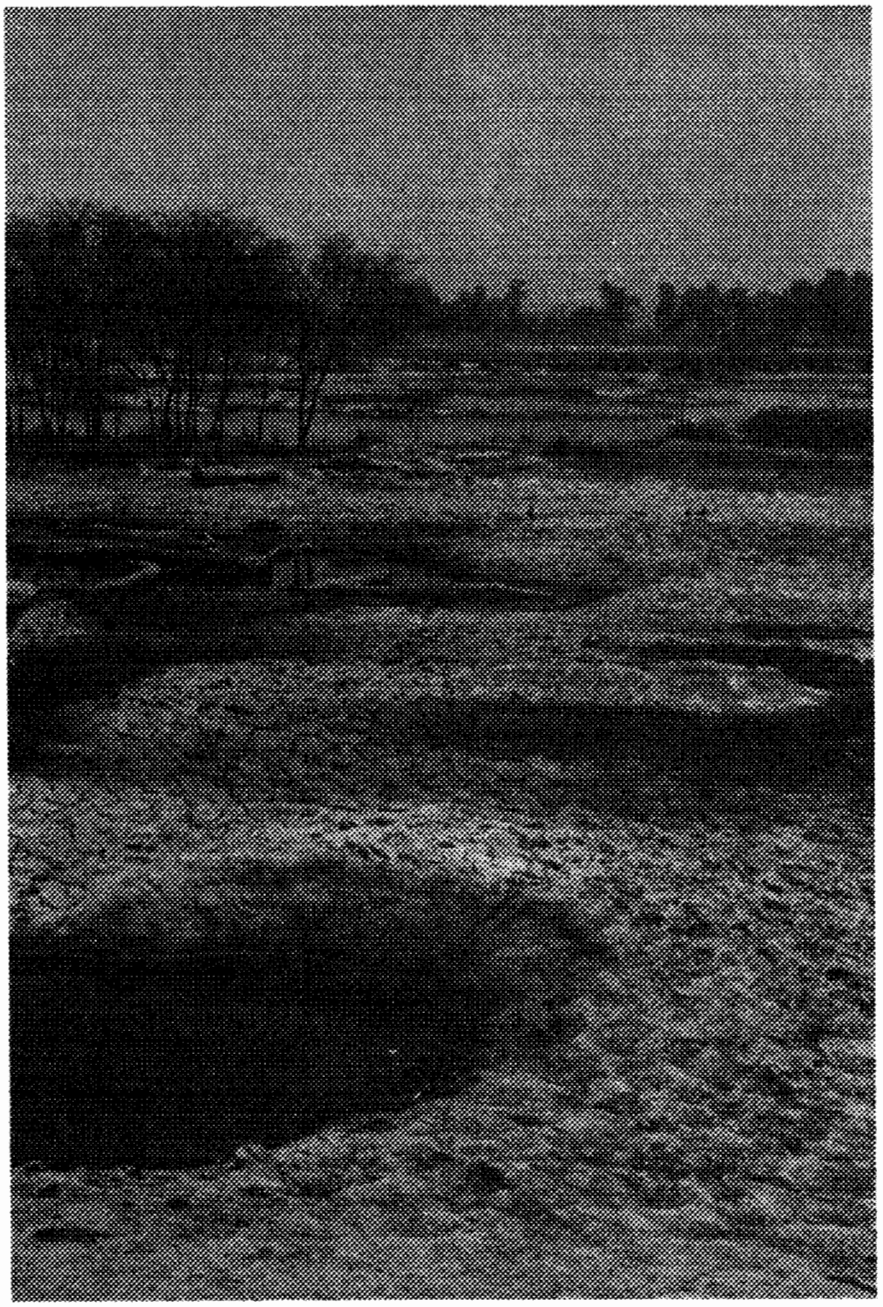
Operating under the authority of the district chief, or bupati, Rachlan developed a full-time staff of 22 persons and identified a capable deputy to whom he has delegated considerable authority. Rachlan has induced farmers to mix crops and persuaded them to sow grass under trees for grazing to boost animal production. He suggested grafting experiments that led to greatly increased cassava yields, and introduced the idea of fish ponds in the high hills where water is free of fertilizer chemicals and fish breed better. He established a farmers' loan bank with a default rate of less than 1%, stimulated construction of small health clinics, set up a landslide warning and protection program, and speeded the resettlement of landless laborers from central Java.

An English development economist, A.P. Thirlwall, wrote that "development implies more than just a rise in real national income; it must be a sustained, secular rise in real income accompanied by changes in social attitudes and customs, which have in the past impeded economic advance."

Talk to the people who work on the Citanduy and it is that need to change that preoccupies them. Finally the observer is tempted to say: "This is it. The global problem is summarized right here, along this river, in this little valley." And perhaps it is.

Vanishing Croplands

"Below that thin layer comprising the delicate organism known as the soil is a planet as lifeless as the moon." In the race to produce more for more people, the very earth that supports us is being pushed to the limit.



This article is excerpted, with permission, from **Worldwatch Paper 24: The Worldwide Loss of Cropland** by Lester Brown, © Worldwatch Institute, 1978. Mr. Brown is the author of **The Twenty Ninth Day.**

Ever since the beginning of agriculture, the area and fertility of cropland has determined the availability of food. When land is scarce, people often go hungry. When soils are depleted and crops are poorly nourished, people are often undernourished as well.

Pressures on the world's croplands have escalated since mid-century as our numbers have increased, raising doubts about long-term food security. In 1950 there was 2.5 billion people in the world. In 1975 there were 4.0 billion. By the end of the century, there will be 6.3 billion of us if current projections materialize.

Growing populations demand more land not only for food production but for other purposes as well. Even as the demand for cropland expands at a record rate, more and more cropland is being converted to nonagricultural uses. In addition, the soaring world demand for food since mid-century has led to excessive pressures on the more vulnerable soils. This in turn has led to soil degradation and cropland abandonment.

Cropland loss and deterioration are not new. The Tigris-Euphrates Valley, once described as the Fertile Crescent, may have formerly supported more people than it does today. The food-deficit lands of North Africa were once the granary of the Roman Empire. What is new is the *scale* of cropland loss and deterioration, a problem that now affects all countries, rich and poor alike.

Direct evidence of the mounting pressures on the global cropland base is seen in accelerating soil erosion, the spread of deserts, and

