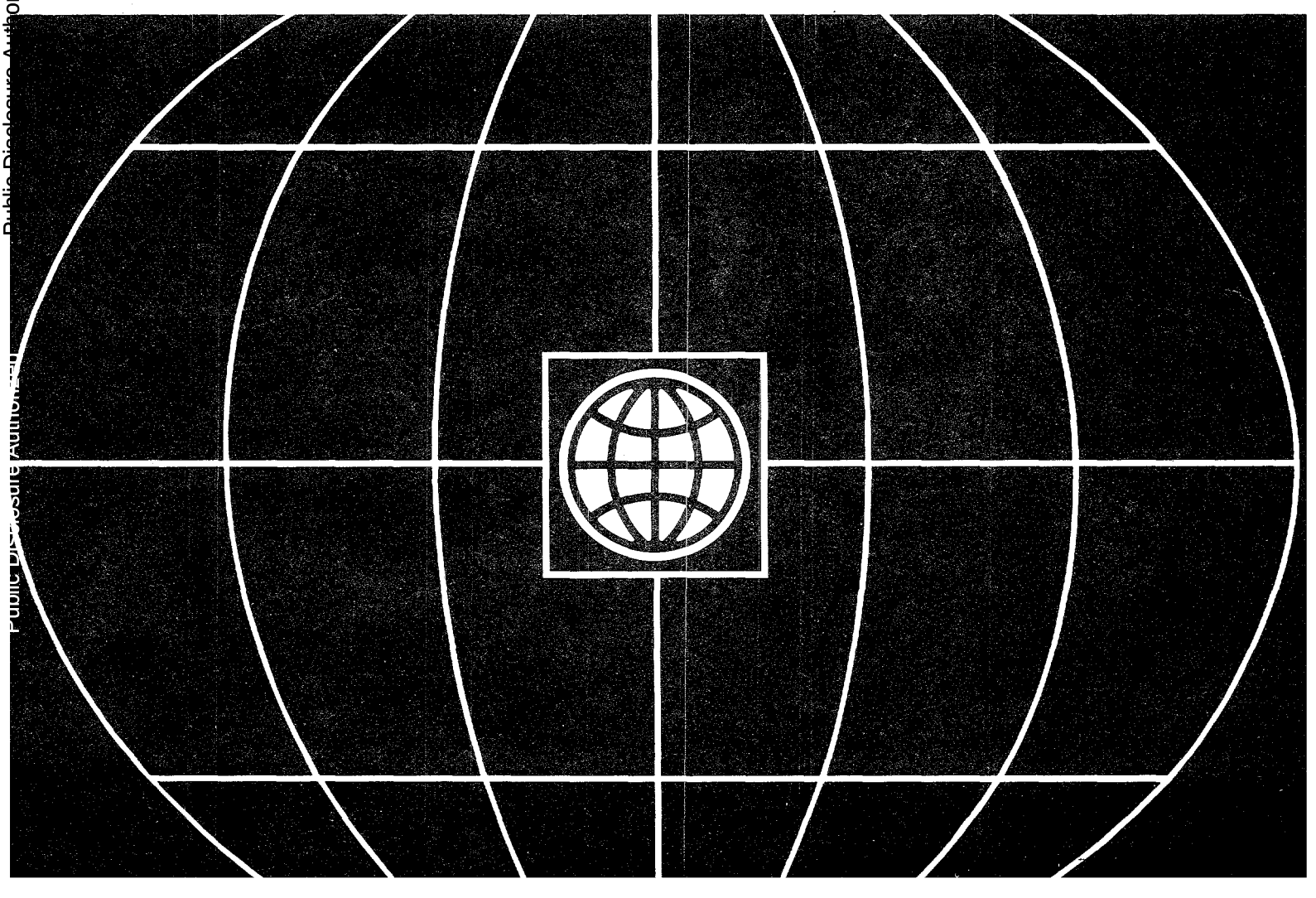
A WORLD BANK COUNTRY STUDY

Indonesia

Sustainable Development of Forests, Land, and Water



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Sustainable Development of Forests, Land, and Water

The World Bank
Washington, D.C.

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US$1.00 = Rupiah (Rp) 1,650
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GOVERNMENT OF INDONESIA FISCAL YEAR

April 1 - March 31

WEIGHTS AND MEASURES

1 kilometer (km)	=	0.62 miles (mi)
1 square kilometer (km^2)	=	100 ha = 0.39 mi^2
1 hectare (1 ha)	=	2.47 acres (ac)
1 kilogram (kg)	=	2.2 pounds (lb)
1 metric ton (t)	=	2,206 pounds

ACRONYMS, ABBREVIATIONS AND LOCAL TERMS

ADB	-	Asian Development Bank
BAKOSURTANAL	-	The Coordinating Agency for National Surveys and Mapping
BAPPEDA	-	Regional Development Planning Boards
BAPPENAS	-	The National Development Planning Agency
BFL	-	Basic Forestry Law
BKLH	-	Provincial Level Environment Office
BKPM	-	Investment Coordinating Board
CHR	-	Complete Harvest and Regeneration
CIDA	-	Canadian International Development Agency
DGCK	-	Directorate General Housing and Human Settlements
DGRRL	-	Directorate General for Reforestation and Land Rehabilitation (MOF)
DGWRD	-	Directorate General of Water Resources Development (MPW)
DR	-	Discount Rate
EIA	-	Environmental Impact Assessment
EMDI	-	Canadian funded Project, Environment Management Development in Indonesia
FAO	-	Food and Agriculture Organization
GIS	-	Geographic Information System
GOI	-	Government of Indonesia
GRDP	-	Gross regional domestic product
HYV	-	high yielding varieties
IGGI	-	Inter Governmental Group on Indonesia
IHE	-	Institute of Hydraulic Engineering
IIED	-	International Institute for Environment and Development
IRR	-	Internal rate of return
IUCN	-	International Union for Conservation of Nature and Natural Resources
IUIDP	-	Integrated Urban Infrastructure Development Program
KEPAS	-	The research group on agroecosystems
KLH	-	Ministry of Population and Environment (also MPE)
LNG	-	Liquid Natural Gas
LRD	-	Land Resources Department of ODA
M&I	-	Municipal and Industrial Water Supply
MHA	-	Ministry of Home Affairs
MOA	-	Ministry of Agriculture
MOF	-	Ministry of Forestry
MOH	-	Ministry of Health
MOI	-	Ministry of Industry
MPE	-	Ministry of Population and Environment (also KLH)
MPW	-	Ministry of Public Works
NES	-	Nucleus Estate and Smallholder
NPV	-	Net Present Value
NGO	-	Non Governmental Organization
ODA	-	British Overseas Development Authority
PKK	-	Indonesian Women's Movement
PMCA	-	Pollution Monitoring and Control Agency
PMU	-	Project Management Unit
PRONA	-	National Land Registration Program
RBE	-	River Basin Enterprises
Repelita	-	Five-Year Development Plan
RePPProt	-	Regional Physical Planning Program for Transmigration
RRA	-	Rapid Rural Appraisal
SLS	-	Indonesian Selective Logging System
SKEPHI	-	Indonesian Society for Forest Protection
TGHK	-	Forest Classification System
UNDP	-	United Nations Development Programme
USAID	-	United States Agency for International Development
WALHI	-	The Indonesian Environmental Forum
WRI	-	World Resources Institute
WWF	-	World Wildlife Fund
YIH	-	The Indonesian Green Foundation
YPMD	-	The Foundation for Rural Village Development

INDONESIA

FORESTS, LAND AND WATER: ISSUES IN SUSTAINABLE DEVELOPMENT

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INDONESIA

FORESTS, LAND AND WATER: ISSUES IN SUSTAINABLE DEVELOPMENT

Preface

This document was prepared as an input into the Bank's Economic Report, presented at the 31st meeting of the Inter-Governmental Group on Indonesia (June 1988). It was also intended as a resource for the preparation of Indonesia's fifth five-year development plan (1989-1994). Although there were many topics which could have been considered, the report focused primarily on issues related to land and forest management in the outer islands, and land and water resource management in Java, as these topics were thought to be central to issues of sustainable development and to illustrate important policy and institutional concerns. The main audience for the report was intended to be Indonesian economic planners, and for this reason the main objective of the report was to demonstrate that increased attention to the environment was necessary to achieve the Government's development objectives.

Background papers prepared by Bank staff and consultants are summarized in the main report.1/ The report also borrows from a parallel effort by the United Nations Development Programme (UNDP) which focused on institutional arrangements for environmental management, and from documents prepared for Indonesia by the International Development Agencies of Canada (CIDA) and the United States (USAID). To take account of recent developments in Indonesia the executive summary has been updated for this publication. The main report has not been revised and provides a snapshot of the situation at the close of Repelita IV. It is gratifying to note that due to the broad efforts of the Ministry of Population and Environment and concerned officials and public interest groups, many of the issues raised in this report are being addressed in the fifth five-year plan.

The preparation team wishes to extend its sincere appreciation to Minister Emil Salim and the staff of the State Ministry for Population and Environment who facilitated this work. Many other Indonesian officials and concerned individuals also made important contributions and the Bank is grateful for their assistance.

1/ This paper was prepared by Gloria Davis with assistance from Richard Ackermann. Background papers were prepared by Dirk Leeuwrik (Upland Watersheds), Daniel Gunaratnam (Water Quantity and Quality), Kyle Peters (Industrial Pollution) and Gloria Davis (Forests and Land Resources). Contributors to these reports are listed in Annex A.

INDONESIA

FORESTS, LAND AND WATER: ISSUES IN SUSTAINABLE DEVELOPMENT

EXECUTIVE SUMMARY

Sustainable Development

Environment and Development

1. Environment and development are intertwined. The sound management of natural resources, including forests, soils and water, is a prerequisite to economic development; and economic development, in turn, is necessary for good environmental management. Economic development and associated education, industrialization and urbanization will be the major factors slowing population growth, reducing pressures to convert marginal lands to agriculture, providing the capital to reduce pollution, and permitting the planned, rational use of natural resources. If growth is pursued without due regard to its immediate impact on the environment and natural resource base, it can jeopardize longer term development. But sound resource management in the absence of economic growth is not feasible in countries where poverty and population increases are major contributors to resource degradation.

2. The concept of sustainable development acknowledges the importance of economic growth, but it differs from previous concepts of development in its recognition that natural resources are finite and that the wasteful use of resources today will cause an unnecessary sacrifice of income and wealth in the future. With this in mind, a sustainable development approach encourages looking beyond immediate preoccupations in order to detect unsustainable practices in their early stages when they are easier and less costly to address. Linked to this strategy is the view that forests, land and water have important ecological functions not easily measured in economic terms, and the belief that new knowledge and growing shortages will increase their future value. Given these premises, a sustainable development approach tries to keep open as many options for future choice as possible, and it urges caution when considering any undertaking with irreversible environmental costs.

3. Those who support policies based on sustainable development acknowledge the strong incentives for both governments and individuals to maximize short-term gain. They recognize that the need for quick returns affects policies in countries at all levels of development and is particularly pressing in poor countries which have serious economic and social problems. For this reason, advocates of sustainable development encourage a broad development of awareness about the implications of current rates of natural resource utilization. They also support a broad participation in future choices and in the distribution of any future benefits from sound resource management.

The Indonesian Context

4. In contrast with many developing countries, Indonesia is very fortunate in terms of her natural endowments. The country has:

(a) a wealth of energy resources, including petroleum and coal, plus the potential for increased hydro and geothermal energy;

(b) rich soils in Java and Bali, and good soils in parts of Sumatra, Sulawesi and many other islands; and

(c) closed canopy forest in more than half of the country, a higher proportion than in any other large country in Asia.

In the last two decades, this wealth of natural resources coupled with good macroeconomic management has helped sustain impressive rates of growth and achieve substantial reductions in poverty.

5. Indonesia also has a long standing commitment to the basic concepts of sound environmental management. For the last decade, the country has had a State Minister concerned with the environment, and more recently the importance of environmental concerns has been reiterated by the President. The seriousness with which the Government views the environment can also be seen in recent legislation requiring environmental impact assessment for all major development projects, in concrete actions such as the nationwide introduction of integrated pest management, in the guidelines for the fifth five-year plan, and in steps to strengthen forest management and introduce measures for pollution abatement.

6. A program to introduce integrated pest management nationwide is one good example of sound environmental management. During the 1970s and early 1980s, Indonesia relied on broad spectrum pesticides, supported by price subsidies, to reduce pest outbreaks and support rice production. As in many other countries, heavy pesticide applications destroyed natural predators. As a result, a previously innocuous insect, the brown planthopper, became a significant pest, and by 1986 it seriously threatened the rice crop in Java. Once the problem was recognized, the Government banned 57 broad spectrum pesticides, reduced pesticide subsidies and developed emergency extension programs to teach farmers to recognize and protect pest predators. Damage declined sharply in 1986/87 and an ecological balance was reestablished. As the first country to introduce such measures nationally, Indonesia has received international recognition and acclaim for these efforts.

7. In summary, the climate for sound environmental management in Indonesia is favorable. The country is fortunate to have generous forests, land and water resources, and policymakers recognize their obligation to future generations to manage these sustainably. There are, however, a number of emerging environmental issues in Indonesia which need to be addressed in the next five years, and this report is intended to help identify these issues and make recommendations for change.

Emerging Environmental Issues in Indonesia

8. Indonesia's environmental pressures are related to population growth and spatial patterns of development. Of the population of 176 million, about 62% (109 million people) are located in the inner islands of Java, Madura, Bali and Lombok, which together have about 8% of Indonesia's land. Population densities in Java, at about 800 people/km^2, are roughly the same as Bangladesh, but Bangladesh is largely flat and has more cultivated land. About 67 million people reside in the outer islands, of which the largest are Sumatra, Kalimantan, Sulawesi and Irian Jaya. With average rural household incomes of about US$450 per year in Java and about US$600 per year in Sumatra and Kalimantan, poverty alleviation will continue to be Indonesia's most pressing development problem.

Table 1: BASIC DATA

Island	Estimated 1988 population	People per km^2	Population growth % p.a.	% land /a in forest department boundaries	% medium and large scale manufacturing
Inner Islands					
Java	106.0	788	1.7	22	80
Bali	2.9	503	1.3	22	3
Outer Islands					
Sumatra	36.2	74	3.1	65	11
Kalimantan	8.5	15	3.0	82	3
Sulawesi	12.3	63	2.2	68	3
Irian Jaya	1.4	3	2.9	99	-
Other	8.6	37	3.0	69	-
Total	175.9	90	2.1	75	100

/a Includes reserves, protection, production and conversion forest.

9. To improve family welfare, reduce poverty and limit population growth, Indonesia has an active family planning program. In 1970 the crude birth rate was 44 births per 1,000 population per year and by 1985 it was 33 per 1000. In this same period the growth rate fell to 1.8% in Java and 2.3% in the country as a whole. However, Government's objective of 22 births per 1,000 population by the year 2000 will be difficult to achieve since poor households desire more than two children for income security.

10. With 2.3 million new entrants to the labor force each year in the 1990s employment generation will continue to be an overriding development objective, and problems related to employment generation will be particularly relevant to environmental concerns. One reason is that Java has very little

capability to absorb more agricultural labor. Virtually all land in Java is used (nearly 75% of Java is under agriculture and 87% is under productive use); average family farms are less than 0.5 ha; and nearly 40% of the population dependent on agriculture is landless. Although Java has 60% of the country's population, of whom 55% are directly dependent on agriculture for employment, agriculture in Java absorbed only 12% of the country's incremental labor force between 1980-85. Agriculture in the outer islands absorbed 30% of the total labor force in this period. At the same time, 38% of Indonesia's new labor force moved into nonagricultural occupations on Java and about 20% found nonagricultural work in the outer islands.

Table 2: SHARE OF EMPLOYMENT GROWTH IN JAVA AND THE OUTER ISLANDS (%)

	1971-80	1980-85
Agriculture		
Java	8	12
Outer Islands	18	30
Total	26	42
Non-Agricultural Occupations		
Java	50	38
Outer Islands	24	20
Total	74	58

Source: Central Bureau of Statistics, SUPAS, 1985.

11. The development process has also produced different environmental pressures in the outer islands and in Java. The outer islands are the repository of most of Indonesia's forest and land resources. They account for close to 60% of all forested area in Southeast Asia, and more than 98% of all forests in Indonesia. These closed canopy forests are of value from both a productive and protective point of view. They are also under increasing pressure. Since 1980, Government-sponsored programs in the outer islands have put nearly 2 million ha into production and there has been a rapid growth in local land use and in the exploitation of timber and other forest products. These factors have led to a sharp increase in the rate of deforestation and an uneven pattern of land use. Primary forests are now thought to be disappearing at a rate of about 900,000 to one million ha per year and many cultivated areas in the outer islands are producing only modest returns on a per hectare basis.

12. In Java, the threat to the environment arises primarily from a growing population, industrial development, and the resulting pressures on land and water resources. An estimated 60% of outer island interprovincial migration is to Java, and 78% of Java interprovincial migration is to the

Jakarta-Bandung corridor. Java's cities are expected to double in size between 1980 and 2000, and there will be more people in cities in Java the year 2000 than there were in all of Java only 50 years before. Under these circumstances, increasing population densities along Java's north coast are straining the capacity of coastal ecosystems to deal with municipal waste and industrial pollution, and shortages of clean water threaten both human health and industrial development.

Land Resource Management in the Outer Islands

Issues in Land Resource Management

13. The population in the outer islands is about 67 million people, with a natural rate of increase of about 2.3% p.a. This alone places considerable pressure on forests and on marginal land. In addition, the less densely populated areas of the outer islands have long attracted spontaneous migrants from Java and Bali as well as more crowded areas in the outer islands such as South Sulawesi, North and West Sumatra. As a result, dryland agriculture expanded at 1.8% p.a. in Java, 3.7% in Sumatra, 4.6% in Kalimantan and 5.6% in Sulawesi in the decade between 1973 and 1983.

14. In response to population pressures and poverty, the Indonesian government has also promoted a variety of agricultural development programs in the outer islands. Between 1980 and 1986, two million people were moved to the outer islands under the transmigration program and about 1.2 million ha of tree crops were planted for local people and transmigrants. The demand for land for private sector development also increased. According to Forest Department statistics, applications were received for 1.6 million ha of land in Repelita III of which 137,000 ha were allocated; and application was made for 1.5 million ha in Repelita IV of which 627,000 were allocated in the first half of the five-year period. Most of the areas were in degraded conversion forest.

15. These programs have contributed to economic development and population growth and the overall rate of population increase in the outer islands, including immigration, is now about 2.6% p.a. With this rate of growth, ensuring sound land use in the outer islands is a major challenge. Key issues to be tackled in land resource management are as follows:

(a) The current land classification system does little to ensure optimal land use from either an economic or environmental point of view. For instance, nearly 30% of all land within Forestry Department boundaries in Sumatra is deforested, but it is not available for development since it is classed as Forest Department land. Other areas with good stands of timber on poor soils, are currently classified as conversion forests. It also appears that some areas with slopes of over 45% have been classified as production forests although they should be protected.

(b) Land use planning is undertaken by a very large number of agencies and data related to land use tends to be centralized and not available in the provinces where land use decisions are currently made. Provinces, in any event, have only limited institutional capacity at this time to address land use problems.

(c) Local smallholders and migrants attracted to new areas of employment face serious constraints in obtaining appropriate land, since most areas which have been previously cultivated are subject to local land claims. These lands are difficult to purchase formally and if purchased informally there may be little security of tenure. This, combined with the fact that newly cleared land tends initially to be more productive, pushes many farmers onto unclaimed forested land.

(d) Development projects also encounter difficulties in identifying and acquiring cultivable land on the scale required. This is partly due to the fact that local land claims constrain the use of previously cultivated land. In addition, Government policies, which regard land as a national asset to be used for public benefit, discourage the payment of compensation for land intended for smallholder development. This limits the amount of cleared and cultivated land which can be acquired from local people for development purposes.

16. The problem of finding land for agricultural development is compounded by the recent expansion of land within permanent forest categories. When the Basic Forestry Law was passed in 1967 there were 26 million ha within permanent forest categories; in 1974 there were 56 million ha; and in 1983, 113 million ha. Although it may seem desirable to have a very large area within permanent forest categories, such classification can be counterproductive unless there is broad local participation in the benefits derived from forestry activities. Since concessionaires alone can legally harvest timber on Forestry Department land, and since they discourage the exploitation of secondary forest products to prevent clearing or poaching, there are few incentives for local smallholders to protect forested land. In fact, the main way local farmers realize benefits from Forestry Department lands is by clearing them for crops.

17. In short, government development programs have created employment, stimulated spontaneous migration and increased the demand for land in the less densely settled areas of the outer islands; but mechanisms have yet to be developed to ensure that land is properly classified and that local people and smallholders attracted into developing areas can obtain appropriate underutilized or deforested land. Under the circumstances, either mechanisms must be developed for improved land classification and land allocation, and for land intensification and land purchase, or development will inevitably occur on land which should be set aside for protective purposes and for timber production.

Approaches to the Problem

18. To address these issues, land use problems in the outer islands need to be tackled on several fronts. First, there are good reasons to shift the emphasis of development at this time from the opening up of new lands to the intensification of production on existing agricultural lands. Not only would crop intensification schemes directed at local smallholders increase production and incomes and reduce pressures on forests and swamps, but evidence suggests that it would often produce greater economic benefits than new settlements, which typically involve high costs for new infrastructure, land clearing and the provision of services. There are, for example, at least 3

million ha of low-yielding and aging rubber in the outer islands which yield 300-500 kg/ha/yr but could produce up to 1,500 kg/ha/yr, if replanted with improved material. There are also opportunities for upgrading coconut and coffee areas and for increasing the production of rainfed foodcrops through the dissemination of improved technologies. Limited new settlement will continue to be necessary to provide land to the landless and to relieve population pressures, but a greater emphasis on intensification would make sense on both environmental and economic grounds.

19. Second, where development projects and employment opportunities have attracted labor to the outer islands, mechanisms need to be developed to permit smallholders to purchase underutilized land and to permit Government to compensate local landowners for land that is used for development purposes. There are areas in the outer islands where cleared land is available at a fair price (US$100-200/ha). This land could potentially be used either by development projects or by local smallholders and migrants, if compensation were paid by government, if land registration were simplified, and if credit were available for land purchase. To protect the more traditional groups, such programs would need to be targeted to areas where the local people are already knit into the cash economy. There are many issues related to land rights which need to be carefully assessed, but it is increasingly clear that the development of rational land markets in the outer islands will be prerequisite to sound land allocation and to forest and watershed protection.

20. Third, in view of their extensive land use and their relatively large impact on forests and protected areas, greater attention is required to the needs of shifting cultivators. Recent data indicate that 11 million ha in Kalimantan and 14 million ha in Sumatra are under shifting cultivation or brush and secondary forest which are generally signs of low intensity agriculture. The number of people practicing shifting cultivation for subsistence exceeds one million families (perhaps five million people) and the number dependent partly upon shifting cultivation is undoubtedly much higher. These farmers are very diverse. They range from traditional cultivators depending entirely on the forest for their subsistence, to wage laborers using small scale slash-and burn agriculture to meet food requirements. Past efforts to settle traditional shifting cultivators outside of forest boundaries have been unsuccessful, largely because cultivation systems were neither technically sustainable nor culturally appropriate. Community forestry schemes or treecrop development projects identified and implemented by local smallholders appear much more likely to succeed. A range of other programs is necessary to meet the needs of other types of cultivators.

21. Fourth, optimal land use in the outer islands will call for amendments to the current system of classifying land for forest and agriculture. In view of the discrepancies in land use, land potential, and current land classification, a number of proposals have been made to alter current land classification categories. These proposals assume that all areas needed for conservation and watershed protection would be set aside, but that decisions would be made about the allocation of other land.

(a) One proposal suggests that all areas suited to food crops or tree crops should be potentially available for conversion. Surprisingly, this would, over time, reduce the area deliberately maintained under

forest cover in an area like Kalimantan by only about 10%. A variation on this proposal would preserve all areas with reasonable timber even though they might be suited to other uses, but it would permit the conversion of degraded forests in areas suited to crops.

(b) Another proposal emphasizes the need to protect forested areas in those provinces with a comparative advantage in timber production. Since Riau, West, Central and East Kalimantan and Irian Jaya have 70% of all commercially valuable species, this proposal would discourage development which is inconsistent with maintaining a significant forest cover in these provinces.

(d) A third position, taken by many foresters and environmentalists, is that the amount of unplanned deforestation will be so large that no planned conversion of forested areas should take place.

Resolving conflicting views and objectives about forest classification will be a major task of Government over the next decade.

22. Finally, to manage land sustainably, Government must develop the basic tools for land use planning and development. The following key steps are required:

(a) the key mapping agencies should agree on a common mapping system;

(b) the geodetic reference system in the outer islands should be completed, as this is the basis for mapping and registration;

(c) Bakosurtanal's ability to compile and recover existing maps and information should be strengthened;

(d) key natural resource information agencies such as the Soils Research Center should be strengthened and their data decentralized; and

(e) maps completed under the transmigration program should be made available to the provinces.

To improve land use planning, the capacity to make good land use decisions must be developed in the provinces. Each province has a provincial planning office, or BAPPEDA, which should be equipped to make land use planning decisions.

23. Recognizing the pervasiveness of the problems, in November 1988 the GOI created a new institution to deal with land related matters. This agency called the National Land Board (Badan Pertanahan Nasional) was created by removing the Directorate General of Agraria from the Ministry of Home Affairs and making it directly accountable to the President. At the time of its formation the mandate of the institution was not yet agreed, but it appeared to be focussed largely on issues related to land registration. Subsequently, the GOI also formed a ministerial level commission to review institutional and policy issues related to spatial planning. The commission is chaired by a senior official in BAPPENAS and includes the head of BPN and several ministers.

24. There is now a need for these new agencies/commissions to focus on a broad spectrum of policy related matters. Among these are:

(a) the allocation of land for forestry and agriculture;

(b) the management of other critical ecosystems such as mangroves and swamps;

(c) the designation of land for urban and industrial development;

(d) social and technical issues in land registration;

(e) policies related to land acquisition and compensation for development projects; and

(f) the allocation of land for private development.

Resolving these issues will be necessary to ensure economic development while protecting Indonesia's forest resources.

Issues in Forest Resource Management in the Outer Islands

Indonesia's Forest Resources

25. Indonesia has about 144 million ha of land within Forestry Department boundaries, about 75% of its surface area. Land within Forestry Department boundaries is divided into five categories: forest set aside for conservation and national parks (13%); forest intended primarily for watershed protection (21%); limited production forest (21%) and regular production forest (24%) in which selective felling is allowed; and conversion forest (21%), which can be converted to agriculture and other uses. In total, 113 million ha in Indonesia are within permanent forest categories, of which about 65 million ha are in limited and regular production forest.

Table 3: AREA WITHIN FOREST BOUNDARIES BY FORESTRY DEPARTMENT CLASSIFICATION
('000 ha)

	Reserves	Protection	Limited production	Production	Conversion	Total
Sumatra	3,684	7,094	7,579	6,821	5,032	30,210
Java	444	554	0	2,014	0	3,012
Kalimantan	4,101	6,924	11,415	14,234	8,293	44,967
Sulawesi	1,406	3,867	3,926	2,092	1,993	13,284
Irian Jaya	8,312	8,649	4,732	7,123	11,775	40,591
Other	779	3,229	2,874	1,581	3,444	11,907
Total	18,726	30,317	30,526	33,865	30,537	143,971
%	13	21	21	24	21	100

Source: Department of Forestry, Project for the Development of Forestry Data and Information Systems, 1986/87.

26. Not all land within Forestry Department boundaries is forested. A recent evaluation of aerial photography from 1981/82 indicates that Indonesia has about 110 million ha of closed canopy forest, roughly 60% of its surface area. Although low in relation to the total amount of land within Forestry Department boundaries, this is a very large area under forest cover. Indonesia has 2.5 times as much land under forests as Western Europe, which is comparable in size, and twice the proportion of its area under forests as the United States. These forests are of enormous commercial and ecological value. In addition to providing foreign exchange, Indonesia's forests protect critical watersheds, prevent soil erosion and stabilize downstream river flows. Indonesia's extensive forest cover and island geography also give it the greatest biodiversity in the Asia region and make it one of the most important countries for conservation in the world.

