

AGRICULTURAL LAND SETTLEMENT

A World Bank Issues Paper

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SUMMARY

This paper¹ discusses selected issues related to the World Bank's lending for land settlement, based on its own experience and that of other organizations. The presumption is that broad, generally applicable policies can be framed even though most settlements are suited to a particular set of conditions in a country or region.

A relatively simple definition of settlement is used — the planned or spontaneous movement of people to areas of underutilized agricultural potential, both rainfed and irrigated. Planned movement indicates that an organizational entity controls the movement and assists, in various degrees, the efforts of settler participants. Settlement includes the more restrictive term "resettlement," and is roughly synonymous with "colonization" as used in the Latin American context.

The Postwar Experience

Although margins of error undoubtedly are large, recent estimates indicate that the global rate of settlement is 4 million to 5 million hectares annually, or less than 1 percent of the cultivated area in developing countries. About 75 percent of this is spontaneous settlement, while the rest occurs in organized projects, frequently government assisted. The success of these efforts, whether measured in terms of expansion of agricultural output or improved welfare of participants, remains a topic of debate. Evaluation of several projects in which the World Bank has not been involved shows that the economic rates of return are well below the appraisal estimates, and sometimes are below plausible estimates of the opportunity costs of capital. The general record suggests that the more complex and costly government-assisted settlement projects are no more likely to succeed than largely spontaneous settlements. Project success is not closely correlated with money outlays per beneficiary, although a threshold level of physical infrastructure and social services is required. justification for a number of settlement projects rests as much on social or political grounds as on economic considerations.

¹All references to the World Bank in this paper apply also to the International Development Association (IDA), unless stated otherwise. The fiscal year (FY) of the two institutions runs from July 1 to June 30.

Organized settlements in virtually every country where they have been attempted have created employment for only a small portion of the increase in the rural labor force. Perhaps the best record is in Malaysia, where government-assisted settlement has been a major source of new jobs in recent years while absorbing nearly 50 percent of the government's development expenditure for agriculture. In Latin America, government settlement projects in the past two decades may have created jobs for only about 2 percent of the rural population increase.

Bank Lending for Settlement

In the fiscal 1962-75 period, the World Bank committed \$429 million for 28 settlement projects—or an average of about 5 percent of total agricultural lending, ranging from zero in some years to 14 percent in fiscal 1974.² Encompassing a total area of about 1.4 million hectares, these 28 projects are expected to provide direct benefits to some 134,000 families. About 53 percent of the lending has been for wholly rainfed settlement and the balance for projects with an irrigation component. Malaysia accounts for about 57 percent of all Bank lending for rainfed settlement, although the Malaysian projects account for only 18 percent of total direct beneficiaries in Bank-assisted projects of this type.

Project costs per direct beneficiary family, in terms of 1975 US dollars, range from less than \$1,000 in small-farm rainfed settlements in Rwanda's Mutara and Ethiopia's Lower Adiabo projects to more than \$20,000 in Malaysia's Keratong project. Costs per hectare for settlements with an irrigation component are nearly four times those in rainfed settlements, while costs per beneficiary family are more than twice as great. The ratios of projected incomes of project beneficiaries to average rural incomes within the country are one measure of a project's equity dimension. They range from about 0.6 in Ethiopia's Wolamo project to 8.3 in Malaysia's Keratong project. Projections of annual net per capita cash income of beneficiaries at full development range from \$20 to \$30 for Mutara in Rwanda and Wolamo in Ethiopia to about \$550 in Keratong in Malaysia and in Zambia's commercial crops project.

Because most Bank-assisted settlement projects have not reached full production, evaluation is tentative. It is estimated that the economic rate of return of Papua New Guinea's Agricultural Development I project is 19 percent, while the appraisal estimate was 9 percent. For the Trinidad and Tobago Crown Lands project, the esti-

² The analysis here is limited to settlement projects supported by the World Bank in fiscal 1962-75.

mated return was approximately zero; the appraisal estimate was 10 percent. Estimates of economic returns in Colombia's Caqueta I, Malaysia's Jengka I, and Senegal's Terres Neuves I projects at mid-term do not differ greatly from the 13 percent to 16 percent range at the time of appraisal.

Major common problems are in management and staff inadequacy, organizational deficiency, overambitious physical targets, underestimates of development costs, and difficulties of cost recovery. While none of these problems is unique to settlement, technical and organizational uncertainties surrounding such projects frequently are greater than in other agricultural projects. On balance, the results of Bank-assisted projects appear to be superior to those of other settlement projects.

The Future

On the basis of present technology, the world's "ultimate potential" arable land area is estimated at about 2,501 million hectares. Some 1,430 million hectares were cropped in 1970. Of the remaining 1,071 million hectares, most are in Latin America (459 million hectares) and tropical Africa (190 million hectares). The majority of developing countries elsewhere also have some land suitable for settlement. Although some 800 million hectares of the land available for settlement are in the humid tropics, the area suitable for sustained agricultural production appears to be considerably smaller. The potentially irrigable area is estimated at nearly 500 million hectares, some of it already settled under rainfed agriculture, compared with 205 million hectares that was under irrigation in 1970. Most of the potential for expansion of irrigation is in Asia and the developed countries.

The uniformly high temperatures, abundant solar energy, and moisture in the humid tropics provide an environment favoring rapid plant growth. But these conditions also create complex soil management problems which must be solved before the full agricultural potential of the new lands can be realized. A program of adaptive crop research to meet the particular needs of these lands can help produce crop varieties, both food and nonfood, which incorporate a wide spectrum of resistance to pests and diseases and also provide economical returns under simple management systems.

Government-assisted settlement of new lands can make a substantial contribution to a rural development program in which accelerated growth of agricultural output and employment creation are important objectives. But to do this will require a larger settlement program than any undertaken in most countries. Such a program

must be replicable and, therefore, have low unit costs. Regardless of such efforts, measures to improve agriculture in already settled areas will continue to be the major means to achieve rural development objectives.

Approaches to organized settlement range from the efficient development of the natural resources in a project area by means of highly organized, relatively capital-intensive projects, to those which place primary emphasis on creating employment for more people in relatively simple, low-cost projects. Both approaches have been used in Bank-assisted settlements, although most World Bank funds have gone to projects in which efficient development of natural resources is the dominant objective.

The World Bank's settlement experience points to a number of general conclusions and recommendations:

- As man/land ratios in already settled areas continue to increase, the numbers of those seeking a livelihood in new lands are likely to rise. Consistent with Bank policies, a major part of the Bank's settlement lending can be viewed as support for a particular form of rural development projects which focus on the rural poor. Carefully designed projects of this type could generate attractive economic and social returns in countries with underutilized lands and a growing rural population. However, rapid increases in output frequently are achieved most efficiently by measures that intensify production in already settled areas. Where underutilized lands exist in settled areas, land reform measures should be supported as an adjunct to new land development.
- The extent of the Bank's involvement in future settlement activity is likely to be small in relation to total investment needs. Its contribution will be measured less by the volume of lending than by the type and quality of the settlement activities supported. The settlement projects the Bank assists should be viewed as prototypes for emulation elsewhere, or as experimental projects from which valuable experience may be derived. A major reason for Bank involvement is to develop approaches which avoid the most serious socioeconomic and ecological problems of spontaneous settlement.
- Future settlement activities should be viewed within a comprehensive development framework which recognizes the need for careful use of all resources in the project area. Bank support for settlement activities is conditioned on assurances that the welfare of the indigenous population will be protected, and that

longer-term environmental impacts will be carefully considered and protective measures taken. Projects should be designed to ensure that timber resources, including commercial timber and fuelwood, are used efficiently.

- The reduction of poverty and scarcity of investment funds will continue as basic considerations in the Bank's choice of projects within and among countries. Where large numbers of the rural landless and a growing rural labor force require that productivity of as many of the rural poor as possible be raised, Bank assistance for settlement projects can be justified in most cases only if costs per beneficiary are relatively low. Setting appropriate income targets, which take account of differences in national income levels, and determining the essential needs of settlers will help to formulate acceptable projects. Current policy also provides for Bank support of more traditional agricultural projects which focus primarily on increased output and improved balance of payments and for which unit costs are lesser concerns.
- The Bank has to be highly selective about the type of settlement projects it finances. It has to seek both satisfactory economic rates of return and the broader goals of employment creation and improved income distribution. Depending on country conditions, the latter objective may limit lending for high-cost projects and divert additional resources to suitable lower-cost projects, thereby spreading the benefits to larger numbers of the poor.
- Where both rainfed and irrigated settlements are technically feasible and economic returns are approximately equal, the generally lower capital/labor ratio for rainfed settlement would favor investment in such projects. Where irrigated settlement is the only technically feasible option, smaller-scale, less capital-intensive (and, frequently, more rapidly maturing) projects may be preferable to large, complex, capital-intensive ones. Additional experience with small-scale irrigation in settlement areas is needed.
- Successful settlement of large areas in the semiarid and humid tropical zones requires improved small-farm technologies and farming systems. Besides continuing support for the international agricultural research centers, national research and extension activities which bear on these problems need to be assisted. It is also necessary to support strongly programs to control or eliminate human and animal diseases which prevent full use of the remaining lands with agricultural potential.

- The Bank's experience with low-cost settlement in the humid tropics of Africa and Latin America is limited. Because these areas have the greatest potential for future settlement, support for some experimental settlement activities in them to identify projects and to gather social, economic, and technical information required for successful development will be considered.
- A modest expansion of the Bank's program of lending for land settlement is justified on the basis of opportunity and need.

Some specific conclusions and recommendations for the design of settlement projects assisted by the World Bank are:

1. Income targets for project beneficiaries have to be carefully chosen to avoid creating rural elites and to extend the benefits of projects to as many people as possible. Because incomes are generally positively correlated with project costs, appropriate income targets influence project design. The preferred income target is a level comparable to what others in the particular country's labor force, having similar aptitudes, skills, and experience, earn. In general, this suggests an income target in settlement moderately above incomes of prospective settlers in their area of origin, to reflect the risk and disutility of pursuing this new and uncertain means of livelihood. A target income at project maturity approximating expected average rural incomes at that time would normally provide adequate incentive and reduce the possibility of creating privileged groups.

2. The size of holdings should be determined in large part by the desired income level. To determine the size, the objective of full use of family labor is an important but secondary consideration; some underemployment in the settlements may be inevitable, where land is scarce and the number of settler candidates is large.

3. Settlement projects should be designed to provide an opportunity for betterment to the family willing to make the effort. It is preferable to choose those who volunteer rather than to recruit vigorously, because successful settlement depends, to a large extent, on the motivation and character of the settler family. Self-selection helps to ensure that a large proportion of settler families are landless and have limited economic opportunities elsewhere.

4. A two-phase approach for settlement projects is recommended to provide quick access to land for a significant number of rural families while minimizing heavy expenditure early in the development period. The first phase includes mapping and resource inventory work to ensure sound land use and to determine appropriate income levels. Careful assessment of the physical resource base is a critical first step. Sufficient financial, technical, and administrative

support, including rural credit, must be provided to reach production levels necessary for viable settlement. The second phase is characterized by an expanded effort by the settlement agency to provide the supporting services for increased production, incomes, and settler welfare.

5. Efficient systems of land clearing should be employed, with as much emphasis on self-help as is realistic and consistent with maintaining appropriate living standards during the initial period. With all inputs priced at their real economic cost, manual clearing methods may be favored in many circumstances. Damage to the soil structure and accelerated erosion from mechanized clearing are risks to be avoided; these considerations also may favor labor-intensive methods.

6. As outlined in *Rural Development, World Bank Sector Policy Paper* (February 1975), the level of social services provided in rural projects should be consistent with standards elsewhere in the country. These services should be the least costly among effective alternatives. Adequate water supply, education, and basic health services, all amenable to upgrading as incomes rise, can be included. Government support for housing should be limited to help with site selection and planning, provision of building materials on credit (when not available on site), issuance of simple building plans, and technical assistance.

7. Ability to pay is an important consideration in establishing cost-recovery policies for settlement projects. Because cash flows from the holdings will be relatively low and be realized after considerable time lag, and because, if properly selected, beneficiaries will be from the lowest income classes, a modest element of subsidy is probably necessary and justified.

8. The tenure system adopted in settlement projects should promote efficient use of resources and serve the borrowers' income distributional goals. Security of tenure is essential. Subdivision of holdings should be strongly discouraged. The extent of land rights accorded to settlers should be directly related to their contributions to land development. In most cases, individually owned and operated farms are the most productive and efficient, and foster the settlers' entrepreneurial development. Experimentation can be encouraged with less orthodox tenure forms and systems that build on indigenous tenure arrangements and help achieve broadly oriented development objectives. Long-term leasehold arrangements may provide a desirable element of flexibility in land management. Where economic efficiency and equity can be ensured, public sector estates

or privately owned nucleus estates with smallholder outgrowers may be an appropriate means to achieve the Bank's and borrowers' development objectives.

9. All reasonable efforts should be made to strengthen the capabilities of an existing government agency or department and entrust it with responsibility for implementation of settlement projects. If this is not possible, a semiautonomous administrative entity may be needed to coordinate essential services from established government departments. Project design should phase out the settlement authority as the project matures.

10. Land settlement projects call for exceptional perception, experience, and continuity among the staff. In most cases, the terms of service required to recruit and retain staff of this caliber must be more attractive than those available to the typical civil servant residing in an urban center.

11. Not all settlers and their offspring will remain in agriculture, in part because of the limited economic possibilities they perceive to exist there, and in part due to the wider range of nonfarm employment and social services believed to exist elsewhere. Therefore, settlement should be designed to provide (a) off-farm employment for the initial and subsequent generations of rural workers, and (b) a wide range of social services at reasonable cost. Relatively large, nucleated settlements generally can provide employment in a wider range of secondary and tertiary activities and support a greater array of social services than smaller settlement schemes with geographically dispersed housing sites. Where land availability and proposed farming systems permit, larger nucleated settlement patterns are to be encouraged.

12. The problem of reconciling adequately economic efficiency and distributional goals in the design of settlement projects could be better handled if the appraisal of future settlement projects were done differently, i.e., by taking into account not only financial and economic returns but also social returns. One approach to this problem is the Bank's new project appraisal methodology, presently being tested.

Chapter 1: THE POSTWAR EXPERIENCE

To accommodate rural population growth and to meet food and agricultural raw material needs, some combination of new land development and more intensive production in already cultivated areas is necessary. The relative importance of either approach varies from country to country and over time within a particular country. Typically, in countries having large land reserves with agricultural potential, new land development has been the principal source of increased output. In land-scarce as well as more developed countries, increased output per unit of area has been relatively more important. Among developing countries, the rate of area expansion slowed in the post-World War II period. This probably reflected declining reserves of accessible arable lands and lower returns from new land development compared with those obtained by applying high-yielding technologies to already cultivated areas.

In a growing number of countries, the lack of significant land reserves precludes consideration of settlement as a major part of a rural development strategy. But where supplies of unused arable land exist, the relative efficacy of these two approaches continues to be a topic of debate. Proponents of new land development point to these reserves, to growing population pressures, burgeoning numbers of rural landless, and continued spontaneous migration as evidence of the need for government-assisted settlement.

Those who favor production intensification in already settled areas cite, as reasons, the mixed record of previous land development efforts, increasing land scarcity, formidable problems of physical access to new and often economically marginal lands, and the recent development of relatively simple production technologies well-suited to older, cultivated areas.