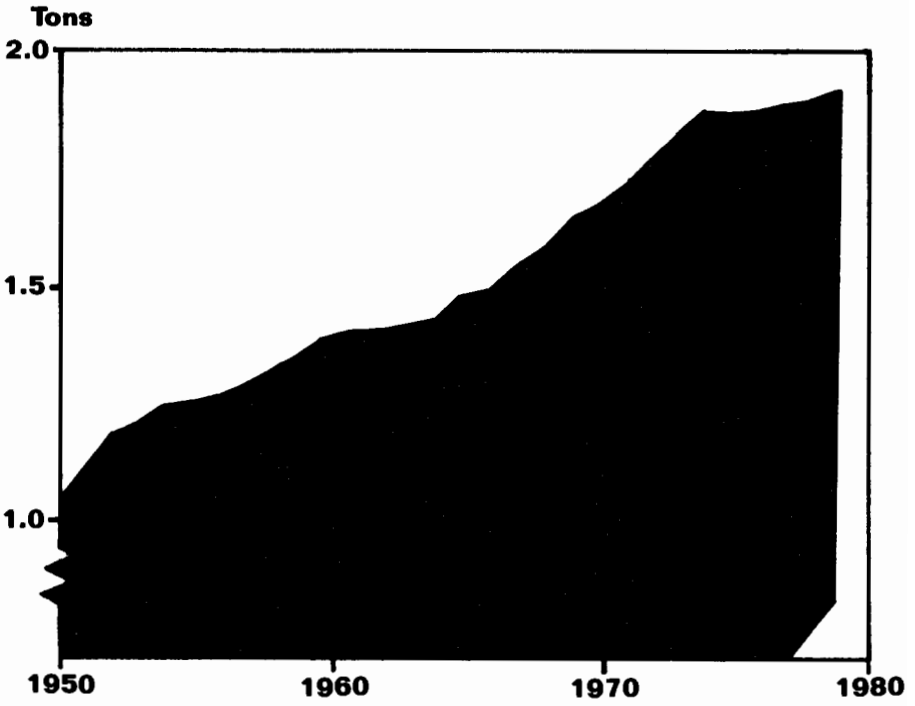
the loss of cropland to nonfarm uses. In the central Sudan and northwest India, sane dunes now occupy land where villages once stood. In the midwestern United States, shopping centers occupy land that only a few years ago was planted in corn. Factories are being built in southern China on land that for generations yielded two rice harvests each year.

Indirectly, excessive pressures are reflected in falling crop yields, growing food deficits, and greater instability in the world food economy. Crop failures are more frequent, as cultivation is extended onto land with less reliable rainfall. During the '70s, prices of wheat, rice, and soybeans have doubled in times of scarcity. After a quarter-century absence, famine returned in the '70s claiming hundreds of thousands of lives in Bangladesh, Ethiopia, and the Sahel zone of Africa.The food shortages that led to these deaths were initially blamed on poor weather, but weather was often the triggering event that brought into focus a more fundamental problem, the growing pressure on local land resources.

A valuable national resource, cropland is the foundation not only of agriculture but of civilization itself. Yet monitoring the condition of the global cropland base has been handicapped by a lack of comprehensive data. Virtually all governments collect statistics on the land being brought into production through irrigation and drainage projects, or through land-clearing, but relatively few systematically compile data on the land being taken out of production. Fewer still attempt to measure topsoil loss through erosion.

Available information indicates a growing worldwide shortage of productive cropland, acute land hunger in many countries, and soaring prices for farmland almost everywhere. The lost of productive cropland is helping to drive food prices upward, thus contributing to inflation and creating troublesome political problems.

World Grain Yield Per Hectare, 1950-77



(Plotted as 3 yr. sliding avg.) **Source: USDA**

The Urbanization of World Population, With Projections to 2000

Year	World Population	Urban Population	Urban Increase	Portion of World Urban
	(millions)	(millions)	(millions)	(percent)
1950	2,501	725		29
1975	3,968	1,547	822	39
2000	6,254	3,127	1,580	50

Source: Derived by the author from United Nations Data.

The historical expansion of cultivated land has been closely related to the growth in human numbers. In response to population pressures, farmers moved from valley to valley and continent to continent, gradually extending the area under cultivation until today, one-tenth of the earth's land surface is under the plow. By the mid-20th century, most frontiers had disappeared. Until that time, increases in land productivity were scarcely perceptible within any given generation.

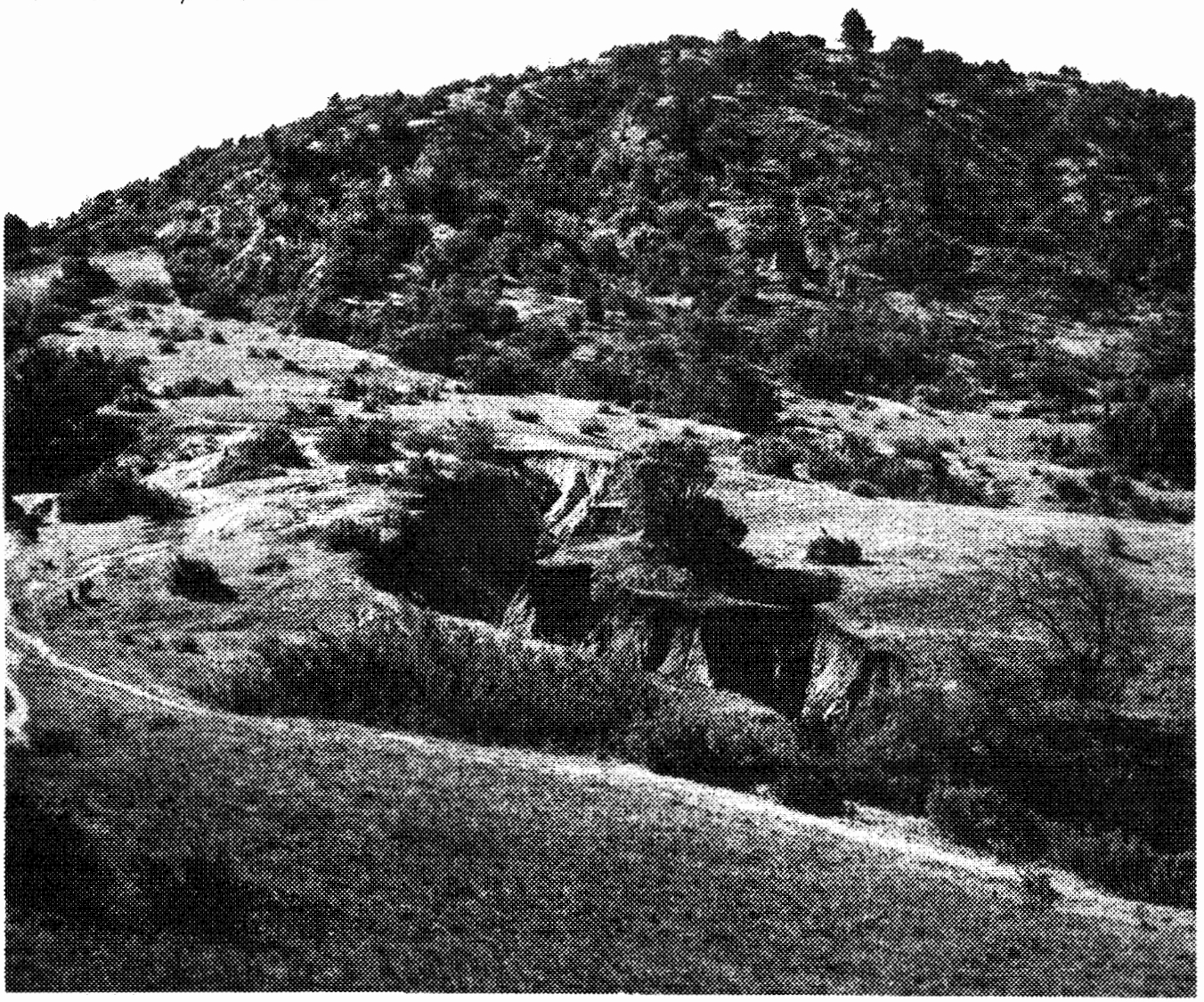
Historically, as the demand for food pressed against available supplies, farmers devised several techniques for extending agriculture onto land that was otherwise unproductive. Dominant among these techniques are irrigation, terracing, and fallowing. Irrigation enables farmers to cultivate land where rainfall is too low to support crops. In mountainous regions, the construction of terraces permits the extension of agriculture onto steeply sloping land that would otherwise be uncultivatable. Centuries of laborious effort are contained in elaborate sys-

tems of terraces in older settled countries such as Japan, China, Nepal, and Indonesia, and in the Andean regions once inhabited by the Incas.