27. In spite of Indonesia's extensive forest cover, there are reasons for concern. In the early 1970s FAO estimated the rate of deforestation in Indonesia at about 300,000 ha/year; in 1981 this estimate was raised to 600,000 ha/year, and recently FAO has suggested that it could be as high as one million ha per year. The data are weak, but Bank estimates confirm that deforestation at these rates is possible (Table 4). It is difficult to disaggregate the causes of forest degradation, since logging creates opportunities for smallholder movement onto forested land, but Bank estimates suggest that about 15-20% of forest depletion is due to poor logging practices; about one-quarter is due to development projects and the remainder is due to smallholder agricultural conversion, both by local people and immigrants. Some of the area converted by smallholders may regenerate into secondary forest.

Table 4: SOURCES OF DEFORESTATION

Source	Best estimate (ha)	Range (ha)
Logging and fire loss	180,000	150,000-250,000
Development projects	250,000	200,000-300,000
Smallholder conversion	500,000	350,000-650,000
Total	900,000	700,000-1,200,000

Source: Bank staff calculations and Atlanta/INPROMA, Vol. III.

28. Although some deforestation is inevitable, deforestation on this scale represents a substantial economic loss and jeopardizes the longer-term availability of forest resources. The cost to the economy of deforestation and timber depletion is conservatively estimated at about $1 billion/year. Moreover, the present rate of deforestation leads to land degradation which reduces the productivity of farmers, disrupts water supplies and threatens the raw material supplies on which export diversification partly depends. Deforestation also has a number of negative consequences of national and international concern. Large scale clearing for agriculture produces smoke and carbon dioxide which contribute to global warming; and forest clearing threatens biological diversity and endangered species. This last point is particularly important in Indonesia where the island topography results in a high degree of endemism and species quickly disappear if the forest cover is destroyed.

Issues in Forest Management

29. Management of forest resources in the outer islands is largely in the hands of private concessionaires. There are over 500 concessions in Indonesia with an average size of 100,000 ha and concessionaires log an estimated 800,000 ha p.a.; this is more than the area logged in all other Southeast Asian countries combined. Logging as currently practiced in Indonesia takes a toll on the forest. Recent surveys show that up to 40% of standing stock is damaged in logging operations and where areas are relogged before the 35 year logging cycle elapses, damage is higher. As valuable species regenerate slowly and only under specific conditions, selective logging also tends to preserve more robust but less valuable species. Since logged-over areas have greatly reduced value, many concessionaires do little to protect their holdings from encroachment and fire once they are logged.

30. One reason for these problems is that there are very few incentives for concessionaires to manage their holdings sustainably. FAO analysis shows that under current financial conditions which assume a high opportunity cost of capital (10% or above) and a long period for regeneration (35-70 years or more), clear felling with no regeneration is financially more attractive to concessionaires than even a nominal investment in restoration of the forest. The relatively short period of timber concessions in relation to the 35 year

logging cycle also contributes to a short-term perspective. These problems are compounded by low taxes and royalties which encourage concessionaires to maximize harvests to capture surplus profits. Bank estimates suggest that the understatement of harvests and declining rates of tax collection between 1980-85 cost the government at least US$1.2 billion in revenues and possibly twice this much. This, in effect, constituted a subsidy to the sector and fueled the "timber boom."

31. The underpricing of natural resources encourages their inefficient use. Import protection of wood-based industries and the ban on log exports have resulted in an underpricing of domestic timber and reduced incentives for efficiency. Since sawmills in Indonesia recover about 43% of logs compared to 55% in comparable developing countries, increases in efficiency could increase output by 28% from the same log volume. Other problems related to underpricing of the resource are the burning of timber in areas clear felled for development, neglect of secondary species and use of valuable hardwoods for low quality products. The past incentive structure treated the natural forest as a nearly free resource and expanded the annual allowable cut in response to supply constraints. In so doing, it also discouraged the development of timber plantations which could take pressure off the natural forest for low quality construction materials. Moreover, since plantation development under current financial conditions is most financially attractive when combined with complete harvest of the natural forest, subsidies for afforestation may now have the effect of encouraging plantation establishment in natural forest areas, rather than on degraded land.

32. There are also problems related to weak management of the sector and a poor knowledge of the resource base. Fifty percent of all Forestry Department staff are in Java, which has less than 2% of all forested land. Forestry Department officials in the outer islands rely largely on concessionaire reports to determine annual allowable cut and this, in turn, leads to an understatement of the volume and quality of merchantable timber (and royalties to be paid) and a tendency to ignore poor logging practices and breaches of the regulations. This situation has led the International Institute for Environment and Development (IIED) to conclude that the Forestry Department should be strengthened, its staff increased and redeployed, training improved and officials given the means to carry out their work without depending on concessionaires.

33. Given that a forest performs both protective and production functions, optimal management of forests would require that those who log the forest or convert land to agriculture should pay a price for the timber which takes into account the full cost of conversion, including the economic value of lost forest products and the loss of the protective value of the forest to the environment. This is difficult since concessionaires, shifting cultivators and transmigrants do not consider the full opportunity cost of forest use and conversion. This indicates a weakness in market mechanisms in the forestry sector which sound forest management policies should seek to offset.

34. Government recognizes the need to address these issues and has recently taken several important measures to manage the sector on a more sustainable basis. In the fifth five-year plan:

(a) targets for log extraction will not be increased as planned, but will be limited to between 31-32 million m^3, roughly the current extraction rate;

(b) logging and processing activities will be integrated since concessionaires with large investments in processing facilities are likely to have greater incentives for sustainable management of the forest;

(c) forest plantations are to be establish only on degraded forest land and to encourage this, leases are to be extended from 20 to 35 years on such land, with an option to renew;

(d) no new licenses will be issued for plywood and sawmill construction;

(e) the inspection service will be strengthened and greater use will be made of remote sensing information from satellites to monitor changes in forest cover;

(f) a new Directorate of Extension has been created to encourage the participation of people in conserving and managing forest resources in cooperation with the Forestry Department; and

(g) human resource development in the Ministry will be strengthened to ensure that the staff of the Ministry can perform better in their forestry management and conservation tasks.

35. In April 1989, Government also announced a 150% increase in the reforestation tax, and a new export tax on sawn timber. The export tax was again increased in late 1989 and this has reduced sawnwood exports. Some of the inefficient mills are now becoming unprofitable and will have to close or restructure to become more efficient. The impact of this policy on industrial efficiency will need to be evaluated after a few years experience with the new tax regime.

36. There are still issues on which analytical work is required. To determine sustainable rates of timber extraction and to establish a framework for improved concession management, additional information will be needed on: (a) the quality and quantity of standing stock; (b) the regenerative capacity of the natural forest (and potential ways to improve it); (c) the elasticity of demand for Indonesian timber and Indonesia's role in setting world prices; (d) the relationship between taxes, royalties and extraction rates. Further research is also needed on measures to increase plantation production and improve silviculture techniques. Beginning in 1988, the Government began to address these issues, with the support of Bank financing. These efforts include an inventory of representative areas to determine the quality and quantity of timber stands, use of SPOT imagery to monitor forest cover, studies on ways to improve concession management, review of the mechanisms levels and revenue collection from the sector, study of shifting cultivators, and strengthening of forest research efforts.

The Reserve System

37. Indonesia has set aside almost 10% of its land area for conservation and protection, a larger proportion than in most developed or developing countries. The country has 319 gazetted conservation areas, including 19 national parks, and it has 187 areas identified and scheduled for incorporation into the protected area system. In total, Indonesia has set aside nearly 20 million ha as reserves and another 30 million ha as permanent protection forest. The National Conservation Plan, the Irian Jaya Development Plan and the Marine Conservation System Plan bring the number of planned or proposed reserve areas to more than 700. These proposals cover the major biogeographic regions of the country and conservation groups agree that these areas if properly managed, would be sufficient to protect biological diversity and endangered species. However, additional work is required to prioritize and demarcate wetland areas.

Table 5: NUMBER OF RESERVES WITH PRIORITY FOR PROTECTION BY BIOGEOGRAPHIC REGION

Region	Number of priority reserves	Number with management plans
Sumatra	16	6
Java and Bali	9	8
Kalimantan	14	5
Nusa Tenggara	8	2
Sulawesi	8	4
Maluku	12	1
Irian Jaya	12	3
Total	79	29

Source: International Union for the Conservation of Nature and Natural Resources

38. To initiate a comprehensive conservation program, strategies need to be developed for each of Indonesia's seven biogeographical regions (Table 5), inventories and management plans should be developed for specific reserves, the management of parks and reserves needs to be decentralized to the provinces, and models are needed for incorporating local people into the planning and implementation of protection programs. This will require additional manpower and funds. To mobilize grant funds internationally and to utilize the technical support and training available in developed countries, the report recommends that selected donor countries cooperate with the provinces in each biogeographical region to develop a comprehensive conservation program. A number of countries appear to be ready to provide financial and technical support if government can develop an appropriate institutional framework to coordinate this effort; and an estimated US$50 million appears to be available on grant for this purpose over the next five years. If successful, such a program would be a milestone in mobilizing international support for conservation purposes.

39. Conservation needs in forested areas are relatively well known, but there are many critical ecosystems in Indonesia that are largely unmanaged, are of critical economic and ecological importance, and in which land use conflicts are increasingly intense. These include wetlands, mangroves,

coastal and marine areas. Many of these areas provide important ecological services in their natural state, but relatively little is known about the economics of alternative uses. Tidal swamps, for example, are both an important reserve for fisheries and wildlife and Indonesia's remaining agricultural frontier. Recently the Department of Forestry has sought authority over coastal and marine reserves, but the number of parties interested in these areas suggests the need for other means of coordination. Under the circumstances, it may be appropriate for the Ministry of Population and Environment and the provinces to take a more active role in the management of critical lands. Plans for the management of tidally affected wetlands are particularly urgent.

Land Resource Management in Java

Urban Land Management

40. Land use issues are important in Java as well as the outer islands. The most significant issues are related to the almost complete utilization of arable land and to rapid urbanization. While population levels in Java's rural areas are growing at about 1% p.a., medium-size cities are growing at 6.5% and are projected to increase fourfold in 25 years. Among the environmental consequences of such urban growth is the loss and degradation of prime agricultural land. An estimated 40,000 ha of cropland is converted to other uses annually and replacing the productive capacity of this land is estimated to cost US$50-100 million/year. Urban and industrial expansion also place pressures on coastal ecosystems and hillside forests; and increasing human populations and the proliferation of small industries contribute to air and water pollution, and to human health problems.

41. These problems are magnified around large urban areas such as Jakarta. The Jakarta metropolitan area with ten million people is currently the eighth largest urban area in the world. It is expected to surpass Los Angeles in size by the year 2000, to become the world's seventh largest city. Given the rate of growth and associated environmental problems, a number of planning studies have been carried out on the Jakarta metropolitan area. These studies have provoked interest in the problems of the region, but they have been only modestly successful in providing the basis for consensus or in attracting funds for remedial actions. Among the major impediments to coherent regional planning are a lack of clear authority among agencies, the top-down nature of spatial planning in the past, a lack of integration between spatial planning and the regulatory framework necessary to support it, and weak integration of planning and budgeting.

42. To address these problems, regional and spatial planning need to be improved. This job is currently delegated to the provinces, but to play this role effectively the BAPPEDAs must be strengthened and line agency roles must be clarified. The new National Land Agency or the new ministerial level commission could play an important role in resolving agency responsibilities. Spatial plans developed at the local level should have broad participation and the instruments for enforcing spatial planning, e.g., licensing, zoning and taxation should be integrated and simplified. Increased local-level participation in planning and revenue generation will, over the longer-term,

help solve the budget problem, but central support for these initiatives is still needed.

Watershed Management

43. Most watersheds in Java are potentially subject to serious erosion, but "critical" areas are thought to cover about 1.9 million ha (15%) and include about 12 million people. Critical areas have somewhat lower population densities (400-500 people/km^2) than the average for Java as a whole (800 people/km^2), and population densities are lower in limestone areas than in areas with fertile volcanic soils. Whereas average erosion in the United States is estimated at about 0.7 tons of soil/ha/year, overall erosion rates in Java are about 6-12 tons/ha/year on volcanic soils and about 20-60 tons/ha/year on limestone soils. On agricultural land they are much higher (Table 6). These high rates are due mainly to the high levels and intensity of tropical rainfall, but they are exacerbated by the loss of ground cover in the hills.

44. Erosion brings benefits in the form of new land, but it also causes siltation of reservoirs and ports, and it raises riverbeds, causing flooding in low-lying areas. The difference between high water and low water levels has also widened in downstream areas, causing disruptions in water supply in some river basins. Bank staff analysis suggests that soil erosion on Java costs the economy about US$400 million/year. Of this, nearly 80% is due to declines in productivity on agricultural land, while only 20% is due to off-site costs such as the siltation of irrigation systems and the loss of reservoir capacity. To date, however, nearly two-thirds of the expenditures in upland programs such as the Regreening Program have been for off-site measures such as afforestation, check dams and gully plugs. This analysis suggests a need to reorient investments away from off-site programs toward the protection of farmland through improved farming practices.

Table 6: ON-SITE COSTS OF EROSION

Province	Total area (km^2)	Average annual soil loss on agricultural land (Tons/ha)	Capitalized value of productivity loss (US$ million)
On-Site			
West Java	47,370	144.3	142
Central Java	33,013	133.3	29
Yogyakarta	3,346	118.2	6
East Java	45,308	76.0	139
Subtotal	129,037	123.2	315
Off-Site			26-91
Total			341-406

Source: Adapted from Magrath and Arens (1989).

45. A number of studies demonstrate the potential for reducing soil loss with improved farm technologies. For example, one study of upland volcanic soils in East Java found soil loss of 476 tons/ha/year with poor terraces, but only 54 tons/ha/year with good terracing. On limestone soils, FAO measured soil erosion rates up to 539 tons/ha/year on slopes of 15-20%, while on similar soils with good terraces they were 48 tons/ha/year. Since an estimated 30-40% of total annual erosion occurs during the first two months of the wet season, cropping systems designed to maintain maximum ground cover could also play an important role in reducing soil erosion.

46. Javanese farmers are quick to adopt new farming systems and modify their farming practices if they perceive an economic advantage in doing so, but the main constraint to the adoption of recommended upland farming practices is their cost. Labor required for the construction of bench terraces amounts to 750-2000 work days/ha ($850-$2,250), which means that farmers must either borrow money to hire labor or forego other income earning opportunities to do the work themselves. Calculation of the gains from terracing suggests that farmers can be expected to adopt good terracing technologies without subsidies, only if they cost less than US$500/ha. To circumvent this constraint, research is needed on lower cost technologies. One promising innovation is the use of vegetative grasses on contours to build natural terraces. Research is also required on cropping systems which minimize the time land is exposed between crops.

47. Upland areas and the more marginal areas of the outer islands have a variety of elevations, slopes, soils, vegetation and moisture regimes, and for

this reason agriculture in these areas is characterized by much greater diversity than in lowland rice growing regions. This means that flexible, bottom up approaches will be needed to identify the characteristics of each agro-ecosystem and to help the farmer experiment with and adopt appropriate interventions. Research on appropriate on-farm soil conversation practices and extension of new technologies is generally the function of the Ministry of Agriculture (MOA). However, the Ministry of Forestry, Directorate General for Reforestation and Land Rehabilitation (DGRRL) has been given the responsibility for all soil and water conservation planning on slopes over 8%. This is an awkward arrangement and requires duplication of services with MOA at the farm level. In the future, considerable effort will need to be devoted to expanding the capacity of both agencies to provide appropriate advice and services to upland farmers, to reducing unnecessary duplication between MOF and MOA, and to effectively involving local government and communities in planning and implementation.

Water Resource Management in Java

Water Quantity

48. Although Java is well endowed with rainfall, most of its rivers are less than 50 km long, and very shallow catchments combined with deforestation have increased the variability in runoff and caused water shortages downstream, particularly in dry years. Under the circumstances, the allocation of surface water and groundwater for agriculture, municipal and industrial use is an issue of increasing importance.

49. Analysis in this report indicates that Java has total surface water flows of about 170 billion cubic meters (Bm^3) annually, but firm water resources, i.e., minimum flows in a once-in-five-year dry year, are only about 78 Bm^3 or 42%. Dams impound 6.9 Bm^3, about 4% of total annual flows. Irrigated agriculture is the major user of surface water, requiring about 60 Bm^3 annually. This is about half the potentially available water and three quarters of the firm water flows. Future water requirements in the year 2010 are projected at about 88 Bm^3 and suggest shortages of 10 Bm^3 in a dry year. Two-thirds of this shortage could be eliminated by increasing the efficiency of water used for irrigation; and it could be reduced another 10% by the construction of new dams (Table 7).

50. Municipal water use is about 2.25 Bm^3, or about 3% of the water used for agriculture. Despite relatively low requirements, however, urban and industrial pollution are reducing the quality of raw water supply, and competition for water in the dry season is already intense, particularly in urban areas like Surabaya, Bandung, Cimanuk, Bogor, Jakarta and Tenggarang. Urban and industrial water use are expected to grow at high rates, reflecting rapid urban and industrial growth and current low levels of piped municipal water supply. Unaccounted-for-water, water lost from piped systems or used without payment, accounts for almost 40% of municipal water, and efficiency improvements and better cost recovery are required if future supply targets are to be met.

Table 7: TOTAL WATER DEFICITS FOR SELECTED CATCHMENTS IN A DRY YEAR (2000)

Catchment area	Irrigation area ha	Deficits in million cubic meters: Without efficiency improvements E - 30%	With efficiency improvements E - 50%	With efficiency improvements E = 50% & Dams
Solo	274,000	1,520	560	560
Jratunseluna	108,000	1,930	840	530
West Semerang	22,000	10	0	0
Pemali Comal	130,000	1,440	530	530
Cissanggarung	42,000	360	190	190
Rentang	90,000	1,030	350	0
Cibeet/Jakarta Cisadane	190,000	1,940	300	290
Banten	55,000	370	65	65
Serayu	197,000	1,060	220	220
South Kedu	55,000	230	120	0
Citanduy	50,000	100	0	0
Telok Lada	31,000	20	0	0
Total	1,244,000	10,010	3,220	2,390

/a E = efficiency. Refers to the percentage of water delivered. Most systems are designed for 50% efficiencies.

Source: Bank staff estimates based on DGWRD data.

51. Groundwater extraction is about 8.7 Bm^3 per year, about 10% of firm surface water flows. However, because groundwater is relatively safe and convenient, it supplies about 60% of water for rural domestic use and is the major source of water in cities which have polluted surface waters. In Jakarta, private groundwater abstraction provides about four times as much water as municipal water supply and it provides 65% of the water for industry. About one million m^3 of groundwater is drawn per day in Jakarta and this has caused salient intrusion into shallow aquifers. This is a particularly serious problem since shallow wells provide most of the water for domestic use. Contaminated groundwater means that many poor households on Java's north coast purchase water from vendors at rates far exceeding those paid by wealthier users of the piped water system.

52. To help emerging water allocation problems, the report suggests increased attention to pricing to improve the efficiency of water use. The cost to Government for supplying irrigation water on-farm in Java is currently about $100 per ha/year. The fact that there is no charge for this water contributes to inefficient use. Government has agreed in principle to recover the cost of operation and maintenance of irrigation systems under the Bank assisted Irrigation Subsector Loan, but the pilot projects do not provide economic incentives for water conservation because they are not linked to the volume of water used.

Appropriate charges for groundwater are even more important than those for surface water, as groundwater is only a partially renewable resource and current abstraction occurs at the expense of future users. Increasing the level of tariffs on groundwater and improving mechanisms for their collection could have a significant impact on the rates of groundwater abstraction on Java's north coast.

53. At the present time, different institutions are responsible for irrigation, municipal water supply, surface and groundwater use. This hampers planning and leads to resource conflicts. To improve the situation, coordination between agencies involved in water resource management must be improved. Existing institutions also need to be strengthened to take multiple water uses into account. Provincial Irrigation Services would be more effective if they were able to monitor water use and make allocational decisions across sectors, and existing Irrigation Committees would function better as water Resource Management Committees responsible for the management of all water use in each subsystem. This would require a broadening of viewpoint and orientation and such Committees would need permanent staff and adequate budget to manage day to day work. Water Users Associations would also benefit from training intended to improve system management and the efficiency of water use.

54. At the river basin and regional level, water resources planning, management and operations could also be improved to better take into account multisectoral needs and environmental concerns. To accomplish this the report suggests a phased approach. Initially coordination among existing agencies could be improved by creation of an interministerial committee with central and provincial representation. This committee might subsequently evolve into a board with a small but highly qualified executive staff. For many basins and provinces, improving coordinating mechanisms would suffice, but for more complex areas an autonomous River Basin Entity (RBE) may be desirable. The RBE would have a larger staff, legally defined authority, and powers to set and enforce standards. It would also be empowered to independently manage its finances, including the imposition of water user and waste disposal charges. Underlying this institutional evolution is the premise that existing entities and staff should perform their historical functions to the extent appropriate under a multisectoral approach, and that provincial and local governments are ultimately responsible for the development and management of their resources.

55. Additional dams may also be justified for selected areas to alleviate water shortages and to prevent damaging floods, but costs and benefits must be carefully assessed. Currently, true multipurpose dam operation does not exist in Indonesia, and any future dams must maximize benefits from all sectors including public water supply, irrigation, flood control, water quality management and power generation. The economic analysis of proposed dams should also take social and environmental costs fully into account.

Water Quality

56. Extent of the Problem. In Java, water pollution poses an immediate threat to the natural ecology, human welfare and industrial growth. This problem is exacerbated by water shortages in the dry season which prevent wastes from being flushed away from urban centers. The most excessive pollutant in Indonesian rivers is fecal coliform from human waste which exceeds recommended

standards in key cities by a thousandfold or more. BOD (biochemical oxygen demand) and COD (chemical oxygen demand) also exceed standards in all provinces indicating excessive pollution levels. Due to high levels of municipal and industrial waste, eight major rivers on Java's north coast are regarded as significantly or seriously polluted.

57. It has not been possible to quantify the cost to the economy of pollution, but major costs are incurred by sickness and the resulting loss of work, and pollution is so severe in areas like Surabaya that industries have been forced to close in dry years because of raw water shortages. The eventual cost of piping unpolluted water to Jakarta to circumvent pollution problems has been estimated at US$1 billion; and an initial pipeline is being constructed at a cost of US$30 million. Costs are also incurred from losses in fisheries and aquaculture and damage suffered by mangroves and fragile coastal areas. A detailed study of pollution costs would be useful to rationalize pollution control measures.

58. Water Supply and Sanitation. In 1986 it was estimated that only 40% of Indonesian households had access to safe water (41% urban, 4% in rural areas). This is low, even by Asian standards. In India, for example, WHO estimates that 75% of urban residents and 31% of rural residents have safe water resources. Sanitation levels in Indonesia are also poor. Only 28% of urban residents and 9% of rural residents had private facilities with subsurface disposal.

59. In the more affluent urban areas water is supplied and wastes are managed through conventional piped water and sewerage systems, while in poorer urban areas low cost water and sanitation are provided under the Kampung Improvement Program (KIP). Nearly 40% of government expenditure in urban areas is for water supply, but sanitation lags badly. In 1988/89 only 5% of urban development expenditures were for sanitation, investments in on-site disposal were negligible, and KIP expenditures on sanitation were declining by about 4% p.a. Under the circumstances, priority should be given to increasing expenditure on sanitation, to providing appropriate technologies and social approaches, and to developing central and provincial capabilities in this field. Nongovernmental organizations are expected to play a strong supporting role.

60. Rural water supply and sanitation are currently under the Ministry of Health, but the Ministry does not have an organizational structure or capability which lends itself to this work. Partly for this reason, nearly 90% of external assistance for water supply and sanitation has been to the urban sector. To improve this situation, a coherent program for rural water supply and sanitation needs to be developed and a decision needs to be made on the most appropriate implementing agency to do the work. Attention to community involvement is appropriate and should be supported.

61. Repelita V gives increased emphasis to water and sanitation and related environmental issues. Investments in water supply have already increased compared to Repelita IV and GOI has embarked on a special program to provide standpipes for water-stressed urban areas. With respect to cost recovery, Jakarta and many other towns have increased water tariffs since 1988, and adopted a mechanism for periodic reviews. The groundwater charge has also been raised significantly in Jakarta where groundwater quantity and quality is

an issue. In addition, reduction of unaccounted-for-water through system rehabilitation and improved billing and collection is recognized as a major objective of all projects. Several pilot programs are underway trying out conventional, low cost and intermediate technologies for sanitation. The pilots indicate that depending on densities and soil conditions the whole range of technologies need to be applied in Indonesia and that the scope for low cost technologies is limited in Jakarta. This means that the sanitation investment needs are very large particularly in Jakarta and that the investments currently planned are grossly inadequate. The environmental problems caused by lack of sanitation facilities are therefore becoming more acute. Integrated water resource planning and management of surface and groundwater will be initiated in the Jabotek area as part of a study component of a recently approved project (JUDP II).

62. The institution arrangements for rural water supply and sanitation have undergone structural changes and at the beginning of Repelita V responsibility for program development was shifted from the Ministry of Health to the Ministry of Public Works. Consequently, the Directorate General of Cipta Karya is now responsible for all rural water supply and sanitation development by providing technical guidance and financial assistance to the local governments. GOI has also recognized the need to place a greater emphasis on the subsector of development as part of the poverty alleviation strategy. Repelita V Plan considers community participation essential to achieve effectiveness and sustainability of the rural water supply and sanitation programs. The Ministry of Health will continue this responsibility in the surveillance and monitoring of drinking water quality. The role of the Ministry of Home Affairs is to enhance village development through community participation.

63. Industrial Pollution. Although industrial pollution is less pervasive than pollution from domestic and municipal waste, it is already a major factor in the overall pollution levels on Java's north coast (Table 8). Industrial pollution, particularly in the form of toxic substances, can also have far more serious consequences than domestic waste, as these substances become concentrated in the food chain and are not removed from water by conventional water treatment processes. Monitoring in the Tangerang Industrial Zone, for example, found serious pollution at all ten monitoring stations, and excess levels of chromium, cadmium, mercury and selenium in different locations.

Table 8: INDUSTRIAL POLLUTION AS A PERCENT OF POLLUTION LOAD IN MAJOR RIVERS ON JAVA'S NORTH COAST

River	Point	Chemical Oxygen Demand	
		Total (tons/day)	% of industrial waste
West Java			
Cisadane	Tangerang	137	55
Banjir	Perompongan	13	31
Lunter	Pulogadung	7	30
Bekasi	Cileungi	14	23
Citarum	Jatiluhur	110	38
Cimanuk	Tomo	21	67
Citanduy	Cikawung	69	42
Central Java			
Serayu	Banyumas	62	34
Progo	Sentolo	36	14
East Java			
Solo	Babat	123	64
Surabaya	Tawangsari	25	28
Brantas	Mojokerto	16	75

Source: Institute of Hydraulic Engineering.

64. The legal structure for an industrial environmental control program is basically in place and existing regulations and decrees are sufficient to redress the current situation. The next step is to strengthen the institutional arrangements for pollution monitoring and control at the center, and to replicate this and provide enforcement powers at the provincial level. This could be done by the provincial environment offices (BKLH) supported by the line agencies; by specialized pollution monitoring and control agencies (PMCAs) formed at the provincial level; by river basin enterprises; or by pollution monitoring and control enterprises with revenue generating and enforcement powers. Pollution control enterprises would have the ability to attract high caliber staff and would have the capacity to generate revenues to help offset the cost of pollution abatement. However, because of the vested interests of existing ministries new institutions may be difficult to form and a staged approach may be necessary. To reach a consensus among Ministries on appropriate institutional arrangements, a lead agency should be selected to consolidate views and help prepare appropriate policies and legislation. MPE can serve this function, but will require technical support.