This paper, drawing on past experience, examines possible future World Bank activities in land settlement.¹ Even though most settlement projects are unique and are carried out in a wide variety of

¹ The literature on land settlement is extensive. Among the comprehensive studies are: Robert Chambers, *Settlement Schemes in Tropical Africa* (New York: Praeger, 1969); John C. de Wilde et al., *Experiences with Agricultural Development in Tropical Africa*, Vols. I and II (Baltimore and London: The Johns Hopkins University Press, 1967); and Michael Nelson, *The Development of Tropical Lands: Policy Issues in Latin America*

agroclimatic conditions, broad, widely applicable policies can be recommended.²

Definitions

Rural settlement projects vary greatly in purpose, character, and size. Settlement objectives, not always specified in project documents, generally concern production, income, and employment, but frequently include such varied elements as famine relief, mass relocation, tsetse fly clearance, consolidation of national boundaries, and furtherance of ideological goals. In some places, settlement programs have been used to divert public attention from the need for more difficult political reforms in the land tenure system.

Settlement types range from state farms with massive infrastructure and extensive social welfare elements to individual smallholdings carved from the jungle by settlers' efforts. Project areas and costs per beneficiary show a similar wide variation. Extensive typologies have been proposed to cover these variations, but none is completely satisfactory. One useful element in classification is the degree and type of government involvement in settlement activities.

Rural settlement is generally defined as the planned or spontaneous movement of people to areas of underutilized agricultural potential. This definition includes development of both rainfed and irrigated agriculture. While land settlement most often takes place in virgin lands, it sometimes includes land used by nomadic herds-men and shifting cultivators which, with better management and infrastructure, can support more intensive agricultural production. This definition does not include development efforts to raise productivity and welfare in lands already intensively used.

Settlement may include a wide variety of farm types ranging from state farms through collective or cooperative endeavors to individual smallholdings. The element of planning implies that an organizational entity controls the movement and assists, to varying degrees, the efforts of settlers. The term "settlement" includes the more restrictive term "resettlement" and is roughly synonymous with "colonization" as frequently used in the Latin American context.

(Baltimore and London: The Johns Hopkins University Press, 1973), published for Resources for the Future, Inc. This paper draws heavily on the Latin American experience as described and analyzed by Nelson.

Studies of settlement in Asia are less extensive. An interesting older work on the Philippines and Indonesia is Karl Pelzer's, *Pioneer Settlement in the Asiatic Tropics* (New York: American Geographical Society, 1945).

² Land settlement is a multifaceted activity carried out in very diverse social, economic, and physical environments. This paper, however, can deal only with a selected number of issues.

Past Role of Settlement

Area and output. Land settlement, as defined here, is largely a phenomenon of the post-World War II period, although some government-assisted efforts can be found in the history of nearly every country. The decade following World War II marks the period of greatest interest in, and national and international support for, planned settlement in areas with substantial land reserves. No reliable, comprehensive global estimates exist of new lands brought into production during this period. However, there is no doubt that the extension of cropped area has been a major source of agricultural growth in Latin America and Africa and, to a lesser extent, in Asia. Most of this increase came through extension of rainfed development. However, in several countries, reduction in fallow areas and expansion of double-cropping contributed significantly to this growth.

Development of new lands continues, although generally with less government enthusiasm than in earlier years. With few country exceptions, the land area cleared and developed in government-assisted settlement is very much less than that developed through purely spontaneous settlement. A recent estimate of the present annual rate of settlement is 4 million to 5 million hectares of which 75 percent is spontaneous and 25 percent organized land development.³

The extent of success. The criterion by which to judge "failure" or "success" of planned settlement projects is itself a subject of debate. Two standards frequently used in evaluation of settlement projects are: (1) the extent of significant gains in agricultural output relative to resources spent on a project; and (2) the extent to which settlement activities contribute to socioeconomic objectives of which improved income distribution and employment creation are the most important. Evaluations of an earlier period were generally made in terms of economic growth or output criteria; these standards continue to figure prominently, although socially oriented objectives are increasingly stressed.

Successful settlement is that which creates employment and builds efficient production systems on underutilized lands. Its goals should be (1) to generate equitable income and welfare levels for settlers;

³ United Nations Secretariat, *The World Food Problem: Proposals for National and International Action*, E/CONF 6514 (New York, November 1974), p. 64. The margins for error are wide. Another view is that in Latin America alone 5 million to 10 million hectares are cleared annually for agriculture. See, Food and Agriculture Organization of the United Nations, *Wood: World Trends and Prospects*, FAO Basic Study No. 16 (Rome, 1967), pp. 53, 54.

(2) to foster social justice; and (3) to ensure long-term productivity of natural resources in the project area.

The contributions that government-assisted settlement projects have made to agricultural output and improved welfare of participants remain conjectural. Projects, examined in detail, present a mixed picture—some notable "successes" as well as "failures." Typically, evaluation of settlement projects three to five years after the start of implementation shows economic rates of return at least 50 percent below those in project appraisal documents. A large proportion of technically and economically successful projects has been based on commercially oriented monocultural farming systems that use technologies proven in the estate sector.

A study of a number of post-World War II settlement projects in Africa, none of which were assisted by the Bank, concludes that in "social and economic terms" the record is discouraging.⁴ Serious implementation problems plagued projects in both the pre- and post-independence period and affected all types of projects ranging from individual smallholder schemes to large state farms. Irrigation settlement schemes appear more prone to failure than settlement projects in rainfed areas. A majority of irrigation projects in Eastern Africa continue to experience difficulties, after absorbing large quantities of money and scarce trained manpower over several years.

The record in Latin America, with more than 100 government-supported settlement projects in the past three decades, may be no better. A recent study, perhaps the most extensive and thorough of its kind, of 24 settlement projects ranging from spontaneous to highly planned and directed ones, examines their effect on employment and their economic viability.⁵ Eight projects are classified as "dynamic," seven as "acceptable," and the remaining nine as "poor." Significantly, no projects with extensive government assistance ("directed colonization") appear among the "dynamic" group. Inadequate technical and administrative capacity in the implementing agencies is identified as the major factor behind this disappointing performance.

Six of the nine settlement projects rated "poor" received extensive public-sector support. On the other hand, three of the eight "dynamic" projects are largely spontaneous settlements, while the other five are either private (domestic or foreign) ventures or received limited government assistance. Moreover, the proportion of "successful" settlements in this sample is biased upward since no com-

⁴ Chambers, *Settlement Schemes*, p. 7.

⁵ Nelson, *The Development of Tropical Lands*, p. 261 ff.

plete failures are included. The study concludes that few spheres of development have a history of—or reputation for—failure to match that of government-sponsored colonization in the humid tropics.

Some of the major problems of settlement are: (1) the agronomic outcome is unusually risky, relative to that of development projects in established areas where the potential is more fully known; (2) settlement projects are particularly susceptible to political manipulation because they entail highly "visible" allocation of people and land; (3) government-assisted settlements demand large inputs of scarce qualified manpower with high opportunity costs; (4) settlements are generally characterized by long gestation periods required to build minimal new infrastructure in the project area; (5) possibilities of earning government revenues or recovery of significant portions of public expenditure are limited because projects often settle landless families at little more than subsistence levels; and (6) spontaneous or low-cost assisted settlements frequently result in adverse environmental effects.

Settlement and Rural Labor Force Growth

The impact of organized settlement on employment creation in most countries has been small relative to the growth of the rural population. For example, in Kenya, where settlement has been a prominent part of rural development, the number settled in all schemes over a recent decade is estimated at about 34,000 families, or perhaps slightly more than one-quarter of a million people. The annual increase in the rural population of 9 million growing at the rate of 3 percent a year, is roughly equal to the numbers settled over this 10-year period.

This situation is not unique. In Indonesia, the number of families settled under all organized schemes over the past 20 years is about 150,000 or perhaps less than one million people. During this period the rural population of Java alone probably increased by 20 million. In Nepal, an estimated 7,000 families settle spontaneously each year in the less densely populated Terai. Since 1965, the Nepal Settlement Company has settled a total of 4,300 families. The Bank-assisted Terai Settlement project is to settle 7,900 families over seven years.

In Malaysia, where settlement activities have absorbed nearly 50 percent of public sector development expenditures for agriculture in recent years, a more favorable picture emerges. In peninsular Malaysia, some 800,000 hectares were developed in 1961-75 and planted largely to rubber and oil palm. This development, adequate to provide approximately 2 hectares per new entrant to the agricultural labor force during that period, has been a major source of

employment in the agricultural sector (about 100,000 new jobs for settler families in 1971-75). Despite this large effort, in 1975 the waiting list of applicants to Malaysia's settlement schemes totaled about 30,000 families. The program has been viewed as technically and economically efficient but of limited effectiveness in reducing poverty.

In the Latin American tropics over the past 20 years, about 40,000 families received government assistance to move into settlements while an equal number already in the project area may have been assisted indirectly. The rural population of the countries where these settlements are located increased by some 25 million during this time. Thus, government settlement projects have involved only about 2 percent of the rural population increase. In one view, these projects are considered to have made no significant contribution to rural welfare.⁶

Although there is a growing appreciation of the shortcomings of settlements, support for them continues, in part because of their political appeal, in part to pursue the search for economically sound programs and, occasionally, to avoid the adverse social and ecological effects of spontaneous development. The justification for public land settlement today, as in the past, rests on a combination of political, economic, and ecological grounds.

⁶ Nelson, *The Development of Tropical Lands*, p. 198.

Chapter 2: SCOPE FOR FUTURE SETTLEMENT

A key determinant of the scope for future settlement is the extent of suitable underutilized land. A precise estimate of this area is difficult to make, both because of incomplete knowledge of the world's soils and because suitability is determined in part by technologies which permit successful exploitation of those resources. Technology will vary from country to country and over time, depending on research and development efforts.

the Land Resource

The Indicative World Plan (IWP) prepared by the Food and Agriculture Organization of the United Nations (FAO), and its subsequent revisions, are among the most comprehensive attempts to estimate the quantity and quality of the world's soils. According to the IWP, about 15 percent of the total land surface in the developing countries is used for annual or permanent crops, with the proportion ranging from less than 10 percent in Latin America and the Europe, Middle East, and North Africa (EMENA) region to approximately 40 percent in Asia. Some 20 percent of the land area in developing countries is under permanent pasture and 30 percent is forest. The remaining 35 percent is either vacant, is in difficult topographic or climatic zones, or is used for nonagricultural purposes.

On the basis of FAO data, the world's arable land area (including land in permanent crops) is estimated at about 1,430 million hectares as of 1970 (see Table 1, page 20). Using FAO soil and climatic data and assuming the availability of the best technology presently known, the world's "ultimate potential" arable area is estimated at 2,501 million hectares.¹ Cultivated land in 1970 was about 57 percent of

¹ Alan M. Strout, *World Agricultural Potential: Evidence from the Recent Past*, Discussion Draft, Massachusetts Institute of Technology Energy Laboratory and Resources for the Future, Inc. (March 1975). Estimates of potentially arable area vary widely. The US President's Science Advisory Committee in *The World Food Problem* (Washington, D.C.: US Government Printing Office, 1967), p. 434, gave a figure of 3,189 million hectares. This estimate was used in Dennis Meadow's work for the Club of Rome. More recent work by scientists at the Agricultural University, Wageningen, Netherlands, based on newer information and detailed country analysis, puts the world's potentially arable area at 3,149 million hectares and quotes an estimate by Russian soil scientists that 5,000 million hectares could be cultivated. See P. Buringh, H. D. J. van Heemst, G. J. Staring, *Computation of the Absolute Maximum Food Production of the World* (Wageningen, January 1975), pp. 4, 47. The significant point is that the ratio of potentially arable to presently cultivated land is large, probably about 2:1, although the possible intensity of land use in the new areas will require further study.

the world's total potentially arable land. Latin America contains an estimated 459 million hectares of land not now cultivated or under permanent crops, and tropical Africa, excluding Nigeria, has about 190 million hectares suitable for cropping. Together, these two regions account for 60 percent of the world's estimated reserve of arable land and about 74 percent of reserves in the developing countries.

Table 1

**Estimates of the World's Arable Land in 1970
and Potential Increase**

Region (1)	Arable land plus land in permanent crops	Ultimate potential (millions of hectares)	Potential increase	Ultimate potential as percentage of 1970 base	Distribution of potential increase (%)
Developed countries (2)	660.5	854	193.5	129	18
Latin America	126.8	586	459.2	455	43
Middle East/Africa I (3) (oil producers)	58.6	87	28.4	148	3
Middle East/Africa II (4) (generally arid)	83.2	161	77.8	195	7
Africa (other, tropical)	92.1	282	189.9	306	17
Centrally planned Asia (5)	130.7	201	70.3	154	7
Asia (other)	278.2	330	51.8	119	5
Total	1,430.1	2,501	1,070.9	175	100

(1) Comprises a sample of 125 countries. Countries with extremely limited agricultural potential and island and city states are excluded.

(2) Australia, Canada, Europe (Eastern and Western), Japan, New Zealand, South Africa, United States, and USSR.

(3) Algeria, Iran, Iraq, Libya, Nigeria, and Saudi Arabia.

(4) Chad, Arab Republic of Egypt, Ethiopia, Israel, Jordan, Lebanon, Mali, Mauritania, Morocco, Niger, Somalia, Sudan, Syrian Arab Republic, Tunisia, and Upper Volta.

(5) China (including Taiwan), Mongolia, Democratic People's Republic of Korea, and Viet Nam.

Source: Arranged from data in Strout, *World Agricultural Potential: Evidence from the Recent Past*.

Similar estimates have been made from FAO data for irrigated areas of the world (see Table 2). In 1970, more than 200 million hectares were irrigated, of which about two-thirds were in South and East Asia. The potentially irrigable area is estimated at nearly 500 million hectares, of which more than half is in Asia and 20 percent in the USSR. The largest percentage potential increase is estimated for the USSR.

These estimates contain several noteworthy features:

I. While the figures are subject to considerable error, the area of underutilized potentially arable land throughout the world is large relative to the land area now cultivated. However, the area capable

Table 2

**Estimates of the World's Land Area under Irrigation in 1970
and Potential Increase**

Region (1)	Land under irrigation	Ultimate potential	Potential increase	Ultimate potential as percentage of 1970 base	Distribution of potential increase
----- (millions of hectares) -----					
Developed countries	47.9	175.3	127.4	366	44
(USSR)	(11.0)	(100.0)	(89.0)	(909)	(31)
Latin America	10.3	27.9	17.6	271	6
Middle East/Africa I	7.0	15.7	8.7	224	3
Middle East/Africa II	5.5	12.1	6.6	220	2
Africa (other, tropical)	1.2	8.4	7.2	700	2
Centrally planned Asia	77.8	123.1	45.3	158	16
Asia (other)	55.9	131.8	75.9	236	26
Total	205.6	494.3	288.7	240	100

(1) Country classification is the same as in Table 1.

Source: Arranged from data in Strout, *World Agricultural Potential: Evidence from the Recent Past*. A more recent estimate for the area under irrigation in 1970, prepared by FAO for the UN Water Conference in 1977, is 224.5 million hectares. Almost the entire difference in the estimates is accounted for by a larger figure in the newer estimate for "Asia (other)."

of sustained production remains a matter of speculation. FAO technicians estimate that only about 15 percent of the Amazon basin is suitable for sustained agriculture, including fallow lands. The proportion in central Africa is considered to be higher. In all regions, most new arable lands are likely to be more suitable for tree crops than for annual food crops. Typically, estimates of underutilized agricultural lands overstate the economic possibilities for development with present and foreseen technologies.