In vast semiarid regions — such as Australia, the western Great Plains of North America, the Anatolian plateaus of Turkey, and the drylands of the Soviet Union — where there is not enough rainfall and moisture to sustain continuous cultivation, alternate year cropping has evolved. Under this system, land lies fallow in alternate years in order to accumulate moisture; all vegetative cover is destroyed during the fallow year, and the land is covered with a dust mulch that curbs the evaporation of water from the soil. The crop produced the following year thus draws on two years of collected moisture. In some situations, this practice would lead to a serious wind erosion if strip-cropping were not practiced simultaneously: alternate strips planted to crops each year serve as windbreakers for the fallow strips.

In the tropics — much of Africa south of the Sahara, Venezuela, parts of Brazil, and the outer islands of Indonesia — where more nutrients are stored in plant materials than in the soil, fallowing is used to restore the fertility of the soil. Stripped of the dense vegetative cover, soils in the humid tropics quickly lose their fertility. Shifting cultivation is a response to that condition. Farmers clear and crop land for two, three, or possibly four years, and then systematically abandon it as crop yields decline; moving on to fresh terrain, they repeat the process. These cultivators return to their starting point after 20 to 25 years, by which time the soil has become fertile enough to support crop production for a few more years.

Over time, irrigation, terracing, strip-cropping, and shifting cultivation enabled farmers to produce food on land where conventional agriculture would not survive. Today, land farmed with these specialized tech-



niques provides a large share of the world's food supply. Without them, the earth's capacity to feed people would be far lower than it is. Although these practices have withstood the test of time, in some areas they are beginning to break down under the pressure of population growth.

The increase in world population and economic activity means land is needed for much more than the production of food. Principle nonagricultural needs are urbanization, energy production, and transportation. Each of these is now claiming cropland in virtually every country.

Wherever national data are available, they usually show the growth of cities to be a leading source of cropland loss. Within the United States, cities are consuming cropland at a record rate. Land-use surveys by the USDA in 1967 and 1975 indicated that some 2.51 million hectares of prime cropland "were converted to urban and build-up uses" during the eight-year span. A study of urban enroachment on agricultural land in Europe (grasslands as well as croplands) from 1960 to 1970 found that West Germany was losing 0.25% of its agricultural land yearly, or 1% every four years.

There is little information on the Third World, where the most rapid urbanization is occurring. Scores of cities in developing countries, such as Lima, Ankara, and Manila, are growing by 5 to 8% yearly. Inevitably, some of this growth comes at the expense of cropland.

No one knows how much cropland was claimed by cities during the third quarter of this century, and it is only possible to estimate how much cropland cities will cover by century's end. To get some idea of the land needs of expanding cities, information is needed on the expected growth in urban numbers and on the amount of land required per person. According to the U.N. demographic division, the urban share of the world population, which was 29% in 1950 and 39% in 1975, is projected to reach 50% by 2000. This means the urban population would expand from 1,547 million in 1975 to 3,127 million just 25 years later.

To estimate the extent of urban enroachment on cropland, we need to know how much land each person will use and the share of that which will be cropland. Within the United States, each person added to the urban population between 1950 and 1960 required an average of .08 of a hectare, but between 1960 and 1970, a period of unprecedented urban sprawl, this figure increased to .13 of a hectare.

If it is assumed, perhaps conservatively, that the projected increase in world urban population of 1,580 million from 1975 to 2000 will need only .04 of a hectare per person, then the world's cities would occupy 63 million hectares by 2000. Assumin that 40% of this total is cropland, expanding cities will cover 25 million hectares of cropland between now and the end of the century.

Although this loss would amount to only 2% of the world cropland base, the share of world food output involved would be larger, for cities are usually situated on the most fertile soils. A study of changing land-use patterns in Canada reports that "half of the farmland lost to urban expansion is coming from the best one-twentieth of our farmland." At current levels of land productivity and food consumption, this loss of 25 million hectares represents the food supply of some 84 million people.

All additions to the world's population require living space, whether they live in the city or the countryside. In the Third World, where land is in critically short supply,cropland is lost each year to village growth. In an analysis of village spread using data over several decades for his native Bangladesh, Akef Quazi, a lecturer in science and technology at the University of Wales, concludes that growth in the number of families and growth in the area occupied by the village are closely related. One reason for this direct correlation is that homes are "made of locally available materials, such as bamboo, thatch, and corrugated iron sheets, and, as such, are never strong enough to hold an upper story. Every new village homestead is being built on cropland." While there are undoubtedly occasional exceptions, Quazzi's general point is a sound one, since Bengali villages are usually surrounded by the fields on which they depend.

A similar situation exists in India, a country of 600,000 villages, nearly all of which are expanding. Living space requirements of the 14 million people added each year are at least partly met by homes built on cropland. In 1976, India estimated that between 1970 and 2000, nonagricultural land use would expand from 16.2 to 26 million hectares, an increase of 60%.

Rivaling the urban sector as a claimant on cropland is the fast-growing global energy sector. During the final quarter of this century, as during the third, the consumption of energy is projected to increase more rapidly than that of food. Like the production of food, the production of energy requires land. Hydroelectric dams often inundate vast stretches of rich bottomland; electric generating plants can cover thousands of hectares.

More often than not, oil refineries and storage tanks are built on prime farmland along rivers and coastal plains. Strip-mining of coal and the diversion of irrigation water for coal gasification both tend to reduce the cultivated area.

All transport systems require land, but some systems use much more than others. Automobile-centered transport systems are voracious consumers of land. An enormous

amount of U.S. cropland has been paved over for the automobile. Millions of hectares are required just to park the nation's 143 million licensed motor vehicles. But even this is rather small compared with the land covered by streets, highways, filling stations, and other service facilities. Moreover, the automobile has encouraged other inefficient uses of land, such as urban sprawl.

The amount of cropland that will be paved over, built on, strip-mined, or flooded by a dam by the end of this century is unknown. However, if world population projections are correct, 2.3 billion people will be added between 1975 and the year 2000, a far larger increase than the 1.5 billion added during the preceding 25 years. Given these population projections and the projected gains in income, every nonfarm claimant on cropland — urbanization, energy production, transportation — will be greater during the last quarter of this century than during the third.

Although the world demand for cropland is greater than ever before, the amount of cropland abandoned each year may also be at a record level. The reasons for cropland abandonment, usually the product of economic pressures interacting with ecological forces, include desertification, severe erosion, waterlogging and salinization of irrigated land, and the diversion of irrigation water to nonfarm uses.

Deserts are now expanding on every continent. Documents prepared for the U.N. Conference on Desertification detailed this expansion and the human creation of desertlike conditions. Some 630 million people, or one in every seven of the world's people, live in arid or semiarid areas. As estimated 78 million people live on lands rendered useless by erosion, dune formation, changes in vegetation, and salt encrustation. Desertification has deprived these people of their means of production, of their livelihood.