65. Other elements of a comprehensive strategy to address industrial pollution would include:

(a) compilation of an initial data base on the extent and nature of industrial pollution, and the identification of regional control priorities;

(b) enactment of reasonable standards (currently in draft form) for industrial discharges as well as for solid waste disposal;

(c) implementation of a well publicized program of enforcement directed against major point source polluters;

(d) identification of subsectors that produce the most toxic wastes and offer the greatest potential for abatement, and a focusing of assistance and enforcement on these sectors;

(e) waste minimization through improved efficiency and raw material and process changes; improved monitoring, cogeneration and recycling; and financing of waste minimization technologies;

(f) upgrading of provincial capacity to take environmental factors into account in issuing location and nuisance licenses;

(g) establishment of hazardous and industrial waste collection, treatment and disposal facilities;

(h) establishment of industrial parks to achieve economies of scale in waste management; and

(i) development of a system of effluent charges.

There is also a need to simplify the environmental impact assessment process in the Ministry of Industry and to eliminate duplication in the approval process.

66. The Government has recognized the importance of these issues and has recently taken the following steps to redress the pollution problems caused by the rapidly expanding industrial base:

(a) a presidential decree has been issued to establish a pollution monitoring and control agency (Bapedal) reporting directly to the President;

(b) a clean rivers program (Prokasih) has been initiated. This program involves eight provincial governments with the objective of reducing water pollution in 20 selected major rivers and will initially focus on industrial pollution;

(c) a new regulation has been enacted for the control of water pollution. This gives governors increased powers to control industrial water pollution and sets up a licensing system for industrial effluents;

(d) prefeasibility studies have been carried out for setting up hazardous waste collection, treatment and disposal facilities in Jabotabek and East Java;

(e) a survey has been initiated of industrial pollution in the tree crops processing subsector, involving some 180 government owned palm oil and rubber processing factories, with the objective of determining the most efficient and cost effective means of controlling these pollution sources; and

(f) programs have begun to set up pollution monitoring and control agencies at provincial level in DKI Jakarta, West Java, North Sumatra and West Kalimantan.

The major issue of how to decentralize the Bapedal authority to the provincial governments has yet to be resolved and legally mandated.

Needed Policy and Institutional Changes

Policy Areas

67. Like all countries, Indonesia faces a number of environmental problems. This paper has focused on four of the most important: deforestation, land degradation, water shortages and water pollution. Of these issues, deforestation and water pollution are the most urgent. However, steps taken to improve land resource management will address both problems of deforestation and land degradation and steps to improve water resource management will address both water resource efficiency, allocation and pollution problems.

68. A major theme in this report is that many resource conflicts can be resolved by increasing the potential of existing resources through intensification and greater efficiency in resource use. The tools for improved efficiency include proper pricing and improved management. The utility of these tools can be seen in the analysis of forest, land and water resource management.

(a) Forestry. Wasteful log extraction and timber processing, the failure to recover timber from areas cleared for development, and weak incentives for plantation development, are all due in part to an underpricing of timber from the natural forest. Under current conditions timber is a partially renewable resource and should be managed on a sector-wide basis taking into account environmental concerns and the need to maximize public revenues rather than extraction rates.

(b) Land. Land allocation conflicts could be reduced by crop intensification, but technologies for crops other than tree crops are weak. Smallholders are also limited in their ability to buy and upgrade underutilized land by tenure problems and shortages of cash, and Government does not pay for underutilized land used for agricultural development. Under these circumstances, local smallholders protect unused land and agricultural development is forced into unclaimed forest areas. To address these problems

increased attention is needed to the technologies for developing marginal land, to programs for land registration, and to the provision of credit for land purchase.

(c) Water. Appropriate pricing is critical to the efficient use of water. Charges for irrigation water in water short areas would conserve resources and potentially benefit end-system users; and groundwater charges uniformly applied in urban areas would help to prevent over extraction. Pollution fines and charges levied against polluters also have the potential to reduce pollution and pay for mitigation.

Institutional Priorities

69. Land Resource Management. The efficient use of forests, land and water resources requires institutional strengthening and better cross-sectoral coordination, and the report makes a number of recommendations along these lines. To improve land resource allocation and ensure appropriate land distribution between forestry, agriculture, mining and urban use, an overall review of land policy is required and a lead agency is needed for this purpose. It would also be desirable for one agency to take the lead in coordinating regional planning and mediating land use disputes. The new National Land Agency could potentially play a major coordinating role at the national level. At the provincial level, this role could be played by the BAPPEDAs, but they will need further institutional and technical support for this purpose.

70. Water Resource Management. Water resource management also runs across sectoral lines, but the options for coordination are somewhat easier because of the dominance of irrigation in the sector. The report therefore recommends that the Directorate General for Water Resource (DGWRD) take the lead in coordinating water resource management. Provincial Irrigation Services should develop Water Resource Divisions to look at water use across sectors, and Irrigation Committees should be reoriented and strengthened to take multiple water use into account. The Subdirectorate for Hydrology, in the Directorate of Environmental Geology (Department of Mines and Metallurgy) should also work closely with the DGWRD on ground water and conjunctive use issues. River Basin Entities could improve water resource management particularly in basins where water resource conflicts occur and pollution levels are high. To improve interagency coordination on water pollution abatement, the report recommends that the Ministry for Population and Environment play an integrating role.

71. Environmental Management. Indonesia has a State Ministry for Population and Environment (MPE). As a State Ministry, MPE has no line agency responsibilities. The fact that Indonesia has a free standing Ministry dealing mainly with the environment is in itself commendable, but Indonesia is also a pioneer in its efforts to develop environmental awareness and institutional structures for dealing with the environment in its line agencies and in the provinces.

72. As a State Ministry, MPE has no direct implementation responsibilities. Instead, a key dimension of MPE's work is to improve the environmental performance of the Government as a whole. This is an extremely ambitious task

and the Ministry is limited in its ability to carry out its mandate by its lack of official authority over other ministries, by its lack of influence over the budget process which generates line agency priorities, and by its own organizational structure, shortages of technically trained staff and small budget.

73. One option to strengthen environmental management would be to form a "Super MPE" along the lines suggested by the UNDP Environment Report. Under this proposal, broad policymaking and regulatory functions would be given to MPE. While attractive, this proposal does not seem feasible in the current Indonesian situation. Another possibility would be to strengthen MPE's influence over the budget process. There are several ways to do this:

(a) by expanding MPE's formal role in the budgetary process in BAPPENAS;

(b) by assigning to MPE critical coordinating functions, e.g., the responsibility for developing a pollution monitoring and control framework, and the authority to submit integrated budget proposals to BAPPENAS for this purpose; and

(c) by giving MPE a role in mobilizing external resources for environmental protection.

Regardless of the approach, increased technical support to MPE, with due regard to absorptive capacity, is required.

74. In Repelita IV, MPE had divisions for Development of the Natural Environment, Development of the Built Environment, Harmony of Environment and Population, and Population. These divisions had little relationship to MPE's major tasks (policy planning, the preparation of standards and regulations, etc.). Furthermore, the categories were overlapping (few environmental issues did not affect population, the natural and built environments) and as a result, the objectives of each division were diffuse and overlapping. UNDP recommended changes, modified slightly by the Bank, were to form divisions for policy analysis and planning; environmental impact assessment (EIA) supervision; land resource management; pollution monitoring and control; and population and public affairs.

75. In preparation for Repelita V the anticipated reorganization of MPE occurred and new divisions were formed. Under the new arrangements MPE will be guided by a priorities and planning committee directly under the Minister. Divisions have also been formed for population; natural resource management; the management of environmental improvement; and support systems for institutional coordination, community participation, information and communications. This arrangement is broadly consistent with recommendations made by UNDP and the Bank. In the next Repelita, the most important challenges facing MPE will be defining a manageable EIA program and establishing appropriate institutional arrangements for natural resource management and pollution control at the provincial level.

76. Recent legislation (PP29/1986) institutes an environmental impact assessment (EIA) process in the line agencies and provides an institutional framework for carrying this out. This legislation provides both problems and

opportunities. The most serious concerns relate to (a) the fact that there are a very large number of projects to be reviewed and very limited capacity to carry out the work; (b) different donors are working with different agencies to develop EIA procedures leading to conflicting standards and priorities; and (c) provincial mechanisms for EIA review have yet to be established. Since this is an important piece of environmental legislation, the danger exists that weak implementation will damage the credibility of the EIA process and of MPE.

77. To address these problems the UNDP Report on the Environment recommends that the EIA process be introduced in stages with each sector initially reviewing only a few high impact projects with significant off-site effects. The Bank strongly supports these recommendations. Improved donor coordination is also required and leadership should be taken by MPE. Finally, the prescribed EIA review structure (consisting of a commission, secretariat, technical team and coordinating office) needs to be established, and to be most effective, these institutions should be given a broad mandate and not confined to EIA review alone.

78. Perhaps the most critical issue facing MPE is the establishment of viable environmental institutions at the provincial level. A unit to deal with environmental matters has been created in each provincial governor's office. This agency, called the Bureau for Population and Environment (BKLH) is a relatively low level (third-echelon), nonoperational (e.g., data collecting) group which reports to an assistant secretary in the Governor's office. In most provinces a coordination team has been formed to support the BKLH, however, the group has only advisory power. Most observers have concluded that the BKLH has been formed at too low a level to be effective and the role of the BKLH and the coordinating team need to be reconsidered. One possibility would be to incorporate BKLH directly into the BAPPEDA, with formal recognition of its role in coordinating environmental matters.

Conclusions

79. Several general lessons can be extracted from this report. First, in a situation where resources are scarce, sustainable development will depend on their intensive and efficient use. To maintain timber production and forest protection functions, land use must be intensified, and to meet water supply requirements, water must be used more efficiently. The lesson is the same in virtually every sector.

80. Second, there are important linkages between and within sectors where environmental issues are involved. For example, land has many uses: for forest production and protection, and for smallholder production and employment. Water use is also multifunctional and future investment decisions will have to consider irrigation, municipal and industrial demands, hydropower and flood control, and pollution management. The issues in these sectors are so important and so interrelated that the report recommends that mechanisms of cross-sectoral coordination be formed to deal with land issues and water issues, that a lead agency be designated in each sector, and that the capacity to deal with each of these sectors be developed at the provincial level.

81. Third, although there are policy issues and financial and technical limitations in key sectors related to the environment, in Indonesia the main

constraints to sound environmental management are institutional. Overlapping institutional responsibilities lead to fragmentation of effort and impasses in decision making. The problem is especially serious in Indonesia because of shortages of skilled manpower. A related institutional point is that the ability to address environmental issues adequately will depend on continuing decentralization of decision making. The Government of Indonesia is making clear and consistent steps in this direction, but support for decentralization requires major adjustments by some donors and will entail significant human resource development.

82. Given this analysis there are a number of areas where additional technical and financial support are needed from donor countries.

(a) Information on the quality and quantity of remaining timber is needed as a basis for determining optimal rates of timber extraction, and policies for concession management, plantation establishment-and revenue generation also need to be reviewed. These issues will be covered in the proposed Bank-assisted Forestry Project. Additional donor support is urgently needed for a nationwide conservation effort, and funds and technical support are needed for agroforestry pilot projects, and for watershed protection.

(b) A major effort is required to reevaluate the land classification system for forestry and agriculture. To improve land use planning BAPPEDA development should be promoted along the lines already undertaken by the Asian Development Bank (ADB) and key information, such as that collected for transmigration, should be made available to the provinces. An externally-assisted project to speed and simplify land registration is recommended.

(c) There are a number of externally-assisted projects underway in Java's upper watersheds. However, further efforts are needed to develop lower cost soil and moisture conservation measures and to disseminate them. The regreening program would also benefit from a program-wide review of costs and benefits and external support where indicated.

(d) In the water resources sector, initiatives already underway to improve efficiency through the introduction of user changes will continue to have strong Bank support. In addition, there is a need to strengthen provincial irrigation services, irrigation committees and water user associations and to enable them to take multiple water uses into account. River basin management should be encouraged in river basins where water allocation is a growing issue, and there is room for improved coordination between donor groups which are presently recommending different strategies in different river basins.

(e) Additional funds are needed for rural water supply and particularly for low-cost sanitation. Far greater attention is needed to pollution monitoring and control and further work is also needed to define the most cost-effective strategies for pollution management.

83. MPE would benefit from technical assistance for policy planning and for key functions, and additional resources are needed to create an awareness of environmental issues, to support environmental studies centers and to encourage NGO sponsored projects. Staffing training needs additional support as does the development of environmental capability in the provinces. The Canadian-funded EMDI (Environmental Management in Indonesia) Project is providing support for a number of vital MPE functions and the World Bank is prepared to support policy analysis, help develop pollution control capability, and strengthen environmental studies centers through MPE.

84. In developed countries, attention to the environment has accompanied higher material standards of living; and in some quarters environmental concerns have been seen primarily as a luxury of the rich. This view is changing. Countries with high population densities, such as those in Asia, cannot afford to wait for future income improvements before attending to problems of water supply, sanitation and pollution control; and developing countries which have poor populations interacting daily with the natural environment, have found that sound natural resource management and the quality of the human environment are matters of overriding importance. Finally, countries which are heavily dependent on their natural resources for employment generation and economic development, now realize that efficient use of these resources is critical to long-term growth. Indonesia has recognized these issues and taken steps toward change.

I. THE MANAGEMENT OF FOREST RESOURCES

A. Indonesia's Forest Resources

Importance

1.1 All forests are important for watershed protection, for lumber, fuelwood and other economic products, and as the habitat for important species of animals and plants, but rain forests are particularly valuable for these purposes. The tropical rain forest is an evolutionary adaptation to high rainfall and poor soils. The multi-storied canopy reduces temperatures and permits the formation of humus, mitigates the impact of intense rainfall, and permits the gradual percolation of water and nutrients into the ground. When such forests are cut and soils are unprotected, runoff increases, organic materials are leached away, fertility declines and erosion occurs. If an area is burned or cultivated over several years, tree seedlings are destroyed, soils are depleted, and the capacity of the forest to regenerate is reduced.

1.2 Among tropical rain forests, Indonesia's forests are of regional and global importance. Indonesia is thought to have nearly 60% of all tropical forest in Asia and perhaps 90% of the remaining virgin stands. Indonesia has the world's richest forest in terms of commercial production and East Kalimantan has the most homogenous and most valuable dipterocarp forests in the world. Forest products are Indonesia's most important non-oil export, and they provided about US$2.5 billion in foreign exchange in 1987.1/ Indonesia's forests also provide poles and timber for domestic construction, and minor forest products such as rattan, resin, turpentine and bamboo make an important contribution to the economy. Finally, Indonesia's rain forest is a reserve of flora and fauna of potential economic value. Tropical forests in general include perhaps one third of the earth's total species, and the value of only a small fraction is known. One study calculated that drugs produced from plants in this genetic storehouse are worth US$20 billion annually in the United States alone, and of the 63 genera from which they are produced, 90% are from the rain forest (Meyers, 1980).

Estimates of Forest Area

1.3 Indonesia has about 191 million hectares of land. In 1981 the Food and Agriculture Organization (FAO) estimated that the country had 114 million ha of forest. This estimate was based on Forestry Department reports and selective sampling so the data's accuracy had been uncertain. Recently, however, an analysis of aerial surveys, mainly from 1981/82,2/ and covering

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1/ Total exports in 1987/88 were estimated at US$17.5 billion.

2/ This analysis was conducted by the Land Resources Department (LRD) of the Overseas Development Administration of the United Kingdom. The project, called the Regional Physical Planning Program for Transmigration (RePPProt), involved work with the Ministry of Transmigration and the Coordinating Agency for National Surveys and Mapping (Bakosurtanal) to identify areas suitable for agricultural development.

data from Sumatra, Kalimantan and Irian Jaya (Table 1.1) indicated a total forest area of about 116 million ha for the period. Neither FAO nor LRD figures reflect the damage caused by the 1983 Kalimantan fire (approximately 3.6 million ha), nor recent deforestation. Taking both factors into account, forest cover is currently estimated at about 110 million ha. Areas under forest cover are indicated in Map 21290.

Table 1.1: ESTIMATES OF AMOUNT OF LAND UNDER FOREST COVER, 1981

Island	FAO Estimate /a	RePPProT Estimate /b
Sumatra	22,200,000	23,300,000
Kalimantan	35,400,000	39,600,000
Irian Jaya	38,000,000	35,000,000
Subtotal	95,600,000	97,900,000
Other	18,000,000	not yet available
Subtotal	18,000,000	18,000,000 /c
Total	113,600,000	115,900,000 /c

/a FAO, Tropical Forest Resources Assessment Project, 1981.
/b LRD/ODA/RePPProT Studies, 1986, 1987.
/c Using FAO estimate of 18 million ha as subtotal for all other islands.

1.4 It is important to note that this is a very large forest area. Indonesia, which is roughly the size of Western Europe (excluding Scandanavia), has 2.5 times as much forest, and it has almost twice as much of its land surface under forests (60%) as the United States (32%). However, while Indonesia is fortunate to have so much forest, there are reasons for concern. The Philippines and Thailand, which were largely forested until this century, have seen their forests reduced to 25% and 30% of the land area, respectively; and no more than 3% of land in the Philippines is mature natural forest. Thailand, a major exporter of tropical hardwoods in the 1960s and 1970s, now imports timber for construction purposes; and land degradation associated with deforestation has become so serious in Thailand that all logging was banned in late 1988.

1.5 There is also evidence that Indonesia's forest area is being rapidly reduced. In the early 1970s, FAO estimated the rate of deforestation in Indonesia at about 300,000 ha/year; in 1981, this estimate was raised to 600,000 ha/year; and recently, FAO suggested that it could be as high as 1 million ha/year. How rapidly Indonesia's forests are disappearing will not be known until reliable time-series data are available. However, figures from several sources tend to confirm FAO's estimate. The Bank, for example, has

reasonable figures on forest conversion for Government-sponsored tree crop and transmigration programs, and this is estimated at about 200,000-300,000 ha/year in the third five-year plan (Repelita III, 1979-84). In recent studies of wood processing, the consulting firm Atlanta/INPROMA estimated deforestation due to logging at about 80,000 ha/year, or about 10% of the annual area logged; and destruction due to forest fires was estimated at about 70,000 ha/year. The latter figure does not include the Kalimantan fire and may be on the low side.

1.6 The greatest uncertainties relate to the loss of forest due to shifting cultivation and smallholder agricultural conversion outside of development projects. The recent RePPProT studies indicate that 14 million ha in Sumatra, 11 million ha in Kalimantan and at least 2 million ha in Irian Jaya are under shifting cultivation or under brush and secondary forest which usually signify previous agricultural use. If this area is expanding at only 2% annually (about half the rate of population growth in the provinces with large areas under shifting cultivation), then deforestation due to various types of smallholder forest conversion in the outer islands would be on the order of 500,000 ha/year. The figure could well be higher. Of this, perhaps half could ultimately regenerate as secondary forest, to be cleared again by smallholders when fertility improves, but virtually all would be lost to timber production.

1.7 These figures, summarized in Table 1.2, suggest that deforestation during 1979-84 could well have approached 900,000-1,000,000 ha/year. The data are rough, but any reasonable range (e.g., deforestation of 700,000 to 1.2 million ha/year) is significant. It is difficult to disaggregate these figures since logging contributes to deforestation by developing roads, which open new land to smallholders, and by providing wage work, which attracts families into the forest. With these caveats in mind, however, these figures suggest that of the area deforested, smallholder agricultural conversion may account for about half, development projects about one quarter, with the remainder due largely to poor logging practices and forest fires.

Table 1.2: SOURCES OF DEFORESTATION
(Hectares per year)

Source	Best estimate	Range
Smallholder conversion	500,000	350,000 - 650,000
Development projects	250,000	200,000 - 300,000
Logging	80,000	80,000 - 150,000
Fire loss	70,000	70,000 - 100,000
Total	900,000	700,000 - 1,200,000

Source: Bank calculations and Atlanta/INPROMA, Vol. III.

1.8 Simple analysis shows that deforestation at this level is associated with very high costs. One hectare of standing timber in primary forest has a net present value (NPV) of at least US$2,500-3,000, and about US$500 if already logged. Shifting cultivation, yielding 2,000 kg of rice per ha for one year with a fallow period of 15-20 years, produces an NPV per ha of about US$120. Assuming 50% of the area opened is in loggable forest and the rest in logged-over areas, the net loss to the economy would be conservatively US$625-750 million/year. With another US$150 million lost to logging damage and fire, losses would be about US$800 million. Loss of minor forest products could bring this figure to US$1 billion/year. The additional loss of timber on sites cleared for development projects could be US$40-100 million, although this would ordinarily be offset by agricultural benefits of greater value.

1.9 In addition to being costly to the economy in terms of foregone timber production, deforestation has a number of negative consequences of national and international concern. Large-scale clearing for agriculture produces smoke and carbon dioxide which contribute to global warming; and most studies place Indonesia second only to Brazil in producing atmospheric pollution from this source. Forest clearing also threatens biological diversity and endangered species. This is particularly serious in Indonesia where its island topography results in a high degree of endemism, and isolated species can be quickly eradicated if the forest cover is destroyed.

1.10 At a national level, deforestation also jeopardizes Indonesia's economic objectives. In particular, it threatens the wood raw material supply on which export diversification partly depends, and it leads to land degradation which disrupts regular water supplies and reduces the productivity of both traditional cultivators and downstream water users. This chapter will focus mainly on issues related to wood raw material supply and on the policies needed to realize the economic objectives of Indonesia's development planners in the timber sector. Important issues related to land degradation and land use in the outer islands are covered in Chapter II.

B. Deforestation and Wood Raw Material Supply

Forest Stock within Forestry Department Boundaries

1.11 About 144 million ha or 75% of Indonesia's land falls within Forestry Department boundaries. The area is divided into five categories: forest set aside for conservation and national parks (13%); forest intended primarily for watershed protection (21%); limited production forest (21%) and regular production forest (24%) in which selective felling is allowed; and conversion forest (21%), which can be converted to agriculture and other uses. Data by province are given in Annex 1, Table 1 and summarized in Table 1.3. Of the 144 million ha, about 113 million ha are within permanent forest categories, of which about 65 million ha are in limited and regular production forest. However, not all of this land is forested.

Table 1.3: AREA WITHIN FOREST BOUNDARIES BY FORESTRY DEPARTMENT CLASSIFICATION
('000 ha)

	Reserves	Protection	Limited Production	Production	Conversion	Total
Sumatra	3,684	7,094	7,579	6,821	5,032	30,210
Java	444	554	0	2,014	0	3,012
Kalimantan	4,101	6,924	11,415	14,234	8,293	44,967
Sulawesi	1,406	3,867	3,926	2,092	1,993	13,284
Irian Jaya	8,312	8,649	4,732	7,123	11,775	40,591
Other	779	3,229	2,874	1,581	3,444	11,907
Total	18,726	30,317	30,526	33,865	30,537	143,971
%	13	21	21	24	21	100

Source: Department of Forestry, Project for the Development of Forestry Data and Information Systems, 1986/87. Details by province in Annex 1, Table 1.

1.12 In order to evaluate the area under closed canopy forest within those areas classified as reserves, protection and production forest, the RePPProt team, at the request of the Bank, superimposed Forestry Department boundaries on 1981/82 aerial photographs of Sumatra, Kalimantan and Irian Jaya. Table 1.4 shows the percent of land not under closed canopy forest in 1981/82. Within the areas set aside for conservation and protection, about 16% of the land in Sumatra and 8% in Kalimantan was deforested; and within the area classified as limited production and production forest, about 30% in Sumatra and 16% in Kalimantan had been converted to other uses. On a provincial basis the figures were even more significant. Sixty percent of the permanent forest area in Lampung was deforested, 43% in South Sumatra, 42% in North Sumatra, and 44% of limited production forest in West Kalimantan was gone (See Annex 1, Tables 2 and 3). These provinces with high levels of deforestation within Forestry Depatment boundaries are generally provinces in which significant development is taking place, and given the widespread agricultural development in the outer islands since 1981/82, these figures could now be higher. This amount of deforestation has clear implications for wood raw material supply and for sustainable rates of timber production.

Table 1.4: PERCENT OF AREA WITHIN FORESTRY DEPARTMENT BOUNDARIES NOT UNDER CLOSED CANOPY FOREST

Province	Reserves	Protection forest	Limited production forest	Regular production forest	Conversion forest
			%		
Sumatra					
D.I. Aceh	3	5	20	26	49
North Sumatra	4	45	46	37	65
West Sumatra	7	27	29	36	38
Riau	15	37	24	8	58
South Sumatra	37	50	49	42	65
Jambi	13	12	13	17	42
Bengkulu	8	12	18	29	45
Lampung	33	76	none	72	85
Sumatra subtotal	16	33	30	29	58
Kalimantan					
West Kalimantan	7	13	44	23	39
Central Kalimantan	25	5	7	18	47
South Kalimantan	60	35	18	34	59
East Kalimantan	4	1	1	7	22
Kalimantan subtotal	9	8	14	17	36
Irian Jaya	15	13	9	9	19
Total	14	17	18	18	37

Source: LRD/RePPProT studies, 1986, 1987.

Estimating Sustainable Rates of Timber Production

1.13 In order to determine sustainable rates of timber production, better data are required on:

(a) the quantity and quality of standing stock;

(b) the regenerative capacity of the forest;

(c) the elasticity of demand for timber (i.e., the ability to substitute other products as the price of timber rises); and

(d) Indonesia's role in setting world market prices.

In spite of these limitations, however, available data already suggest broad limits to sustainable rates of extraction from Indonesia's forests.3/

1.14 Estimating Log Production. To estimate log production it is first necessary to evaluate how much forest there is within exploitable forest categories (i.e., regular and limited production forest and conversion forest). Table 1.5 shows that the two major timber producing provinces, Sumatra and Kalimantan, have about 42 million ha of closed canopy forest.4/ This figure probably overstates the area actually available for timber production since (a) selective logging has removed many of the most valuable species and damaged many remaining stems; (b) some production forest areas are too remote or too steep to be economically logged; and (c) cessionaires ordinarily log only in production and limited production forest, and serious difficulties have been encountered in utilizing timber from conversion forest areas cleared for development projects.

1.15 Table 1.5 also shows rough estimates of projected forest loss for 1981-91 and for 1991-2001 with and without policies to limit deforestation. Using the assumptions outlined earlier and including potential harvests from conversion forest, the analysis suggests the forest area in Sumatra and Kalimantan from which commercial timber can be drawn could be on the order of 35 million ha in 1991 and 27-30 million ha in year 2001. If timber from conversion areas is not utilized, the area would be about 25% less.

1.16 Using Indonesian assumptions that forested land on average adds 1.1 m^3 of roundwood equivalent/ha/year; also assuming that Kalimantan and Sumatra will continue to produce 80% of the country's timber for the foreseeable future and that plantations will not significantly increase production in the next 15 years; the estimated maximum sustainable rate of timber production in the year 2001 would be on the order of 30-40 million m^3 of roundwood/year. If the yields from conversion forests are not recovered and half of all deforestation occurs in production forest, the sustainable rate of production would be closer to 30 million m^3/year. These figures are very rough.

3/ The Bank has recently approved a Forestry Management and Conservation Project which will make a systematic inventory of the quantity and quality of representative areas of production forest. The project will also evaluate assumptions about regeneration and optimal rates of extraction in order to develop improved forest policies.

4/ Sumatra and Kalimantan are Indonesia's major timber-producing islands, producing over 80% of its commercial timber in 1986. In 1985, Sumatra produced about 8.2 million m^3 (32%) of round logs and Kalimantan about 12.0 million m^3 (48%).

Table 1.5: FORESTED LAND WITHIN EXPLOITABLE FOREST CATEGORIES IN KALIMANTAN AND SUMATRA

	Sumatra	Kalimantan	Total
	million ha		
Land under Closed Canopy Forest, 1981/82 /a			
Limited production areas	4.7	10.2	14.9
Regular production areas	4.9	11.0	15.9
Conversion areas	3.6	7.4	11.0
Total Area, 1981/82	13.2	28.6	41.8
Estimated Conversion, 1981-91			
Smallholder conversion /b	1.1	2.3	3.4
Development projects /c	1.3	0.5	1.8
Kalimantan fire /d	-	1.8	1.8
Total Conversion, 1981-91	2.4	4.6	7.0
Estimated Forested Area, 1991	10.8	24.0	34.8
Estimated Forested Area, 2001			
With improved policies	9.4	22.0	30.4
No policy change	7.8	19.0	26.8

/a LRD/RePPProT.
/b Based on the land already deforested within production forest boundaries.
/c Based on the assumption that all forest conversion for development projects is from conversion forest area.
/d Estimated area burned with commercial timber.