2. The possibility of expanding cultivated area varies widely among countries. The largest areas of potentially arable lands not yet cultivated, although in many cases already under livestock or forestry exploitation, are in the Latin American and African tropics. Possibly as many as 800 million hectares, or nearly 75 percent, of the underutilized potentially arable lands lie in the humid tropics within about 25 latitude degrees of the equator.²

3. Elsewhere, such as in South Asia, some countries of East Asia, the Eastern Mediterranean and North Africa, certain parts of Latin America (the Andean highlands), and Western Africa (areas in the Savannah zone), there is little scope for expansion of the land area.

² National Academy of Sciences, *Soils of the Humid Tropics* (Washington, D.C. 1972), p. 2.

Here, the thrust of future agricultural development must be directed to more intensive land use in already cropped areas.

4. The increase in the potentially irrigable area in relative terms, i.e., as a percent of the 1970 base, is very much larger than the possible relative increase in the total arable area. However, in absolute terms, the potential increase in the amount of cropped area possible through irrigation, about 290 million hectares, is less than one-third as large as the arable land increase.

5. The relative increase in potentially irrigable areas is large in all regions, although the absolute increase is small in Africa and Latin America.

Research Needs

Development of most remaining underutilized or vacant lands is hampered by one or more constraints, i.e., lack of physical access and unfavorable economics related to distance, the presence of debilitating animal or human diseases, difficult climate or topography, and soils of limited productivity under cropping and management systems known to potential settlers. Some of these constraints, such as those related to physical access, can be overcome with the application of presently available technology and capital expenditure. Other constraints, particularly those related to soil management and cropping systems, require additional time and, in some cases, a stronger agricultural research effort.

Until recently, relatively little research was directed to problems of small farm systems in the humid tropics. Research is under way on several of these problems at international and local research centers. The International Institute of Tropical Agriculture (IITA) in Nigeria and the International Center for Tropical Agriculture (CIAT) in Colombia are examining problems of agriculture in humid tropical areas, while the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India has begun work on problems of crop production in low rainfall areas. Additional efforts are needed to develop (1) productive linkages among national and international research centers; (2) complementary adaptive research in national research programs; and (3) effective extension channels to communicate research results to settlement farmers.

Additional work on effective management of tropical soils is among the highest research priorities for settlement. In this environment of high temperatures, abundant solar energy, and moisture, microbiological and chemical activities are accelerated, leaching of nutrients is increased, and problems of soil structure, seasonal waterlogging, and erosion become more serious. The management of soils and

crops in the tropics, where the bulk of future settlement will occur, is profoundly different from and much more difficult than in the temperate zones. This complicates the transfer of agricultural technologies from temperate to tropical zones. In large areas of the Amazon basin, where soils are badly leached, the initial research and management efforts must be to restore and retain basic fertility.

A strengthened program of adaptive crop research to meet the particular needs of cropping programs in the new lands also is of high priority. Breakthroughs in cereal production technologies in the past decade have been largely in wheat, maize, and irrigated rice. The successful application of these technologies usually requires plant protection, high levels of management, and controlled water application. These conditions do not exist in most areas where low-cost settlement may be expected. Crop varieties, both food and non-food, are needed which incorporate a wider spectrum of resistance to pests and diseases, and which provide economic returns under less sophisticated management systems. Over the medium and longer term, research efforts should concentrate on ways to improve the biological efficiency of crop varieties, so that there may be less dependence on the purchased inputs in areas that have poor physical and social infrastructure.

Past agricultural research in tropical areas has focused primarily on export or industrial crops. Except for rice, research on less widely known cereals and other food crops has received less emphasis. This deficiency is being corrected through expanded research efforts at international and national centers on several crops likely to be important in future settlement areas. These crops include tubers and root crops, upland rice, sorghum and millets, pulses, oilseeds, oil palm, and hybrid dwarf coconut. While beef production technologies for the tropics are quite well developed, research on forage and pastures in tropical soils should be strengthened, and possibilities explored to develop intensive agricultural systems in which the first stage is livestock production. In semiarid areas, additional research on drought-resistant legumes and grasses is required. Socio-economic studies of farming systems in settlement areas are essential both to design settlement projects and to guide agronomic research.

Chapter 3: POLICY ISSUES

Agricultural projects, typically, consist of traditional single-component, commodity-oriented projects which emphasize economic efficiency, improved balance of payments, and technically sound agricultural resource development. As explained in the previously mentioned Rural Development paper, Bank lending in the rural sector was to be divided equally between agricultural projects and rural development projects. The latter are defined to focus on the rural poor, i.e., where at least half of the beneficiaries are "poor," according to specified criteria. Land settlement schemes are considered a promising form of rural development projects.

The Policy Framework

To ensure that half of Bank rural sector lending goes to rural development projects, increased efforts have been made to develop projects which reach large numbers of the rural poor, are low in cost per participant relative to benefits, and provide an economic return at least equal to the opportunity cost of capital. Low capital cost per beneficiary is not by itself a criterion for a good project, but it is an important element in designing projects that reach large numbers of the rural poor.

The Bank's rural sector lending in the period, fiscal 1975-79, is to benefit 100 million people, of whom 60 million are in the poverty target group. Lending for groups other than the rural poor is permitted where it can be justified on grounds of urgent domestic food needs and/or balance of payments considerations. Current policy also supports resource-oriented projects in which development costs per beneficiary are lesser concerns. However, capital constraints on the Bank's lending may continue and the Bank will remain deeply concerned about distributional issues. therefore, this paper assumes that capital constraints and distributional objectives are fundamental considerations in the design of the World Bank's future lending program in rural areas.

Approaches to settlement. At the extremes, two approaches to land development may be envisaged. One has as its major objective efficient development of the natural resources in the project area.

Typically, capital-intensive development and production techniques are used to realize high yields as quickly as possible. Production efficiency and attractive financial returns dominate project objectives. Employment creation and development of human resources are concomitants of this approach, though often considered of secondary importance.

The other approach to land settlement has a stronger social orientation of project objectives, with greater emphasis on employment and income distribution goals. The pace of physical development is slower, but settlers are more heavily involved both in decision making and labor contribution. Cash inputs and yields per hectare may be lower, agricultural support and social services provided by government are minimal, and public sector costs per beneficiary relatively low.

World Bank projects are found along a continuum between these two approaches. Some, such as the Terres Neuves II, Alto Turi, and Terai settlement projects, represent an effort to encourage maximum settler participation, limit financial costs, and ensure replicability because of financial and trained manpower constraints. Others, such as those in Malaysia, recognize employment and distribution aspects, but incur the higher costs considered essential for technical and financial success. The first category of settlement projects is a special type of rural development project in which low costs help to achieve distribution objectives. The second type of settlement projects falls in the category of orthodox agricultural projects, where cost per direct beneficiary is a less important consideration in project design.

Unit costs as decision criteria. Low project cost per direct beneficiary is not a fully satisfactory criterion for defining good projects or for use in allocating Bank funds. By itself this criterion is incomplete and potentially misleading; low costs alone do not ensure achievement of distribution objectives, and benefits to indirect beneficiaries, potentially important in some agricultural projects, are not taken into account. But despite its deficiencies, the unit-cost guideline is a convenient device for dealing with the problems raised by capital scarcity and the policy objective of reaching large numbers of people. A careful estimate of public sector costs per beneficiary family should be part of the preparation of every settlement project.

A proposed new Bank methodology in social cost-benefit analysis offers a more comprehensive and theoretically satisfactory basis to incorporate distribution goals in project selection. Bank concern with distribution issues adds support to this methodology which is now being tested.

The World Bank lending program reflects a continued sensitivity to the need for both economic efficiency and a judicious use of funds so as to benefit as large a number of the rural poor as possible. Country differences in natural resources and income levels will result in a great diversity of project types and unit costs.

For every project, an adequate rate of return is a necessary condition for acceptance. Low cost per beneficiary, relative to unit costs in alternative agricultural development projects, is not necessarily to be preferred, but a high-cost project must be given special scrutiny to determine its appropriateness for Bank support. The Bank may find itself unable to help finance land settlement projects which, although economically sound with respect to output, fail to meet distribution criteria or, equally important, are indefensible when competing uses of funds are considered. The fungibility of Bank funds among projects and countries is a major factor behind this stress on unit costs.

Because physical infrastructure is lacking, public sector costs per direct beneficiary in new settlement areas are likely to be higher than in already cultivated areas. Costs per family in irrigated settlement or tree-crop agriculture will probably also be relatively large. Such projects may be acceptable to the Bank for the reasons noted earlier, although unusually costly projects may have to be discouraged.'

¹ The Indonesia Transmigration project, approved in fiscal 1977, may provide valuable experience in settlement projects for the humid tropics. The objectives of the project are to reduce population pressure on Java, Madura, and Bali and to develop the natural resources of the outer islands. Basic criteria employed in project design are: (1) potential family income for transmigrants should be adequate to attract settlers who are capable and energetic, but landless; (2) government benefits to settlers should not be excessive relative to those provided to other Indonesians; (3) adequate incentives must be offered to elicit settler effort and involvement in project development; and (4) the cost to the government must be at a level to permit the settlement of several thousand families per year over an extended period. Despite considerable ecological similarities in the project areas, the Indonesian Government rejected the approach followed in neighboring Malaysia on grounds of high costs. The project will develop 5-hectare holdings for rubber and food crop production. During the first three years, the settlement agency will help establish an initial 1 hectare of rubber which will be intercropped to provide immediate food needs and limited income for the settler. Thereafter, the settler may continue to increase the area planted to rubber or food crops, at a pace decided by individual drive and ability, until the 5 hectares are under production. The settlement authority will arrange to clear and prepare the land for the first 1 hectare of rubber, provide high-yielding planting material, and ensure a high standard of planting and maintenance. The farmer will intercrop with rice and legumes. All inputs will be provided in kind. The holding is expected to provide the settler family with a net income at project maturity of \$800 to \$1,000 per year. Institutional credit will be available to assist in developing the remaining 4 hectares. Government expenditures per family are estimated to total approximately \$5,000, including about \$400 for project administration, \$2,000 for infrastructure, and \$2,600 for onfarm investment. Full amortization of the \$5,000 is not considered desirable, nor would it permit the income target to be achieved.

New Settlement versus More Intensive Land Use

The proper balance between investment in new land development and more intensive production in already cropped areas may be an important issue in some places. This question will be resolved in part by the relative emphasis placed on narrowly defined economic efficiency criteria and on distribution and employment objectives. In most cases, production intensification in already settled areas will leave unchanged both the pattern of landownership and the basic distribution of rural incomes. On the other hand, by providing access to land, new land development can have a greater impact on income distribution. The distribution effect will depend on the size of the settlement program and the extent to which its beneficiaries are among the poorest groups in rural society.

Additional resources for an already settled agricultural area, where basic physical infrastructure is in place, can be expected to generate greater economic returns than resources invested in new areas, where a good portion is needed for essential infrastructure. A comparison of economic rates of return in Bank appraisal reports for area development and land settlement, while sometimes misleading, tends to confirm this. The appraisal estimate of the average economic rate of return, weighted by project cost, of Bank-assisted land settlement projects examined in this paper was approximately 16 percent (for basic data, see Annex 1, Table 1:1). A similar calculation for 16 area development projects approved in fiscal 1975 reveals an average rate of return of approximately 25 percent (see Annex 2, Table 2:1). Economic efficiency arguments are likely to favor more intensive production in already settled areas.

A stronger case can be made for carefully designed, well-executed land settlement as a means to new employment. Typically, projects to intensify agricultural production in already settled areas are sited where agricultural potential is large but where population density and underemployment are high, although hired labor may be used during peak seasons. Under these conditions, an increase in productivity per unit of land area generally increases the total demand for labor and could generate some increase in seasonal employment. The major effect is to reduce underemployment in agriculture. The number of permanent new jobs created in agricultural production is likely to be small although, as in the case of settlement projects which generate marketable output, some additional employment will be created in the agricultural processing, trade, and service sectors. In contrast, settlement of new land obvi-

ously creates new jobs, the cost of which depends on project design. Two projects in Malaysia, one relating to land settlement, the other to production intensification in a settled area, illustrate these points and probably typify the situation in several countries.*

Settlement Costs and Project Design

Where population pressure and underutilized arable land coexist, spontaneous settlement will occur regardless of government policy. This is the dominant form of settlement at present, and it is likely to remain so for the future. Therefore, much of the Bank's support of settlement will be designed to prevent the most adverse socioeconomic and environmental effects of this uncontrolled occupancy of new lands.

Settlement projects are needed that focus on the rural poor and that have low unit cost and replicability. But the focus on low unit costs must not result in projects which are grossly undercapitalized.³ Unit costs are a function of project design, which in turn is determined largely by specific sectoral and country circumstances, e.g., size of holding, income targets, proposed cropping program, project gestation periods, and the level of social services provided. The object is to reduce public sector outlays to the minimum required to attain efficiency and social goals.

The Western Johore Agricultural Development project is to improve small-farm agriculture in a well-settled area of peninsular Malaysia. Under this project, drainage and flood protection works and feeder roads will be built; several multipurpose agricultural development units will be established; agricultural services will be provided; and agricultural processing facilities will be created. Some 12,000 "full-time job equivalents" will be created by 1983, and 24,000 by 2003, at a cost per job of about \$4,200 and \$8,400, respectively. However, underemployment in the project area possibly is as high as 50 percent at present, or the equivalent of 27,000 unemployed among the 30,000 target families with 1.8 workers each. Although additional casual employment will be created at times of peak seasons and in the processing and service sectors, the major employment effect will be to reduce agricultural underemployment. The estimated rate of return in the appraisal is nearly 15 percent.

The Johore Land Settlement project is one of five Bank-supported projects in Malaysia for the development of rubber and oil palm holdings from virgin jungle. Low-income, generally landless, rural families are the direct beneficiaries. The project consists of clearing 32,800 hectares of jungle, planting 26,300 hectares with oil palm, building housing for, and settling, about 4,400 families, constructing public buildings, palm oil mills, and roads, and making water available. The project will provide permanent employment for 4,900 workers in the oil palm holdings and 5,300 in nearby villages and urban areas. In addition, approximately 6,000 workers will be employed during the four-year development period. The project cost per permanent job created is \$8,800. The estimated rate of return is about 15 percent.

³ Numerous examples can be cited of unsuccessful low-cost, government-assisted settlement projects. In many such cases, the criteria of success hinge on narrow efficiency considerations such as yields per unit of land. Full consideration of the welfare benefits to settler families, who otherwise are likely to remain landless, would probably lead to more generous conclusions about the projects' achievements. Moreover, deficiencies in project performance frequently can be traced to inadequate provision by government of supporting agricultural and social services. To a large extent, deficiencies in project administration have prevented adequate testing of low-cost approaches to settlement.

Among the required basic principles are maximum use of settler family labor in the development phase of the settlement project, government provision of minimum but adequate agricultural support and social services, and, to the extent possible, deferment of heavy expenditure on infrastructure. Each of these principles relates to more specific elements of project design.