Fed by the human pressures on their fringes — overgrazing, deforestation, and overplowing — virtually all the world's major deserts are expanding. As human and livestock numbers multiple, the creation of deserts or desertlike conditions is accelerating throughout the Middle East and in Iran, Afghanistan, Pakistan, and northwestern India.

Soil erosion is an even more widespread problem. Soil scientists classify erosion into two main categories — sheet erosion, and rill or gully formation. Continuous erosion is usually found on sloping lands that are farmed without soil conservation techniques such as terracing and strip-cropping. This leads to productivity declines in the short run, and to land abandonment over the long term. The difference between rills and gullies is one of scale: the depth of rills can be measured in inches, but that of gullies is usually measured in feet. Gullies usually appear where subsoils are also erodible.

Although severe gullying, leading to land abandonment, is now common in many parts of the world, it has received the least official attention in those countries where the process is most advanced. A U.N. report on soil deterioration and cropland loss in Latin America notes its serious dimensions in the Andean regions. Throughout the Andean countries gullies are advancing through the steeply sloping countryside like the tentacles of a giant malignancy. As these gullies eat their way across fields, farmers who are already desperate for land continue to till what's left, right up to the very edge of the gully. In so doing, they feed the gully, accelerating its progress across the countryside.

The irrigated lands that provide a disproportionately large share of the world's food are threatened both by ecological forces — waterlogging and salinity — and economic forces that

divert water to competing uses. Waterlogging and salinity develop wherever surface water from the rivers or streams is diverted to irrigate land that has inadequate underground drainage. This net addition to the natural underground water supply gradually raises the water table. Once the water table is within a few feet of the surface, the growth of deep-rooted crops is impaired and the early symptoms of waterlogging appear.

As the water table rises further, water begins to evaporate through the remaining few inches of soil, thereby concentrating the minerals and salt near the surface. Eventually the salt concentrations reach a level that prohibits plant growth. Glistening white expanses of heavily salted, abandoned cropland are visible from the air in countries traditionally dependent on irrigation, such as Iraq and Pakistan.

The problem is as old as irrigation itself. Indeed, the decline of some of the early civillizations in the Middle East is now traced to the waterlogging and salinity caused by their irrigation systems. Although the designers of the earliest irrigation systems in the Tigris-Euphrates Valley did not understand the subterranean hydrology well enough to prescribe corrective action, modern irrigation engineers do. A U.N. report, however, estimates salvage costs at $650 per hectare.

Responding effectively to the threats to cropland associated with mounting food demands poses a dilemma for farmers and government planners alike. Both economic pressures and political instincts encourage a short-term focus, a desire to expand current output to satisfy immediate needs. But this pressure to wring more food out of the land can have devastating consequences for the soil.

Over much of the earth's surface, the thin layer of topsoil is only inches deep, usually less than a foot. Any loss from that layer can reduce the soil's innate fertility. Forty years ago, G.V. Jacks and R.O. Whyte graphically described the essential role of topsoil: "Below that thin layer comprising the delicate organism known as the soil is a planet as lifeless as the moon."

The erosion of soil is an integral part of the natural system. It occurs even when land is in grass or forests. But when land is cleared and planted to crops, the process invariably accelerates. Whenever erosion begins to exceed the natural rate of soil formation, the layer of topsoil becomes thinner. Once enough topsoil is lost, the cropland is abandoned. Eventually the topsoil will disappear entirely, leaving only subsoil or bare rock. But the gradual loss of topsoil and the slow decline in inherent fertility that precedes abandonment may take years, decades, or even centuries.

In some parts of the world, the doubling of demand for food over the past generation has forced farmers onto land that is either too dry or too steep to cultivate and is thus highly vulnerable to erosion. Explosive Third World population growth has forced farmers onto mountainous soils without sufficient time to construct terraces. Once the natural cover is removed from unterraced mountainous land, the topsoil quickly washes down into the valley below.

In the Andean countries of Latin America, skewed landownership patterns aggravate this problem. Wealthy ranchers use the relatively level valley floors for cattle grazing, forcing small landholders onto steeply sloping fields for the production of subsistence crops. This peculiar inversion in land-use patterns is leading to severe soil erosion on slopes, impairing the productive capacity of both the mountainside and the valleys.

In dryland wheat areas of the world, pressures to reduce the area in fallow could lead to widespread

drying up soils. This proved catastrophic in the U.S. Great Plains during the Dust Bowls of the '30s and in the Virgin Lands of the Soviet Union during the '60s. Except where land can be irrigated, the basic natural constraints on cultivation under low-rainfall conditions cannot be altered substantially.

In Ethiopia, the deterioration of soils was brought into focus by a drought that culminated in famine in 1974. A foreign ambassador in Addis Ababa described the origin of the problem in graphic terms: "Ethiopia is quite literally going down the river." More recently, the U.S. AID mission reported; "There is an environmental nightmare unfolding before our eyes . . . It is the result of the acts of millions of Ethiopians struggling for survival: scratching the surface of eroded land and eroding it further; cutting down the trees for warmth and fuel and leaving the country denuded . . . Over one billion — one billion — tons of topsoil flow from Ethiopia's highlands each year."

According to U.N. estimates, erosion robs Colombia of 426 million tons of fertile topsoil each year. Colombia's topsoil is relatively thin; given the poorly nourished condition of many of its people, the country can ill afford such a massive loss of this life-sustaining resource. In Pakistan, the progressive deforestation of recent decades has led to widespread soil erosion. At some point, these losses in Ethiopia, Colombia, Pakistan, and other severely affected countries may begin to sabotage farmers' efforts to expand output.

Agricultural land can no longer be treated as a reservoir, an inexhaustible source of land for industry, urbanization, and the energy sector. Cropland is becoming scarce. In a world of continuously growing demand for food, it must be viewed as an irreplacable resource, one that is paved over or otherwise taken out of production only under the most pressing circumstances and as a result of conscious public policy.

In some situations, adjustments are needed in land use within agriculture as well as between agriculture and other sectors of the economy. The prevailing social structure in several countries in Latin America has led to grazing on valley floors and the plowing of mountainsides. Intelligent land-use policies would reverse this situation with a thorough land reform program. In effect, existing social structures in some countries are simply not compatible with the wise management of land resources.

Historically, land in most countries was allocated to various uses through the marketplace, but unfortunately the market does not shield cropland from competing interests. As cropland becomes more scarce, it can be protected from competing nonfarm demands only through some form of land-use planning. Such planning can occur at the national level, the local level, or both. It can rely primarily on land-use restrictions in the form of legislation or government decrees, or it can rely on incentives such as differential tax rates. Each society will need to employ approaches suited to its own circumstances.

The future balance between people and cropland is likely to be affected more by population policy than by any other single factor. Growth in human numbers not only generates a demand for more cropland, but it also simultaneously generates pressures to convert cropland to nonfarm uses. Thus far, policymakers have assumed that projected increases in population over the final quarter of this century will materialize. But the social costs of remaining on the projected demographic path may become too great. A fundamental rethinking of population policies at the national level may well be unavoidable in many countries.