1.17 Estimating Log Demand. Table 1.6 shows Bank estimates of the demand for logs under low-, medium- and high-growth scenarios in the year 2000. All scenarios assume that local demand for sawn wood will increase at 3% p.a. and for plywood at 5% p.a. from a low base. Under the low-growth scenario, sawn wood exports grow at 1.5% p.a. and plywood at 3%, while under the high-growth scenario they both increase at 5% p.a. Both estimates are well below Governments' original targets for Repelita V (1989-94). In scenarios with efficiency improvements, efficiency in sawn wood production is improved from 43%, the current average, to 55% (see Annex 1, Table 4). As Table 1.6 indicates, however, even under assumptions of low growth and efficiency improvement, extraction rates in the year 2000 could be on the order of 35 million m^3 of roundwood. The Bank's high-growth scenario would lead to extraction rates up to 48 million m^3. Extrapolating from the previous analysis, high rates of growth in the logging industry would not be sustainable, and if pursued would lead to further forest depletion.

Table 1.6: RATES OF EXTRACTION AND SUSTAINABLE LEVELS OF PRODUCTION IN THE YEAR 2001
(million m^3 roundwood)

Extraction Rates	
Low growth with efficiency improvements	34.7
Low growth, no efficiency improvements	40.0
High-growth with efficiency improvements	41.1
High-growth, no efficiency improvements	48.3
Sustainable Production Levels	
Production from Sumatra and Kalimantan	
With improved policies	33.4
No policy change	29.5
Total estimated national production	
With improved policies	42.0
No policy change	36.8

Source: Bank staff calculations (see Annex 1, Table 4).

1.18 Under the circumstances, if timber production is to be managed sustainably for the foreseeable future, Government needs policies that:

(a) slow the conversion of production forest;

(b) control the rate of timber extraction;

(c) encourage efficiency improvements in saw milling and plywood production;

(d) ensure the use of timber from areas cleared for development projects;

(e) promote the use of secondary forest products; and increase downstream value added; and

(f) support afforestation and plantation development.

1.19 Indonesian officials have expressed concern that controlling the rate of log extraction would significantly reduce export earnings, but this assumption is tempered by several important factors. Since Indonesia is the world's major producer of tropical hardwoods, controlling nearly 40% of the market, lower production could be offset in part by price increases. Second, reductions in allowable extraction rates would encourage both improved efficiency in the production of saw timber and downstream processing. It would also increase the emphasis given to timber recovery in conversion areas and lead to better exploitation of available, but less common sources of timber such as wood from rubber trees and lesser-known species. Such policies might encourage the development of other secondary forest products.

1.20 Some authorities have minimized the threat to Indonesia's timber production, suggesting that shortfalls can be made up by logging in Irian Jaya, a province which has 28% of Indonesia's production forest and has experienced less timber exploitation to date. These figures are deceptive, however, as Irian Jaya has a forest of relatively low commercial value. Atlanta/INPROMA (1986) estimates that Irian Jaya has less than 10% of Indonesia's commercially valuable species. Moreover, because of limited infrastructure and the relatively high costs of extraction, logging in many areas of the province is not commercially attractive. Therefore, while declining timber resources in Sumatra and Kalimantan are likely to increase the pressure on Irian Jaya's forests, its timber can by no means compensate economically for a decline in timber production from the rich dipterocarp forests of western Indonesia.

C. Issues in Forest Management

The Concession System

1.21 In Java, state forests are managed by a Forestry Department agency (Perum Perhutani), but in the outer islands, Indonesia's logging industry and management of its natural forests are primarily in the hands of private concessionaires. Concessionaires are responsible for preparing forest inventories, for proposing 20-year, five-year and annual operating plans to the Forestry Department, and for protecting the concession areas from encroachment and fire. There are now over 500 concessions, with an average size of about 100,000 ha. In Indonesia an estimated 800,000 ha are logged annually, more than the total area logged in all other countries in the region.

1.22 Indonesian concessionaires receive twenty-year concessions, but they work under a selective logging system which permits the extraction of trees over 50 cm in diameter once every 35 years. There are numerous problems with this system. First, selective logging is damaging to the forest. Recent surveys show that up to 40% of standing stock is damaged in logging operations (Atlanta/INPROMA, 1986) and where, as often happens, concessions are relogged before the harvest cycle is completed, damage and depletion are even higher. As valuable dipterocarps regenerate slowly, and only under specific forest conditions, selective logging also tends to alter the species mix toward less valuable species. Second, the relatively short length of the concession agreement, compared to the harvest cycle of 35 years, encourages concessionaires to take a short-term management perspective. Beyond meeting necessary regulations, firms have little corporate interest in providing the conditions needed to encourage regeneration or to minimize fire hazards and encroachment.

1.23 Difficulties inherent in the concession system are magnified by Forestry Department procedures. Nearly 50% of all forestry staff manage forestry resources on Java, while officials in the outer islands are almost entirely dependent on the concessionaires for information and access to concessions. Forestry Department officials rely largely on concessionaires' reports to determine the annual allowable cut, which in turn determines the volume of timber which can be extracted from a concession and the royalties to be paid. This leads to (a) understatement of the volume and quality of

merchantable timber, and hence the royalties to be paid; and (b) a tendency to ignore poor logging practices and breaches of regulations, such as those intended to prevent relogging in selectively logged areas. The negative consequences of these practices include an understatement of log extraction, significant reduction in revenues to Government, overlogging and resource depletion.

1.24 Forestry Department officials are aware of these problems, and Government's commitment to change is reflected in its support for the forestry policy studies now underway with World Bank support. However, the difficulties inherent in addressing these issues should not be minimized. There is no evidence, for example, that a state-owned corporation would be run better than private concessions, and there is little evidence that increasing the number of Forestry Department staff and/or their supervisory functions would improve the situation under current conditions. Instead attention must be focused on incentives for better forest management by timber concessionaires and on changing development policies which contribute to deforestation.

Financial Analysis of Forest Management Systems

1.25 In order to determine whether some logging systems provide stronger incentives to the concessionaires for better management, FAO undertook a financial analysis of the returns to six types of forest management and harvesting systems (FAO/Sedjo, 1987). The analysis covered two systems of natural tropical hardwood forest management (selective logging and complete harvest with regeneration), one experimental regime intended to re-establish dipterocarp hardwoods on logged-over areas, and three kinds of forest plantations of fast-growing species. The systems represent a cross-section of the management regimes actually being practiced, under consideration, or showing promise at this time (see Annex 1, Table 5 for details).

1.26 Table 1.7 summarizes the discounted net present value (NPV) of one hectare of forested land under the management systems analyzed, using a 10% discount rate. With stable timber prices, the two systems that rely on natural regeneration have a higher NPV than saw timber plantations. It also indicates that the NPV for plantation development is negative if benefits from clear felling are excluded from the calculation or if plantations are established on bare ground. This means that the return to capital for plantation development in Indonesia is currently less than 10%. (In fact, the internal rates of return [IRR] were less than 6% on the models run.) If timber prices are projected to increase at 1% p.a., saw timber becomes more attractive when associated with clear felling, but postharvest IRRs remain under 10%.

Table 1.7: ALTERNATIVE LOGGING SYSTEMS AT A 10% DISCOUNT RATE

Logging System	Total NPV (US$)	Rank	IRR /a	Postharvest NPV (US$)	Postharvest Rank
No Price Increase					
Selective logging	2,177	2	+	67	1
Commercial harvest	2,553	1	+	3	2
Clear felling and saw timber plantations	2,130	3	+	-420	3
Saw timber plantation on bare ground	-420	4	-	-420	3
At 1% p.a. Real Price Increase					
Selective logging	2,245	3	+	135	1
Commercial harvest	2,560	1	+	10	2
Clear felling and saw timber plantations	2,519	2	+	-31	3]
Saw timber plantation on bare ground	-31	4	-	-31	3

/a Over 10% = plus (+), under 10% = minus (-).

1.27 This analysis leads to two important conclusions. First, for the foreseeable future, timber extraction from the natural forest with natural regeneration will continue to characterize the Indonesian timber industry. However, annual real price increases above 1% for hardwoods would improve the returns to other management systems. Second, the fact that plantation development is financially attractive only when linked with clear felling of commercially valuable natural forest species suggests that pressures to establish plantations may cause the conversion of natural forest rather than afforestation of underutilized land. Such a policy would not be sound in economic or environmental terms, and, to the extent possible, the conversion of primary forest with good regenerative potential should be discouraged.

1.28 Several secondary points emerged from the FAO analysis. The internal rate of return to pulpwood production as feedstock to a nearby mill is attractive. However, the industry is restructuring and opportunities for expansion may be limited. Intensive dipterocarp management, an experimental regime to re-establish the most commercially valuable species on logged-over lands, is also encouraging and would have good returns if replicable. However, this program has not yet been tried on a sufficient scale to recommend widespread adoption. This indicates the need to do further research on technologies for re-establishing commercial species in the natural forest.

Comparison of Natural Forest Management Systems

1.29 On the assumption that a natural forest managed for sustainable timber production can contribute to economic and environmental objectives, FAO

examined two natural forest management regimes to determine which one is financially or environmentally more attractive. The first system, the Indonesian selective logging system (SLS), permits only the harvest of timber over 50 cm in diameter and relies on the growth of residual stock to harvest again in 35 years. The second, the complete harvest and regeneration (CHR) system, a variant of the Malaysian uniform harvest system, permits harvest of virtually all merchantable standing timber and relies largely on small trees and seedlings for reharvest in 70 years. The arguments for CHR are that it supplies more timber on average per hectare; it reduces the problem of residual stands damaged by selective logging and relogging; and in some areas, it already reflects current practice.

1.30 The findings, shown in Table 1.8, indicate that clear felling of commercially valuable species with natural regeneration is financially more attractive than selective logging, although this conclusion is sensitive to economic assumptions. For example, an increase in timber prices or a reduction in the discount rate makes selective logging more attractive than complete harvesting. Also, the postharvest value of CHR is low when compared to selective logging, and there is evidence that CHR produces a second stand of less valuable species. For these reasons, concessionaires have fewer incentives to protect an area logged under CHR. In Malaysia, in fact, there has been widespread conversion of logged areas to agriculture on the grounds that they have no further economic value for timber production. Given these drawbacks, there is clearly a need for closer scrutiny of the Malaysian experience before strong recommendations about natural forest management can be made on either financial or environmental grounds.

Table 1.8: DISCOUNTED NET PRESENT VALUE (NPV) OF NATURAL FOREST MANAGEMENT SYSTEMS

Model	NPV (US$) by harvest year			Postharvest NPV(US$)	
	0	35	70	Year 0	Year 70
6% Discount Rate					
CHR - Optimal	2,550	-	43	2,593	43
CHR - Normal	2,550	(41)	43	2,542	2
Clear Felling - No regeneration	2,550	-	-	2,550	0
Selection Logging - Optimal	2,100	273	36	2,409	309
Selective Logging - Normal	2,100	227	21	2,348	248
10% Discount Rate					
CHR - Optimal	2,550	-	3	2,553	3
CHR - Normal	2,550	(49)	3	2,504	-46
Clear Felling - No regeneration	2,550	-	-	2,550	0
Selective Logging - Optimal	2,100	74	3	2,177	77
Selective Logging - Normal	2,100	62	2	2,164	64

Source: FAO/Sedjo, 1987.

1.31 Regardless of system used, at discount rates of 6% or 10%, the more timber that is removed from the area in the first year, the more financially attractive the NPV. In fact, clear felling with no regeneration whatsoever is more attractive financially than a nominal investment in restoration of the forest. This is true since regeneration costs are incurred early, and the NPV of timber 50 or 70 years hence is negligible. This finding helps explain the concessionaire's disregard for timber destruction in the initial logging phase and suggests that a change in concession length alone may not be sufficient to modify concessionaire behavior. More generally, this fact suggests that a policy aimed at maximizing harvests from the natural forest under current economic and financial conditions may cause irreversible damage to the forest and the species mix within it, and it implies that such a strategy could foreclose future options.

Issues in Plantation Development

1.32 Indonesia has ambitious plans for the establishment of timber plantations, starting from 120,000 ha/year in the fourth five-year plan and rising to 360,000 ha/year in the sixth. Plantations that supply more timber per hectare than the natural forest can have a positive environmental impact by supplying low-quality timber to the domestic market and reducing pressures on the natural forest from logging. However, as noted, the rates of return to plantation investment are currently low (less than 6%) and have been insufficient to produce significant private investment in plantation development. To address this problem, the Forestry Department has established a reforestation subsidy of Rp 675,000 (US$425) per hectare to be paid to concessionaires who plant fast-growing species on concession land. This subsidy is to be financed from a reforestation tax of US$4/$m^3$ on logs extracted from the forest. In practice, concessionaires are permitted to plant trees and deduct the amount of the reforestation subsidy due them from the reforestation tax which they would otherwise pay.

1.33 There are numerous problems implicit in these arrangements. The most important problem is that there are no provisions for managing the trees after three years. Tree species are poorly selected and there is little control over the land on which trees are planted. Furthermore, since the concessionaire has no stake in the trees, because of short tenure and uncertainty about Government's intentions for recovering the reforestation subsidy when the trees are harvested, the concessionaire often plants the trees at the lowest possible cost and provides little or no maintenance. Although it generally costs US$700-1,000/ha to plant and maintain a good stand of trees, some concessionaires are spending much less on reforestation and making a profit on the US$425 subsidy. Unfortunately, the unmanaged timber stands are likely to be worthless at maturity. Unless policies are changed, the possibility exists that large areas of plantation species will be established which have little or no economic value and cannot serve their major environmental function, i.e., reducing pressure on the natural forest. In the unlikely event that 4.4 million ha could be planted by the year 2000, this could amount to foregone revenues of up to US$2 billion in constant prices, funds which could have been used to establish a viable plantation sector.

1.34 Finally, current plantation development subsidies ignore important locational considerations. For example, provinces such as Lampung and South Sumatra, plus some eastern islands, already suffer localized shortages of wood for domestic construction and this leads to poaching in the natural forest. Other provinces such as Central and East Kalimantan have rich dipterocarp forests and a comparative advantage in quality hardwood production. However, linking logging and reforestation by means of the reforestation subsidy could mean that most plantations were established in Kalimantan, even though natural regeneration would be more economically and environmentally sound. It is also possible that plantations elsewhere would be neglected because concessionaires would not be concerned with forgiveness of the reforestation tax. To address this problem the reforestation tax should be collected and paid out only after locational factors have been taken into account. These issues need to be considered in formulating plantation policy and will be reviewed in the Bank-assisted Forestry Project.

D. Policy and Institutional Changes Needed for Improved Forest Management

1.35 The preceding analysis suggests that under current financial conditions the incentives for good forest management and/or reforestation by the private sector are slight and that without Government intervention, forest depletion as a result of logging will continue. Key problems are related to an underpricing of forest resources and weak management of the sector. Deforestation is also related to land tenure and land allocation issues which are covered in Chapter II.

Resource Pricing and Rent Seeking

1.36 The Problem. Like most agricultural commodities, timber production is affected by price subsidies. In developed countries, such as the United States, timber extraction on state-owned land is subsidized by the provision of infrastructure and other services to concession holders, and such subsidies are one factor which keeps prices low for softwood timber. Although Southeast Asian hardwoods have valuable properties not found in temperate softwoods, incentives provided by Southeast Asian countries to concessionaires to increase harvests over the past 20 years have resulted in (a) an oversupply of hardwoods and low timber prices; (b) lack of strong price differentiation between hardwoods and softwoods; and (c) substitution of hardwoods for softwoods at very low prices. One example of this is found in Indonesia where valuable dipterocarps (*meranti*) are used for plywood cores.

1.37 Such practices might be justified if timber resources were completely renewable and if future value could be captured at a future date. However, hardwoods appear to be only a partially renewable resource. According to a recent report by the World Resources Institute, the World Bank and the United Nations Development Programme, of the 33 developing countries which were net timber exporters in 1985, only 10 will be important exporters in the year 2000; the rest will have lost most of their productive forest. Even in Indonesia, which is expected to remain a major producer, the number and quality of valuable dipterocarps is declining; and there have been no programs outside of research centers to enrich or restore dipterocarp forests. This suggests that as a matter of policy, valuable species should be reserved for

high-quality uses and should be priced high enough (through taxes and royalties) to force the use of low-quality species for rough construction purposes. In Indonesia this would promote better utilization of lesser known species and stimulate plantation development.

1.38 Rent Seeking. As with any natural resource, there is an economic rent relating to the standing stock of trees. The rent is the difference between the sale value of the timber and the costs of harvesting it, including a reasonable profit margin to the concessionaire. This rent approximates the maximum amount a forest concessionaire would be willing to pay for the concession. Low rates of rent "capture" have several important effects. The first is to limit Government revenues. Since such revenues should be available for development purposes, there is a cost to the public in terms of the foregone benefits. The second is to leave the rent available to other parties, giving rise to "rent seeking" by concessionaires. This means that there is pressure to harvest large areas in order to obtain quick profits. The net result is an acceleration in the rate of forest depletion as concessionaires rush to secure their share of high profits. Finally, high profits permit concessionaires to sell good timber products at low prices, even though the practice may not be economically sound.

1.39 In Indonesia, a comparatively low proportion of the forests economic rent has historically been taken as Government tax. In 1980, this was estimated at only about 40% of available rent on those logs on which taxes were paid, about half the amount collected in the adjacent timber-producing area of Sabah, Malaysia. Since then rent collection has fallen further. There are two important areas where Government has failed to collect revenues due to it.

(a) Declining Rates of Collection. Total tax collections fell from Rp 341 billion in 1980 to Rp 200 billion in 1984, and in dollar terms from US$545 million to US$191 million. Part of this was due to a decline in levels harvested, as a result of the ban on round log exports, but the amount of tax collected per m^3 also declined from almost US$22/$m^3$ in 1980 to less than US$10/$m^3$ in 1985. This slide was permitted, in part, to finance the construction of the domestic wood processing industry.

(b) Understatement of Harvested Volumes. During Repelita III (1979-84) taxes and royalties were collected on about 85.8 million m^3 of logs, compared to FAO estimates of the 124.8 million m^3 actually harvested during the period. Assuming that taxes and royalties averaged only US$10/$m^3$, losses in taxes and revenues are estimated at about US$400 million or US$80 million/year due to understatement of harvest volume.

1.40 Total revenues collected by the Forestry Department during 1980-85 amounted to US$1.55 billion. If revenues had been collected on all timber harvested (estimated at 125 million m^3) and taxes had approximated the already low 1980 level of US$22/$m^3$ (with no increase for inflation), revenue collection would have been US$2.75 billion, or US$1.2 billion more than the amount collected in the five-year period. Production would have had to increase by 50% to accomplish the same revenue-generating effect for Government. In effect, this $1.2 billion amounts to a Government subsidy to the timber industry which fueled the "timber boom."

1.41 To address this problem, Government must raise taxes and royalties to achieve more rational rates of extraction and improve Government revenues. There are, however, practical problems in capturing existing rents where incentives are low for accurate reporting and monitoring. In principle, a number of different approaches could be taken.

(a) Competitive Bidding. Government might require competitive bidding for the next round of concession rights, i.e., beyond the first 20 years. The existing concessionaire could be given the "right of first refusal" in recognition of his earlier investments.

(b) Stumpage Tax. A greater proportion of revenues could be generated as a stumpage tax, a tax on the total volume of standing timber whether or not harvested, thus reducing the tendency to distort or under-report harvested volume.

(c) Export Taxes. Taxes could be collected primarily on export products. This does not provide a mechanism for full rent collection from timber going into domestic production and, unmodified, could distort the pattern of production for domestic versus international markets.

1.42 Each of these arrangements has advantages and disadvantages and further investigation is required on optimal taxation levels, mechanisms of taxation, and differentiation in taxes to discourage the use of valuable hardwoods for low-value products. Such an analysis will be carried out under the Bank-assisted Forestry Management and Conservation Project. Whatever method of revenue generation is chosen, however, there is a need for Government to increase taxes and royalties while the cost of extraction to the concessionaire is relatively low and the timber supply large. The time is coming when the best timber will be depleted and the cost of timber extraction will rise. There will then be pressure on Government to reduce taxes and royalties in order to maintain high levels of extraction and foreign exchange earnings. The trade-offs will be difficult, and both sustaining wood raw material supply and maintaining the economic viability of the wood processing industry will involve important policy decisions with increasing environmental significance.

Improving Forest Management

1.43 A recent study by the International Institute for Environment and Development (IIED, London, 1988) on Natural Forest Management for Sustainable Timber Production notes that despite legislation and intentions to the contrary, the extent of tropical rain forest being managed for sustainable production is negligible. It further states that "comprehensive and urgent measure are absolutely necessary if the tropical timber trade is to continue in the long term to handle material which even approaches the quality it is accustomed to, and if other goods and services provided by the forest are to be maintained." Among the essential conditions given by IIED for sustainable timber production are the following:

(a) establishment and protection of a permanent forest estate;

(b) secure conditions for forest managers and certainty of future returns;

(c) adequate control of harvests;

(d) economic and financial policies which do not encourage over-exploitation and forest degradation;

(e) improved knowledge about stocks, and research on the means to increase the productivity and value of logged-over stands; and

(f) greater attention to the environmental and social consequences of logging.

Several of these points bear elaboration.

1.44 Institutional Changes. Indonesia has demarcated a permanent forest estate, but as yet it does not have the means to manage and protect it. Part of the problem lies with the institutional arrangements for forest protection and harvest management. As noted earlier, about 50% of Forestry Department staff are in Java and those in the outer islands are mostly dependent on concessionaires for information and access to concessions. Under these circumstances, there is little control by the Forestry Department over extraction practices. This leads IIED to suggest that Indonesia's Forestry Department should be strengthened, its staff increased and reallocated, training improved, and officials given the means to carry out their work without having to depend on the concessionaires. These recommendations are sound.

1.45 At a broader level, some observers argue that more drastic changes are needed and that the Forestry Department should manage log extraction like the extraction of other non-renewable resources such as oil. In the oil industry the value of the resource leads to considerable investment in its management; the extraction rate and the price and profit margins of contractors are carefully controlled on an industry-wide basis to maximize Government revenues from the sector. In Malaysia, the state of Sabah is experimenting with such arrangements and is phasing out some concessions and turning their management over to the Sabah Foundation which manages forest resources (and revenues) for the public benefit. Whatever the arrangement, it is clear that too few resources are currently spent on industry management and that not enough consideration has been given to managing the sector for the public welfare.

1.46 Incentives for Improved Management. To improve forest management incentives are also needed to ensure that forest managers have security of future returns. Those with a stake in the forest include local inhabitants, concessionaires, and plantation developers. First and foremost are the local people. For adequate forest management the local population must be given a strong incentive to protect the forest estate. This is not possible where the benefits of timber production do not accrue to the local people, at least in part. In fact, current policies which forbid timber exploitation by those

other than concessionaires abet deforestation and encourage shifting cultivation which becomes the main way for local people to take advantage of the land. This situation suggests that policies should be developed that will allow local people to share in timber revenues or increase the value (marketability) of secondary forest products.

1.47 Incentives for good management must also be increased for concessionaires. Although, as noted earlier, financial incentives for sustained timber management are weak, most observers agree that some system is needed to extend the interest of the concessionaire beyond the current 20-year period. Possibilities include:

(a) Awarding a concession on a rollover basis, whereby every five years it would be extended for 20 years, subject to satisfactory performance;

(b) Extending the concession to at least 35 years to ensure that the area is harvested over the full rotation period (this runs the risk of locking in poor concessionaires); or

(c) Giving wide latitude to concessionaires to sell their concession rights, subject to Government approval. This would give the concessionaire an interest in maintaining the value of the concession as an asset.

The first alternative seems most promising, but the main objective in any solution would be to provide the concessionaires, even those who plan to discontinue, an incentive to maintain the forest's long-term productivity.

1.48 It is also critical that plantation developers be given a strong financial stake in the plantations they establish. To do this, Government may wish to treat timber development like other forms of tree crop development. For purposes of reforestation, the concessionaire could apply for permission to establish plantations on the same basis as a private tree crop estate, i.e. to acquire a 30-year lease. Another incentive would be relaxation of the export ban on round logs from timber plantations. This would have the dual purpose of stimulating investment and promoting the establishment of higher-quality plantations aimed at the export market. Concessionaires also need to be given better technical support for proper species selection and appropriate site section, and conversion of natural forest should be strongly discouraged.

1.49 Other Needed Changes. In the future, the technical basis for increased timber production will require far greater attention. Research is needed on sustainable management of the natural forest, possibly including improved silviculture techniques and enrichment planning. Further work is also needed to increase the volume and quality of plantation timber. Additional attention is needed to the production and marketing of secondary forest products which will encourage smallholders to utilize, not convert, forested land and to mixed agroforestry systems which will help restore the diversity of resources available for human use.

1.50 Further attention should also be given to the environmental implications of logging. Useful studies would explore the total economic and environmental benefits to be derived from production as well as protected forests. Felling techniques should be developed which minimize loss of

habitat and land disturbance and maximize regenerative potential. The linkages between watershed protection and timber production also need to be further explored; and the consequences of forest burning on soils and atmosphere need to be better understood.

1.51 Finally, far greater attention is needed to halt deforestation from development projects and shifting cultivation. Transmigration and tree crop development projects, which cost US$4,000-10,000 per family, provide very powerful incentives for people to move to remote areas. Those who move attract relatives and friends and because it is difficult for spontaneous migrants to obtain secure tenure to previously cultivated land forest encroachment results. With Indonesia's poverty and population pressure, it is difficult to argue that no such development should take place, but far greater care is needed to ensure that smallholders can obtain underutilized and degraded land and that projects which intensify the use of cultivated land are given preference to projects which lead to deforestation.

Recent Developments

1.52 Since this report was initially written and discussed with Government, the fifth five-year plan (Repelita V, 1989-94) has been agreed. In this plan the Forestry Department has emphasized its commitment to managing its resources on a sustainable basis. To achieve this, the Department is taking the following steps:

(a) the annual log extraction from forests will be limited to between 31-32 million m^3;

(b) the inspection service will be strengthened and greater use will be made of remote sensing information from satellites to monitor changes in forest cover;

(c) in order to conserve forest resources, no new licenses will be issued for plywood and sawmill construction;

(d) logging and processing activities will be integrated since concessionaires with large investments in processing facilities have greater incentives for sustainable management of the forest;

(e) increases in forest industry exports will be encouraged through increase in value added and efficiency in processing activities;

(f) a new Directorate of Extension has been created to encourage the participation of people in conserving and managing forest resources in cooperation with the Forestry Department; and

(g) human resource development in the ministry will be strengthened to ensure that the staff of the Ministry can perform better in their forestry management and conservation tasks.

1.53 MOF has also announced that forest plantations will be established on degraded lands only, and for this purpose incentives will be strengthened by increasing the land lease period from the current 20 years to 35 years with an option to renew for another 35 years if the forest plantations are maintained.

1.54 In April 1989, the Government announced a 150% increase in the reforestation tax and a new export tax on sawn timber. The export tax was increased sharply in late 1989, and this has reduced sawnwood exports. Some of the inefficient sawnmills that were flourishing because of the lower priced material, are now becoming unprofitable and will have to close or to restructure to become more efficient. While this will have some conservation benefits, this may offer some indirect protection to other wood processing industries, which could then become less efficient users of wood. The impact of this policy on industrial efficiency will need to be evaluated after a few year's experience with the new tax regime. However, the overall tax effort proposed through these policy changes remain impressive. The proposed change will help both the internal resource mobilization effort and conservation through the higher reforestation fund. The higher wood price to the mills will encourage increased efficiency of wood utilization and will further assist in conservation of forest resources.