Target incomes and settler selection. Appropriate income targets, like overall project design, will vary from country to country. The preferred criterion is an income level comparable to what other members of the particular country's labor force earn who have similar aptitudes, experience, skills, and attitudes toward risk. In general, this suggests a level somewhat above the incomes of prospective settlers in their area of origin to reflect the risk and disutility of pursuing a new and uncertain means of livelihood. It also suggests that income targets of some existing Bank projects, which are several times those likely to be realized by similarly equipped workers elsewhere, may be too high from an equity viewpoint. A target income at project maturity that approximates average rural incomes at the same time would normally provide adequate incentive while not creating privileged groups.

The income target is a major determinant of the appropriate size of holdings. It is hoped that the holding size will also provide full employment for settler family labor. However, when land is scarce and the number of potential settlers is large, some underemployment may be inevitable. The welfare of society in these circumstances is likely to be best served by accommodating larger numbers of the landless on smaller holdings than by giving fewer settlers adequate holdings which will fully use labor supplies, while unsuccessful candidates go without meaningful employment.

Successful settlement depends to a large extent on the initiative and character of the settler family. Appropriately viewed as a productive outlet for excess rural labor, settlement projects should be designed to provide an opportunity for betterment to settler families willing to undertake the considerable effort required. The initiative to move to the settlement should come from potential settlers rather than the settlement authority. A large element of settler volunteerism is preferable in most instances to vigorous recruitment by the authority. Self-selection also helps to ensure that a large proportion of settler families will be poor, landless, and with limited economic opportunities elsewhere. Settler performance will be good if a clearly discernible relationship exists between effort and reward. In cases where other than the poor seek settlement lands, or the

number of potential settlers exceeds available places, some selection by the authorities will be necessary. In general, the record demonstrates that settlers who actively seek settlement opportunities because of economic need will develop an affinity for their land, a strong commitment to the success of their endeavors, and a desire and ability to use fully any assistance the government provides.

The phasing of settlement. The phasing of development expenditure is an important determinant of economic returns. Too frequently, heavy expenditure in the early years of the project is assumed essential to reach quickly high levels of output and ensure attractive returns. Generally, this approach implies capital-intensive development methods, costly hired labor inputs in the early stages of development, and minimal contributions of labor or finance by settler families, who typically are both poor and inexperienced in sophisticated agricultural methods. The approach is satisfactory, possibly even essential, where technically efficient natural resource development dominates project objectives or where the land resource can be developed effectively only with capital-intensive methods. It is less appropriate where employment creation is an important consideration.

A two-phase approach to settlement projects is suggested, although in practice a continuum of actions comprising these phases will probably occur. The major objective of phasing is to provide quick access to land at low initial cost for a significant number of rural families, while establishing a solid base for continuing productivity and income gains in the future. Phasing also helps to identify and correct management errors. If competent field staff is available, much of the detailed planning in this approach can be carried out at the project level.

In the first phase, the key activity necessary for sound long-term development is to establish the productive potential of the physical resource base.⁴ On this basis, cropping and land use programs are decided to ensure sound physical development and appropriate income levels. At this point, essential infrastructure is established, holdings are demarcated, settlers introduced to their lands, and adequate financial, technical, and administrative support provided for viable settlement. In areas of rapid, spontaneous settlement, area surveys and lot demarcation have to be done quickly to prevent haphazard development and avoid the risk of the planning effort being overwhelmed by a population influx. Administrative measures

⁴Remote sensing imagery can facilitate project identification and preparation. Annex 4 describes the application of this technology.

to provide tenure security have to be accorded high priority. Basic soil conservation and adaptive agricultural research are necessary and should be started in this phase. It is important to be aware of the dangers of land deterioration in the absence of technical advice and inputs and the risks to settlers' health if no basic health services are available.

Income requirements in the early months of the first phase can best be met by hiring settlers to do essential development work, such as road building, soil conservation, land clearing, and other self-help activities. Special efforts need to be made in project design and implementation to ensure adequate food supplies, particularly in the early stages of settlement when production uncertainties are greatest.⁵ Farm enterprises which generate marketable output will be necessary to provide the cash flow required for successful settlement. The base for this production should be established in this phase.

The second phase is marked by an accelerated effort to increase production and incomes on settler farms. The settlement agency will have to take measures to encourage the use of high-yielding technologies. Agricultural support services to provide technical advice, credit, and other nonfarm inputs will be strengthened. An effective credit program is essential and can substitute for some expenditures otherwise required of the implementing agency. Particular efforts are necessary at this stage to strengthen marketing services for farm production, an aspect frequently not given enough attention.

Simple farming systems, consistent with technical and economic viability, should be maintained. However, in both phases, training of settlers and staff is essential for continual upgrading of management and technical skills required for these schemes as they mature. Social services also can be expanded and upgraded, in some cases with the contributions of settlers as higher incomes permit.

Land development costs. Typically, money outlays for land clearing and the development components of settlement are the largest part of project costs.⁶ Expenditures in this category generally are

⁵ A sensitive test of welfare in settlement projects is the nutritional status of children. Between the ages of 12 and 60 months, a child's growth rate is almost linear at 250 grams per month. Normal aggregate monthly weight gain of a random sample of 100 children should be about 25 kilograms. If the monthly increase falls below 20 kilograms, a problem with the children's food supply is apparent. This simple testing process was used successfully in Haiti.

⁶ On a project cost-weighted basis, the breakdown of total costs for the Bank settlement projects examined in this paper is: agricultural development, 33 percent; roads and other civil works, 25 percent; price and physical contingencies, 22 percent; administration and related expenditures, 14 percent; and social services, 6 percent.

essential and provide few opportunities for cost economies, e.g., fertilizers, other agricultural chemicals, and planting materials. The land clearing activity, however, offers more flexibility, with technical possibilities ranging from fully mechanized clearing, using heavy equipment, to clearing virgin lands largely with settlers' efforts.

On the premise that capital typically is costly and labor relatively inexpensive in potential settlement areas, the use of manual clearing methods is to be encouraged.⁷ The risks of damage to soil structure and accelerated erosion from mechanized clearing are additional points in favor of more labor-intensive methods. But where these dangers do not exist, and where mechanized clearing permits more labor-intensive cropping or production programs with significant "downstream" linkages, mechanization may provide more total employment than manual clearing. The appropriate technology will be determined to a large extent by factors such as terrain, soils, climate, previous vegetative growth, planned cropping patterns, and relative costs of capital and labor. Annex 3 provides a theoretical model to examine the interplay of these factors.

The economic advantages of manual clearing have become greater in recent years with the sharper increase in costs of machinery and their operation relative to labor costs. Moreover, there may be a fuller appreciation among project planners of the possibilities for manual clearing on settlement projects, particularly in response to genuine population pressures and the presence of well-motivated settlers. The Terres Neuves projects in Senegal may be representative.⁸

Housing and social services. Settlers are willing to undergo the hardship of settlement if they believe their welfare ultimately will be greater. Consumption of agricultural produce and money incomes from off-farm sales are just two of several determinants of settler

⁷Nelson, *The Development of Tropical Lands*, p. 225, suggests that in conditions typical of the humid tropics in Latin America, cash outlays per hectare with mechanical clearing may be 15 to 25 times as high as with unpaid family labor (tool purchase only), and perhaps three times as high as with contract hand felling and burning.

⁸Terres Neuves I, approved in fiscal 1971, was to resettle in eastern Senegal some 300 families from the country's densely populated "Groundnut basin." Two hectares were to be cleared for each family by mechanical means, after which the family would clear manually an additional 8 hectares. In 1972, costs of mechanized land clearing were running at twice the appraisal estimates and supervision reports noted that the viability of future settlements would require land clearing at a cost less than half the actual outlays. At that time, settlers were clearing their remaining land areas in a satisfactory manner and at a rate faster than that envisaged at appraisal. The Appraisal Report for Terres Neuves II proposed full hand clearing by the settlers who would be paid for a portion of this work. Government outlays per family with manual clearing were estimated as \$710 less than with mechanized clearing. The rate of return for Terres Neuves II was estimated at 18 percent, while that for Terres Neuves I was 13 percent at appraisal.

welfare; others are the quality of housing, and the type and extent of social services the settlers can expect.

The initial standard of these services should be no higher than that necessary to keep the settlers on their holdings. A typical approach in high-cost settlements is to have the settlement agency construct housing facilities to high standards. This breaches the principle of avoiding heavy infrastructure investments early in the project life. It adds substantial sums to the settlers' loan obligation, and precludes settler participation in a construction activity in which they generally have considerable knowledge and experience.

Settlement agencies find it difficult to provide housing at a cost which the project and settlers can reasonably expect to amortize. Government support in the construction of settler housing is best limited to assistance in site selection and planning, provision of building materials on credit, the issuance of building plans when necessary to ensure minimal standards, and granting of technical assistance where required. Settler housing is one of the areas in which sizable economies in public sector outlays can be made without prejudicing project success.

Adequate supplies of potable water, essential to settler welfare and health, must be available when the holdings are occupied. However, cost economies are possible through appropriate system design. Ideally, heavy initial investment in water supplies should be avoided, but the system should be amenable to upgrading as settlers' incomes and ability to pay operating costs increase.

Minimal preventive and curative health services are also essential to viable settlement and have to be provided from the time settlers enter the scheme. Again, careful design is essential to minimize investment and operational costs during the early years of the project. Experience shows that settlers are willing to pay a substantial share of operating costs for adequate health services.

The appropriate standard of social services for settlement projects will vary from country to country. Their level in rural development projects should be consistent with the standards found elsewhere in the country, and be the least costly among possible alternatives. A minimum level of social services is essential for project success; some of the operating costs can be met by users' fees as the project matures. The system should be amenable to upgrading, with recurring costs kept within the amount of funds available.

In general, the objectives of settlement projects are best served if the first priority in spending limited development funds is to build a sound base for agricultural growth. With agricultural development

under way, both the demand for a growing range of social services and the ability to support them will be enhanced.

Recovery of project costs. The basic issues which relate to cost recovery are efficient allocation of resources, distribution of project benefits among participants, and generation of public revenues for other development efforts. The efficiency goal implies that project resources reflect real economic costs. Distribution and savings objectives require recovery policies based on participants' ability to pay. Thus, special attention has to be given to identify project beneficiaries and classify them in various income groups. One hundred percent of "project rent" (incremental net cash farm income less allowances for uncertainty and additional family labor and management charges) is suggested as the upper limit for recovery, although for beneficiaries realizing project incomes below the "critical consumption level" (perhaps half the national average per capita income) optimum cost recovery may well approach zero.

Ability of the settler to pay is determined largely by the volume and timing of cash flows from the holding. There is both economic and social justification to recover most, if not all, development expenditure in strongly growth-oriented projects, perhaps typical of high-cost settlement where per capita incomes are likely to be relatively high. The settlement model described here assumes that distribution objectives are important, development outlays per beneficiary are small, and that cash incomes of participants will be low in the early project years. For these reasons, the repayment obligation must be relatively small and follow an appropriate grace period. A modest element of subsidy for settlement of this type seems both justified and necessary.

Cost-recovery practices vary widely among Bank-assisted settlement projects, although the general principle is that beneficiaries pay for a significant proportion of public funds spent on their behalf. At one extreme are projects, such as those in Malaysia and Papua New Guinea, in which loan repayments of nearly all financial outlays by the settlement agency are recovered. At the other extreme are projects, such as in Brazil's Alto Turi, where, in addition to production credit extended under the project, settlers repay only the negligible real costs of land surveys and demarcation. Actual cost recoveries in some projects have fallen short of appraisal estimates.

Institutional Elements of Settlement

Land tenure. The land tenure system defines the rights and obligations with respect to acquisition and use of land and is a critical

determinant of the size and distribution of agricultural incomes. The ideal tenure system is one that provides adequate incentives to produce, to adopt improved technologies, and to invest. It should afford reasonable security to those who till the land and give them opportunity for meaningful participation in public decisions which affect their welfare. A good tenure system can also be the means to generate adequate employment opportunities and promote a more equal distribution of income. Although these several objectives frequently are complementary, especially over the long run, possibilities for conflict obviously exist.

The Bank has found that project objectives, among which technical efficiency and economic viability are dominant, are best met by a project design that promotes individual landholdings through the issuance of freehold or leasehold titles. However, exceptions do exist. Recent projects incorporate a wide array of tenure systems to reflect local customs or unique project objectives.⁹

In practice, the degree of freedom which planners have to create alternative tenure forms is greatly constrained by the sociopolitical factors in each country. Within these constraints, however, several general considerations apply. Equity and security are essential under any tenure form. Subdivision into uneconomic units has to be strongly discouraged. Settlers must be aware of their rights and obligations, and the settlement authority has to have the necessary enforcement authority.

In general, settlers' land rights should bear a direct relationship to their contribution to the development of the land. When a government's contribution is large relative to that of the settlers, as in costly irrigation projects, the authority should retain a large element of control over use of the land. In lower-cost settlement, where settlers' contributions are correspondingly larger, it is both appropriate and necessary for incentive purposes to grant more extensive land rights to settlers.

In most circumstances, individually owned and operated farms are likely to be the most conducive to productive efficiency and the development of settlers' initiative and entrepreneurial capabilities. But the merits of freehold tenure may decline as distributional and

⁹ Bank-assisted settlement projects in Malaysia incorporate a "cooperative" landholding system in oil palm schemes under which settlers are expected to receive title to a specified acreage, not individually identified, that constitutes part of a larger area held in common. In Ethiopia, the Lower Adiabo project, building on the indigenous tenure system, established village land cooperatives leased from the government and subleased to individual farmers. Farm leases cannot be sold or mortgaged. They carry conditions for development and good husbandry. In a number of settlement projects, group ranching components are included.

egalitarian objectives are accorded greater priority. It is increasingly recognized that the traditional pattern of smallholder agriculture makes it difficult to provide technical advice, modern inputs, credit, and marketing services efficiently.

Experiments with less orthodox tenure forms are to be encouraged, in order to evolve systems which build on indigenous tenure arrangements and to help achieve broadly oriented development objectives. Long-term leasehold arrangements may provide a greater degree of flexibility in land management as compared with freehold tenure systems. Where economic efficiency can be ensured, group farming systems, public-sector estates, or privately owned estates with smallholder outgrowers could be the best means to introduce new cropping systems and technologies, and simultaneously satisfy employment and distribution goals.

Land reform measures to distribute underutilized lands can often be a valuable adjunct to new land development efforts. In several countries, bold redistributive programs could release large areas of land, already equipped with basic infrastructure, for settlement at costs lower than those entailed in opening up new lands. The Bank will continue to urge this approach where underutilized lands exist and provide financial support as necessary to use those lands most effectively.

Organization and staffing. The deficiencies of numerous settlement projects, and often the most direct causes of failure, are in their organization and staffing. The problems relate to the organizational structure for effective implementation and operation as well as to the performance of managerial and technical staff within that structure. The most common organizational problems are due to inadequate interagency coordination and cooperation, which, in turn, reflect jurisdictional jealousies, inadequate role definition among agencies, and harmful competition for limited budgetary and manpower resources.

An established government department, operating under the normal civil service strictures, frequently is unsuited to implement and manage settlement projects. Effective management requires flexibility in decision making, and considerable managerial discretion, i.e., adequate authority to ensure the cooperation of the several government agencies which provide the specialized services needed to implement settlement projects, such as land surveys, water, and extension services. A regular government department, hierarchically equal with those which provide these ancillary services, is often not in a position to ensure the needed coordination.