The changing food prospect may lead to the abandonment to pronatilist policies and the active encouragement of small families. Other governments may join those of China and Singapore in advocating a maximum of two children per couple and in making family planning universally available. With future rates of population growth bearing so heavily on the prospect of eliminating hunger, the fact that one-half of the world's couples do not yet have access to family planning services is not only socially irresponsible, but politically inexcusable as well. If population growth is to be reduced to a socially acceptable rate, unprecedented changes in government policies and in individual attitudes will be required. Such changes are not likely to occur without a better understanding of the precarious balance between people and cropland.

The convulsive changes in the world food economy during the '70s reflect in part the growing pressures on the cropland base. They should be regarded not as an aberration, but rather as a signal that pressures on the cropland are in some ways becoming unbearable. They may in fact be advance tremors warning of the quake to come.

Threats to the world cropland base from the nonfarm sector are very real. Evidence that the soils on which we depend for our food are deteriorating is overwhelming. What is not nearly as evident is how political leaders will respond. But the time left in which to respond is measured in years, not decades.

The issue is not whether the equilibrium between people and land eventually will be reestablished. It will be. If the deterioration is not arrested by man, then nature will ultimately intervene with its own checks. The times call for a new land ethic, a new reverence for land, and for a better understanding of our dependence on a resource that is too often taken for granted.

CARING FOR HEALTH

A pilot project is bringing the basics of sanitation and health care to small villages in rural Bolivia.

By John Metelsky
AID Public Affairs Officer

Rural Bolivia has one of the highest infant death rates in South America — one out of four children die before their first birthday.

Bolivia, a landlocked country with about 6 million people, is the poorest nation in South America. Per capita income is $390 per year. Life expectancy is 45 years, and there is only one doctor for every 2,100 people.

"The tragedy is that most of the babies die from diseases that are preventable — measles, whooping cough, malnutrition and diarrhea," says Nancy Ruther, a nutrition development officer with AID.

Ruther has served since April 1974 in Bolivia, where one-fifth of the population suffers from malnutrition. The daily diet of tropical children contains only 72% of the calories required. She estimates 60% of the people suffer from goiter, a chronic enlargement of the thyroid gland caused by iodine deficiency.

A former Dayton, Ohio, resident, Ruther, 27, received her B.A. degree in Latin American studies from the University of Pittsburgh in 1972 and will receive her M.S. in international relations when she completes her thesis. Ruther works closely with the Bolivians to bring basic health services to the poor campesinos (small farmers) in Santa Cruz in eastern Bolivia. The fastest growing province in the country, Santa Cruz lies in the tropical lowlands, where malaria, yellow fever and other diseases threaten economic development.

Dr. Evaristo Maida (center) discusses health problems with Nancy Ruther in a home in La Por Fia.

Ruther directs AID's Montero health delivery project. Her programs concentrate on maternal and child health, family planning, nutrition, communicable diseases, safe water and latrines.

"A major cause of disease stems from lack of safe water for drinking and for basic hygiene," says Ruther. "If you're dirty and can't wash your clothes or dishes because you don't have water or the available water is contaminated, this condition creates an ideal breeding ground for parasites and microbes."

AID began assessing health needs in 1974. "From that assessment," Ruther explains, "came AID's pilot health project in rural areas of Montero, a city in Santa Cruz. It's known as the 'Montero Health Project,' and 24 communities participate." To support the program, AID is providing $640,000 for health services for small communities of 60 to 3,000 people.

"This was the first time we ever mounted a major preventive health care program in a rural area. We've developed a model health program in Santa Cruz. Although it's only been underway less than a year, it's already helping 12,000 campesinos in rural Montero, and is still growing.

"We've vaccinated more than 60% of the children under 12 against major childhood diseases. Also, we've built an auxiliary nurses' training school and administrative building. Twelve Bolivian nurses and 17 health promoters are now working in the field."

Ruther and other AID officials work closely with Bolivian health specialists and villagers to create small outreach teams in Montero. A team consists of a doctor, a public

Auxiliary nurse Lucinda Prado examines an unwilling patient at the health post.

health nurse, a lab technician, a statistician to handle paperwork and a sanitation technician to find safe water sources and encourage communities to build latrines.

"With the outreach teams, we've organized 24 communities. From four central locations, two auxiliary nurses visit satellite communities. In addition, a community hires a health promoter who develops a community map and visits every home to identify the campesinos who are the highest health risks. For instance, if the promoter finds a 2-year-old child who has been coughing heavily for a few days and has diarrhea and a fever, he informs the auxiliary nurse. The nurse visits the patient and may recommend hospital care."

Health promoters must read and write enough Spanish to take six weeks of training and to maintain records and fill out health forms.

"The promoters and the outreach team determine the community's most pressing health needs," explains Ruther. "If they find 95% of the village homes don't have latrines, they make latrine-building their first health priority."

At community meetings, promoters and auxiliary nurses explain the importance of safe drinking water, latrines, and personal hygiene. They explain how water can contain harmful bacteria. They point out the importance of building and using latrines and stress the proper disposal of human waste. Providing clean water and sewers is a high priority.

Vaccination campaigns are another major part of the program. "The campaigns are not easy," Ruther says. "The DPT triple vaccine—for prevention of diptheria, whooping cough and tetanus—is difficult, because you must vaccinate the child two or three times. Everyone turns out with their children for the first shot. But since there has been no promoter in the community for follow-up, when the second shot is due only half of the

people show up. For the third shot, half again show up. You end up with effective vaccination of only 25% of the children."

Under the new AID program auxiliary nurses and health promoters remind every family about the second and third shots. "That system works in Guatemala, Colombia, Venezuela and other countries," says Ruther. "We expect it to work here."

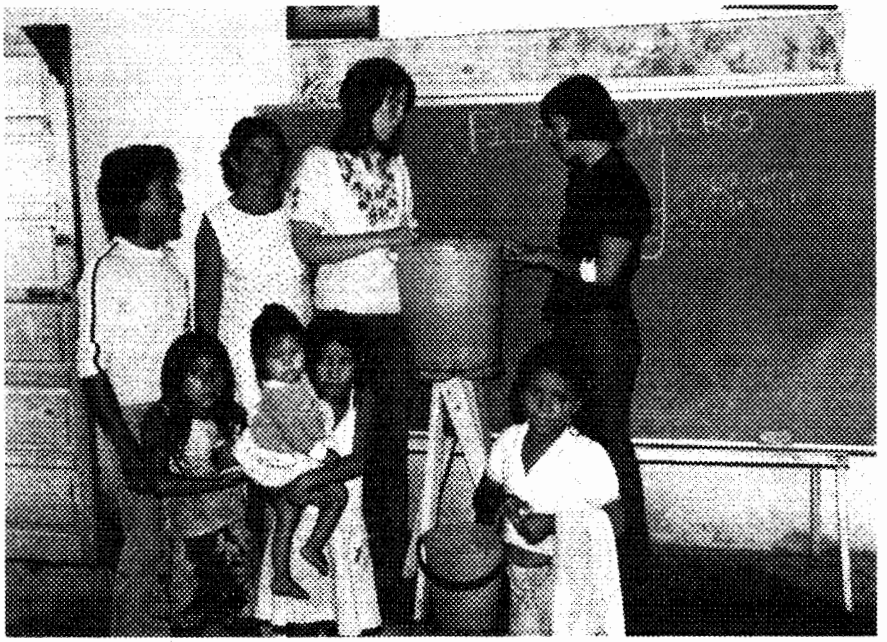
She recently visited a health post in a hamlet called La Por Fia, about 60 miles north of the city of Santa Cruz. The health post, a small, one-story, two-room building, was made of white-painted stucco. "This is a good example of a health post, because the villagers built it themselves with their own money. AID provided some supervision and construction materials."