E. Managing and Protecting Conservation Areas and Wildlife Reserves

1.55 Stretching some 5,110 km from west to east, Indonesia encompasses the greatest part of the Malaysian floristic region, one of the richest botanical areas in the world. The country spans two of the world's major biogeographic regions: the Oriental region, which includes the islands of Sumatra, Kalimantan, Java and Bali on the Sunda shelf; and the Australian region with Irian Jaya resting on the Sahul Shelf, along with the rest of Papuasia and Australia. In between lies Wallacea, which has a mixture of elements from these two very different parts of the world. Indonesia's territorial waters encompass some 3,650,000 km^2, nearly twice as much as the land area, and the country has the largest coastal and near-coastal environments in the region. These include extensive mangroves and swamps, and tens of thousands of kilometers of coral reefs.

1.56 Despite its richness, there are over 200 animals in Indonesia listed by the International Union for Conservation of Nature and Natural Resources (IUCN) as threatened or endangered. Some of the more well known include the Javan and Sumatran rhinoceros, Asian elephant, Sumatran tiger, clouded leopard, orangutan, Sulawesi macaque, and birds such as the Bali starling. A fantastic diversity of plants also occurs in Indonesia, including the endangered fishtail palm, climbing palm and rafflesia, the world's largest flower. Indonesia's level of endemism is exceeded only by Madagascar and amounts to one of the world's great treasures of natural biota. Indonesia is therefore considered one of the world's six "megadiversity" countries, based on their extremely high diversity of species. Because of the economic and scientific importance of preserving biological species worldwide, the country is receiving growing attention and support from major environmental groups.

The Reserve System

1.57 Indonesia has set aside almost 10% of its land area for conservation and protection, a much larger area than so designated in most developed or developing countries. The country has 319 gazetted conservation areas, including 19 national parks, and it has 187 areas identified and scheduled for incorporation into the protected area system. In total, nearly 20 million ha are set aside as reserves and another 30 million ha are set aside as permanent protection forest (refer back to Table 1.3). The National Conservation Plan, the Irian Jaya Development Plan and the Marine Conservation Systems Plan bring the number of planned or proposed reserve areas to more than 700. These proposals cover the major biogeographic regions of the country and, if properly managed, would be sufficient to protect biological diversity and endangered species. Additional work is required to prioritize wetland areas. If these areas could be protected, it would answer many of the concerns of conservationists and permit decisions on the allocation and management of other forested land to be more easily made on the basis of sustainable production and optimal land use.

1.58 The National Conservation Plan for Indonesia (FAO, 1981) evaluated each protected area by quantifying the relationships among three parameters: (a) importance in preserving genetic diversity; (b) socioeconomic justification; and (c) the need for management and the feasibility of protection. Reserves receiving a priority one rating are of major national importance, contain the most valuable or best examples of different habitat types and require most urgent attention. Based on this system of analysis, there are a total of 79 priority areas for protection (Annex 1, Table 6). These areas represent Indonesia's seven biogeographic regions to obtain the widest possible representation of important flora and fauna, and the number of reserves in each biogeographic region is shown in Table 1.9.

Constraints to Conservation

1.59 The main constraints to conservation in Indonesia are: the absence of incentives for local people to preserve the natural habitat, a lack of awareness of the issues, the absence of clear priorities and strategies, shortages of manpower and overcentralization of responsibility, and a severe shortage of funds.

1.60 Benefits to Local People. It will not be possible to protect and preserve critical ecosystems unless the people who are asked to forego short-term gains by setting aside land used for production perceive some tangible benefits from doing so. Close coordination with the local people will be necessary in order to identify the benefits they need to participate in conservation projects. Such benefits might include permission to extract traditional resources, particularly where this does not degrade the reserve, or the provision of alternative income-earning opportunities, either in conjunction with reserve management (tourism, etc.) or in adjacent areas such as buffer zones. Several pilot programs are underway to work with local smallholders in forested areas and these are discussed in Chapter II.

Table 1.9: NUMBER OF RESERVES WITH PRIORITY FOR PROTECTION BY BIOGEOGRAPHIC REGION

Region	Number of priority reserves	Number with management plans
Sumatra	16	6
Java and Bali	9	8
Kalimantan	14	5
Nusa Tenggara	8	2
Sulawesi	8	4
Maluku	12	1
Irian Jaya	12	3
Total	79	29

Source: International Union for the Conservation of Nature and Natural Resources (IUCN).

1.61 Awareness. During the late 1970s, nongovernmental organizations (NGOs) concerned with environmental protection and awareness, and with wildlife conservation and appreciation, greatly expanded their membership and influence in Indonesia. They helped foster the growing conservation movement in the country through campaigns, publications, seminars and active project work. The Indonesian Environmental Forum (WALHI), the Green Indonesia Foundation (YIH), and the Indonesian Society for Forest Protection (SKEPHI) have been leaders in this effort and have developed a strong and dedicated following, particularly among university students. The State Ministry for Population and Environment (MPE), the Conservation Directorate in the Forestry Department and the larger NGOs have promoted nature appreciation clubs at universities and schools throughout the country. Far more could be done, however, to introduce conservation through parks and educational activities, to target school-age children and people in rural areas, to promote the work of NGOs, and to support regional environmental study centers at major provincial universities.

1.62 Priorities and Strategies. With limited manpower and funds, priorities for protection, whether by location, habitat type or species, must be clear and focused. To develop appropriate strategies for each biographic region, the following initiatives, many of which will require external support, are necessary:

(a) a comprehensive review of each biogeographic region;

(b) inventories of and management plans for neglected wetland areas;

(c) additional species studies to determine the range and areas of concentration for rare and endangered species; and

(d) techniques for protecting important reserves, possibly including buffer zones and social forestry programs.

1.63 Manpower Development. The shortage of trained and motivated people in wildlife management and protection is a particularly serious problem. Staff recruited from the forestry service are not yet trained in conservation strategy; entire specializations (e.g., marine conservation) are lacking; and guard staff are poorly paid and, hence, poorly motivated. There is therefore an urgent need for manpower development. Critical elements of this program would include training of middle-level managers by strengthening university curricula and by providing overseas training; developing a marine conservation training center, possibly located in Ambon; developing regional programs for training field-level guards and staff; and providing appropriate incentives and supervision; and expanding conservation awareness and education programs in the regions.

1.64 Decentralization. One of the most critical steps in improving the management of protected areas is to develop the concern, manpower and capacity to address the problem at the provincial and local level. As a first step, provinces in conjunction with the Forestry Department should be encouraged to develop priorities for conservation and to coordinate with their neighbors in a single biogeographic region to ensure protection of critical habitat. Appropriate individuals in the provinces should be identified for training, as Jakarta staff are seldom willing to move to the provinces. This pattern would be consistent with the general process of decentralization in Indonesia, in which the center provides guidelines and implementation is increasingly carried out by local or provincial governments.

1.65 Fund Increases. Under Repelita IV (1984-89), the total budget and revenues provided by the Forestry Department for conservation was about US$12 million, including external commitments of about US$4 million. Less than half was for reserve management, which is insufficient. The minimum cost of protecting priority reserves, undertaking other strategic work and species studies, and training staff is estimated at about US$100 million in the next five-year plan (Repelita V) or about US$20 million/year. This figure is based on the amount of money that could be spent within each biogeographical region (Table 1.10). Additional funds are required to do an adequate job, but absorptive capacity is severely limited. Since funds to support conservation need to be increased at least sixfold, mobilizing adequate financial resources is critical to Indonesia's conservation effort.

A Proposal for Action

1.66 If Indonesia's forests and wildlife are of value globally, then presumably other countries should be willing to share in the cost of preserving them. Indonesia, with per capita income of US$500/year and other

pressing social and economic problems, cannot alone bear the burden of protecting tropical ecosystems of global value. Assistance from better-off countries and NGOs will be required.

1.67 To circumvent resource and manpower constraints, the Bank recommends that the Government of Indonesia invite interested donors to support Indonesian conservation efforts by providing funds and technical assistance for conservation awareness, strategic planning, manpower development and reserve protection. Donors and Government could share the costs of such an effort on roughly a 50/50 basis. Since different biogeographic regions have distinct needs, and reserve areas within regions are in different stages of demarcation and protection, this report also recommends that one or two donor countries be asked to provide support for an entire reserve system and for manpower development program within one of the seven biogeographic regions. The bilateral agency would then have an interest in determining priorities and providing technical and financial support for the system as a whole. Potential donors include Australia, Canada, the Federal Republic of Germany, Japan, the Netherlands, the Nordic Countries, the United Kingdom, and the United States. Several smaller donors with strong environmental interests might be encouraged to cooperate.

Table 1.10: RESOURCES REQUIRED DURING REPELITA V TO ESTABLISH THE RESERVE AREA SYSTEM

	Total cost (US$ million)	Donor share (US$ million)	Donors with interests in specific areas /a
Sumatra	20.0	10.0	Several
Java/Bali	10.0	5.0	GOI with IBRD
Kalimantan	20.0	10.0	Fed. Rep. of Germany, France, U.S.
Nusa Tenggara	10.0	5.0	Australia
Sulawesi	10.0	5.0	Canada
Maluku	15.0	7.5	The Netherlands
Irian Jaya	15.0	7.5	Several
Total	100.0	50.0	

/a Not an exhaustive list.

Based on the costs of managing protected areas in externally financed projects, but scaled back to take account of limited absorptive capacity and manpower.

1.68 The rough financial estimates in Table 1.10 assume: (a) that the cost of developing a protection system in the seven biogeographic regions is roughly proportional to the number of priority areas to be preserved within the region; (b) that manpower development and special studies would be

included as part of the cost; and (c) that Government, through the reforestation tax or other measures, would mobilize about half of the resources required. The ability of provincial institutions to absorb available funds would be very limited at first, but is expected to grow over the five-year period.

1.69 Development and implementation of such a program of mutual assistance would take considerable effort and goodwill. Government, for its part, would have to establish an appropriate organizational framework for managing and coordinating the work of donor agencies. An international NGO such as IUCN might be asked to take the lead in coordination, or this function could be served by a donor country or by the Bank. Government would also have to assign to the task officials who had strong conservation values and an ability to work with expatriate teams. Expatriates, in turn, would have to be committed not only to the preservation of Indonesia's natural resources, but to a transfer of technology and human resource development. The objective justifies the adjustments required, and if successful, this type of cooperation would be a milestone in mobilizing multilateral support for conservation purposes.

II. LAND RESOURCE MANAGEMENT

A. Land Use Issues in the Outer Islands

2.1 The major land use issue in the outer islands relates to expanding agricultural development and the encroachment of agriculture onto forested lands. There are also important issues related to land tenure, land classification, and land use management. To address these issues, this chapter describes the problems faced by smallholders and development programs in identifying land for economically productive purposes, discusses alternatives to current practice, describes the overall policy and institutional changes needed for sound land use management. The chapter also touches on land use issues in Java.

Pressures on the Land

2.2 In the early 1970s, the Indonesian economy experienced a steady shift away from agriculture toward other sectors. With about 70% of the population living in rural areas and dependent, directly or indirectly, on agriculture for subsistence, such a change was welcome. However, as a result of declining oil revenues in the 1980s, rates of growth and employment generation slowed. For example, growth in manufacturing declined from about 13% p.a. in the 1970s to about 3.7% after 1983. This placed renewed pressure on agriculture to absorb surplus labor. The agriculture sector, which absorbed about 26% of the new entrants to the labor force during 1971-80, absorbed nearly 42% during 1980-85 (Table 2.1)

Table 2.1: SHARE OF EMPLOYMENT GROWTH (%) IN JAVA AND THE OUTER ISLANDS

Area	1971-80	1980-85
Java		
Agriculture	8	12
Other	50	38
Subtotal	58	50
Outer Islands		
Agriculture	18	30
Other	24	20
Subtotal	42	50
Total		
Agriculture	26	42
Other	74	58
Total	100	100

Source: Central Bureau of Statistics, SUPAS, 1985.

2.3 Despite pressures on agriculture in Java to absorb labor, the sector's capacity to do so was limited. By the early 1980s, 75% of the surface area of Java was cultivated and 87% was in productive use (including forests, aquaculture, and house lots). Virtually all economically irrigable areas were under the command of irrigation systems and 94% of wet rice fields were planted to high-yielding rice. Thus, while opportunities remained for increasing agricultural production in Java, there was little room for increased agricultural employment. Landless Javanese laborers who wanted to find employment in agriculture had to do so by moving to the outer islands.

2.4 In the late 1980s, conditions in the outer islands are placing similar pressures on the land. Although 40% of Indonesians live in the outer islands, only 20% of medium- and large-scale industries are located there. This means that new entrants to the labor force are likely to seek employment in agriculture. Government investment programs have also encouraged land development in the outer islands. Between 1980 and 1986, more than 2 million people moved from the inner to the outer islands through the Government-sponsored transmigration program; and an estimated 1.2 million ha of tree crops were planted under government-sponsored programs. The data reflect these forces at work. Although Java has a larger total population dependent on agriculture than the outer islands, from 1980 to 1985 agriculture in Java absorbed only 12% of all new entrants into the labor force, while agriculture in the outer islands absorbed 30% (Table 2.1).1/

2.5 Agricultural expansion as a result of these factors is reflected in Table 2.2. The data, aggregated from local-level statistics rather than aerial photography, are subject to error, though indicative of trends. Between 1973 and 1983, dryland production in the outer islands roughly increased by more than 50% and expanded by 3.4 million ha. Growth was particularly rapid in Sulawesi (5.6% p.a.), Kalimantan (4.6% p.a.) and Sumatra (3.7% p.a.). These data suggest the increasing demands for land in the outer islands and the increasing importance of trade-offs among forests, agriculture and other land uses.

1/ While Java's average agricultural gross regional domestic product (GRDP) per worker (Rp 393,000 in 1980), is about the same as that in other islands, there is a large difference in the productivity of land as measured by agricultural GRDP per hectare. Sumatra as a whole requires 2.1 ha to equal the productivity of 1.0 ha on Java, while Central Kalimantan requires 6 ha and Irian Jaya, 12 ha. This indicates that farmers in the outer islands currently require more land per family to earn the same income as in Java. This is due partly to lower soil fertility and partly to lower levels of infrastructure and investment in some outer island provinces.

Table 2.2: AVERAGE ANNUAL RATE OF EXPANSION FOR WETLAND AND DRYLAND RICE (%)

Island	1963-73		1973-83	
	Wetland	Dryland	Wetland	Dryland
Java	0.4	-0.8	1.1	1.8
Sumatra	2.9	-1.2	2.2	3.7
Nusa Tenggara/Bali	1.8	2.7	2.2	3.7
Kalimantan	4.6	2.3	3.5	4.6
Sulawesi	6.1	4.1	1.6	5.6
Total	1.7	0.6	1.7	3.6

Source: Kasryno, Faisal, et al., "Pola Usaha Pertanian dan Pola Tanam," 1986. BPS Agricultural Census, 1983.

Land Availability

2.6 The population in the outer islands is about 65 million and the growth rate is about 2.3% p.a. without immigration. This alone places considerable pressure on the land and forests. In addition, the outer islands provide opportunities to migrants from overcrowded areas in other islands. Regions in North and West Sumatra, and North and South Sulawesi have been centers of out-migration for many years.2/ Since the 1930s, outer island migrants have been joined by Javanese migrants moving in large numbers, mainly to southern Sumatra. Prior to 1980, the majority moved "spontaneously", i.e., without government assistance. Recently, however, Government has promoted a number of large-scale development programs in the outer islands intended both to combat poverty and address population pressure on Java. These programs have provided strong incentives to move and strong demands for land, but to date mechanisms to obtain land outside development programs have been limited, and this has had adverse impacts on the environment.

2.7 Land availability depends in part on traditional land tenure arrangements which vary from place to place. In Sumatra virtually all land, whether cultivated or not, is claimed by local clans or Margas; whereas in Kalimantan, claims are extended mainly to those lands which have been previously cultivated or harvested by local people. Under traditional law or adat the question of permanent alienation of land does not arise, although clans or local families can grant permission to others for short-term or long-term use of the land. These arrangements are often subject revocation, however, and under the circumstances newcomers are often reluctant to invest

2/ Historically, movement in Sumatra has been from the fertile highlands in the west and north to the less-fertile lowlands in the south and east, and there has been extensive movement from South Sulawesi to East Kalimantan and to the coastal areas in the eastern islands.

in perennial crops or soil conservation measures and may find it preferable to clear unclaimed forested land.

2.8 Under the Basic Agrarian Law of 1960, the Government assumed the right to reallocate underutilized lands for public benefit and has used this power to acquire and redistribute land for development purposes. Such transfer must be done with the consent of local people and the inability to obtain local consent to land transfer is a frequent cause of project delays. The Basic Agrarian Law also introduced procedures for land transfer, and outright sale accompanied by land titling is increasing; but land registration is a long and cumbersome process which frustrates both buyers and sellers (see Annex 2). Without land title, however, outsiders, whether from the outer islands or Java, have little security and are subject to claims that the seller of land had no right to do so. Again difficulties associated with land purchase encourages smallholders to encroach on forested land.

2.9 To further complicate the picture, the amount of land under Forestry Department jurisdiction was recently formalized and expanded under the Basic Forestry Law (BFL). When the BFL was passed in 1967 about 26 million ha of land were within Forestry Department boundaries. In 1980, in response to development pressures, instructions were issued to the provinces to prepare a Consensus Forestry Land Use Plan (TGHK). In the reclassification, which was largely completed by 1983, the amount of land within Forestry Department boundaries was increased to 113 million ha. This is nearly 60% of the country's surface area (Table 2.3). If areas earmarked for potential conversion to other uses are included, 75% of the country is now within Forestry Department boundaries. Since 1983, additional areas have been reserved for mining and oil exploration, and in many cases, mining and oil reserves overlap with forestry boundaries.

Table 2.3: CHANGES IN AREAS WITHIN FORESTRY DEPARTMENT BOUNDARIES, 1972-84

Province	Area in Permanent Forest Categories /a			% Land in permanent forest	% Land in all forest categories
	1972	1984	Ratio 1984 to 1972		
	----- (Hectares) ------				
Sumatra	9,043,000	25,176,000	2.8	54	65
Java	2,814,000	3,013,000	1.1	22	22
Kalimantan	5,848,000	36,674,000	6.3	67	82
Sulawesi	6,408,000	11,291,000	1.8	58	68
Irian Jaya	--	28,816,000	-	70	99
Other	1,688,000	4,364,000	2.6	49	69
Total	25,841,000	112,742,000	4.4	59	75

/a Includes reserves, protection, limited production and production forest.

Source: Forestry Department Statistics.

2.10 With such a large area within Forestry Department boundaries, development projects face serious problems acquiring land. Although 30% of the land within forestry boundaries in Sumatra is deforested, and 15% of all rubber in Sumatra is now on Forestry Department land, none of these areas can be used for tree crop intensification programs directed at local smallholders. The problem is exacerbated by Government policies which regard land as a national asset and discourage the payment of compensation for land intended for smallholder development. Not surprisingly this limits the land which can be voluntarily acquired for development purposes.

2.11 Traditional shifting cultivators also face potential difficulties, as the BFL recognizes the rights of local people to harvest forest products other than timber, but it does not allow local smallholders to log or to cultivate Forestry Department land. This means that local smallholders have only limited incentives to protect the forest or to invest in stable production systems. In some countries in South and Southeast Asia (e.g., Philippines) the forest estate has been almost completely eliminated by local farmers who had no rights to forest products and, therefore, strong incentives to clear the land, even for marginal returns. To date, the problem is less serious in Indonesia, but the data for some provinces show that there is already a higher proportion of land under shifting cultivation within Forestry Department boundaries than outside them.

Economic Returns to Alternative Land Uses

2.12 If areas set aside for conservation and watershed protection were adequately protected, then whether land should remain under forests or be used for agriculture should depend, in part, on the economic returns to alternative land use systems. To evaluate this, Bank staff calculated the net present value (NPV) and return per hectare for several common production systems in the outer islands, including shifting cultivation, sedentary food crop production, tree crop production and forestry (Table 2.4). This analysis supports the view that shifting cultivation under optimal conditions provides a higher income per work day than most sedentary food crop systems. In the optimal case, however, food production would be substantially in excess of normal family requirements, an unusual situation. If production is, on average, only sufficient to meet a family's subsistence needs (a more typical situation where short-fallow rotation is being practiced), then low-input, low-output food crop production on adequate soils is slightly more attractive in terms of total household income (although the return per work day is still higher for shifting cultivation). Farming systems based on block-planted tree crops ordinarily provide better financial returns than short-fallow shifting cultivation or low-input food crop cultivation on marginal soils.

Table 2.4: NET PRESENT VALUE OF ALTERNATIVE PRODUCTION SYSTEMS
(10% Discount Rate, 1987 Constant Rp)

Production System	Net return per work day (Rp)	Net farm income (Rp)	Land needed for this return (ha)	NPV per hectare (Rp)	NPV per hectare (US$)
Shifting Cultivation					
Short fallow	2,200	1,861,000	12	87,000	53
Sedentary Cultivation					
Low-input food crops	1,900	2,576,000	1.5	736,600	446
Smallholder rubber	2,500	4,708,000	2.0	1,850,000	1,182
Rubber and house garden	2,300	6,060,000	2.5	1,758,000	1,065
Timber Production					
Low-value stand (US$15/ha/yr)		-	1.0	211,000	128
Moderate-value stand (US$35/ha/yr)		-	1.0	492,000	298
Good-value stand (US$65/ha/yr)		-	1.0	913,000	553

Source: Bank staff estimates from staff appraisal reports.

2.13 If land, not household, productivity is assessed, however, the results are quite different. The net present value of the returns to one hectare of land under shifting cultivation over time is about US$50-120. Under low-input food crops on adequate agricultural land it is about US$450. Sustained food crop production is difficult on poor-quality soils. Systems with block-planted rubber have an NPV of about US$1,100/ha with current low commodity prices. Timber production in a good stand of natural forest produces a NPV of about US$550, which is better than shifting cultivation and somewhat better than sedentary food crop production. Rubber production has an NPV higher than either food crops or timber-production, although some timber producing areas may have NPVs approaching those of tree crop production.

2.14 These data suggest that, from an economic rather than a social point of view, it is preferable to use marginal land for timber production, rather than shifting cultivation. Low-output food crops and timber production have roughly the same NPV per hectare, but only where there are adequate soils. Timber production is more attractive on poor soils. Tree crops have the highest economic return per hectare on reasonable soils. In general, environmental benefits are consistent with economic benefits. Smallholder food crop production on marginal soils generally produces low household incomes and may lead to extensive land use with an adverse impact on soils and forests. Compared to food crops, tree crops reduce levels of erosion and provide a habitat for some wildlife, but they reduce the diversity found in

the natural forest. On poor soils, timber production is attractive from both an economic and environmental point of view.

B. Alternative Approaches to Agricultural Development

Background

2.15 Transmigration. The major land settlement scheme in Indonesia has been the Government's transmigration program. The main objective of the program is to move people from overcrowded areas in the inner islands to the less populated outer islands. Transmigration can be fully sponsored, partially assisted, or unassisted (spontaneous), and local resettlement also occurs. Migrants generally receive about 2 ha of land and land titles after five years. The cost of the program is estimated at about US$6,000 per family. To date, there has been little cost recovery which has provided a strong incentive for people to move. Between 1980 and 1986, more than 2 million people moved from the inner to the outer islands on the transmigration program (Table 2.5), and in support of the program, about 800,000 ha of land were cleared. Of this, about 300,000 ha were in brush and secondary forest and an equal amount was in logged-over primary forest; the remainder was not forested. Another 500,000 ha were allocated, but the land has not yet been cleared.

Table 2.5: SPONSORED SETTLEMENT IN THE OUTER ISLANDS
(Families)

Years (Repelita)	Sumatra	Kalimantan	Sulawesi	Irian Jaya	Total
1969-74 (I)	22,000	6,000	11,400	100	39,500
1974-79 (II)	33,000	11,000	9,000	2,000	55,000
1979-84 (III)	227,000	70,600	51,000	16,600	365,200
1984-86 (IV)	84,500	38,300	23,800	7,400	154,000
Total	366,500	125,900	95,200	26,100	613,700
%	60	20	15	5	100

Source: World Bank, Transmigration Sector Review, 1986.

2.16 A central question in the evaluation of transmigration is whether sites on marginal soils can be sustained. To date, agricultural production on transmigration sites has been based mainly on low-input food crop production. As noted previously, traditional cultivators typically rely on shifting cultivation to circumvent the limitations of low-fertility soils and, ordinarily, 15-20 ha of land are needed to sustain a family on this basis. Given the widespread nature of this adaptation, some critics of transmigration have argued that transmigrants will not be able to sustain food crop production on 1-2 ha of marginal land, and as a corollary, suggest that transmigrants will either have to turn to shifting cultivation or abandon their sites.

2.17 Although the data are not all in, due to the short time many migrants have been on site, it appears that land constraints, combined with cultural, technical and economic factors (including the presence of off-farm work) have enabled sponsored migrants to meet their subsistence needs from sedentary cultivation. Extensive cultivation by sponsored migrants who received land is not common, although it could increase if soil fertility deteriorates further, and there is little site abandonment. When migrants do leave, others usually take their place. However, incomes from agriculture are low, households are dependent on off-farm work, and the program has had a significant impact on forested land. There is also evidence that spontaneous migrants expand the areas of settlement well beyond the initial site, and they may shift from place to place if soil fertility declines.

2.18 In mid-1986, the transmigration program was curtailed due to declining oil revenues and implementation problems. Through the remainder of Repelita IV (1984-89) and Repelita V (1989-94), the funds available for transmigration are to be used primarily to upgrade the infrastructure and production systems on existing sites. In the absence of government-sponsored settlement, however, the number of spontaneous migrants moving to the outer islands is expected to increase. Since these migrants do not have access to land, encroachment on forested lands and extensive cultivation may also increase. For this reason, the management of spontaneous migration will be one of the most pressing problems facing government in the next five-year plan.

2.19 Tree Crop Development. In recent years, the main vehicles for Indonesian tree crop development have been (a) the nucleus estate and smallholder (NES) program in which government-owned estates plant new areas for the estate (20%) and for smallholders (80%); and (b) project management units (PMUs) under the Directorate General of Estates which help existing smallholders plant or replant on their own land. In recent years about one quarter of all tree crops were planted by estates and three quarters by smallholders under PMU supervision. Private estate development has recently been encouraged. In most tree crop development programs some cost recovery is expected from the farmers although there has been only limited collection to date.

2.20 Compared to transmigration, a relatively small area of primary forest has been used for estate crop development.3/ It is now becoming increasingly difficult, however, for estates to identify land which is not forested and not already under smallholder production, and land acquisition is a growing problem. PMU projects on smallholder land have good prospects for intensifying production systems and can help limit shifting cultivation and improve smallholder incomes. For these reasons, they are attractive on both environmental and equity grounds. However, recent PMU programs have suffered from the poor quality of planting, and to be cost-effective, program implementation and cost recovery mechanisms must be improved.

2.21 Given budgetary constraints, Government has recently launched an ambitious program to encourage private estate development in which 40% of all

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3/ Statistics from the estate crop sector indicate that about 46,000 ha of forested land were cleared for tree crops in Repelita III, about 40% of the total area allocated for this purpose in the plan period.

block-planted areas would be for the estate and 60% for smallholders. In anticipation of such expansion, requests have been made for the reservation of large areas of land. According to Forestry Department statistics, 1.6 million ha of land were requested for agriculture in Repelita III, of which 137,000 ha were allocated in the five-year period; and 1.5 million ha were requested in the first half of Repelita IV, of which 627,000 ha have been provided. Virtually all allocated land was transferred from areas already earmarked for conversion and not all was forested. Nevertheless, the magnitude of these numbers indicates large and growing pressure for agricultural land.

2.22 Because of budgetary constraints, it is difficult to predict the total area of government-sponsored and private tree crop development likely to occur in Repelita V. However, with a reasonable increase in development expenditures and measures to overcome quality control and credit recovery problems, 500,000-1 million ha of tree crops could be planted in Repelita V, virtually all in the outer islands (see Table 2.6). This large area presents Government with clear development options with respect to land use. Either arrangements will have to be made to permit the upgrading of existing agricultural land, or the expansion of this area will have to be made at the expense of forests and wetlands.