All reasonable efforts should be made to strengthen the capabilities of an existing agency or department and entrust it with the responsibility for land settlement. To strengthen an existing department is more consistent with the Bank's and the country's interest in institution building than is the establishment of a new project implementation unit. If the appropriate capabilities cannot be developed within the present organizational structure, a semiautonomous administrative body may have to be created. Typically, this agency receives policy guidance from the cabinet or a ministerial level committee. Its major responsibility is to implement and manage approved settlement projects through coordination and supervision of services from established government departments. The functional roles of these departments should be preserved. Rarely does the settlement agency need to develop the specialized capabilities required in settlement projects, e.g., in survey work, or the provision of health and education services. The project design should include the phasing out of the settlement authority at project maturity and the relinquishment of its responsibilities to regular government departments.

The performance of agency managerial and technical staff is no less important than proper organization. Because of the socioeconomic and technical uncertainties and long gestation periods, land settlement demands exceptional perception, experience, and continuity in the staff. In addition to formal training and experience, less tangible characteristics of leadership, ability to organize and command the respect of people, and good judgment in day-to-day decision making are needed. Continuity of service is essential, and special inducements may be necessary to keep the staff. The terms of service to attract and retain competent staff in a land settlement project have to be more attractive than those available to the typical civil servant residing in an urban center.

In many countries, the supply of qualified technical and managerial manpower is as limiting as the financial constraints. This should be reflected both in the choice of agricultural projects and in the manner by which staff are employed within a project. Efficient use of scarce, qualified extension staff is accomplished by using group demonstrations or community leaders to spread improved technologies. Manpower constraints are additional arguments to support administratively and technologically simple settlement schemes which rely upon well-motivated settlers. Some economies in the number of project-level staff may be possible with appropriate project design, but attempts to economize on the quality of staff are likely to be counterproductive. The most effective way to achieve good staff per-

formance is to place the settlement program with a capable agency that can offer attractive salary and career prospects, and is willing to delegate authority and responsibility to its field offices.

Bank experience indicates that low-cost settlement projects generally require less skilled manpower per beneficiary family than higher-cost schemes. Differences in project composition and design preclude complete comparability; nevertheless, analysis of 11 Bank-assisted settlement projects indicates that "high-cost" schemes, arbitrarily defined as those with a project cost greater than \$7,000 per beneficiary family, in 1975 dollars, on average used about three times as many skilled staff per 1,000 beneficiary families as lower-cost projects (see Table 3). However, the quality of staff and management appears to be a more important determinant of project success than the staff/settler ratio.

Table 3

**Ratio of Skilled Staff to Beneficiary Families
in World Bank-assisted Settlement Projects**

Project	Cost (1)	Skilled staff beneficiary ratio (2)
	(US \$)	
Cost per beneficiary family (3) greater than \$7,000		
Malaysia: Jengka I	18,900	1:15
Trinidad and Tobago: Crown Lands	18,530	1:40
Malaysia: Jengka II	18,100	1:20
Senegal: Terres Neuves I	7,700	1:55
Kenya: Scheduled Areas	7,280	1:18
	Average	1:30
Cost per beneficiary family (3) less than \$7,000		
Senegal: Terres Neuves II	4,470	1:229
Colombia: Caqueta I	3,730	1:93
Brazil: Alto Turi	2,610	1:21
Malawi: Karonga	1,340	1:50
Ethiopia: Wolamo	1,340	1:50
Rwanda: Mutara	820	1:17
	Average	1:99

(1) Cost calculation explained in footnote 3 on page 42.

(2) Skilled staff includes all professional and technical staff at headquarters and the project site; excludes clerical workers, drivers, etc.

(3) Recipients, lessees, or owners of farmlands developed by the project.

Indirect and Second Generation Employment

With some exceptions noted below, settlement planners have not given explicit consideration in project design to indirect employment, i.e., employment in project-related or project-generated activities. Equally neglected is the consideration of employment for the settlers' children as they mature and enter the labor force. It is frequently assumed that settlers' dependents will carry on with the agricultural enterprise, although the evidence strongly suggests that not all intend to remain in agriculture—in part because of the limited possibilities they perceive to exist there, and in part due to the wider range of employment opportunities and social services believed to await them in urban areas.

A realistic planning assumption is that some settlers, and many of their children, will seek livelihoods in nonfarm employment. The issue is how to design settlements (1) to provide more off-farm employment opportunities to the present and subsequent generations of rural workers and (2) to provide a wider range of social services to settlement communities at a reasonable cost. Both of these considerations can be viewed in terms of the pattern and size of settlements.¹⁰

With respect to the pattern of settlements, a common approach is to locate each settler family on its plot of agricultural land, frequently in a linear fashion along an access road. This dispersed pattern of settlement may be preferable where holdings are more than about 20 hectares each, or where close supervision of crop and animal production activities is necessary. However, this approach makes the equitable provision of public utilities and social services at a low cost difficult. Hence, the village type of nucleated settlements is increasingly common.

The size of settlements also is important, although little is known of the process by which the creation of primary employment through settlement affects the character of a region's economic growth. Most nonprimary economic activities (i.e., other than agriculture, forestry, and related processing activities) require a work force with the various essential skills and a minimum local population to provide market outlets. Studies in Malaysia, where the establishment of nucleated settlements has become standard practice in the larger projects, suggest that a settlement of 2,500 families at full development may provide employment for nearly all of its labor force (of which more than two-thirds would be employed in nonprimary activities), while

¹⁰ The pattern relates to the design of the settlement living areas. Dispersed patterns (settlers living on their respective agricultural holdings) and nucleated patterns (house lots clustered around a common service center) represent the extremes

a settlement of 400 families could provide employment for only 70 percent of its much smaller work force. The Malaysian experience, which indicates that the proportion of the work force employed in the primary sector declines sharply as settlement size increases, appears to be typical of situations in other countries as well. The size of nonagricultural employment also depends on possibilities for forward and backward linkages and income levels in the project area.

Besides the wider range of secondary and tertiary activities, larger settlements are able to support a greater array of social services, such as secondary schools and curative health facilities. Per family costs of social services tend to decline as the size and concentration of settlements increase. These considerations lead to the conclusion that land settlement must be planned within an integrated regional framework that includes development of related agro-industrial and service sectors. In many cases, the infrastructure required for the development of new areas cannot be economically justified on the basis of agricultural production alone.

In summary, the interests of both settlers and their children are best served in most instances by larger, nucleated settlement. Where only small pockets of land remain for settlement, this option, of course, is not feasible. Nor is it practical in projects with large livestock components encompassing individually owned flocks or herds. The benefits are of several types—greater employment opportunities, higher service standards, reduced infrastructure costs, reduced migration to large urban centers, and more balanced regional growth.¹¹ To the maximum extent possible, settlement projects should be designed to realize these benefits. This entails careful physical planning of the settlement site, demarcation of public service areas, judicious location and timing of infrastructure development, and appropriate fiscal and other incentives for nonprimary activities.

Irrigated and Rainfed Settlement

Well-managed irrigation projects frequently constitute highly efficient systems of land use, and in many countries are the major means to increased agricultural production. But these systems generally are demanding of experienced technical and administrative manpower, and their costs per hectare and capital/labor ratios are high relative to those in rainfed agriculture. Where finance and qualified manpower are limited and some priority is given to maximizing employment creation within these constraints, a difficult policy issue is the

¹¹ In recognition of these benefits, the Malaysian Government has steadily increased the average size of settlement in Bank-assisted projects from about 400 families in Jengka I to more than 1,600 in the Keratong project.

optimum allocation of resources as between rainfed and irrigated agriculture, or, in the context of this paper, between rainfed and irrigated settlement.

The development of irrigation will continue to be an important part of the World Bank's lending for agriculture. In several countries, opportunities for expansion of rainfed agriculture are nearly exhausted. In a large number of countries, a doubling of output from existing irrigation projects is quite feasible with rehabilitation and improved management. Building on sunk costs, expenditure of additional funds would undoubtedly pay handsome returns.

The choice between rainfed and irrigated settlement, when both are technically possible, is more difficult. Where economic returns are approximately equal, as indicated by orthodox project analysis, the generally more attractive capital/labor ratio for rainfed settlement would favor that approach. Also favoring rainfed settlement are the relatively high costs of controlling water-associated diseases, such as schistosomiasis, as irrigation is expanded for low-income, poorly educated settlers. Where irrigation is the only technically feasible option, smaller-scale, less capital-intensive and, frequently, more rapidly maturing project designs may be preferable to large, complex, capital-intensive projects. Additional experience is needed with small irrigation projects to establish more clearly the merits of such an approach.

Chapter 4: BANK LENDING FOR SETTLEMENT

World Bank lending for land settlement has been a relatively small part of the lending for agriculture. In the period, fiscal 1962-75, lending for settlement projects averaged about 5 percent of total agricultural lending. Annual variations have been large, ranging from zero in some years to a high of about 14 percent in fiscal 1974. Bank lending for settlement totaled \$429 million through fiscal 1975, of which 53 percent was for wholly rainfed settlement and the balance for projects with an irrigation component.¹ These projects cover an agricultural area of about 1.4 million hectares and are to benefit some 134,000 families directly² (see Annex 1 for details).

The bulk of World Bank funds for settlement has gone to countries in the East Asia and Pacific region. In the period fiscal 1967-75, Malaysia, the largest recipient, received five loans totaling \$128 million or 30 percent of all Bank lending for settlement. Malaysia absorbed 57 percent of all loans for rainfed settlement, but accounted for only 18 percent of direct beneficiaries in this type of settlement. Countries in the Eastern Africa region were the second largest group of recipients, accounting for \$122.4 million, of which \$62 million was for Sudan's Rahad irrigation project. A loan of \$73 million for Balikh I, an irrigated settlement in Syria, is the only settlement loan in the Europe, Middle East, and North Africa (EMENA) region.

Unit Costs and Income Targets

Costs per beneficiary family and per hectare developed vary widely among Bank-assisted projects³ (see Annex 1, Table 1:2). For small-farm rainfed settlement projects, costs per beneficiary family are

¹These figures are of projects that contain a significant element of settlement, frequently on land already grazed or partially cultivated. Any settlement project with an irrigation component, regardless of that component's relative size, is classified as an irrigation settlement.

² Direct beneficiary families are defined as the recipients, lessees, or owners of the farms developed by the project. They are distinguished from indirect beneficiaries, i.e., those who are employed as paid laborers on the settlement farms or in nonfarm employment created by the project. In practice, it is often difficult to distinguish direct from indirect beneficiaries and to estimate their numbers. It could be argued that all who receive increased incomes or services as a result of a project are direct beneficiaries.

³ A comparison of costs among projects is difficult because loans are made in different years, because of the presence of nonsettlement components in some projects, the existence of both monetary and nonmonetary costs, differences between costs at ap-

lowest in Rwanda's Mutara and Ethiopia's Lower Adiabo (about \$850) and highest in Malaysia's settlement schemes (about \$20,000). For rainfed settlements, costs per beneficiary family are highest in Zambia's Commercial Crops project (about \$68,000), in which some 300 farm families are being assisted on relatively large farms (70 to 700 hectares) and work made for about 4,000 permanent laborers.⁴ Costs per hectare in settlements with irrigation components are nearly four times those in rainfed settlements, while costs per beneficiary family are more than twice as great (see Table 4, page 44). As would be expected, tree-crop projects are generally much more costly than annual crop projects, while costs in forest areas are higher than in the savannah.

Whether the project target income is appropriate is best judged by comparing it with other income measures within the country and region where the project is located.⁵ The extent to which some settlement projects create rural "elites" can be estimated by comparing project income targets with average rural incomes, preferably in the same year for which project income is estimated. For Bank-assisted projects, this ratio ranges from 0.6 (Ethiopia's Wolamo) to 8.3 (Malaysia's Keratong). Ratios near this upper extreme pose issues about rural equity and, because income levels tend to be linked to unit costs, about the replicability of the projects.

Performance of Bank-assisted Settlement Projects

Performance of projects assisted by the World Bank has been examined by supervision missions, in project completion reports, and, most comprehensively, by the Bank's Operations Evaluation Department (OED).

By the end of 1976, OED studies of Trinidad and Tobago's Crown Lands and Papua New Guinea's Agricultural Development I projects

praisal and realized costs, and because of definitional problems as to which components might legitimately be classified as settlement costs. All costs for providing health, education, and housing in the project area and for access roads are included in this estimate of costs per beneficiary family. These estimates are only approximate orders of magnitude. Derivation of precise, fully comparable unit costs is not possible.

The analysis is based on information in the Bank's appraisal reports. Several adjustments were made. Excluded from total project costs were: all nonmonetary costs (generally represented by settler labor), price contingencies, and interest charges during the construction or development period. The resulting project costs were converted to 1975 dollar terms.

⁴This example highlights the need to distinguish project costs per beneficiary family, as defined in footnote 2 on page 42, from project costs per job created.

⁵ Intercountry comparisons of incomes for project beneficiaries indicate very different income standards among settlement projects. In current dollar terms, net per capita annual cash incomes of beneficiaries at full development were estimated, at time of appraisal, from \$20 to \$30 in Ethiopia's Wolamo and Rwanda's Mutara to approximately \$550 in Malaysia's Keratong and Zambia's Commercial Crops projects.

Table 4

**Loan Value and Average Unit Costs in World Bank-assisted
Settlement Projects, Fiscal Years 1962-75**

Settlement projects	Loan value (US\$ millions)	Total project cost at appraisal ⁽¹⁾			Total area (000 hectares)	Direct beneficiaries (000 families)	Unit cost (1975 US\$)	
		Current US\$ millions	1975 US\$ millions	Per hectare			Per hectare	Per beneficiary family
Settlement projects with irrigation components ⁽²⁾	203.1	434.0	544.5	260.7	38.9	2,100	14,000	
Rainfed settlements	226.2	414.4	611.6	1,134.0	94.7	539	6,460	
All settlement projects	429.3	848.4	1,156.1	1,394.7	133.9	830	8,650	

(1) Excludes price contingencies and interest during construction.

(2) Includes Amibara, Atlantico No. 3, Balikh, Cordoba, Karonga, Rahad, and San Lorenzo projects. See Annex 1, pages 57-61, for project locations and descriptions.

were nearing completion. For the Crown Lands project, the economic rate of return estimated in the appraisal report was 10 percent; OED's estimate is approximately zero. The appraisal estimate for the Papua New Guinea project was 9 percent, and OED's estimate is 19 percent.

Midterm evaluation by the Bank's regional staff indicates a rate of return for Colombia's Caqueta I of 15 percent, compared with 16.5 percent at appraisal. For Senegal's Terres Neuves I project, both estimates are 13 percent. Studies for Malaysia's Jengka I suggest that its economic rate of return may approximate the 16 percent estimated at appraisal.

Compared with the sizable shortfalls experienced by several typical Latin American settlement projects not assisted by the Bank, the economic performance of those supported by the World Bank appears to be superior. The generally favorable record of Bank-assisted settlement projects reflects, in part, the large volume of loans to the well-administered Malaysian settlement program in which technical efficiency and financial performance appear to be high.