Two young auxiliary nurses, Mercedes Vaca and Lucinda Prado, were examining a youngster in the post. They have completed six months of nurses training and treat about 25 patients a week. They are members of the health committee elected by the town's 600 inhabitants. For the basic services provided by the committee, each family pays up to five pesos a month—about $1.

The money paid for construction of the health post and a health promoter. Every patient also pays a small sum for treatment, usually 5% over cost. A penicillin injection costs about $1.

"It costs about $3 to have a baby," says Ruther, "but $3 is a lot of money for the campesinos."

According to nurse Vaca, at the beginning of the program many patients afflicted with diarrhea visited the health post. After the health committee explained the importance of clean water and personal hygiene and showed the people how to make simple but effective water filters, diarrhea cases dropped 60%. Because they have limited nurses' training, they only provide minor medical services, such as giving injections, setting broken bones and curing minor wounds.



AID nutrition development officer Nancy Ruther (left, holding bucket) and auxiliary nurse Mercedes Vaca demonstrate construction of a simple home-made water filter to La Por Fia villagers.

While in la Por Fia, Ruther and the two nurses visited a sick woman, 60-year-old Marcelina Machuca. She lives in a typical palm house which has dirt floor and no electricity, water, toilet, or screening. Domestic animals often share the rooms in these homes. There is little privacy and the crowded conditions breed insects and other disease carriers.

The sick woman complained of abdominal pains. Nurse Vaca said, "I knew she had a serious ailment, because her blood pressure and temperature went up and down. She also had a high fever at times." Her diagnosis was confirmed by Dr. Evaristo Maida during his regular visit to the health post. He said the woman had a swollen pancreas and arranged to send her to a Montero hospital. The woman's husband was reluctant to let her go, because he had no money. Dr. Maida assured the man he would keep costs down.

"No money for medical services is just one of the health problems plaguing rural Bolivia," Ruther explains. "Another problem is the extreme cultural differences in the population. About 65% of Bolivia's population consists of Aymara and Quechua Indians, about 25% mixed, and the rest Europeans, primarily Spanish.

"The cultural differences in nutrition are very obvious. For example, the Quechua and Aymara Indians believe that if a pregnant woman eats cheese, she will have a dumb child — unable to speak. If she eats eggs, she'll have a yellow child — jaundiced.

"In both cultures, milk is practically non-existent. The Indians don't even have a word for milk. There's almost a complete taboo against it. A few school children accept non-fat dry milk from donation programs. Otherwise, they rarely consume milk or cheese." Ruther says the Indians do not feed babies fruit juice, because they believe it causes an acid stomach.

"Sometimes, the problems are overwhelming. But this new health project is a step in the right direction. If the project continues to succeed, we will use it as a model for other areas of Bolivia."

Material for this article was supplied by Philip M. Roedel, senior fisheries advisor on loan to AID's Office of Agriculture from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

Fishing For the Future

"Give a man a fish, and you feed him once. Teach a man to fish, and he can feed himself." This Chinese proverb is taking on special meaning for developing countries in search of low-cost protein.

Fisheries, including aquaculture, have a major role to play in meeting world food needs. Though fishery production will never begin to meet global needs for animal protein, fish can provide a substantially increased supply of high-value food.

Fish are nutritious, high in certain essential amino acids, especially lysine, and low in polyunsaturated fats. They can mean the difference between good health and malnutrition, and are a preferred food in many societies. There are far more of them in the sea (and the lakes and streams) than have been caught. With proper management, the number that can be taken safely on a sustainable basis can be markedly increased. Wild fish are a renewable natural resource and many stocks are underutilized. Some kinds of fish can be domesticated and cultured for man's benefit. This is particularly true in the tropics, where there are serious nutritional problems.

The world fish catch in 1976 was 73.4 million metric tons (mmt). FOA in 1977 estimated that the potential sustainable yield may be as much as 455 mmt. This, however, presumes development of non-conventional species (e.g. antarctic krill) and requires a huge capital investment.

The National Academy of Sciences, in its 1977 World Food and Nutrition Study, estimates the LDCs can increase their current catches by 20-30 mmt per year by harvesting the resources near their shores at an optimal rate. This is roughly double the current catch FAO attributes to the LDCs. Add to this an increase in aquaculture and you are talking about a lot of animal protein, enough to at least minimize malnutrition in many parts of the world.

The term small-scale fishery encompasses subsistence fisheries and is more or less synonymous with artisanal fisheries. We are talking about rural inland and coastal fishermen in the poorest of the developing countries whose catch goes largely for human consumption, who are themselves poor, and who fish with relatively unsophisticated gear and vessels in nearshore marine waters or in the freshwater environment. This does not exclude fishery ventures aimed at high-value products for either the domestic or the tourist trade if they have substantial employment-generating effects, but the priority is on fish production as a source of relatively low-cost protein and as a source of employment.

The number of people who are engaged in or dependent on small-scale fisheries runs into the tens of millions. A 1976 FAO estimate placed the number between 20 and 30 million. Indonesia estimates it has a million full-time fishermen, with another million part-time.

The problems of upgrading these rural fishing communities are massive and complex. There are no simple solutions. Expert knowledge

in such diverse disciplines as biology, economics, sociology, food technology, public administration, law and marine engineering may be required in any given case.

In the late 1960s, AID's interest in fisheries dropped to a minimum, and it is only in the past two or three years that a formal fishery program has been reinstated. It is still modest, but it is growing, and there have been a number of requests from AID missions for feasibility assessments of fishery potential, most recently from Guinea-Bissau and Djibouti.

Earlier this year, I traveled to both countries to evaluate the fisheries potential and to study the prospects for future AID assistance for small-scale fisheries in the two countries.

Guinea-Bissau

Guinea-Bissau is on the West African coast between Senegal and Guinea. Its territory also includes the offshore Bijagos Archipelago.

Fisheries have assumed a significant role in the government's national plans. Fish are abundant and the people like to eat them. The government wants to develop a strong fishery tradition to bring their artisanal fishermen from archaic practices to modern technology. It recognizes the magnitude of the problem that encompasses every aspect of fisheries. There is, however, an almost total lack of governmental know-how, of basic supplies, transport services and the like, and this has so far prevented rational development.

Offshore stocks have been fished heavily by distant water fleets; the Soviet Union is reported to take about 100,000 metric tons annually. The impact of this fishing upon the offshore stocks is uncertain; some believe there remains substantial unexploited reserves, while others feel that situation is serious. Guinea-Bissau is attempting to get foreign fishing under control in her 150-mile zone of extended jurisdiction. Regardless of her success, the offshore fisheries will have minimal impact on the coastal stocks sought by the artisanal fleet.

These coastal stocks, protected under Guinea-Bissau law from exploitation by the large-scale fleets, both foreign and domestic, offer a great potential for development, both in the fin fisheries and in shrimp. The coastline is more than 1500 km. long and the Bijagos archipelago has vast protected waters.