Table 2.6: TREE CROP PLANTING PROGRAMS

Commodity	Repelita III achievements	Repelita IV estimates	Repelita V projections
	ha		
Rubber	262,000	120,000	250,000
Oil palm	59,700	120,000	300,000
Coconut	193,300	78,000	200,000
Beverage crops	217,000	200,000	250,000
Total Hectares	732,200	488,000	1,000,000

Alternative Approaches to Agricultural Development

2.23 Since forest conversion entails relatively large opportunity costs in terms of foregone timber revenues, and both forest and swamp conversion may involve the destruction of important ecosystems and wildlife habitat, the question arises whether options exist that would meet Government objectives without the large-scale conversion of forests and swamps. The answer lies to some extent in the intensification of areas currently under low-intensity production. There are at least 3 million ha of low-productivity rubber in the outer islands which yield 350-500 kg/ha/year and which could be upgraded by smallholders with PMU assistance and produce 1,200-1,500 kg/ha/year. Opportunities also exist for upgrading coconut and coffee areas and for upgrading rainfed food crop production by improving existing technologies.

2.24 Not only would land intensification reduce pressures on forests and swamps, the evidence suggests it would have economic benefits. Table 2.7 compares the estimated rates of return where Government (a) provides access to remote areas and clears forested land in large-scale settlement projects; or (b) allocates money for land purchase and land registration in areas where access already exists. As indicated, the high costs of infrastructure and land clearing associated with large-scale settlements produce low rates of return. However, if programs were developed to permit new settlers, whether transmigrants or locals, to purchase underutilized, cleared and accessible land, economic returns would be significantly increased. Government's production and equity objectives could be met at far lower cost, and pressures on natural forest areas could be reduced.

Table 2.7: ECONOMIC RATES OF RETURN TO NEW SETTLEMENT IN REMOTE AREAS, AND IN AREAS WHERE LAND IS PURCHASED FOR INTENSIFICATION (%)

	Agriculture only		Agriculture and off-farm work	
Models /a	Large-scale settlement	Land purchase	Large-scale settlement	Land purchase
Low-input food crops	negative	5	1	15
Diversified food crops	2	14	4	17
High-input food crops /b	2	16	7	27
Smallholder tree crops	8	13	9	15

/a Adapted from World Bank, Transmigration Sector Review, 1986.
/b Observed primarily in research areas.

2.25 Large areas of underutilized or degraded lands in the outer islands are not available to settlers because of traditional land claims. However, there are other areas where land is available at a fair price (US$100-200/ha). This land could potentially be used either by development projects or by local smallholders and immigrants, if government agencies were prepared to compensate people for land used for development, land registration were simplified, and credit were available for land purchase. Some observers are concerned that accelerating land sales would put local people at a disadvantage; to avoid this, land purchase, credit and land registration should be targetted to areas where the local people are already fully knit into the cash economy.4/ In spite of the difficulties involved, however, it is increasingly clear that the development of rational land markets in the outer islands will be a prerequisite to sound land allocation and to forest and watershed protection. The steps needed to free underutilized and degraded land for development, to facilitate land transfer and to ensure fair treatment of buyers and sellers are described in Annex 2.

4/ An estimated 4 million people are relatively isolated from the cash economy. These people are mainly in Irian Jaya and interior Kalimantan.

C. Alternative Approaches to Shifting Cultivation

2.26 One important form of smallholder production is shifting cultivation. Shifting cultivation, like the forest itself, is an evolutionary adaption to low-fertility soils. Under such production systems, forested areas are cleared and burned to take advantage of nutrients in the ash. When soil fertility declines, the area is left fallow and bush regenerates. Since farmers generally prefer to cut secondary rather than primary forest, they return to the same plot after 10-20 years where they clear and burn again. When land and population balances allow for sufficiently long fallow periods, such systems are productive and sustainable. Of the 65 million people in the outer islands the large majority are sedentary cultivators. The Forestry Department estimates that about 1 million families are practicing shifting cultivation on 7.3 million hectares (Table 2.8). If part-time shifting cultivators are included, however, the figure undoubtedly exceeds this number. According to LRD figures, the amount of land under long-fallow rotation in Kalimantan and Sumatra alone is about 25 million ha.

Table 2.8: ESTIMATES OF AREA AND FAMILIES PRACTICING SHIFTING CULTIVATION

Island	Forestry Department estimates /a			LRD Estimates /b	
	Area ha	Families	ha/family	Under shifting cultivation	Affected by shifting cultivation
				ha	
Sumatra	932,000	261,000	4	n.a.	n.a.
Kalimantan	4,052,000	229,000	18	5,457,000	11,240,000
Sulawesi	1,350,000	245,000	18	n.a.	n.a.
Irian Jaya	204,000	120,000	2	1,400,000	2,000,000
Other	772,000	204,000	4	n.a.	n.a.
Total	7,310,000	1,060,000	7		

/a Forestry Department, Forestry Statistics of Indonesia, 1985/86, p. 118.
/b LRD/RePPProT Studies, 1986, 1987.

2.27 Shifting cultivators are very diverse. There are traditional cultivators in Central Kalimantan and Central Sulawesi who are largely dependent on shifting cultivation for subsistence, while Buginese immigrants in East Kalimantan produce pepper for cash on fields which are cultivated for 6-10 years and then moved. One of the most common farming systems in Sumatra for the last 100 years has been based on food crops and rubber. Rubber trees are tapped when prices are high and left unattended when prices are low, and from time to time they are cut down for food crops and replanted. Some spontaneous immigrants who rely on agriculture for their livelihoods shift from year to year, simply because they cannot obtain secure tenure to the land which they cultivate.

2.28 Over the past decade a number of programs have been developed to relocate shifting cultivators from the forest. None has been carried out on a large scale, and only about 10,000 families (50,000 people) were resettled through such schemes between 1972 and 1982. Virtually all these programs were failures, either because they involved forced relocation, which left the farmers apathetic and dependent, or because they provided insufficient land to maintain productivity on low-fertility soils.

2.29 A number of lessons have been learned from past settlement schemes, among them are the following:

(a) Programs must be designed with local participation. The participation of the local people is necessary to identify the benefits to be achieved and the means of realizing them. Where programs are involuntary, participants become dependent on government for continued support and promising possibilities are frequently overlooked.

(b) Programs must be technically viable. To earn a reasonable income from low-fertility soils, a relatively large area for production is required. Yet more often than not, resettlement schemes give farmers 1-2 ha of land on the assumption that they will practice sedentary agriculture, even though the soils are not suitable, initial capital is not provided, and farmers lack the background or experience to know what to do. Such programs should be discouraged.

(c) Programs directed at local smallholders must be culturally acceptable. For example, Javanese and Balinese can often earn an adequate living on transmigration schemes and most consider themselves better off than before. But those cultivators who have little experience with hoeing, animal tillage or new technologies, and forest dwellers who are deprived of the forest resources they depended on in the past are generally unable to meet their subsistence needs in such settings. For these reasons, resettlement within existing transmigration schemes is most appropriate for spontaneous migrants who are anxious to obtain secure land title to new land.

(d) Programs should draw on the farmer's past experience. Tree crop intensification schemes are often attractive in those areas of Sumatra and West Kalimantan where farmers already have rubber or oil palm or have worked as estate laborers. Since 2 ha of tree crops can produce the same income as 30-40 ha under shifting cultivation, low-input tree crops can be used to stabilize the production systems of some shifting cultivators, and they are attractive to many sedentary cultivators who practice shifting cultivation on the side.

Alternatives to Past Approaches

2.30 Where local cultivators have little interest in or knowledge of sedentary agriculture, efforts to resettle them have not been successful, and alternative approaches are required. As noted earlier, many smallholders on forestry land have few incentives to maintain the land under forest cover. If

these smallholders could benefit through the sale of timber or secondary forest products, or through the provision of alternative cropping systems, deforestation could potentially be reduced. This suggests that projects should recognize traditional land rights and provide security of tenure; work closely with farmers to understand their needs and to improve the income-earning potential of their production systems; and strive to develop forest management systems in which local smallholders clearly benefit. Such programs are often termed "social" or "community" forestry.

2.31 The objective of social forestry programs is to help forest-dwelling people manage their resources sustainably. Key elements of such a program are:

(a) data collection on existing forest conditions, local production systems and needs;

(b) development of local organizations for participatory forest management;

(c) introduction of appropriate technical innovations that provide a variety of short-, medium-, and long-term benefits such as agroforestry systems; and

(d) the development and legalization of long-term contractual/tenurial arrangements to provide local people with security and incentives for investment in sustainable forest management.

Reorientation of the forestry service towards "social" forestry and away from "custodial" forestry is also required.

2.32 The Ford Foundation, in cooperation with the Forestry Department and several NGOs, has initiated pilot projects in social forestry at locations in Java, South and East Kalimantan, South Sulawesi, and Irian Jaya. In addition, the Ford Foundation is cooperating with the Bogor Agricultural Institute in the development of a social forestry research program. The United Nations Environment Programme's Man and Biosphere Program in Indonesia also includes several forest reserves where local people are encouraged to help protect local wildlife and forests, although the program is small and underfunded. Given the potential of social forestry programs to improve smallholder incomes and to reduce the encroachment on areas set aside for conservation and watershed protection, a much larger effort is required to evaluate existing social forestry projects in both Indonesia and neighboring countries, and to design and initiate new pilot projects, research, and training programs.

2.33 A study of shifting cultivation has been included in the Bank-assisted Forestry Management and Conservation Project. The study will develop a typology of shifting cultivators so that planners can better understand the diversity of systems involved. It will evaluate agroforestry schemes tried elsewhere in Southeast Asia, review mechanisms to provide security of tenure, and recommend alternative approaches for upgrading local production systems and appropriate institutional arrangements for doing so. The study, which is intended to minimize both relocation and adverse impacts on the forest, will

be carried out by the Forestry Department to increase the awareness of social issues within the agency. When completed, a major redirection of funds may be desirable to improve local production systems in remote areas and in critical watersheds.

D. Land Allocation in the Outer Islands

Land Classification Systems

2.34 Forests provide ecological services such as watershed protection and riverflow stabilization, and forest cover appears to have an impact on local rainfall and, perhaps, on global climate. For these reasons, the more land that remains under forest cover the better from an environmental point of view. However, the very large areas within forestry boundaries in Indonesia, the poor quality of data on which these boundaries were based, and the presence of large cultivated areas within forestry boundaries suggest that land allocation for forestry and agricultural needs to be reviewed. Several approaches have been suggested, but the objectives and the criteria for land classification have yet to be agreed.

2.35 One approach to land allocation in the outer islands has been proposed by LRD which, in the process of mapping land suitability in Kalimantan, found that many areas classified as production forest had slopes over 45% and should be protected. It also found that the area suited to food crops was limited, but that large areas within production forest categories had the slope and soil requirements suitable for tree crops. Accordingly, LRD proposed revised forestry boundaries which would significantly increase the amount of land in reserves and protection forest (due mainly to the large area found to be over 45% slope) and would put all areas where agriculture was not counterindicated into a conversion category. Table 2.9 summarizes the results of this exercise in Kalimantan.

Table 2.9: PERCENT OF KALIMANTAN LAND UNDER CURRENT FORESTRY CATEGORIES AND PROPOSED LRD REVISION

Forest category	Current boundaries	Proposed revision
	%	
Reserves and protection forest	19	30
Production forest	47	26
Conversion and nonforest categories	34	44

Source: LRD/RePPProT Studies, 1986, 1987.

2.36 If the LRD recommendations were followed, the amount of land in Kalimantan in reserves and protection forests would increase from about 10 million ha to 16 million ha; the amount of land which could potentially be converted to agriculture would increase from about 11 million ha to 23 million ha; and the amount of land remaining in permanent production forest would be reduced from about 25 million ha to 14.5 million ha. In East Kalimantan,

Indonesia's richest timber-producing province, this classification system would potentially reduce the land within production forest categories from 50% of the total land area (9.8 million ha) to 22% (4.3 million ha).

2.37 LRD's contention that a far larger area of Kalimantan is over 45% slope than currently recognized should be carefully investigated by the Forestry Department to ensure that such areas are adequately classified and protected. The suggestion that 10 million ha could be added to the land available for agricultural development is more contentious. Although not all land would be converted, and conversion would occur over many years, a classification system of this type would have repercussions for the area under permanent forest cover.

2.38 The LRD proposal assumes agriculture would have priority over timber production in areas suitable to tree crop production. In contrast, Forestry in Land Use Policy for Indonesia (M.S. Ross, 1984) takes a somewhat different approach. It argues that after land has been allocated for agriculture to meet the basic food needs of the population, a decision about what land should be maintained as production forest must weigh those attributes that contribute to the financial value of the production forest, e.g., regenerative potential, location and accessibility. Forests with lower quality, either because of depletion or species mix, would have lower priority for preservation than higher-quality forests, and the least valuable forest land would be released first. In order to implement such a system, all agencies would have to agree on an appropriate land classification system, taking both agricultural needs and forest type into account.

2.39 A third approach to land classification would take into account the comparative advantage of provinces for agriculture and timber production. Table 2.10 shows the percentage of land in each province within permanent forest areas and the estimated percentage of commercially harvestable timber. As indicated, Kalimantan, which has one third of the area within permanent forest boundaries, has more than half (55%) of the commercially valuable timber, and East Kalimantan alone has almost one quarter of all commercially valuable trees in Indonesia. Irian Jaya with one quarter of the area within production forest has only 9% of the commercially valuable species.

2.40 In the past, each province has been encouraged to be self-sufficient in rice production, raise secondary food crops (e.g., soybeans), plant tree crops, produce timber and accept migrants, even though some provinces may have a strong comparative advantage in one form of production over another. To continue this policy is neither economically nor environmentally sound. Kalimantan, particularly East Kalimantan, has a strong comparative advantage in timber production, but has poor soils and is not well suited to food crops. Under the circumstances, Government should consider policies which minimize movement to East Kalimantan for land settlement. In contrast, provinces like North and South Sumatra have relatively good infrastructure in comparison with other outer island provinces and have a strong comparative advantage in tree crops.

Table 2.10: PROPORTION OF COMMERCIAL TIMBER IN THE NATURAL FOREST BY PROVINCE

Province	% Forest in permanent forest categories /a	% Commercially marketable timber /b
Sumatra		
Aceh	3.0	4.0
North Sumatra	3.0	2.0
West Sumatra	3.0	2.0
Riau	6.0	9.0
Jambi	4.0	3.5
South Sumatra	2.0	2.5
Lampung	1.0	0.0
Bengkulu	1.0	1.0
Sumatra Subtotal	22.0	24.0
Kalimantan		
West Kalimantan	7.0	8.5
Central Kalimantan	10.0	19.0
South Kalimantan	2.0	3.0
East Kalimantan	14.0	24.0
Kalimantan Subtotal	32.0	55.0
Sulawesi		
North Sulawesi	1.0	1.0
Central Sulawesi	4.0	4.0
South Sulawesi	2.0	1.0
Southeast Sulawesi	3.0	0.0
Sulawesi Subtotal	10.0	6.0
Eastern Islands		
Bali and Nusa Tenggara	2.0	0.0
Maluku	4.0	5.5
Irian Jaya	25.0	9.0
Eastern Islands Subtotal	31.0	14.5
Java and smaller islands	5.0	0.0
Total	100.0	100.0

/a Forestry Department statistics.
/b Atlanta/INPROMA, Wood Raw Material Supply, 1987.

2.41 All these approaches to land use are based on the assumption that additional land should be allocated to agriculture and that some forest or degraded forest land should be used for agricultural production. However, many foresters and environmentalists argue that the amount of unplanned conversion is likely to be so large that no planned conversion should take place. They also contend that the economic value of the natural forest is underrated. Under the circumstances, they argue that existing forest boundaries should be defended to the greatest extent possible. Whether this can be done will depend largely on whether Government can develop land intensification systems to improve smallholder production and develop the mechanisms to permit farmers to buy and sell underutilized lands.

Land Use Issues Involving Critical Ecosystems Other than Forests

2.42 There are many land resource areas other than forests which are of ecological and economic importance, and in which land use conflicts are also becoming increasingly intense. Chief among these are wetlands, mangrove, and coastal areas.5/ Most coastal regions are flat and have poor drainage networks so that rainwater, floodwater and water backed up by tidal action are trapped on the land. This forms swampy areas which are relatively inhospitable to people and difficult to cultivate without major drainage works. Because of their physical characteristics and the cost of suitable technologies to develop them, swamps have relatively low population densities. For this reason they are one of Indonesia's richest areas for wildlife conservation and one of its last agricultural frontiers.

2.43 Experience with smallholder settlement in swamplands has been mixed. Both the best transmigration settlements and the worst are in tidally influenced areas and numerous technical problems must be overcome if smallholders are to be settled in swamps.6/ Recently, however, private investors, who have difficulty obtaining land in upland areas due to land tenure problems, have discovered the development potential of swamplands and in Repelita IV a large number of applications were made for the reservation of swamplands for development purposes. Since it is technically difficult to develop swamplands, the danger exists that undercapitalized developers without adequate technical knowledge may occupy large tracts of land, but destroy its value both for production and protection purposes.

2.44 To minimize the adverse environmental impacts which might be associated with future swampland development, studies are needed at the provincial

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5/ Indonesia originally had an estimated 36.5 million ha of peat, freshwater and mangrove swamps of which about 25 million ha remain, about 12% of total land area. About 3,365,000 ha of swampland are in reserves.

6/ Because of the high organic content of swamp soils, some older communities in tidal reclamation schemes produce two to four times as much rice as upland communities. Swamps are also suitable for oil palm and coconut, but not for rubber, coffee, tea, and cocoa.

level to identify areas which are most important for conservation and protection and to determine what criteria should be used for conversion. A study of priority areas for conservation in Sumatra is about to be undertaken by the Asia Wetlands Bureau in cooperation with the Forestry Department, with financial assistance from the Netherlands. It will take at least two years to complete. In addition, thorough work is required on the hydrological impact of drainage on downstream and coastal areas and on possible mitigatory measures to reduce acidification and other adverse effects. This work could potentially improve understanding of swamp ecosystems and help develop criteria for swampland development.

2.45 A major problem in swampland development and in the development and protection of other sensitive ecosystems such as mangroves and coastal reefs is that no single agency is responsible for their management. Data on the services provided to these areas is incomplete, and the extent of their degradation is unknown. Technical, economic and environmental guidelines on their management do not exist. Under the circumstances, there is a strong case to be made for increasing the role of one agency, in coordinating other agencies involved in the management of environmentally sensitive areas and in building the needed capacity in the provinces to take these issues of land management into account.

E. Selected Land Use Issues in Java

Overview

2.46 Land allocation issues are important in Java as well as the outer islands. The most significant aspects of demographic change in Java involve the almost complete utilization of available arable land in rural areas and rapid urbanization. As Table 2.11 suggests, population levels in rural areas in Java are growing at rates of less than 1% per year; while small, medium and large cities are growing, on average, about 3.5% per year. Medium-size cities in West Java are projected to grow at 6.5% per year and to increase fourfold in 25 years. Urban populations should reach more than 50 million people by the year 2000, more than the entire population of Java in 1950, and most of this population growth is concentrated along Java's north coast.

Table 2.11: RURAL AND URBAN POPULATION GROWTH IN JAVA

Province	Population (million) 1985	1990	2000	2010	Average growth rate (%)
West Java	30.834	36.581	43.325	54.175	2.5
Rural	23.373	24.993	27.626	28.468	0.9
Small & medium	5.412	9.306	13.076	20.657	6.5
Large	2.049	2.282	2.623	5.050	3.5
Central Java	26.707	27.896	30.854	34.745	1.0
Rural	21.172	21.405	21.889	22.288	0.2
Small & medium	2.959	3.471	4.794	6.667	3.3
Large	2.576	3.020	4.171	5.790	3.3
East Java	32.040	34.669	40.758	48.200	1.6
Rural	25.318	26.748	29.718	32.734	1.0
Small & medium	3.245	3.842	5.411	7.698	3.5
Large	3.477	4.079	5.629	7.768	3.3
DKI (Jakarta)	7.629	8.887	11.376	12.000	2.3
DI Yogyakarta	3.055	3.290	3.847	4.551	1.6
Rural	2.337	2.439	2.650	2.862	0.8
Urban	0.718	0.851	1.197	1.689	3.5
Total Java	100.265	111.323	130.160	153.671	1.8

Source: Bank staff estimates extrapolated from data provided by the Directorate General, Cipta Karya (DGCK).

2.47 One consequence of this growth is that both rural and urban population increases are causing the conversion of prime agricultural land to residential use. Despite Java's slow rate of rural population growth and declining share of national population, its rural population is expanding by about 150,000 new agricultural households per year. In general, this means declining farm sizes and increased landlessness, but so intense is land pressure in Java that the need for houselots alone is estimated to require the conversion of some 10,000 ha of agricultural land per year. The Indonesia National Urban Development Strategy Project (INUDS) has calculated that Indonesian cities will also expand by 376,000 ha between 1980 and 1995, of which 222,500 ha would be in Java (Table 2.12). Thus, Javanese cities are expected to expand by about 15,000 ha per year. Roads, industries and other uses are expected to increase total land conversion to 40,000 ha per year. This may considerably understate rates of conversion in Java, as the Directorate General, Agraria reported applications to convert 76,000 ha of agricultural land to other uses in 1986.

Table 2.12: AREA EXPANSION OF CITIES IN INDONESIA, 1980-95

Island/ province/(metro)	Urban area 1980 '000 ha	1980 %	Urban area 1995 '000 ha	1995 %	Area expansion, 1980-95 ('000 ha) Total	Annual	%
Java	289.7	63	512.2	61	222.5	14.8	59
Jakarta	39.3	9	65.4	8	26.2	1.7	7
(Jabotabek) /a	122.6	27	185.2	22	62.7	4.2	17
West Java	77.7	17	171.4	21	93.7	6.2	25
(Bandung Metro)	24.9	5	49.4	6	24.5	1.6	7
Central Java	76.3	17	117.4	14	41.2	2.7	11
(Semarang Metro)	15.2	3	26.1	3	10.9	0.7	3
DI Yogyakarta	9.4	2	16.6	2	7.2	0.5	2
(Yogyakarta)	5.8	1	11.8	1	6.1	0.4	2
East Java	87.1	19	141.3	17	54.2	3.6	14
(Surabaya Metro)	28.1	6	53.8	6	25.6	1.7	7
Sumatra	90.6	20	164.3	20	73.7	4.9	20
(Medan Metro)	20.0	4	41.9	5	21.9	1.5	6
(Palembang)	11.7	3	24.5	3	12.8	0.9	3
Kalimantan	26.5	6	60.1	7	33.6	2.2	9
Sulawesi	28.7	6	59.3	7	30.6	2.0	8
(Ujung Pandang)	8.8	2	22.6	3	13.8	0.9	4
Eastern Islands	23.5	6	39.5	5	16.0	1.1	5
Bali/Nusa Tenggara	16.1	4	28.3	3	12.2	0.8	3
Maluku	3.0	1	5.9	1	2.9	0.2	1
Irian Jaya	4.4	1	5.3	1	0.9	0.1	1
Indonesia Total	459.0	100	835.5	100	376.5	25.1	100

/a Includes all of Jakarta and the urban areas of the Kabupatens of Bogor, Bekasi Karawang and Tangerang. Source: ER+MC International, "Proposal for an Action Program in the Jakarta-Puncak Corridor" (Jakarta: UNEP/KLH, 1984).

Source: Peter Gardiner, INUDS Project, Jakarta, 1987.

2.48 Reactions to urban and industrial expansion are mixed. On one hand, such expansion is desirable as cities create high-density living space, which relieves population pressures in rural areas, and industries have far higher productivity and income-generating effects per hectare than agriculture. On the other hand, such conversion entails costs to the economy. Since it requires US$2,000-3,000 to create one hectare of new irrigated land, the cost of compensating for the 40,000 ha on Java that are converted to other uses

could be as high as US$50-100 million/year, or US$1-2 billion between 1980 and year 2000. Since about 7.5 million ha in Java are under production, conversion at recent rates over a 20-year period would also reduce the cultivated land on Java by about 10%. While manageable, this would place additional pressure on agriculture in the outer islands.

2.49 Urban and industrial expansion also entail other environmental costs. Increasing population densities put pressure on critical ecosystems such as coastal mangroves and hillside forests. The destruction of mangroves, in turn, leads to increased coastal erosion, damage to urban dwellings from wind and waves, and destruction of fish-breeding areas. Deforestation leads to increased soil erosion, siltation, flooding and other downstream effects. Increasing human populations and the proliferation of small-scale industries contribute to surface water pollution, which is hazardous to human health and detrimental to coastal ecosystems and fisheries. Water pollution, in turn, leads to increased abstraction of groundwater and the salinization of shallow aquifers. These problems are common to both developed and developing countries, but they are mitigated to some extent in developed countries through appropriate pricing (taxes) and other incentives, such as zoning and spatial planning. To date, however, there has been only limited success with land resource planning in Java, in spite of a number of efforts.

The Jakarta Metropolitan Area - A Case Study in Land Use

2.50 The Jakarta metropolitan area now has about 10 million people and with growth rates of 5% p.a., it is doubling in size every 15 years. Already the eighth largest urban agglomeration in the world, the Jakarta area is expected to surpass Los Angeles in size by the year 2000, becoming the world's seventh largest city.7/ Areas such as Depok and Cibinang on the periphery of Jakarta are expanding at a rate of 10% p.a. This growth has created intense pressure on city services and led to a number of environmental problems. In response to the increasing density of human activity and environmental impacts, a number of planning studies have been carried out in the Jakarta area. Their purpose has been to develop an effective land use policy, taking environmental factors into account. Some of the most important follow:

2.51 Jabotabek. The Jabotabek Metropolitan Planning Study, begun in 1976 by the Ministry of Public Works (MPW), was the first study in Indonesia that acknowledged the existence of a metropolitan region, extending beyond city boundaries. It covered Jakarta and the three surrounding districts Bogor, Tangerang and Bekasi (Figure 2.1). This study advocated deconcentration of urban growth to ancillary urban centers around Jakarta. To do so, it proposed incentives such as upgrading infrastructure in selected urban areas. Although the proposal was sound, it was difficult to obtain agreement across agencies on investments needed and the plan was not adopted. However, many provisions in the plan affected later thinking.

2.52 Jakarta-Puncak Clearing House Study of Critical Lands. In 1983, UNEP undertook a major study on the management of urban growth along a north-south

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7/ Year 2000 ranking: (1) Mexico City (32 million), Tokyo (26 million), New York (22 million), Shanghai (19 million), Beijing (19 million), Seoul (19 million), Jakarta (17 million).

axis from the coast (Jakarta) to the mountains (Bogor-Puncak) and beyond (Ciancur). Among the major environmental problems identified were severe water pollution from both urban and agricultural uses, unnecessary loss and degradation of prime agricultural land, deforestation and potentially serious erosion in the mountains above Jakarta, flash floods and reduced water supply, and extensive loss of natural habitats in forests and coastal areas. The main purpose of the Clearing House report was to illustrate environmental linkages and identify projects and sources of funds. Priority projects included water pollution control in two of the most severely affected locations, water quality improvements in three polluted waterways, prevention of forest loss and erosion in the foothills, conservation of natural forest areas and establishment of marine parks to protect coastal areas. The report served to focus attention on the environment as a regional rather than sectoral problem, but UNEP was not successful in mobilizing resources for proposed projects and aggregate resource requirements prevented both implementation and replication of the approach.

2.53 West Java Urban Development Project. This study, again by MPW, argued against limiting growth and counseled against a strategy that would depend on significant public acquisition of land for urban development. Instead, it advocated guiding urbanization through improved spatial planning efforts. The plan conceived the development area as a series of zones running parallel to the coast and recommended development along an east-west axis, excluding both low-lying areas and uplands (Map 21082). Five towns were selected as growth centers: Tangerang, Bekasi, Karawang, Cikampek and Cikarang. The report sidesteps complex issues of land regulation and reflects inherent limitations in the spatial planning approach when not buttressed by needed regulatory and policy measures.