Some common problems encountered in Bank-assisted settlement projects are:

1. Management and staff inadequacies. These relate to competence of management and staff as well as staff shortages, slowness in recruitment, and rapid turnover of personnel. This problem is the most important and frequently encountered problem.
2. Organizational problems. Key among these is the lack of coordination or cooperation among participating agencies which results in implementation delays. Failure to decentralize authority and decision making is common, particularly in the early years of projects.
3. Overambitious physical targets. Most projects experience shortfalls in physical production targets, e.g., crop yields, clinics built, access roads constructed, and settler houses completed. In some cases, unforeseen technical or engineering problems are to blame; more frequently, the causes are deficiencies in management and organization.
4. Incorrect estimates of settler labor needs. With some exceptions, the ability of settler families to develop or cultivate the area allocated is overestimated. Actual production falls short of targets, although high product prices in 1973-74 frequently generated settler incomes in these years which exceeded appraisal estimates.
5. Low estimates of development costs. Most projects supported by the Bank were in the development phase during the 1972-74

period of rapid inflation, when actual costs generally ran ahead of appraisal estimates. However, the record for settlement projects is not likely to differ significantly from that of other Bank-assisted projects.

6. Difficulties in cost recovery. Most Bank-assisted settlement projects include measures to recover at least some portion of investment costs. Performance has been mixed, but in no case has it been as good as was envisaged at appraisal. Technically efficient schemes, such as Malaysia's Jengka projects, have the best record. Efforts to recover short-term and medium-term credit have generally been satisfactory.

Chapter 5: THE FUTURE

World Bank-assisted settlement projects, which until fiscal 1975 covered an area of about 1.4 million hectares, represent only a small fraction of global settlement, whether assisted or spontaneous. Given the potential arable land area, the future growth in population, and investment required for future settlement activity in developing countries, the role of the World Bank will remain relatively small. The Bank's potential contribution to future settlement should be measured not so much by the volume of its lending program as by the type and quality of the settlement activities it supports. Bank-assisted settlement projects should be looked upon as prototypes to be emulated elsewhere, or as pilot projects from which valuable experience or information may be gained.

Land settlement projects have to be planned within a broad framework that develops the careful use of all the resources in the project area. It is necessary to ensure that commercial timber and fuelwood resources in the area are used to the fullest, either before the agricultural development phase or increasingly as settlement expands to agriculturally marginal lands, as an integral and permanent part of the project. Project design for timber resource development will receive the same careful consideration as the agricultural components. Bank experience in the Alto Turi, Terai, and Jengka projects, for example, indicates both the problems and the potentials in this field.

As population pressures result in the development of less agriculturally suitable land, much of it characterized by fragile ecological systems, settlement authorities must give greater attention to environmental impact. The design of projects in these areas will increasingly need to include components which ensure sound, long-term use of all natural resources. Support by the World Bank for the projects may well depend on assurances that longer-term environmental impacts have been appropriately considered, and that suitable safeguards are provided to protect the nonrenewable resources in the project area.

The welfare of indigenous populations in new settlement areas has to be fully protected. Adequate protection of their interests are to be among the conditions the Bank requires to support such projects. In the case of primitive populations, this may require the estab-

lishment of "protected reserves." In other areas, populated by nomadic groups or shifting cultivators, suitable alternative means of livelihood will have to be provided, either in the project area or elsewhere.

As rural populations expand and man/land ratios in already settled areas increase, the numbers of those seeking livelihoods in new lands are likely to rise. Most of these new lands are inherently less productive with known technology than areas already cultivated, and will require new technologies for efficient exploitation. On the research front, some new priorities may be required to develop efficient small-scale farms in the semiarid zones and the humid tropics.

The bulk of the remaining underutilized lands lies in the humid tropics of Latin America and Africa. The Bank's experience with low-cost settlement in these areas is limited. Other efforts at settlement in some of these areas have proved problematic, in part because full-scale projects were attempted without adequate knowledge of the resource base and of other technical and economic factors. Much valuable information and experience could come from Bank-supported experimental programs to evolve technologies and approaches useful in the development of efficient farming systems. Many variables could be examined, including soil management, cropping programs based on less well-known but promising crops, integrated crop/livestock farming systems, appropriate technologies in soil cultivation, crop processing, and water supply. A study of alternative organizational models could also be helpful, e.g., tenure arrangements and delivery systems for agricultural support services. In such experimental projects, close links to national and international research centers are essential, both to obtain the necessary technical underpinning and to generate feedback to the centers and settlement authorities.

Since settlement, to a large extent, is tailored to a particular set of conditions in a country or region, several widely dispersed experimental projects which encompass diverse agroclimatic zones may be best. Possibilities include sites in the Amazon basin, the Congo basin, the outer islands of Indonesia, the semiarid regions of sub-Saharan Africa, south Sudan and, for irrigated settlement, the Mekong basin. The social benefits of such efforts might be especially attractive to Indonesia, for example, where some 20 million hectares are supposedly available for near-term agricultural development in south Sumatera, southeast Kalimantan, and Sulawesi.

Important for long-term global settlement is continued World Bank support of development programs to eliminate or control animal and human diseases which presently limit the full use of poten-

tially productive lands. A successful program to control trypanosomiasis in the tsetse belt of Africa would permit intensified use of about 700 million hectares with good potential for extensive livestock production and, in some areas, more productive mixed-farming settlements. Chemical systems for controlling the tsetse fly have been developed, and experimentation and research at the International Laboratory for Research on Animal Diseases (ILRAD) in Kenya may promise even more effective methods. Similarly, means are becoming available to control onchocerciasis, or riverblindness, in Western Africa, a disease that prevents development of some of the best alluvial soils of the region. Effective control programs would permit more intensive use of some 70 million hectares where this disease is now endemic. An expansion of malaria control programs would also open up additional lands for settlement.

Both new land development and increased production from presently cropped areas will be necessary to meet global food and fiber needs over the longer term. Background documents prepared by the United Nations for the 1974 World Food Conference proposed a land settlement program that would increase the cropped area in developing countries from about 737 million hectares in 1970 to 890 million hectares in 1985.¹ This increase implies an annual rate of land development roughly twice the estimated 4 million to 5 million hectares at present, of which only one-quarter is "organized" or government-assisted. Sound use of remaining unused arable lands requires well-designed, carefully implemented settlement programs. A modest expansion in the World Bank's settlement activities over the past is justified on the basis of need and opportunity.

¹UN Secretariat, *The World Food Problem: Proposals for National and International Action*, World Food Conference, ECONF. 65/4 (August 1974), p. 64, para 202.

ANNEXES

Selected Data on World Bank-assisted Settlement Projects

Region Country	Project ⁽¹⁾	Project cost (US\$ millions)				
		Roads and civil works	Social ser- vices	Agri- cultural develop- ment	Adminis- tra- tion and other	Total cost ⁽²⁾
Eastern Africa						
Ethiopia	Wolamo Agricultural Development (FY1970)	0.1	—	3.3	1.3	5.1
	Amibara Irrigation (FY1973)	9.5	—	3.0	4.9	22.8
	Lower Adiabo Agricultural Development (FY1975)	1.0	0.1	4.5	3.7	13.5
Kenya	Development and Settlement of Land in Scheduled Areas (FY1962)	8.9	1.7	12.5	1.4	24.5 16.0 ^(*)
Malawi	Karonga Rural Development (FY1972)	1.5	0.3	2.6	2.5	7.8
Rwanda	Mutara Agricultural Development (FY1974)	1.6	0.2	1.6	0.5	4.3
Sudan	Rahad Irrigation (FY1973)	104.1	11.1	48.8	10.9	239.3
Zambia	Commercial Crops Farming Development (FY1970)	6.0	—	2.1	2.1	11.1
	Integrated Family Farming Development (FY1973)	2.2	1.3	3.5	5.7	15.2
Western Africa						
Senegal	Terres Neuves I (FY1971)	0.31	—	0.44	0.89	1.78
	Terres Neuves II (FY1976)	0.41	0.27	0.91	0.66	2.96
East Asia and Pacific						
Malaysia	Jengka I (FY1968)	3.4	5.4	13.0	6.5	29.1
	Jengka II (FY1970)	2.2	4.5	14.7	6.8	28.6
	Jengka III (FY1973)	3.0	6.0	19.9	12.1	49.8
	Johore Land Settlement (FY1974)	4.5	9.5	50.0	7.9	89.8
	Keratong Land Settlement (FY1975)	3.7	7.4	48.0	6.2	98.7
Papua New Guinea	Agricultural Development I (FY1969)	0.7	0.5	1.5	0.7	3.4
	Agricultural Development II (FY1970)	1.4	0.2	6.6	0.4	8.8
South Asia						
Nepal	Terai Land Settlement (FY1974)	3.0	—	4.4	1.6	11.5
Europe, Middle East, and North Africa						
Syrian Arab Republic	Balikh Irrigation (FY1974)	86.9	3.6	7.0	14.5	170.4

For footnotes, see pages 54 and 55.

**Annex 1
Table 1:1**

World Bank loan or IDA credit (US\$ millions)	Project area (000 hectares)			Beneficiaries (000 families)		Economic rate of return (%)		Per capita income (US\$)	
	Original occupation	New	Total	New	Total	At appraisal	Post-appraisal	Beneficiary at full development ⁽³⁾	Rural at time of appraisal
3.5	13.2	6.3	19.5	1.0	7.8	13.0	—	32	7-102
17.0	10.0	—	10.0	—	0.8	16.0	—	142	37 ⁽⁴⁾
9.5	60.0	—	60.0	7.0	12.0	17.0	—	30	25 ⁽⁵⁾
8.4 3.0 ⁽⁶⁾	72.9	—	72.9	7.8 5.0	7.8 5.0	13.0	—	50-92	n.a.
6.6	3.2	3.0	5.8	2.8	4.6	12.0	—	58	1 ⁽⁷⁾
3.8 62.0	45.0 —	—	45.0 126.0	5.7 13.7	5.7 13.7	12.5 13.5	— 16.5	22 90-110	n.a. n.a.
5.5	3.0	21.6	24.6	0.3	0.3	19.0	—	554	91
11.5	0.6	10.7	11.3	5.4	6.3	20.0	—	106	60
1.35 2.0	1.0 —	3.0 6.0	4.0 6.0	0.3 0.6	0.55 0.6	13.0 18.0	13.0 —	80 110	47 70
14.0 13.0	— —	11.3 12.3	11.3 12.3	2.8 3.0	2.8 3.0	16.0 11.0 18.0 ⁽⁸⁾	— — —	256 208 ⁽⁹⁾ 262 ⁽¹⁰⁾ 349 ⁽⁹⁾ 241 ⁽¹⁰⁾	147 134 40
25.0	—	16.2	16.2	4.0	4.0	15.5	—		
40.0	—	26.3	26.3	4.4	4.4	14.8	—	320	68
36.0	—	22.3	22.3	3.4	3.4	23.0	—	542	65
1.5	—	4.7	4.7	0.6	0.6	9.0	—	164	n.a.
5.0	65.0	3.2	68.2	1.0	1.0	15.0	—	142	n.a.
6.0	1.0	17.6	18.6	9.0	9.0	17.0 ⁽¹¹⁾	—	46-64	17
73.0 ⁽¹²⁾	22.8	18.2	41.0	3.0	7.5	11.0	—	252	165

(continued)

Selected Data on World Bank-assisted Settlement Projects (continued)

Region Country	Project ⁽¹⁾	Project cost (US\$ millions)				
		Roads and civil works	Social ser- vices	Agricul- tural develop- ment	Adminis- tra- tion and other	Total cost ⁽²⁾
Latin America and the Caribbean						
Brazil	Alto Turi Land Settlement (FY1973)	3.6	0.2	6.0	2.2	14.2
Colombia	Atlantico No. 3 Irrigation (FY1967)	6.3	0.6	1.9	3.3	14.4
	Caqueta I (FY1971)	6.6	0.7	12.6	1.7	21.6
	Second Atlantico Development (FY1972)	4.6	—	2.2	1.7	9.7
	Caqueta II (FY1975)	9.2	1.6	15.8	3.7	37.1
	Cordoba II (FY1975)	20.7	2.1	7.1	7.6	51.1
Peru	San Lorenzo Irrigation and Settlement (FY1965)	9.1	—	12.6	8.1	29.8
Trinidad and Tobago	Crown Lands Settlement (FY1967)	2.1	—	6.9	1.5	11.0

⁽¹⁾ Each settlement project listed here has unique features. Some project details supplementing the data in this table are described on pages 57-61. The year in parentheses beside each project name is the fiscal year in which the project loan or credit was approved by the World Bank or IDA.

It should be stressed that data in the table refer to estimates made at the time of appraisal. Several projects have been altered, some substantially, since appraisal.

⁽²⁾ Total project cost figures also include allowances for price and physical contingencies.

⁽³⁾ Generally refers to net cash income exclusive of value of home consumption and after payment of any development charges. Per capita figures derive from an assumed farm family of 5.5 people.

⁽⁴⁾ National average per capita income.

⁽⁵⁾ In the project area.

⁽⁶⁾ The project was substantially revised in 1964, at which time the large-scale "assisted-owner" farm component was eliminated; as a result, a portion of the original loan was canceled.

Table 1:1

World Bank loan or IDA credit (US\$ millions)	Project area (000 hectares)			Beneficiaries (000 families)		Economic rate of return (%)		Per capita income (US\$)	
	Original occupation	New	Total	New	Total	At appraisal	Post-appraisal	Beneficiary at full development(3)	Rural at time of appraisal
6.7	116.0	92.0	208.0	3.0	5.2	16.0	—	73	28
9.0	7.2	2.7	9.9	2.5	2.5	11.0 25.0 ⁽¹³⁾	—	400 164 ⁽¹⁴⁾	n.a.
8.1	—	280.0	280.0 ⁽¹⁵⁾	2.8	7.8	16.5	15.0	235	n.a.
5.0	8.8	8.2	17.0	1.1	1.8	23.0	—	263	180
19.5	200.0	—	200.0 ⁽¹⁶⁾	12.2	12.2	14.0	—	250-550	210
29.0	44.0	6.0	50.0	1.0	5.3	31.0	—	1,460	180
11.0	14.3	17.7	32.0	0.8	1.6	16.0	—	n.a.	n.a.
5.0	—	5.0	5.0	1.6	1.6	16.0	10.0	314	111

(7) Annual cash income in the project area is estimated at \$8 per family.

(8) Return is 11 percent to rubber, 18 percent to oil palm.

(9) To rubber settler.

(10) To oil palm settler.

(11) The return to the total project is 42 percent. It is 17 percent to the settlement component.

(12) A Bank loan of \$63 million and an IDA credit of \$10 million have been proposed.

(13) Eleven percent on irrigated area, 25 percent on flood-protected area.

(14) Per capita income is projected to be \$400 in the irrigated area, \$164 in the rainfed area.

(15) Project area includes 280,000 hectares of new land settlement and additional land occupied by partially established settlers.

(16) Some of this area is partially settled and would be upgraded.

n.a.—Not available.