This part of West Africa is known for the richness of its fishery resources and there is every reason to believe that the opportunity exists to increase coastal catches substantially without danger of overfishing.

During my visit, I met with about 40 fishermen in Cacheu, located at the mouth of a river. They made it abundantly clear that their needs were at an elemental level and that they understood very well what their problems were and what needed to be done to overcome them. Approximately 200 fishermen are based in Chacheu. They have some 40 traditional boats ranging from 15 to 40 feet in length. During the past several years, fishing operations have gradually declined so that at present only about 10 boats operate on a reasonably regular basis. This decline is due to the lack of materials for construction of fishing gear, and the lack of spare parts and maintenance facilities for motors and other supplies.

Prospects appear excellent for development of fisheries at this port: the area is rich in fish and shrimp, boats and fishermen are available (many young people wish to pursue fishing but are restricted by lack of opportunity) and markets are available to absorb an increase in production.

The basic requirement to promote increased fishing is to provide the fishermen with the means to operate on a regular basis. This entails making available motors for the boats, fuel, materials for construction of fishing gear and associated needs, and credit facilities. The fishermen stated that if the motors and materials were available, they would purchase them, either directly or through credit arrangements, depending on individual status.

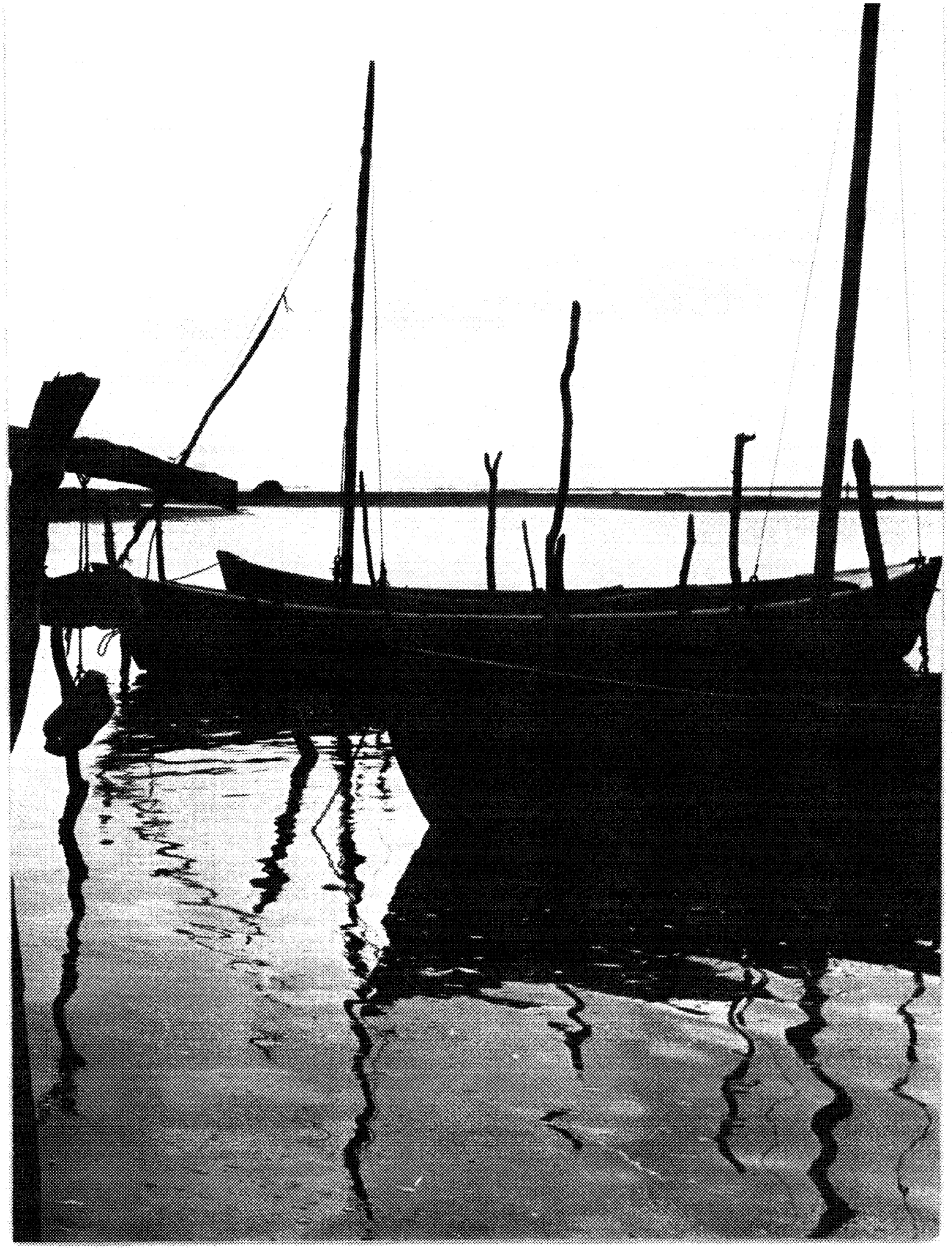
Fish now is sold mainly on the local market or transported to Bissau. Very little reaches the interior. The population likes fish and would buy it regularly if it were available. However, the fishermen need an insulated truck to distribute the catch on a regular basis. Road access is available to interior centers, although many of the roads are in bad condition.

Djibouti

In Djibouti, there seemed little question that the waters can support a far greater fish catch than the current 500-700 metric tons per year. The few fishermen there catch all they can sell with no difficulty. The catch is sold close to the landing places or soon after landing in the Djibouti city market. The in-shore waters I visited abound with fish, and those marketed appear to be choice species in excellent shape. The problem is not the supply of fish or, at this time at least, fishing technology. It is twofold: lack of a marketing system that will permit holding, transporting, and distributing the catch to the greatest number of people, and, most important, a population which for the most part has not traditionally eaten fish.

There is a living aquatic resource currently going to waste so far as human nutrition is concerned. The fishery can be expanded, the government strongly supports fishery development, there is sufficient demand among existing fish-eaters to utilize some increased catch, there is a large latent demand among potential fish eaters (with due apology to sheep and goats) that can be filled.

During my visit, I met with



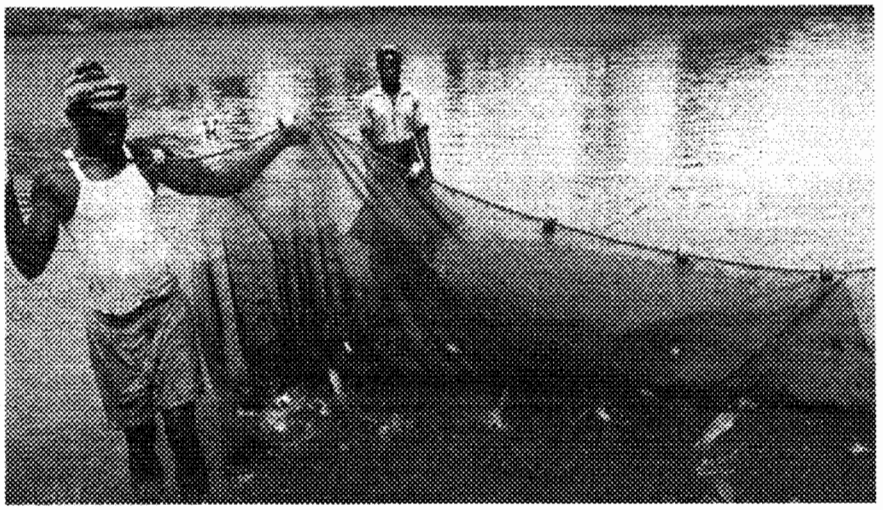
Mohamed Moussa Chehem, director of Djiboutian Fisheries. He emphasized the priority given to fisheries by the government. They believe it is possible to develop the industry beyond small-scale operations to include a larger-scale industry for export.