2.54 In spite of the very large effort involved, a consensus has been achieved on only the most rudimentary aspects of these proposals. Problems have resulted from a lack of clear authority and differing perceptions by agencies of the problems involved and of the appropriate use of regulatory licensing and planning frameworks. So deep-seated are the differences that the republic's vice president was recently called upon to mediate between agencies in an effort to develop a land use plan for the Jakarta-Puncak corridor.

F. The Tools for Land Use Planning

Agency Coordination

2.55 There are numerous institutions with strong vested interests in land use planning and land allocation in urban and rural areas. Among the most important are:.

(a) Agraria. The Basic Agrarian Law envisioned that the Directorate General of Agraria in the Ministry of Home Affairs (MHA) would take the lead in developing a comprehensive land use plan. In practice, however, Agraria has been mainly involved in land use mapping and land registration, and since the 1960s, it has had a limited role in macro-planning.

(b) Cipta Karya. The Directorate General of Human Settlements (Cipta Karya or DGCK) in the Ministry of Public Works (MPW) is the strongest advocate for spatial planning. To date, however, Cipta Karya has been mainly involved with housing and urban issues, and it is not well represented in rural areas.

(c) Agriculture. The Soils Research Center in the Ministry of Agriculture has a role to play in determining land suitability for agriculture. However, until recently the agency has been underfunded, understaffed and overcentralized. Its main function to date has been largely investigating soil type and recommending appropriate farming systems.

(d) BAPPEDAs. Each province has a provincial planning office, or BAPPEDA, which can and should help make land use planning decisions. The obstacles, however, are large. Most data are aggregated at the center and unavailable in the provinces, and skills are limited, particularly among government staff. On the other hand, only local staff have the regional knowledge and access to the detailed local-level data.

(e) Municipalities. Urban areas have their own local-level governments and planning apparatus, and they frequently have only limited interest in the impact of growth and other environmental concerns outside their city boundaries.

This fragmentation of responsibilities has led to a virtual impasse in land-related matters. Efforts at sharing responsibilities through steering committees have proven ineffective. Under the circumstances, it is critical to identify a lead agency which can coordinate the others.

Development of An Integrated Land Use Policy

2.56 The absence of a coherent land use policy is a major impediment to environmentally and economically sound development in both the outer islands and in Java. Each agency has its own needs and objectives and there are no mechanisms, particularly at the center, for establishing cross-sectoral guidelines or mediating disputes. In the outer islands, the Forestry Department has stepped into the breach and developed a land use plan for 75% of the country's land area; but forestry categories have been drawn up without detailed knowledge of the slope and forest conditions, have incorporated local cultivators within Forestry Department boundaries, and have not taken agricultural needs or land suitability into account in defining conversion categories. In Java, land conversion and urbanization are also proceeding without clear definitions of optimal land use.

2.57 Therefore, given the pace of development and the opportunity which still exists to make decisions affecting land use, Indonesia should give serious consideration to a comprehensive review of all aspects of land policy. This would include a review of the Basic Agrarian Law, the Basic Forestry Law and procedures for land registration and land allocation, especially in the outer islands. It would also include a review of measures for spatial planning and zoning, licensing and taxation policy, particularly in Java.

Guidelines on Spatial Planning

2.58 In Indonesia the concept of spatial planning refers to the process of planning and designing efficient land utilization. Spatial planning can be a powerful tool for environmental management, and legislation on spatial planning is about to be proposed by the State Ministry for Population and Environment (MPE). Spatial planning frameworks have been developed within the Ministry of Public Works, both for specific regions and for sectors such as transmigration. While useful as information tools, implementation of such plans has been limited by their top-down development and the lack of appropriate mechanisms for enforcement. To address the first problem, spatial planning will require broad participation at the provincial, district and subdistrict level. The importance of this cannot be overstated. While the central government can provide broad guidelines and technical support, final plans must incorporate the views of the "consumers," i.e., local-level officials with the authority to license and control.

2.59 The tools for implementing such plans, once developed, include a wide range of instruments, most of which are only beginning to be developed in Indonesia. These include zoning for specific types of land use, e.g., residential or industrial, licensing by the various agencies involved, and taxation to control land use. The principle in taxation is that conversion to suboptimal land uses, from the point of view of the economy, can only be agreed at a price which will compensate the public. For example, virtually all industrialized countries protect agricultural land from encroachment by a two-tiered taxation system in which nonagricultural development is taxed at higher rates, reflecting in part the cost of providing additional services. Spatial plans as broad development guidelines cannot be effective without the appropriate regulatory and licensing support and these must be agreed upon, with broad agency participation.

Improved Data Collection and Mapping Services

2.60 In the past decade, Government has undertaken large-scale aerial photography, land resource assessment and mapping in urban and rural areas. But problems remain. There are still no standard base maps for Indonesia, data are fragmented and redundant, and an adequate geodetic control system, which is critical for mapping and land registration, has yet to be completed in the outer islands. The reasons are understandable. There are numerous agencies involved in data collection (Table 2.13); and relatively new agencies, such as the National Coordinating Agency for Surveying and Mapping (Bakosurtanal), have had limited absorptive capacity and have remained underfunded and understaffed in relation to the task. Given ambitious development targets, line agencies have requested and received relatively large amounts of money to do land resource assessment for their own projects (e.g., estates, irrigation, transmigration and oil exploration), but the data gathered on this scale have not been absorbed by Bakosurtanal and are frequently inaccessible to others.

Table 2.13: PARTIAL LIST OF LAND RESOURCE INVENTORY AND MAPPING AGENCIES IN INDONESIA

Armed Forces Survey and Mapping Service
Army Topographic Service (PUSURTABRI)
Naval Hydro-Oceanographic Service
Air Force Aerial Photographic Service
Bakosurtanal (National Coordinating Agency for Surveying and Mapping)
Directorate of Geology
Geological Mapping Division
Directorate of Meteorology and Geophysics
LAPAN (National Space and Aeronautics Institute)
Ministry of Agriculture
Soils Research Institute
Directorate General of Estates
Ministry of Forestry (MOF)
Agency for Forest Land Use Inventories
Ministry of Home Affairs (MHA)
Directorate General, Agraria
BAPPEDAs
Ministry of Public Works (MPW)
Directorate General for Water Resources Development (DGWRD)
Directorate General of Human Settlements (Cipta Karya, DGCK)
MPW Mapping Center (PUSDATA)
Various Directorates
Ministry of Transmigration
Directorate General for Site Selection Planning and Programming
Pertamina (the national oil production corporation)

Source: State Ministry for Population and Environment (MPE).

2.61 Under the circumstances, there is a need to consolidate the existing piecemeal efforts to carry out mapping and land resource inventories. Key agencies should be identified and strengthened, and they should be given adequate funds and technical support to carry out their work. Priority should be given to fundamentals, such as base maps and an adequate geodetic network, and training and manpower development should be accelerated. To determine what agencies should be strengthened, stronger coordination is needed among those agencies involved in data collection, compilation and dissemination.

2.62 A major issue requiring attention is the effective utilization of mapping done in connection with Government's transmigration program. In the past decade, the Bank has committed about US$200 million to surveys and mapping intended to identify land with agricultural potential in the outer islands. This work evaluates soils, present land use and forest cover and would be useful for a wide variety of planning purposes. Its dissemination is particularly important, since transmigration has slowed and land is being committed for other purposes. In relation to the initial cost of collection, only small budgetary outlays are now needed to make this data base useful to the provinces.

Land Use Planning at the Provincial Level

2.63 Bakosurtanal, with Asian Development Bank (ADB) support, has recently initiated a project (Loan 730-IND) to strengthen key land resource information centers and to improve the capacity of the BAPPEDAs (regional planning boards) in eight Sumatran provinces to make appropriate land use decisions. Under the project, a simplified geographic information system (GIS) is to be established in the land use subsection of the physical and infrastructure section of each BAPPEDA. Data would be obtained from local, provincial and national agencies to (a) evaluate the suitability of areas selected by the provincial service offices for a particular type of proposed development; (b) provide planners within the line agencies with maps showing areas suitable for specific types of development; (c) enable boundaries to be drawn more accurately than at present; (d) permit a better delineation of areas for conservation and watershed protection; and (e) improve the selection of farming systems suited to specific agroclimatic conditions.

2.64 This project is now being implemented, and some lessons are already clear. As was known, the capacity of the BAPPEDA to evaluate land use is weak and setting up the units requires strong technical support, probably in excess of that provided by the small team from ADB. On the other hand, early experience with mapping boundaries, identifying overlapping claims, isolating "hot spots" (e.g., areas where protected wildlife and people are coming into contact) and devising programs to deal with these problems confirms that only within the provinces can authorities find adequate solutions. The fact that ADB has provided salary support to project staff has been a major factor in permitting full- time commitment and improving the quality of work.

Recent Developments

2.65 In November 1988, Government announced the formation of a new National Land Agency (Badan Pertanahan Nasional). This agency was created by removing the Directorate General of Agraria and its provincial offices from the Ministry of Home Affairs and making it directly accountable to the President. Under these arrangements, the new agency is a potential focal point for coordination. This is a very significant step toward improved land use management. At the time of formation, the new agency's mandate was not yet clear. During subsequent meetings with officials from the new agency, however, the Bank urged that the agency undertake a comprehensive review of land use policy covering issues related to:

(a) the allocation of land for forestry and agriculture;

(b) the management of other critical ecosystems such as mangroves and swamps;

(c) the management of land for urban and industrial development;

(d) social and technical issues in land registration; and

(e) policies related to land acquisition and compensation.

At the provincial level, the roles of the BAPPEDAs, the former provincial Agraria offices and the municipalities also need to be clarified.

2.66 To manage land sustainably, the new agency should also give due consideration to improving the basic tools for land use planning. To do this:

(a) the geodetic reference system in the outer islands should be completed as this is the basis for mapping and land registration;

(b) Bakosurtanal and the Forestry Department should agree on a common mapping system;

(c) Bakosurtanal's ability to compile and recover existing maps should be strengthened;

(d) agencies for natural resource inventory such as the Soils Research Center should be strengthened and data decentralized;

(e) data collected in conjunction with the transmigration program should be decentralized; and

(f) spatial plans should be developed in cooperation with local-level agencies and the instruments for spatial planning, e.g. licensing, zoning and taxation, should be integrated and simplified.

The mandate of the National Land Agency should be extended to permit coordination on these issues.

III. JAVA UPLANDS AND WATERSHED MANAGEMENT

Introduction

3.1 Java's watersheds differ in many significant ways from those in the other islands. In general, they are both more fertile and far more densely populated. This means that opportunities for afforestation or exclusion of existing populations are limited, and other means must be sought to restrict or reduce soil erosion and its on-site and off-site effects. This chapter deals exclusively with watershed management in Java, based on detailed study and analysis; but many of the lessons learned are applicable to the outer islands as well.

A. Land and Demographic Factors in Java

Physical Features

3.2 Java is dominated by a range of volcanoes with elevations ranging from 300 meters (m) to about 3650 m above sea level. Roughly one third of Java's land area is flat or nearly flat, one third hilly or sloping, and one third steeply to very steeply sloping and mountainous (Table 3.1). Java's land area is drained by more than 100 rivers, most of which are less than 50 km long and drain directly into the sea. The great natural fertility of Javanese soils is largely due to the deposition of recent volcanic materials. There is hardly an area on Java that has not received some volcanic ash deposit during the last 50 years. This makes most Javanese watersheds far more resilient than watersheds with shallow, slowly renewed soils such as those in Haiti, Nepal and even non-volcanic areas in Java and the other islands of the Indonesian archipelago.

Table 3.1: AREAS IN VARIOUS SLOPE CLASSES IN JAVA

Land Type	Hectares
Slope class 0-8%	4,404,000
Slope class 8-30%	4,817,000
Slope class over 30%	3,596,000
Tidal lands	201,000
Volcanic cones, wasteland	200,000
Total	13,218,000

Source: FAO Agroecological Data Base.

3.3 Most of Java's watersheds are classified as "critical" in the sense that they are subject to actual or potential degradation due to erosion, but there is no precise definition of "critical." The simplest definition considers any land with slope greater than 50% as critical, while other definitions involve criteria such as yield potential, ability to regulate water flow and ability to serve protective functions. The total area of all watersheds listed as "critical" covers about 7.8 million ha or 60% of Java (Table 3.2). For practical purposes, however, the most threatened lands are located primarily in the steep upper watershed where actual or potential land degradation is worst. This comprises about 1.9 million ha or about 15% of Java's total land area. Areas with the greatest erosion risk as reflected by rainfall intensity and current land use are shown in Maps 21468-21470.

Table 3.2: POPULATION AND POPULATION DENSITY IN CRITICAL WATERSHEDS OF JAVA

Watershed	Total area (ha)	Upper watershed area (ha)	Population /a in upper watersheds	Population density in upper watersheds (people/km^2)
Ciliwung/ Cisadane	536,532	96,516	796,696	825
Ciujung	682,415	143,700	nd	nd
Citarum	1,029,610	183,440	952,391	519
Cimanuk	592,612	388,061	2,174,912	560
Citanduy	486,121	352,520	2,396,860	679
Serayu	652,837	169,195	1,200,431	709
Lusi	734,400	173,746	870,468	501
Serang	nd	171,625	nd	nd
Solo	2,002,137	121,014	727,379	601
Brantas	1,158,149	205,000	1,619,000	790
Total	7,874,813/b	1,913,817	10,738,137/c	671

/a 1983 data (including upland cities such as Bandung, Malang).
/b Compared to Java's total area of 13.2 million ha.
/c Including Ciujung and Serang, estimated at 12 million.

nd = no data

Source: Ministry of Forestry. Feasibility studies for upper watershed management in Java's critical watersheds, 1985.

Demographic Factors

3.4 Of Java's roughly 100 million people, an estimated 12 million reside in upper watershed areas. Differences in population density relate to soil

fertility and carrying capacity. The average population density is 671 per km^2 in upland areas, compared to 788 per km^2 for Java as a whole. In individual upper watersheds, however, population density is lower, ranging between 400 and 550 per km^2 (e.g., upper Solo, 432 per km^2). On the more fertile and productive volcanic soils, average population density is markedly higher than in limestone areas which are more erodible and have lower inherent soil fertility (Table 3.3).

Table 3.3: COMPARATIVE POPULATION DENSITIES

Area	Average population density
Average for all Java (1987)	788 per km^2
Districts in volcanic areas of upper watersheds	550-820 per km^2
Districts in limestone areas of upper watersheds	430-570 per km^2
Average for all Indonesia (1987)	90 per km^2

Source: 1983-85 district-level data.

3.5 Overall, Java's population grew 1.8% per year between 1980 and 1985, but the annual growth rate in upper watersheds was closer to 1.0%. From 1974 to 1984, the average annual growth rate in the upper Solo watershed (Wonogiri) was 1.0% and in Gunung Kidul it was between 0.9% and 1.0%. Even with these low rates of growth, there is pressure to cultivate new lands and more and more marginal land is being brought into production; but contrary to popular perception, given the high population densities in the upper watersheds, it is unlikely that population growth in the lowlands is forcing people into the uplands.

3.6 The slow rate of population growth in upland areas, compared to lowland areas, is apparently due to movement induced by limited employment opportunities. In addition, in order to reduce environmental degradation and poverty in upland areas, populations in critical watersheds have also been targeted for recruitment by transmigration authorities. From April 1984 to February 1986, 109,433 families were moved through the transmigration program, of which 35% were from critical watersheds, even though these areas have only about 12% of Java's population. This rate of out-migration alone would be sufficient to lower the growth rate in upper watersheds to 0.9% per year. Since sponsored transmigration ceased in mid-1986, there may now be increased pressure on underemployed labor in upper watersheds to seek alternatives elsewhere.

3.7 Although data on income distribution in upland and lowland areas are not available, some information exists on patterns of landlessness. A survey of eight rural Javanese villages (Wiradi and Manning, 1984) found that 36% of village households had no land at all. Of these, about 11% rented agricultural land. However, landlessness was higher in lowland villages than in upper watersheds. While 2-24% of the households in upland areas were landless, the portion was 28-73% in lowland villages (Table 3.4). Since there

are many more families in the lowlands, landlessness and poverty are higher in the lowlands than in upland areas, but many households in critical upland areas are among the poorest in Java.

Table 3.4: GINI RATIOS FOR SAWAH LAND OWNED, EIGHT LOW, MEDIUM AND UPLAND VILLAGES OF JAVA, 1982/83

Village	Type/a	% HH /b landless	GINI Ratio: Land owned: All HH	GINI Ratio: Land owned: Owners only	GINI Ratio: Cultivated: All HH	GINI Ratio: Cultivated: Cultivators
Wargabinangun	Low	73.3	0.86	0.62	0.76	0.52
Lanjan	Low	28.1	0.63	0.50	0.63	0.48
Gemarang	Low	65.7	0.81	0.54	0.72	0.45
Sukosari	Medium	51.7	0.74	0.50	0.77	0.53
Sukaambit	Medium	31.3	0.64	0.49	0.51	0.39
Gunungwangi	Upland	23.7	0.58	0.45	0.49	0.37
Malausma	Upland	2.4	0.50	0.48	0.47	0.44
Ciwangi	Upland	21.0	0.63	0.54	0.59	0.47
All villages		36.3	0.69	0.54	0.68	0.52

Note: The Gini ratio measures the degree of equality or inequality of distribution of land or income: a Gini ratio of 0.0 indicates perfect equality of distribution and a ratio of 1.0 a complete concentration of all resources.

/a Lowland villages = 8, 2 and 45 meters above sea level. Medium villages = 334 and 330 meters a.s.l. Upland villages = >700 meters a.s.l.
/b HH = Household; land area in hectares.

Source: Wiradi Gunawan and Chris Manning. "Land Ownership, Tenancy, and Sources of Household Income: Community Patterns from a Partial Recensus of Eight Villages in Rural Java" (Yayasan Penelitian Survey Agro Ekonomi, Bogor, Indonesia, 1984).

Current Land Use

3.8 Table 3.5 summarizes trends in land use on Java over the last 100 years. As clearly indicated, agriculture dominates. In upland areas (predominant slopes greater than 30%), approximately 51% of the land is devoted to rainfed agriculture, 23% to wet rice cultivation, 1% to other uses and 25% to forests. Also as indicated, land use in Java has largely stabilized. The potential for expanding irrigated rice areas has largely been exhausted, as has the potential for rainfed agricultural land. Forested areas are estimated to have declined at a rate of about 18,000 ha annually over the

last 50 years, a trend that has only recently slowed, due to the lack of additional lands suited to agriculture. Today, Java has an estimated 2.4 million ha of natural and plantation forest, but as much as one third is of very poor quality.

Table 3.5: LAND CLASSIFICATION BY AREA ON JAVA AND MADURA, 1883-1983 ('000 ha)

Irrigated Farm Land	1883/a	1913	1938	1963	1973	1978	1983
Irrigated Farm Land	1,845	2,220	3,368	2,528	nd	3,511	3,501
Rainfed Farm Land	640	1,775	3,251	3,119	nd	3,520	3,407
Estates	24/b	675/b	1,012	613	649	615	595
Home Gardens and Compounds	nd	n.a.	1,252	nd	nd	1,592	1,615
State Forest	nd	nd	3,035	3,000/b	2,891	2,319	2,396/b
Fishponds	nd	nd	54	nd	nd	36	30
Nonfarm Land Uses /f	nd	nd	1,247	nd	nd	1,626	1,675
Total	--	---	13,219	---	---	13,219	13,219

/a Does not include Madura island.
/b Or most relevant data, 1875, 1920, 1965 and 1981, respectively.

3.9 Because of the wide variety of elevations, slopes, soils, vegetation and moisture regimes, agriculture in the upper watersheds is characterized by much greater diversity than the lowland areas. A large proportion of the uplands is suitable for growing annual, perennial and tree crops, while the flatter, alluvial soils are suitable for irrigated crops. Annual crops are cultivated on the lower to middle slopes, and, to a lesser extent, mixed gardens with tree crops are grown. Unsustainable dryland practices are often used for annual crops. Typical upland cropping sequences include dryland rice, corn, peanuts, cassava and cowpeas, in many variations. On steeper slopes, a wide variety tree crops for food and timber may be planted as part of more sustainable agroforestry systems.

B. Environmental Degradation

Physical Indicators

3.10 Soil Erosion. Some of the important physical indicators of environmental degradation in Java's watersheds are soil erosion, increased silt content of river water and increased irregularity of river flows. Java's soil erosion derives from geological erosion (natural erosion) as a result of land upheaval and climatic factors and accelerated erosion as a result of land use.

3.11 Geological erosion is practically unavoidable. On Java it may assume serious proportions, as in the case of volcanic mudflows, landslides and similar cases of mass movement of soil and rocks. On the other hand, volcanic eruptions on Java have greatly contributed to accretion and deposition of new soil materials from volcanic ash. Because of tectonic uplift and volcanic activity, it is believed that natural erosion was roughly in balance with new soil formation in Java prior to extensive cultivation in the uplands.

3.12 Accelerated erosion is a consequence of land use by humans. Progressive deforestation, followed by regular soil tillage and removal of other protective vegetative cover, has exposed more and steeper lands to erosion. Particularly serious are the increasing areas under annual cropping systems which disturb the soil and leave it exposed during critical periods at the beginning of the wet season. An additional source of erosion and sedimentation in the uplands of Java is road construction, which may induce serious landslides on otherwise stable slopes. Along with dryland agriculture, road construction is probably the most important human activity contributing to erosion and sedimentation.

3.13 Climate and the geological origin of soil are the major factors in determining its development, fertility and erodibility. Table 3.6 shows differences in rates of erosion in volcanic and limestone areas. Volcanic soils are generally less erodible than sedimentary (limestone) soils, which are often shallower and more poorly drained. More important, however, due to high rainfall, natural erosion on any soil in Indonesia is far higher than it is in temperate areas. Erosion on volcanic soils is perhaps 10 times as great (0.6 mm and 7.2 tons/ha) as average erosion in the United States (0.06 mm or 0.7 tons/ha) and on limestone soils it can be nearly 100 times (5 mm and 60 tons/ha) higher than in the United States. Of the critical upper watershed areas, perhaps two-thirds are in volcanic areas and one-third are in limestone areas.

Table 3.6: A COMPARISON OF EROSION RATES IN VOLCANIC AND LIMESTONE AREAS IN JAVA

	Volcanic areas	Limestone/marl areas
Rutten (1917)	0.1-0.6 mm (1.2-7.2 tons/ha)	1.6-5.0 mm (19-60 tons/ha)
Mohr (1933)	0.5-1.0 mm (6-12 tons/ha)	2.0-5.0 mm (24-60 tons/ha)

3.14 Silt Content. The silt content of river water is another indicator of erosion and the Solo River in Java carries 60 times more sediment than the Rhine, even though it is only one third as long. Sedimentation in Java has been measured since about 1910 (with interruptions) and is now measured on a daily basis in major watersheds. The collected data show an increase in sediment content over time, but over the last decade, the rate of increase

appears to have leveled off (Table 3.7). Heavy sediment loads entail costly downstream effects, including siltation of dams, reservoirs and irrigation systems, raising of riverbeds and corresponding lowland flooding, and siltation of ports and navigation channels.

Table 3.7: MAXIMUM OBSERVED SILT CONTENT OF SOME RIVER WATERS IN SELECTED UPPER WATERSHEDS OF JAVA
(Mg per liter)

	1911/ 1912	1932/ 1933	1970	1971	1972	1973	1974	1975	1976
Ciliwung	1,150	2,750		8,980	10,100	30,500	36,500		
Citanduy		983	3,650	2,200	4,550				
Cikawung		300	2,600	1,250	5,850	1,510	2,230	4,220	
B. Solo			4,530	13,700					23,700
Kali Konto				95	222	738	600	8,400	5,000

Source: Mardjono and Badruddin, 1981.

3.15 Increased Irregularity of River Flows. As a result of deforestation in upper watersheds, incoming rainfall runs off more freely and concentrates more rapidly in waterways, thus causing flash floods. Because less moisture is retained, water tables decrease and the duration of flows becomes shorter. Low flows during the normal dry season may disappear altogether. A commonly used measure of increased irregularity of river flows is the ratio of observed maximum discharge rate to minimum discharge rate (ratio Qmax/Qmin) over a year. Although there are difficulties associated with the interpretation of time-series data for watersheds on Java, in part because variations primarily reflect the intensity of storm flows, it appears that the difference between high water and low water flows has widened in the Ciliwung, Citanduy, Cikawung and Kali Konto watersheds during the 1970/80 decade (Table 3.7). In other watersheds, the trend is less evident. (For details see Annex 3A, Table 1). Some rivers also show a decrease in dry season flows which can be as serious as an increase in flood levels if it reduces downstream water supplies to municipal and industrial users.

Economic Losses due to Upland Degradation

3.16 Erosion has on-site and off-site effects. The principal on-site effects include loss of fertile topsoil, reduction in soil depth, loss of soil moisture required for crop growth, and loss of capacity to produce more profitable crops. These on-site effects are theoretically quantifiable. Their consequences can potentially be valued in terms of net income, capital assets, and wealth distribution, although these factors are difficult to measure in practice. The deposition of soil particles at downstream locations also imposes off-site costs.

3.17 It is important to try to separate the relative effects of human-induced erosion from that of natural erosion. With limited exceptions, geological erosion needs to be taken by policymakers as a given. Manmade erosion is more susceptible to policy interventions, especially to alterations in land use or farming systems. On the other hand, some consequences of erosion, particularly off-site ones, inflict the same costs regardless of the origin of soil loss, and it is difficult to evaluate the relative impact of geological and human-induced erosion. Methodological problems are caused by the lack of data on the relationship between observed erosion and measured sediment yield at different points and due to uncertainties about the time lags involved.

3.18 While recognizing the difficulties in relating cause and effect in dealing with soil erosion, an attempt has been made to account for the economic losses due to on-site and off-site effects of soil erosion on Java. Details of the methodology and steps followed are included in Annex 3B. Since the distribution of soils is fairly well known, as is the erodibility of these soils under the various conditions of slope, rainfall erosivity and plant cover, soil losses under major types of land use and production systems were quantified and related to soil-specific and crop-specific productivity losses. The quantification of these productivity losses was then used to provide an order-of-magnitude estimate of the on-site cost of erosion to the national economy. Table 3.8 summarizes the results of this analysis.

Table 3.8: ON-SITE COSTS OF EROSION

Province	Total area (Km^2)	Average annual soil loss on agricultural land (Metric ton per ha)	Weighted average annual productivity loss (%)	Capitalized value of productivity loss (US$ M)
West Java	47,370	144.3	4.4	141.5
Central Java	33,013	133.3	4.1	29.1
Yogyakarta	3,346	118.2	4.7	5.7
East Java	45,308	76.0	3.8	138.6
Java Total	129,037	123.2	-	315.0

Source: Adapted from Magrath and Arens, 1989.

3.19 The off-site costs of erosion were also estimated including costs associated with: (a) siltation of irrigation systems; (b) dredging of harbors and waterways; and (c) losses of hydroelectric and irrigation capacity due to sedimentation of reservoirs. Some off-site consequences of erosion were not quantified due to lack of data. These included increased irregularity of river flows, flood damage due to sedimentation and raising of stream beds; loss of infrastructure, human life, livestock and crops due to flooding; and

disruption of domestic and industrial water supplies due to reduced dry season water flows. The results of this analysis are summarized in Table 3.9.

Table 3.9: TOTAL ESTIMATED ANNUAL COSTS OF SOIL EROSION ON JAVA
(US$ million)

	West Java	Central Java	Yogyakarta	East Java	Java Total
On-site	142	29	6	139	315
Off-site					
Irrigation System					
Siltation	1.7-5.7	0.8-2.7	0.1-0.5	1.2-4.0	7.9-12.9
Harbor Dredging					
(1984-85)	0.4-0.9	0.1-0.3	--	0.9-2.2	1.4-3.4
Reservoir					
Sedimentation	9.0-41.3	3.5-16.3	--	3.8-17.3	16.3-74.9
Total	152.6-189.4	33.5-48.4	5.8-6.2	144.5-162.2	340.6-406.2

Source: Adapted from Magrath and Arens, 1989.