Table 1:2
**Unit Costs and Income Ratios of World Bank-assisted
Settlement Projects**

Region Project ⁽¹⁾	Project cost ⁽²⁾		Unit Cost (1975 US\$)		Ratio of per capita incomes in project area ⁽⁴⁾ vs. rural ⁽⁵⁾
	Current US\$ millions	1975 ⁽³⁾ US\$ millions	Per hectare	Per beneficiary family	
Eastern Africa					
Wolamo Agricultural Development	4.9	10.0	540	1,340	0.6
Amibara Irrigation	20.0	28.2	2,820	35,280	3.8
Lower Adiabo Agricultural Development	9.9	11.4	170	860	1.2
Development and Settlement in Scheduled Areas	16.0	35.6	490	7,280	n.a.
Karonga Rural Development	7.2	12.0	2,070	2,610	n.a.
Mutara Agricultural Development	4.0	5.6	100	820	n.a.
Rahad Irrigation	193.4	222.3	1,760	16,200	n.a.
Commercial Crops Farming Development	10.5	20.2	830	67,730	6.1
Integrated Family Farming Development	14.7	20.7	1,830	3,290	1.8
Western Africa					
Terres Neuves I	2.4	4.4	1,060	7,700	1.7
Terres Neuves II	2.6	2.6	450	4,470	1.6
East Asia and Pacific					
Jengka I	24.9	53.0	4,700	18,900	1.7
Jengka II	28.3	54.4	4,400	18,100	1.8
Jengka III	42.7	60.1	3,700	15,000	7.4
Johore Land Settlement	75.3	86.6	3,300	19,700	4.7
Keratong Land Settlement	69.3	79.7	3,600	23,400	8.3
Agricultural Development I	3.4	6.9	1,470	11,530	n.a.
Agricultural Development II	8.6	16.5	240	16,650	n.a.
South Asia					
Terai Land Settlement	9.4	10.8	580	1,210	3.2
Europe, Middle East, and North Africa					
Balikh Irrigation	131.5	151.1	3,730	20,330	1.5
Latin America and the Caribbean					
Alto Turi Land Settlement	13.7	22.8	100	3,730	2.6
Atlantico No. 3 Irrigation	12.4	26.4	2,680	10,610	n.a.
Caqueta I	19.3	35.1	130	4,470	n.a.
Second Atlantico Development	9.4	15.7	920	8,700	1.5
Caqueta II	31.8	31.8	170	2,720	1.9
Cordoba II	39.7	39.7	830	7,830	8.1
San Lorenzo Irrigation and Settlement	29.8	64.8	3,670	14,620	n.a.
Crown Lands Settlement	13.0	27.7	5,500	18,530	2.8

(1) See Table 1:1 and description of projects, pages 57-61, for additional detail.

(2) Excludes price contingencies and interest during construction.

(3) Converted to 1975 dollars by using the World Bank's index of international inflation (April 1976), based on unit value indices of manufactured exports by developed countries, as regularly published in the *UN Monthly Bulletin of Statistics*.

(4) At full development.

(5) At time of appraisal.

n.a.—Not available.

Description of Projects in Tables 1:1 and 1:2 of Annex 1

EASTERN AFRICA

Ethiopia. The Wolamo Agricultural Development project is to build infrastructure in three densely populated highland areas with 6,000 families and assist settlement in the savannah for 700 families in place, with another 1,050 families to be added.

The Amibara Irrigation project would convert 10,000 hectares grazed by nomadic herds into 34 commercial farms (7,600 hectares), provide 800 small-scale settlements (2,000 hectares) for former nomads, and a 400-hectare agricultural research station. Irrigated cotton is the major crop. Full-time employment would be created for 2,000 workers and seasonal employment of three months per year for 7,000.

The Lower Adiabo Agricultural Development project would settle 7,000 migrating farmers and assist 5,000 resident farmers. The project's agricultural development costs include \$2 million for cooperative development.

Kenya. Development and Settlement of Land in Scheduled Areas. The original proposal was to settle 1,800 "assisted owners," each on 20 hectares, and 6,000 "smallholder" farmers each on 6.1 hectares. The land, previously cultivated by European farmers, was of high potential. The project, divided into eight subprojects comprising 35 schemes, was substantially revised in 1964. The "assisted-owner" component was eliminated and part of the original Bank loan canceled. The number of beneficiary families was estimated as 5,000 in 1968.

Malawi. The Karonga Rural Development project was to establish two irrigated double-cropped rice schemes on about 600 hectares with 830 settlement families, and six rainfed schemes on 2,400 hectares with 2,000 families. The project was also to improve rainfed agriculture on 3,200 hectares occupied by 1,750 farmers by providing them with physical infrastructure, as well as agricultural and social services. The annual per capita beneficiary income of \$58 at full development is based on a double-cropped, 1.2-hectare rice farm operated with owned oxen.

Rwanda. The Mutara Agricultural Development project would settle 4,300 families on 12,000 hectares divided into plots of 2 hectares to 2.5 hectares, and develop 31,000 hectares into 120 group ranches. At full development, project beneficiaries are expected to produce annual per capita subsistence consumption worth \$33, in addition to other income of \$22.

 **Sudan.** The Rahad Irrigation project would develop irrigated agriculture on 126,000 hectares, install agricultural processing and storage facilities, settle 13,700 tenant families, and provide seasonal work for 90,000 laborers. Total project costs were originally estimated at approximately \$96.1 million, but had increased to \$239.3 million by mid-1975. In 1975, the IDA credit was increased from \$42 million to \$62 million. The IDA credit covers 26 percent of estimated project costs. Additional funds were to be provided by the Government of Sudan, the Kuwait Fund for Arab Economic Development, and by other aid donors.

Zambia. The Commercial Crops Farming Development project would train tobacco and maize farmers on 270 farms of 69 hectares each, 15 farms of 202 hectares each, and improve another 15 farms of 202 hectares each. Project beneficiaries were to be 15 already established families and 285 newly settled farm families. By the fifth year of the project, about 4,000 permanent farm laborers would be employed. Annual per capita income of \$554 is expected to be achieved in the twenty-first year after land purchase for beneficiary families on the 69-hectare holdings.

The Integrated Family Farming Development project would settle 5,400 new growers of maize and tobacco, and service 900 established farmers. Project components include construction of roads to transport crops, soil conservation measures, establishing tree and tobacco nurseries, water supplies, primary schools, and dispensaries. Per capita rural income figure of \$60 is actually GNP per capita for persons in small-scale agriculture at the time of project appraisal.

WESTERN AFRICA

Senegal. The Terres Neuves I project is to resettle 300 families from the "Groundnut belt" to the eastern region, where land is available and some spontaneous settlement has been occurring. Each settler is to receive 2 hectares of land, mechanically cleared and free of charge. He is then expected to clear manually an additional 8 hectares. The project also is to provide extension and credit services to 250 farm families originally settled in the project area.

The project, entitled the Terres Neuves *II* Resettlement and Eastern Senegal Technical Assistance project, would settle 450 families in new villages and 150 families in established villages. Another 1,000 families will benefit from project roads, water supply, and social infrastructure. Settlers are encouraged to clear all land manually. The per capita income figures include subsistence.

EAST ASIA AND PACIFIC

Malaysia. The *Jengka I* project, originally known as the Jengka Triangle project, is to settle 2,770 families on 11,300 hectares to be planted with oil palm. The project would provide housing and other necessary agricultural and social services.

The *jengka II* project is to clear 13,000 hectares of forest, plant 6,800 hectares with oil palm, 5,500 hectares with rubber, and 300 hectares to other crops, and settle 3,000 families. The forestry sub-project would establish a modern logging and timber processing complex.

The *jengka III* project is to clear 17,800 hectares of forest, plant 8,500 hectares with oil palm, 6,900 hectares with rubber, and 800 hectares with cocoa, and to settle 4,000 families. The project would also provide jobs to 3,000 mill and other workers, as well as 4,000 contract workers during development.

The Johore Land Settlement project would clear 32,800 hectares of forest, plant 26,300 hectares with oil palm, and settle 4,400 settler families. About 10,200 permanent jobs would be created for settler families, of which 4,900 are in oil palm schemes, and another 5,300 in villages and nearby urban centers.

The Keratong Land Settlement project would clear 25,500 hectares of forest, plant 22,300 hectares with oil palm, and settle 3,400 families..

Papua New Guinea. The Agricultural Development *I* project is to settle 580 smallholder families on 3,500 hectares planted to oil palm. In addition, the project would develop a nucleus oil palm estate of 1,200 hectares.

The Agricultural Development *II* project was to assist new planting and replanting of 4,000 hectares of coconuts, improve 61,000 hectares of grazing land, and settle 980 smallholder families on 3,200 hectares of oil palm. The production units, besides the smallholders, include 15 ranches and 25 coconut estates.

SOUTH ASIA

Nepal. The Terai Land Settlement project would regularize spontaneous settlement in the Terai region. It would assist timber exploitation and provide agricultural services to about 7,900 settler families. The settlers were to be offered 2-hectare plots which they were to clear. Settlers were to construct their own housing. The project is expected to provide full-time or part-time employment in forestry to 1,100 workers.

EUROPE, MIDDLE EAST, AND NORTH AFRICA

Syria. The Balikh Irrigation project was to settle 3,000 of the 11,400 families displaced by the dam construction on the Euphrates River and assist another 4,000 to 5,000 families already in the project area. Assistance includes a \$73 million Bank loan and a \$10 million IDA credit.

LATIN AMERICA AND THE CARIBBEAN

Brazil. The Alto Turi Land Settlement project was to benefit 5,200 families, of which 2,200 families are spontaneous settlers already in place. Construction of 305 kilometers of roads, improvement of 80 kilometers of existing roads, expansion of agricultural research facilities, cooperative establishment, land and water surveys, and exploitation of forest reserves are some of the project components. Total project cost of \$14.2 million includes the value of family labor estimated as \$2.7 million, but excludes interest on a World Bank loan of \$1.1 million during development.

Colombia. The Atlantico No. 3 Irrigation project is to develop 3,900 hectares for irrigation and protect 6,000 hectares from floods. About 4,700 hectares of the area were under crops at appraisal.

The Caqueta I Land Colonization project was to open up 280,000 hectares of undeveloped land for 2,800 new settlers and service 3,500 partially established settlers by building 380 kilometers of roads, 90 primary schools, and six health centers. In late 1973 these targets were reduced by about 30 percent.

The Second Atlantico Development project would provide for additional drainage works, roads, farm machinery, and land preparation in the Atlantico No. 3 Irrigation project area. About 17,000 hectares in total, of which 8,800 hectares were previously cropped, would be made suitable to grow two crops a year under rainfed conditions. Each of the 1,800 beneficiary families was to receive an 8-hectare plot ready for cultivation.

The Caqueta *II* project provides funds for land clearing, pasture establishment, cattle breeding and fattening, road construction, forestry and erosion control, and technical assistance to farmers. The project is expected to benefit 3,250 families directly and 9,000 indirectly.

The Cordoba *II* project is to complete drainage work on 40,000 hectares, level 20,000 hectares, settle 1,000 families on this land, and develop double-cropping on 10,000 hectares. Beneficiaries include 2,200 settler families and 800 established farms. Annual per capita income of beneficiaries at full development is based on a 2-hectare to 20-hectare medium-sized farm.

Peru. The San Lorenzo Irrigation and Settlement project would ready 32,000 hectares of land for irrigation with civil works and on-farm development. The scope of the project was reduced in 1967, because of water shortage, to 18,000 hectares, and the Bank loan was reduced from \$11 million to \$6.5 million.

Trinidad and Tobago. The Crown Lands Settlement project was to develop 5,000 hectares for 200 dairy farms, 70 pig farms, 176 citrus farms (later reduced to 70 in number), 1,118 vegetable farms, and 80 tobacco farms.

Selected Data on World Bank-assisted Rural Development Projects Approved in Fiscal Year 1975

Region Country	Project ⁽¹⁾	Project costs (US\$ millions)				Total cost ⁽²⁾
		Roads and civil works	Social ser- vices	Agri- cultural develop- ment	Adminis- tration and other	
Eastern Africa						
Kenya	Group Farms Rehabilitation	—	—	12.6	1.7	23.2
Madagascar	Village Livestock and Rural Development	13	3.1	3.1	0.7	12.8
Malawi	Lilongwe Land Development, Phase III	—	0.7	7.7	1.0	12.1
Tanzania	Kigoma Rural Development	—	4.4	4.3	0.8	13.3
Western Africa						
Ivory Coast	Cotton Areas Rural Development	4.1	4.4	27.5	—	52.5
Nigeria	Funtuā Agricultural Development	4.6	—	33.6	5.5	57.6
	Gombe Agricultural Development	2.4	—	22.9	6.5	42.1
	Gusau Agricultural Development	2.4	—	19.5	6.2	37.4
Sierra Leone	Integrated Rural Development	2.3	—	6.4	1.9	13.7
East Asia and Pacific						
Philippines	Rural Development	26.8	1.9	2.3	—	50.0
South Asia						
India	West Bengal Agricultural Development	—	—	49.6	0.3	67.0
Europe, Middle East, and North Africa						
Morocco	Mecknes Agricultural Development	3.1	3.4	7.4	4.3	32.4
Yemen Arab Republic	Southern Uplands Rural Development	6.1	1.8	2.6	5.3	23.2
Latin America and the Caribbean						
Mexico	Integrated Rural Development (PIDER)	13.0	37.0	154.0	8.0	295.0
	Papaloapan Basin Development	28.7	31.6	20.3	0.2	138.5
Paraguay	Small Farmer Credit and Rural Development	5.1	1.4	9.1	0.2	15.8

⁽¹⁾ It should be stressed that data in the table refer to estimates made at time of appraisal. Some projects have been altered during the course of implementation.

⁽²⁾ Total project cost figures also include allowances for price and physical Contingencies.

⁽³⁾ Generally refers to net cash income exclusive of value of home consumption and after payment of any development charges. Per capita figures derive from an assumed farm family of 5.5 people.

⁽⁴⁾ World Bank loan of \$7.5 million and IDA credit of \$7.5 million.

⁽⁵⁾ Economic rate of return of 54 percent for the coffee estates and 29 percent for the mixed farm.

⁽⁶⁾ On the group large-scale mixed farms.

⁽⁷⁾ Per capita incomes at full development will range from \$30 for residents in about 200 villages; \$65 for 1,600 families who will receive project extension services, and \$340 for 50 families engaged in the pig fattening program.

⁽⁸⁾ Depending upon farm size and crops. Includes subsistence income.

⁽⁹⁾ Includes onfarm consumption.

Annex 2

World Bank loan or IDA credit (US\$ millions)	Project area (000 hectares)	Beneficiaries (000 families)	Economic rate of return (%)	Per capita income (US\$)	
				Bene-ficiary at full development ⁽³⁾	Rural at time of appraisal
15.0 ⁽⁴⁾	60	12.6	42 ⁽⁵⁾	28 ⁽⁶⁾	70
9.6	16,200	80	69	30 ⁽⁷⁾	70
8.5	352	101	18	84-328 ⁽⁸⁾	54
10.0	—	50	22	40	85
31.0	10,800	84.2	47	82	120
29.0	750	60	41	63 ⁽⁹⁾	41
21.1	530	32	17	60	41
19.0	380	41	16	55	41
11.0 ⁽¹⁰⁾	560	14	26	40-100 ⁽¹¹⁾	54
25.0	90	30	15-25 ⁽¹²⁾	98-287 ⁽¹³⁾	77
34.0	2,600	200	33-50 ⁽¹⁴⁾	119-298 ⁽¹⁵⁾	45
14.0	170	8.6	24	140-1,130 ⁽¹⁶⁾	31-105
10.0	50	21	19	50-770 ⁽¹⁷⁾	20-120
110.0	123	120	16	128-200 ⁽¹⁸⁾	188
50.0	120	25.8	26	77-833 ⁽¹⁹⁾	188
11.0	83	7	13	364 ⁽²⁰⁾	159

(10) Bank loan of \$5.5 million and IDA credit of \$5.5 million.

(11) Per capita income of \$100 for farmers in the Eastern Project Area, and \$40 for those in the Northern Project Area.

(12) A 15 percent to 25 percent rate of return for the irrigation and agricultural works, and 18 percent for the national highway improvement.