The director noted that meat is currently being imported. People can't afford it; they need to be able to buy animal protein at low cost. Fishing, therefore, would help many people by providing a less expensive source of animal protein and by creating local employment. He felt that there is a market, but a lack of facilities and equipment.

towns. The potential payoff looks good.

The government's ideas for fishery development, which is clearly given priority, seem essentially compatible with AID policy. Consumption of fish is low because the people are traditionally meat-eaters, there are few (300 or so) fishermen, and they lack the necessary supplies and facilities.

The government's plan is to buy fish from the fishermen in Djibouti city, keep it in the freezer plant at the Fisheries Office (the plant was not in operating condition at the time of my visit) and distribute it through a series of small markets to be built around the city (there are currently only two fresh fish markets downtown). People will take note, demand will grow because fish will be cheaper than meat, and employment in the fisheries will rise. All this will require a promotional backup to "sell" the public on fish.



We spent a day on a boat trip to Obock and Tadjoura using the embassy's Boston whaler, fast but wet and rough-riding in the light chop. Dr. Denis, the French advisor to the fishery director, accompanied the U.S. party.

No question but that there are lots of fish near those two towns. We saw them in the water, being landed, and being sold in a stand set up on the beach at Obock. We met the local district officials and talked with fishermen (there aren't many of them over there, the business being across the bay in Djibouti City). Despite obvious difficulties (power, ice, transport vessels, to name some), it seems well worth the money to try to get something going in both

The project will, as it prospers, interest others in becoming fishermen and gradually utilize more of Djibouti's seemingly abundant coastal stocks.

Based on these and other visits to other countries, it seems clear that fish can and should play a larger role in meeting the protein needs of the less developed countries, if fisheries are given proper attention and management.

In Print

A book review by David M. Daugherty

Sterling Wortman and Ralph W. Cummings, Jr., To Feed This World, Johns Hopkins University Press, Baltimore, 1978. $25.00 hardcover; $6.95 paperback.

David Daugherty is on the International Programs Staff of the Science and Education Administration, U.S. Department of Agriculture, and liaison to AID's Development Support Bureau.

Wortman and Cummings describe a sound basis for hope in providing adequate food for the world's burgeoning population, and a strategy to meet this objective.

Tracing the history of agriculture from the beginning of man's habitation, the authors divide the development of agriculture into three eras. The first era consists of the evolutionary development of traditional farming systems, characterized solely by the inputs of man, his animals, seed and land. This era continued up to the beginning of the 20th century.

The second era of agriculture development, occurring within the first three-quarters of this century, represents an agricultural revolution based upon the application of scientific knowledge supported and strengthened by industry. Genetic manipulation to improve crop varieties and animal strains and scientifically based methods of controlling pests and plant diseases illustrate the advances in agricultural development contributed by science. The production of farm machinery, agricultural pesticides and chemical fertilizers are examples of industry's role.

The authors believe we are now entering into a third and perhaps more crucial era of agricultural development — the era of forced-pace agricultural and rural development

efforts. Convincing evidence is presented that if rapid and effective food production programs are initiated, the world's present physical resources are adequate to provide food for its growing population. The authors contend that crop yields are at only a fraction of their potential and that governments must commit themselves to pursuing aggressive forced-pace policies by developing new lands, providing agricultural inputs such as fertilizers and pesticides, and building the necessary infrastructure to generate agricultural technology and training.

Governments of the less-developed countries are now aware, more than at any time in the past, that the developed countries cannot feed the world alone, that costs of imported food can be reduced through local production increases, and that the rural poor can become a means for economic development through a process of expanded production and subsequent currency generation.

The authors examine a number of efforts to accelerate agricultural development in the developed and developing countries. The successes of agriculture in the U.S. and Japan serve as an introduction to several case studies. The authors note that neither the U.S. nor Japanese programs developed under the intense pressures faced by the low income countries today.

Three types of agricultural development programs are examined using studies from a number of developing countries. They are: comprehensive national efforts to accelerate agricultural output; National Commodity Programs, to spur development of specific commodities like wheat or maize; and Defined Area Projects, designed to increase production and economic levels of discretely defined areas of a country.

The first 10 chapters of *To Feed This World* are devoted to providing a well-documented and referenced background for the development strategy proposed in the remaining six chapters. True to their objective, these chapters provide a clear, concise discourse on where the world has been and how it can move toward self-sufficiency in food production. The authors provide the reader a clear and understandable conception of the complex problems facing agricultural development. The message is not one of gloom and despair, but is a clear call for the world community, particularly the less-developed nations, to roll up their sleeves and work out practical solutions to problems that affect us all.

Experiences in land tenure problems are reviewed, and a number of alternative approaches are offered to implement land reform and tenure activities. Action plans, it is stressed, are dependent upon many factors that must be carefully weighed when initiating tenure and land reform programs. Such programs by their very nature raise sensitive issues.

Wortman and Cummings make the case that agricultural research in the developing countries, if modeled after the university and federal research systems of the U.S., must be reorganized to address the current needs for developmental research. Their argument is valid, and points strongly to the need for establishment of a cadre of international research specialists in the United States who can respond to the unique research needs of the developing countries.

A research model effective in the more sophisticated U.S. environment is not the model capable of producing optimum results in the poorer countries of the world. The scientific capability of U.S. agricultural scientists is unchallenged, but we must learn to integrate our research with developmental objectives when working in the developing countries. Often no efficient system of knowledge adaptation or transfer is available in the less-developed countries and we must train our development assistance scientists to work more directly with the subsistence farmer.

Wortman and Cummings conclude by describing the shortcomings of U.S. government assistance in agricultural development and by making a number of recommendations to improve our technical assistance. They call for a permanent organization to develop and guide a national strategy for all technical assistance. In addition, they suggest the establishment of a research and study center or developmental "war college" staffed by government and university personnel, which would develop strategies for rapid agricultural development and train agricultural specialists.

The authors' biases do show through in much of the book and one wonders whether they place too much emphasis upon research and the biological components of agricultural development. Nevertheless, the principles evoked are not compromised, and for those biologically inclined, this added weight may seem justified.

One of the most noteworthy aspects of the book is the liberal use of explanatory footnotes and the extensive reference list at the close of each chapter. This documentation, along with a profusion of instructive graphs and tables, sets the work on a scholarly plane and establishes it as an important reference and text in the agricultural development field. A comprehensive index is also provided.

The book should be read and studied carefully by everyone involved with agricultural development. Its contents should be evaluated particularly by decision makers in countries of the developing world and by agricultural officers of donor agencies.

The persuasiveness of the work lies in its carefully researched presentation and in the broad knowledge and extensive experience of the authors Sterling Wortman, president of Rockefeller Foundation's Agriculture Development Service (IADS), and Ralph Cummings, Jr., agricultural economist and IADS program officer.

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