(13) Per capita incomes of \$90 to \$108 in rainfed areas, and \$155 to \$240 in irrigated areas.

(14) Rates of return range from 33 percent for deep tubewell to 50 percent for most other investments.

(15) Approximate incomes from a 2-hectare and a 5-hectare irrigated farm, respectively.

(16) The highest per capita incomes \$375 to \$1,130 will be realized in the irrigated areas; \$140 to \$380 in rainfed areas; and \$275 to \$320 by farmers with a 1-hectare share in an orchard.

(17) Income varies, depending on farm size.

(18) \$128 per capita in rainfed areas and \$200 in irrigated areas.

(19) Per capita income is expected to vary widely, depending on geographic area, farm size, and crop.

(20) Includes subsistence income.

Description of Projects in Table of Annex 2

EASTERN AFRICA

Kenya. The Croup Farms Rehabilitation project is to assist the rehabilitation of 90 large-scale mixed farms and 36 coffee estates; provide technical and management services, medium- and long-term credit; and create a large-scale farm management, recruiting, training, and extension service.

Madagascar. The Village Livestock and Rural Development project would assist in the development of an intensive veterinary and livestock extension service over a wide area of the country; improve communal pasture; construct about 170 kilometers of roads, and improve about 280 kilometers of secondary and tertiary roads; and build schools and health centers.

Malawi. The Lilongwe Land Development project's Phase III is the final phase of an integrated development scheme. This project will continue support for extension services, farm credit, road construction and maintenance, and social infrastructure.

Tanzania. The Kigoma Rural Development project is to continue the village development work begun under Operation Kigoma. It is to establish new villages for about 250,000 people and provide infrastructure, training, technical assistance, marketing, and credit for additional farm inputs.

WESTERN AFRICA

Ivory Coast. The Cotton Areas Rural Development project is to raise incomes and living standards for 84,000 farm families by providing technical assistance and other inputs to improve farming, roads, other transportation, and water supply.

Nigeria. The *Funtua Agricultural Development* project would, over a five-year period, construct 1,500 kilometers of roads, and dams and ponds; provide extension services, marketing services, and credit to 60,000 families. An additional 40,000 families would benefit from improved infrastructure and marketing facilities.

The Combe Agricultural Development project is to build 1,000 kilometers of roads, and dams and ponds for water supply, provide training facilities, and seasonal and medium-term credit for production inputs and equipment.

The Gusau Agricultural Development project is to provide, over a five-year development period, physical infrastructure, training, agricultural support services, and seasonal and medium-term credit to 41,000 farm families. An additional 27,000 families would benefit from improved infrastructure and marketing arrangements in the project area.

Sierra Leone. The Integrated Rural Development project covers two separate areas, the Northern and the Eastern Project Area, with a total of 14,000 farm families. The project is to build 20 miles and improve 280 miles of roads, develop other infrastructure, extension services, and provide farm credit. In addition, another 65,000 families would benefit indirectly from the social infrastructure.

EAST ASIA

Philippines. The Rural Development project is to construct bridges; improve port facilities, water control and irrigation; and build or improve 530 kilometers of roads.

SOUTH ASIA

India. The West Bengal Agricultural Development project, to be implemented over a four-year period, would provide credit to construct 18,300 tubewells, agroservice centers, marketing facilities, and extension services. The project would benefit about 200,000 farm families.

EUROPE, MIDDLE EAST, AND NORTH AFRICA

Morocco. Under the Mecknes Agricultural Development project the Government would redistribute 30,000 hectares of formerly foreign-owned land to 8,500 rural families and consolidate existing farms; construct 160 kilometers of access roads; build or rehabilitate irrigation systems; and develop other infrastructure.

Yemen Arab Republic. The Southern Uplands Rural Development project is Yemen's first integrated rural development project. It would provide farm credit and extension services; construct and upgrade 180 kilometers of feeder roads; and expand and improve irrigation and village water supply systems.

LATIN AMERICA AND THE CARIBBEAN

Mexico. The Integrated Rural Development project would help to complete investment in 15 microregions and assist in the develop-

ment of 15 others. The project is to provide feeder roads, markets, extension services, and social infrastructure. Investments will be made to improve or develop irrigation, livestock, and fruit production through the provision of medium-term and long-term farm credit. The estimated rate of return varies between 11 percent and 23 percent for different microregions, averaging about 16 percent.

The *Papaloapan* Basin Development project would develop rain-fed agriculture, feeder roads, marketing facilities, and social infrastructure. Credit would be made available for fixed investment on farms and for working capital. In addition to the direct beneficiaries, another 324,000 people would benefit from new medical centers, and 137,000 from electrical services.

Paraguay. The Small Farmer Credit and Rural Development project would provide basic infrastructure and make credit available for long-term investments and short-term working capital needs of small farmers.

The Economics of Mechanized and Manual hand Clearing

Costs of land clearing for agricultural settlement vary widely, depending on the technology used, terrain, climate, previous vegetative growth, and the cropping program. The technology used for clearing may be a controversial aspect of rural settlement. The argument against mechanized clearing, using heavy, motorized equipment, is that it is capital intensive and labor saving in an environment where capital is frequently scarce and labor abundant. The counter argument is that mechanization is essential for rapid and full utilization of project infrastructure and it is, therefore, required to ensure attractive economic returns.

The relative merits of mechanized or manual clearing are determined by the interplay of several factors, including the opportunity costs and requirements of capital and labor, the effects on yields of these two technologies, and the time required to bring the land into full production. A theoretical model to estimate "indifference points" between the two approaches has been developed.¹

m_i = added cost of mechanized land clearing in year i

t^j = first year of production with hand clearing.

t^k = first year of production with mechanized clearing.

t^l = year of completion of mechanized clearing.

t^m = year of reaching full production (b) with mechanized clearing.

t^n = year of reaching full production (b) with hand clearing.

b_i = benefits with mechanization.

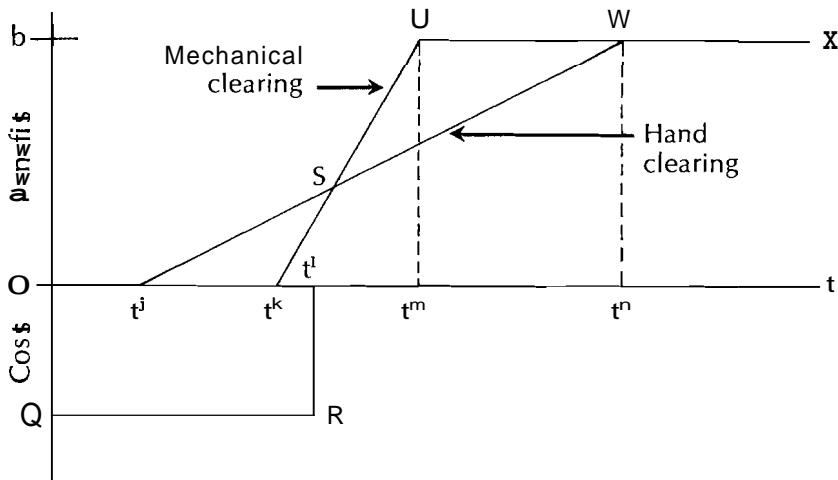
h_i = benefits with manual clearing.

r = discount rate.

(All cost and benefit variables are defined per unit area of land.)

¹Nelson, The Development of Tropical Lands, pp. 171-4.

Graphically, the typical relation among variables might be:



Mechanical clearing is economically preferable when $SUW - t^l t^k S > OQRt^l$, in present value (discounted) terms. ($OQRt^l$ represents the added costs of mechanized over manual methods.) The indifference point, i.e., the loci of variables for which hand and mechanized clearing are equally attractive in economic terms, is defined as:

$$\sum_{i=1}^{t^l} \frac{m_i}{(1+r)^i} = \sum_{i=t^k}^{t^n} \frac{b_i}{(1+r)^i} - \sum_{i=t^l}^{t^n} \frac{h_i}{(1+r)^i}$$

(A) = (B) - (C)

Thus, indifference between the two approaches is established when the present value of additional costs of mechanized clearing (A) equals the difference between the present value of benefits from mechanization (B) and the present value of benefits from hand clearing (C).

Several policy questions can be explored with the model. (Assume in all cases hypothetical, but plausible, values for $t^j=1$, $t^k=2$, $t^l=4$.)

	Variables		
Constant term assumptions	Independent	Dependent	
Question A How is the "economically justified" level of mechanization costs (in present value terms) affected by changes in the discount rate?	r	$\sum \frac{m^i}{(1 + r)^i}$	
$t^m = 8; t^n = 11$	10	109	
$b = 240$	12	94	
$b_i = 40; h_i = 24$	14	80	
	16	69	
	20	51	
Question B How is the "economically justified" level of mechanization costs (in present value terms) affected by changes in the time required to reach full production with hand clearing?	t^n	$\sum \frac{m^i}{(1 + r)^i}$	
$t^m = 8;$	11	94	
$b = 240;$	13	191	
$b_i = 40;$	15	277	
$r = 12$	25	575	
(Value of h_i , dependent on value of t^n)			
Question C How is the "economically justified" level of mechanization costs (in present value terms) affected by changes in the time required to reach full production with mechanized clearing?	t^m	$\sum \frac{m^i}{(1 + r)^i}$	
$t^n = 11;$	4	379	
$b = 240;$	6	226	
$b_i = 24;$	8	94	
$r = 12$	10	-21	
(Value of b_i , dependent on value of t^m)	12	-121	
Question D How is the "economically justified" level of mechanization costs (in present value terms) affected by changes in the benefits at full production?	b	$\sum \frac{m^i}{(1 + r)^i}$	
$t^m = 8; t^n = 11;$	120	47	
$r = 12$	240	94	
(Values of b_i and h_i dependent on value of b)	480	187	

It is plausible to assume that O , t^j , t^k , and t^l typically will not differ greatly, and changes in these values thus will not significantly affect the "economically justifiable" level of mechanization costs. On these assumptions, the supportable level of mechanization costs is not sensitive to the discount rate (Question A). On the other hand, the justifiable level of mechanization costs is sensitive to the time required to reach full production under both hand clearing (Question B) and mechanized clearing (Question C). As Question B indicates, if the time required to reach full production with hand clearing increases by a factor of 2.3 ($25 + 11$), the supportable cost of mechanization rises by a factor of 6.1 ($575 \div 94$).

The Use of Remote Sensing Imagery in Preparing Land Settlement Projects

Ideally, areas for land settlement should be selected on the basis of regional development studies, which analyze and assess natural and human resources in each area. Resource surveys can take considerable time and be very costly if carried out solely and comprehensively by traditional methods, such as aerial photography and ground surveys. Resource survey and evaluation work at first entails the broad reconnaissance type of surveys over very large areas before choosing to survey more promising sites. The means to do the broad reconnaissance survey is now possible by satellite remote sensing imagery. From the viewpoint of land settlement, it can provide fairly detailed surveys of vegetation types and land use patterns (with resolution down to contiguous areas of 60 x 80 meters), broad soil surveys, and, where topographic maps are absent or deficient, information on physical and cultural features, such as rivers, roads, villages, and towns.

Analysis of the data from satellite remote sensing imagery, together with statistical and other natural and human resource data, should make it possible to single out promising areas for more detailed investigations. These could be done by using aerial remote sensing imagery¹ and aerial photography, singly or in combination, and following up with detailed ground surveys.

To date, little use has been made of satellite remote sensing imagery in land settlement schemes, but an example of what it can do was demonstrated in a settlement project in Nepal where the government had requested Bank assistance. Interpretation of the black and white transparencies of the proposed project area indicated that it was fairly heavily settled already. Ground inspection confirmed that this was the case. It became necessary, therefore, to find an alternative area. This was done with the aid of satellite remote sensing imagery.

Satellite remote sensing imagery can be obtained in a number of ways and can follow two broad approaches—with the use of film and of computer tapes. Film provides considerably less detail and

¹ Aerial remote sensing imagery predates satellite remote sensing imagery. The same type of equipment is used; in the one, it is mounted in an aircraft and, in the other, in a satellite. The scale, however, is quite different. Aerial remote sensing imagery is larger scale and offers greater resolution, but it covers less area and does not have the sequential capabilities of satellite remote sensing imagery.

resolution, but helps to identify promising areas for detailed analysis using computer tapes. Both the films and tapes are produced by the Earth Resources Observation System (EROS), a program of the United States Department of the Interior, administered by the United States Geological Survey. Black and white negatives and computer compatible tapes are for sale to the public and may be ordered from EROS² or from other ground receiving stations. The film negatives can then be interpreted, using color enhancement to bring out different aspects of the four spectral bands which are made available by the multispectral scanner instrument in the satellite. The tapes can be precision processed and then analyzed. Topographic maps are required to "fix" the geographic location of the images, and "ground truthing"³ has to be carried out to identify the "spectral signatures"⁴ of, for example, the different types of vegetation. Developing countries can have all this work, with the possible exception of the ground truthing, carried out by one of a number of specialist commercial firms, or they can purchase the equipment and use their own trained staff to carry out the interpretation and analysis work. Ground truthing is most economically done by locally staffed survey teams.

At prices prevailing in 1976, a ground receiving station can cost between \$1 million and \$5 million, and interpretation/evaluation equipment between \$300,000 and \$600,000. Complete computer facilities and buildings for the processing facilities add from \$3 million to \$5 million. Computer tapes purchased from EROS are about \$200 per tape; commercial firms charge from \$2,000 to \$2,500 to precision process and analyze each tape above a minimum number. If it is desired to cover a whole country, including water bodies and all border areas outside the particular country, the current cost estimate of covering such an area with precision processed and interpreted imagery is about 7 cents a square mile or about 3 cents a square kilometer.¹ The cost would be less than half if the area required to be surveyed is within a country and overlapping areas outside are not required. Each tape covers 34,225 square kilometers or 13,214 square miles.

² EROS Data Center, Sioux Falls, South Dakota 57198, U.S.A.

³ To confirm on the ground the details indicated in the satellite imagery.

⁴The distinctive reflectance emitted by different physical features and objects on the earth's surface which can be recorded by the satellite.

⁵This figure includes the foreign exchange costs of ground truthing for land use or land cover, as expended in a recent case study. The costs of aircraft, field survey vehicles, and salaries of local technicians are not included. Additional ground truthing of soils, hydrology, geology, etc., could understandably take more time and raise costs considerably.

The following sequence illustrates the logical steps in using remote sensing imagery to identify settlement areas.⁶

1. Delineate area to be surveyed.
2. Have a remote sensing index compiled by a commercial firm and evaluate the availability of remote sensing imagery; review data for cloud coverage and frequency of coverage by seasons.
3. Order 70 mm. negatives, 70 mm. positive transparencies (4 sets) from the EROS Data Center.
4. Have a commercial firm enlarge the 70 mm. film products to the scale of 1:250,000 in Band 7 (black and white) and make color enhancements at the 1:500,000 scale (2 sets).
5. Receive items (3) and (4) and arrange for the ground truthing of the film products by local staff.
6. Order computer compatible tapes from EROS.
7. Invite bids from commercial firms for a tape analysis in 16 categories, color separated, and map annotated.
8. Select company to process the computer compatible tapes, to screen spectral data, and rework some into final products.
9. Carry out the analysis of the final products by local land use capability, agricultural, water, and other specialists, and have the results integrated and evaluated by regional/rural/settlement planning experts.

⁶This assumes that the countries do not have their own ground receiving station and/or do not have their own processing equipment.

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