3.20 Taking these factors into account, the on-site cost of soil erosion on Java is estimated at about US$315 million per year, while the off-site costs are estimated at US$25-90 million per year. Per hectare of arable dryland, the on-site cost would equal US$68 per year, the off-site cost US$5-19 per year. These costs are lower than expected and relatively modest when compared to losses attributed to deforestation in the outer islands (estimated at US$1 billion annually) or to the very large costs of water pollution in the lowlands. Furthermore, costs associated with on-site degradation are four to ten times higher than the cost of off-site effects. This suggests that soil erosion programs should emphasize on-site interventions to reduce erosion and to increase productivity and incomes more than interventions to reduce off-site effects.

C. Current Programs and Projects in Upper Watersheds

Government Agencies Involved in Watershed Management

3.21 The need for watershed management arises from the interconnected nature of soil and water systems. In particular, the transport of waterborne silt across property boundaries requires, in addition to technological interventions, planning and collective action on a watershed basis. Watershed management explicitly recognizes that upstream land use generates not only direct outputs such as timber, food and fodder, but also downstream effects such as water level and sedimentation. In the absence of unified management or some similar institutional mechanism, upstream users will select management strategies without consideration of their impact on downstream users.

3.22 Because of the cross-sectoral nature of watershed concerns, numerous agencies are involved in watershed management in Java, of which the major are:

(a) Perum Perhutani, a parastatal under MOF that functions as the forestry service in Java. This agency has been mainly concerned with forest management, production and security. However, it has recently begun to adopt a more participatory approach, working with villages to improve living conditions in order to reduce encroachment on state forest land.

(b) The Ministry of Forestry (MOF), or Forestry Department, is the lead agency for the Government's Regreening Program and Reforestation Program. Through its Directorate General for Reforestation and Land Rehabilitation (DGRRL), MOF has responsibility for soil and water conservation planning for all land of greater than 8% slope regardless of its tenure or present land use. DGRRL activities also include reforestation, check dams, and demonstration farms to promote a standardized and subsidized package of bench terracing and improved dryland agricultural practices.

(c) The Ministry of Agriculture (MOA) has a minor office, the Sub-Directorate for Soil Conservation, under its Directorate General for Food Crops. It supports research and extension to intensify dryland agriculture in Java's uplands. This research is oriented along commodity lines, but is increasingly integrating soil conservation practices into improved upland farming systems.

(d) The Ministry of Public Works (MPW) has broad water resource management responsibilities, but in watershed development programs it is responsible for water control structures, irrigation systems, and monitoring water flows and sedimentation. MPW is also responsible for the planning, design and construction of roads and major water control structures in upper watersheds.

(e) The Ministry of Home Affairs (MHA) supports the provincial and local-level governments in their efforts to plan and coordinate regional development activities, including those relating to watershed

management. It plays a role in the national Regreening Program and is the lead agency for the externally assisted Upland Agriculture and Conservation Project in East and Central Java.

(f) The State Ministry for Population and Environment (MPE) monitors the activities of the various agencies involved in the planning and implementation of watershed management activities. It has been a principal proponent of the concept of watersheds as units for the analysis, planning, and management of land and water resources.

(g) The National Development Planning Agency (BAPPENAS) exerts a significant influence over the programs of the various government agencies through its control over budgetary allocations. However, since agriculture, forestry, water resources and environmental management are under different sectors, the BAPPENAS review process tends to compartmentalize rather than integrate the activities of the planning and implementing agencies.

Due, in part, to the numerous agencies involved in watershed management and their different mandates and objectives, and despite concerted efforts to the contrary, only the rudiments of a policy toward cohesive watershed management and land use in Java are in place. Instead, most interventions occur in donor-assisted programs in selected upper watershed areas.

Table 3.10: GOI AND FOREIGN-ASSISTED PROGRAMS IN TO UPPER WATERSHEDS IN JAVA

GOI Programs in Upper Watersheds of Java	Rp billion 1981-81	1982-83	1983-84	1976-86
Regreening Program		22.88	22.63	166 /a
Reforestation Program	4.41			32 /a
Total				198

Foreign-Assisted Upper Watershed Projects in Java /b	US$ million Committed as of mid-1987	Spent as of mid-1987
Upper Solo Watershed Project (FAO/UNDP)	1.18	1.18
Yogyakarta Rural Development (IDA/IBRD)	10.00 /c	10.00 /c
Kali Konto (Netherlands)	3.26	.46
Citanduy II (USAID)	16.76	12.10
Uplands Agriculture and Conservation (USAID, IBRD)	30.20	1.84
Total	50.22	25.84

/a MOF and agency estimates, and extrapolations therefrom.
/b See Annex 3C for details.
/c Assuming two thirds of the project's $15.1 million expenditures was for uplands.

Major Watershed Programs

3.23 Solo Watershed Project. The earliest externally assisted program dealing with upper watershed degradation and sustainable production systems on Java was the FAO Solo Watershed Project (1972-78), funded by UNDP. The Solo Project developed the integrated terracing/fodder/animal husbandry system to replace annual cultivation on upland slopes, which system became the model for subsequent upland projects, including the Regreening Program. In areas up to 50% slope, this basic approach involves subsidizing bench terrace construction through cash wages and/or free agricultural inputs, either directly or through the provision of credit. Terrace construction is then complemented by improving crop husbandry and by introducing grasses on the riser and lip to support livestock and to help control erosion. On slopes greater than 50%, the Regreening Program and other projects discouraged farmers from growing annual crops and instead encouraged them to plant tree crops for cash income.

3.24 Regreening Program. Government's Regreening Program (INPRES Penghijauan), executed by the Forestry Department, is by far the largest upper watershed program in Java, with estimated expenditures of US$166 million in Java during 1976-86 (Table 3.10).1/ Regreening funds are for privately owned land, as distinct from the Government's program for state forests, the Reforestation Program (INPRES Reboisasi). Regreening covers a large number of activities other than afforestation, and of regreening expenditures in 1982/83, 62% was for check dam construction, 22% for agriculture and silviculture (nurseries, model farms, social forestry), 10% for rehabilitation of terraces (Table 3.11).

Table 3.11: REGREENING FOR JAVA, 1982/83, 1983/84, BY ACTIVITY
(Rp '000 and percent)

	1982/83	1983/84
Nurseries	1,735,000	1,258,000
	(9%)	(5%)
Planting	1,025,836	1,644,705
	(5%)	(7%)
Terraces	2,218,000	3,688,000
	(11%)	(15%)
Check Dams	12,450,000	12,690,000
	(62%)	(54%)
Model Farms	1,716,000	3,217,000
	(8%)	(14%)
Social Forestry	951,000	1,138,000
	(5%)	(5%)
Total	20,097,000	23,635,000

Source: Forestry Department.

1/ Regreening cost US$466 million for all of Indonesia, or 2.0-6.2% of annual central payments to regional governments during 1976-85.

3.25 Since 1976, some 3.5 million ha have been planted with trees under the Regreening Program, but survival rates, estimated overall at 12-20%, have been low. This is due to the poor quality of seedlings and supply problems, and the to lack of attention to providing alternative sources of food supply for local people. By 1980, concern about low survival rates of seedlings and a desire for immediate results from erosion control in project activities led to the inclusion of check dam construction and model farms in the Regreening Program. Programs have just been started to involve local people in project design.

3.26 One strength of the Regreening Program has been its direct channeling of earmarked funds to local government. However, rigid central planning and budgeting procedures and poor coordination between the lead agency (Forestry) and other ministries whose participation is crucial (agriculture, public works, home affairs) have caused major implementation problems. Furthermore, Government's emphasis on equity through projects for the uplands, rather than best technical options, has frequently resulted in check dams and other works that are poorly sited and built to low technical standards. While there is no doubt that the program has had results, it has been costly in terms of what has been achieved.

3.27 Externally Assisted Projects. Since 1973, the Bank, FAO, UNDP, USAID and the Netherlands government have contributed US$25.8 to five donor-assisted programs that have substantially or entirely focused on Java's uplands (see Annex 3C). In 1988, the Bank began support of a US$35 million upper watershed soil conservation and agriculture project in the Wonogiri dam catchment area. In spite of the importance attached to these activities, total donor assistance since 1973 was only US$3 million more than the regreening expenditures in Java for one year, 1982/83 (US$22.6 million).

3.28 Government's Regreening Program and donor-assisted programs differ significantly in terms of scale, objectives and technical support. Whereas regreening extends to all nine "critical" watersheds in Java and 18 provinces outside Java, no donor-assisted project operates in more than two watersheds or two provinces. Moreover, regreening has been viewed as a vehicle for employment-creation in underdeveloped rural areas and distributing funds to such locations to stimulate more balanced regional development. Donor-assisted watershed projects have emphasized increasing the productivity and incomes of upland farms, soil conservation, and in some cases, local institution-building. Given the predominance of the Regreening Program in Government expenditures, a strong argument can be made for program-wide review and support.

D. Upland Farming Systems

3.29 Although there are numerous Government programs in the uplands, the real watershed managers of Java are its upland farmers and families. Constrained by poverty and technology, their pursuit of arable land to produce food, fuel and fodder has a profound effect on soil and water resources. Despite considerable research and speculation about the objectives and

opportunities pursued by Java's upland farmers, important questions remain unanswered. For example, a variety of government projects and programs seek to promote changes in farming systems and land use in order to raise incomes and reduce erosion. However, the success of many of these efforts in either raising farm incomes or in reducing environmental degradation is uncertain. To understand the reasons for success or failure, the motivations of farmers and the effectiveness of interventions must be understood.

Overview

3.30 Although production for home consumption is still a major feature of upland agriculture on Java, several factors are changing the subsistence-based economies of the uplands: (a) the increasing availability of markets; (b) the presence of off-farm work; and (c) increased landlessness. An increasingly important change is the degree of market involvement (Roche, 1988). In part as a result of rising incomes among urban-dwellers and lowland rice producers, market demands are resulting in a diversification of the rural economy in some parts of Java. The rising demand for fruits, vegetables and meats has resulted in changes in cropping patterns in some upland areas away from the major secondary crops grown for subsistence.

3.31 The second important change is in the availability of off-farm work. Surveys conducted by the Rural Dynamics Study show that one fifth of the economically active population of rural areas engages in short-term seasonal migration in order to work as laborers, pedicab drivers and in small-scale trade (Colter, as cited in Roche, 1988). Over 1976-83, rural household income in the West Java Cimanuk watershed rose by 3.9% per year, with the largest annual growth (5.5%) occurring among medium-size farms (0.25-0.50 ha). Income of landless households rose by 4.7-4.8% per year, and mostly due to increases in earnings from nonagricultural employment.

3.32 Landlessness and tenancy are also increasing with significant ramifications for farming practices. In Java's uplands, a wide range of wage labor, contract hire and sharecropping takes place in farm production, each with implications for the adoption of new technologies and for decisions between subsistence and cash cropping. To date, however, there are few studies examining tenancy and its impact on the adoption of new technologies.

3.33 These trends have important and often contradictory implications for soil erosion. Shifts in demand toward higher-value products implies higher farm incomes and greater returns to land, which can be expected to promote the adoption of conservation measures. There is also some evidence that higher-value crops may be grown using less-erosive farming practices. However, the increased availability of off-farm employment also means that labor-intensive conservation works have become more costly and in some cases less attractive, and under some tenancy arrangements, tenant farmers have few incentives to adopt soil conservation measures. Studies disaggregating these factors are rare and contradictory and better work in this field would be helpful.

The Impact of Improved Farming Practices and Soil Conservation Measures

3.34 Over the last 15 years, yields of major dryland crops in Java have consistently risen despite ongoing erosion. For example, over 1972-83, upland

rice, maize and cassava yields on Java increased 4.3%, 4.7% and 2.8% per year, respectively (Roche, 1988). Fertilizer inputs also rose in the case of maize, from 38 kg/ha to nearly 106 kg/ha, and for cassava, from 8 kg/ha to more than 16 kg/ha (Central Bureau of Statistics). Increased fertilizer use, plus the release and rapid adoption of high-yielding maize varieties (Arjuna, Hibrida C-1), have masked declines in the productivity of the resource base. In other words, yield increases have been possible through the continued intensification of farming practices, offsetting the effects of productivity loss which may be occurring through erosion. Only a few studies are available that have tried to separate the effect of improved or increased use of inputs from the underlying productivity losses caused by erosion. These are summarized in Table 3.12. This table suggests that yields would have been even higher, had it been possible to curtail erosion.

Table 3.12: YIELD LOSS ATTRIBUTABLE TO EROSION

Area	Annual decline in yields as the result of erosion (%) /a	Source
Yogyakarta	1.5	IBRD (1979)
Jratunseluna	2.0	USAID/IBRD
Upper Solo Basin	5.0	Ramsay and Muljadi
West Java	4.4	Magrath and Arens
Central Java	3.8	Magrath and Arens
Yogyakarta	4.7	Magrath and Arens
East Java	4.1	Magrath and Arens

/a Decline in yields as a percent of previous year's production.

3.35 There are significant differences in rates of erosion with different management practices. Data from West Java suggest that the type of crop affects erosion rates, varying from virtually no erosion under dense forest to 136 tons/ha of soil lost to erosion with a tuberous crop such as potatoes (Table 3.13). With conservation measures, however, these erosion rates can be considerably reduced. In a separate study (cited in Roche, 1988) on volcanic slopes in the Brantas watershed, areas grown with corn on poor terraces had erosion rates nine times as high (476 tons/ha) as areas on similar volcanic soils with good terraces (54 tons/ha). Further, in limestone areas of the Upper Solo River Basin, erosion rates were four times higher (192 tons/ha) on poor terraces than on good terraces (48 tons/ha) according to FAO and project data. This indicates that planned intervention can have a considerable impact on erosion.

Table 3.13: EROSION RATES ON JAVA UNDER VARIOUS CONDITIONS OF SOIL, SLOPE, VEGETATION COVER AND MANAGEMENT

REGOSOLS, WEST JAVA, 10% SLOPE

Crop	Soil loss (tons/ha p.a.) Without conservation	With conservation
Potatoes	136.0	43.5 (contour plough)
Onions	11.0	3.1 (terracing)
Grasses	0.2	-
Trees and intercropping	27.1	6.8 (mulching)
Dense forest	0.0	-

Source: Suwardjo, S., Sukmana dan Sofiah (1975): Beberapa data dan masalah percobaan konservasi tanah untuk pencegahan erosi. Bogor, L.P.T. no. 11, 1975.

Agricultural Packages to Improve Incomes and Reduce Erosion

3.36 There are numerous examples where the introduction of terraces, together with the use of new varieties, higher value crops and increased inputs (particularly fertilizer and pesticides), have considerably improved the net returns from upland cultivation. For example, in Tulungrejo village of the Kali Konto watershed, the financial internal rates of return for planting coffee or avocado on steep slopes are 35% and 16%, respectively. The internal rates of return for planting fuel wood (e.g., Calliandra and King grass) for fodder are 10% and 27%, respectively. This compares very favorably with the standard food crop rotation of maize and cassava and can be successfully promoted if the farmer's food crop requirements can be satisfied elsewhere and if his cash flow problems can be overcome through the provision of credit or subsidies on labor costs.

3.37 The standard method of promoting soil conservation and improved upland agriculture is demonstration plots (demplots or model farms) located on farmers' fields. Participant farmers receive technical assistance, a financial subsidy and improved inputs. Project areas surrounding demplots receive technical assistance and a small subsidy or no subsidy. Farmers in areas outside the project area may become aware of the benefits of the proposed technology and follow program recommendations, but this is done without direct subsidy. Evidence on the rate of spontaneous adoption of soil conservation measures is weak, but research on the Citanduy Project, sponsored by USAID, claims that a demonstration plot of 10 ha will induce adoption of conservation on more than 400 ha of surrounding farms within five years (Tampobolon and Saragih, 1986). However, some of these terraces are of poor quality and their soil conservation benefit is limited.

Constraints to Adopting New Technologies

3.38 In general, upland farmers on Java are quick to adopt new farming systems and modify their land management practices if they perceive an

economic advantage from doing so. Moreover, farmers appear responsive to new information provided by research and extension services on improved techniques and cropping patterns; even non-participants in upland projects spontaneously adopt and adapt those techniques and cropping patterns that can boost productivity and incomes.

3.39 The main constraint to the adoption of new technologies is that soil conservation techniques in upland farms require a substantial investment of time and money. For example, bench terracing on slopes of 50% or less requires labor ranging from 750 to 1,800 work days per ha, depending on the slope (Table 3.14).2/ This implies construction costs of between US$420 and US$2,060 per ha in areas where household incomes average US$300-500 per year. In addition, the costs of planting materials, tools and fertilizer required to build and establish a crop on the terrace in the first year average US$112/ha. These estimates do not include the additional costs to the farmer of periodic maintenance of terraces, waterways and drop structures.

Table 3.14: LABOR REQUIREMENTS AND COST/HA AT VARIOUS PROJECT SITES AND SLOPE RANGES

Site	Slope (%)	Work days per ha	Total Cost (Rp '000) at wage rates per work day	
			Rp 700	Rp 350
Upper Solo /a	5 - 30	750	525	263
	30 - 50	1,520	1,140	570
Citanduy II /b	10 - 15	789	551	275
	45 - 50	1,742	1,219	610
Yogyakarta /c	40 - 50	1,833	1,283	642

/a Gauchon, Some Aspect of Watershed Management Economics, 1976.
/b Project staff (typed data).
/c Yogyakarta Rural Development Project, Working Paper C-5, Appendix I.

Source: Bersten, R. and Sinega, R, 1986.

3.40 Under the circumstances, the major issues facing the farmer are the opportunity cost of his labor and additional expenditures. It is generally assumed that labor for constructing terraces is provided by the farmer during the dry season. Assuming a four-month dry season, a single farmer could provide a maximum of 100 work-days each dry season, far short of the terracing requirements for even a half hectare holding (375-900 days). In addition, the labor for terracing may require additional cash expenditures or hired labor. Thus, from the farmer's perspective, the cost of terracing not only implies foregoing income-earning opportunities, either in off-farm employment during the dry season and/or less labor time devoted to crop and farm production, but also additional expenditures on material and possibly livestock feed costs.

2/ Compares to about 300 work-days per ha of labor for secondary crops.

Calculations of the net present value of the gains from terracing in the Citanduy II project suggest that only to the extent that terracing costs were around US$500 or less (1984/85 prices) could farmers afford to adopt terracing without credit or subsidies. Upgrading of existing terraces, which requires considerably less work, may be economically justified and financially attractive to farmers.

3.41 The trade-off between productivity increases and costs and their effect on farmers' behavior can be illustrated by a number of examples found in the literature.

(a) Soil conservation practices are less likely to be accepted in areas where there are small productivity losses from erosion. In Ngadas, commercial vegetable farmers on deep volcanic topsoils (growing mainly potato, but also onions, garlic and cabbages) do not appear to experience significant declines in yields, despite average annual erosion rates of 150-200 tons/ha and the loss of 2 cm of soil each year. Therefore, for these farmers, soil conservation measures are not perceived to as a high priority.

(b) Adoption of soil conservation practices is slow where there is a lack of sufficient marketing and transportation facilities. Marketing of commodities is less profitable where there are high transportation costs or price discrimination and this may also retard adoption. According to Tampubolon and Saragih (1986), the poor adoption record of model farm technology around the Sadabumi model farm in Citanduy was due to poor access roads and inefficient marketing, which reduced incentives to increase productivity.

(c) Adoption of erosion control measures is affected by the extent to which farmers receive income from off-farm employment. If farmers derive most or all of their income from working their land and have security of tenure, they will be more prone to invest in activities to maintain and improve productivity. Farmers with a large proportion of their income from off-farm employment tend to respond to reduced profitability of their agricultural land by devoting more labor to off-farm work.

(d) Conservation farming is more readily adopted by wealthier farmers with ready cash. In East Java, only relatively wealthy farmers who engaged in profitable commercial apple production (approximately US$3,000-6,000 per year profits, 1986 prices) could afford to construct effective backsloping terraces. Similarly, a survey of farmers who did not adopt bench terracing technology in the Citanduy watershed of West Java revealed that 87% cited lack of money as the reason for not constructing terraces.

(e) Adoption of soil conservation measures is also linked to tenancy, although the data are somewhat contradictory. In general, owner-operators have the strongest incentives for investment in permanent structures and tenants are unlikely to make long-term investments unless they are directly compensated or realize significant short-term gains. However, some tenants will invest in low-cost conservation measures and some landowners arrange for tenants to carry out soil conservation works.

3.42 In summary, upland farmers face significant costs in adopting soil conservation measures and making changes in farming systems. They are likely to make changes in their land management only if there is a perceived economic advantage in doing so. In addition, the more productive or profitable the land, the more farmers will be willing to maintain and invest in better land management and erosion control practices. Higher productivity and returns ensure that farmers can afford to maintain terraces and other conservation structures and to continue with labor-intensive erosion control measures. Adoption of soil conservation measures is also thought to be related to tenancy, with tenants less likely to invest in major soil conservation works, but the data on this matter are limited.

E. Scope for Improving On-farm Practices

Developing Cost-Effective Technologies

3.43 Agricultural Practices. As noted above, the cost of on-farm conservation practices, particularly bench terracing, is a major constraint to the widespread adoption of these technologies, particularly in poorer areas. The Citanduy II project suggests that the returns from selected agroforestry and bench terracing investments are sufficient to repay loans at 24% annual interest. However, such investments require a medium-term loan for at least two years and short-term loans for succeeding years. Agroforestry requires long-term loans for at least seven years. After nine years of investment in terracing and 12 years of investment in agroforestry, all loans can potentially be repaid. Such loans require considerable confidence by farmers that increased production will permit repayment. The ability and willingness of Citanduy farmers to take loans on these terms is apparently related to the fact that they are on relatively good soils and are full-time farmers with reasonable incomes from other agricultural sources which ensure the ability to repay.

3.44 To make recommended farm practices more attractive, a major effort is needed to identify and introduce less costly interventions which nevertheless have benefits in terms of productivity and erosion control. One promising initiative is the use of vegetative grasses along contours. This system is currently being used with considerable success in India. Contour planting of Vetiver grass, for example, creates natural terraces stabilized by the root system of the grass. This function is illustrated in Figure 3.1. Leguminous trees have also been used to reduce soil erosion with the added benefit of nitrogen fixation. The main advantage of vegetative systems is that moisture conservation increases productivity at relatively low cost. While considerable work is needed in Indonesia to determine which measures are most effective, there can be no doubt that a major cost reduction is required if benefits are to accrue to farmers in the poorer areas.

3.45 Institutional Implications. As noted, DGRRL in the Ministry of Forestry is responsible for soil conservation on all lands over 8% slope, whether cultivated or not. However, since on-farm soil conservation activities are an integral part of agricultural practices, for which the Ministry of Agriculture is responsible and has the technical capacity, many observers feel that consideration should be given to making MOA responsible

for soil conservation on agricultural land. One of the most important functions of MOA in the uplands could then be an expanded research effort to develop more cost-effective technologies for on-farm erosion control.

3.46 MOA is also needed to link new technologies to ongoing extension. The extension services should be conduits of new information, technology and skills provided by the research stations and should in turn provide useful feedback to researchers on field results and on farmers' reactions to the new systems. Training should stress an integrated systems approach rather than the traditional production-oriented approach for each crop. Again, investments will be required to make these necessary changes in the extension services.

3.47 There is a general lack of technical knowledge among local government officials about natural resource utilization and conservation. Conservation land use planning and implementation, and watershed management are virtually unknown to agencies in local government. For these reasons, there is a need to strengthen the technical capacity of local staff and to improve their ability to undertake economic and social analysis. There is also a need to develop more effective interaction between agencies providing technical planning and supervision and local implementing agencies. The technical preparation of local personnel at the district and subdistrict level and the ability to coordinate with other agencies is a precondition to the success of conservation programs with the so-called top-down/bottom-up approach.

3.48 Interventions also need to be carefully tailored to specific conditions. This is often difficult because of over-standardized approaches. One way to address this problem could be to develop a more sophisticated typology of the uplands, along the lines already begun by the KEPAS group (see Annex 3D). The outcome of such a typology is a set of fairly large-scale agroecosystem zones, each of which can be technically regarded as a "general recommendation domain." Such domains are defined so that innovations or interventions that work in one place should work anywhere else in the same or similar domains. Within each zone there are distinct micro-watersheds, each again with its characteristic features which have to be seen as a single system.

3.49 At the bottom of the agroecosystem's hierarchy, the farming system can only be designed and developed by the farmer. With this in mind, a major shift is required in the extension message. Farmers need help understanding the variables affecting crop production in order to evaluate their own farming systems and to learn from pragmatic experimentation. More time must be given to learning from successful farmers and enlisting them in the education of others. No one formula will apply in the uplands and pragmatic methods will be required to identify site-specific problems and overcome them.

Other Factors Affecting Success

3.50 Numerous other factors affect the adoption rates of soil conversation measures proposed for upper watersheds.

(a) Soil Type. Volcanic soils, having the lowest erodibility, give the highest net returns, whereas sedimentary (limestone) soils have low,

and in some cases negative, net returns. This is due to the generally lower fertility of the limestone soils, to the higher labor requirements for terracing and greater soil erodibility. Improved technologies are needed for limestone areas.

(b) Inclusion of Livestock. The introduction of livestock in the farming systems by various upper watershed projects increases household income and nutrition, reduces vulnerability to crop failure and encourages farmers to maintain a grass cover on terraces. With terraces already established, a farming household can significantly raise productivity from animal husbandry with a relatively small additional investment in terms of labor and material costs, making the entire package more attractive.

(c) Income Generation in Early Years. The main constraint to developing agroforestry-based systems is the long "waiting" period before trees mature. A preferred approach has been to develop farming systems incorporating a mix of trees that can be harvested, or that produce fruit at different times, to spread income flows throughout the year and gradually phase out annual cropping.

(d) Nursery Development. A key component in the establishment of perennial crop gardens and agroforestry systems on steep slopes in the Kali Konto Project has been the development of village-level nurseries backed up by central forestry and perennial crop nurseries at the subdistrict level. These nurseries supply planting material, train and encourage farmers in the establishment of their own nurseries and serve as demonstration sites for high-yielding varieties.

(e) Marketing. Marketing facilities in the upland villages are also important and improved market information systems are also needed. Mobilizing existing farmers' groups to market their produce would increase cost efficiency. To facilitate this, the extension workers' knowledge of postharvest technologies should be upgraded. These measures are particularly needed for the development of high-value commercial produce, such as tree crops, fruits, vegetables and legumes in the uplands.

(f) Credit. The widespread adoption of soil conservation practices will also be dependent on the availability of multipurpose credit at affordable rates to farmers and rural entrepreneurs. There should be an expansion of the credit institutions to meet the diverse credit needs of upland borrowers and the constraint posed by requiring land title as collateral should be overcome. More detailed information on credit arrangements is included in Annex 3F.

3.51 On-farm investments to improve productivity and conserve soil (a properly combined package of soil and water conservation and agricultural practices) have relatively immediate on-site benefits. Besides their directly productive potential, such investments are justified both on grounds of equity as well as for the considerable potential that exists for environmentally sustainable development. Investments should be made on a catchment basis

within the context of regional or area development plans and be directed towards diversification and generation of off-farm employment opportunities and incomes.

F. Scope for Improving Other Soil Conservation Measures

Bench Terraces

3.52 On-farm soil conservation in Java's watersheds has relied almost entirely on bench terracing (on all slopes below 50% and on all soil types). Other conservation techniques, such as ridge terraces, contour ditches, grass strips, and so on, are used to a lesser extent. Bench terracing with improved agricultural practices on volcanic soils can greatly reduce runoff and erosion. For instance, experiments on Latosol soils with 15-22% slopes have shown a reduction in soil loss from 158 tons/ha to 6 tons/ha with terracing. In the upper catchment, soil loss of 21 mm per year was reduced to 2 mm per year after terracing (Table 3.15). Yield increases from terracing are largely due to reduced runoff and improved moisture availability. Studies indicate that these increases may be significant, especially in combination with improved inputs and management.

Table 3.15: SOIL LOSS BEFORE AND AFTER BENCH TERRACING

	Before Terracing		After Terracing	
	Soil loss in mm	Runoff coefficient %	Soil loss in mm	Runoff coefficient %
Tapan	21	80	2	40
Dumpul	20	75	1	30
Wader	14	75	2	30

Source: FAO Upper Solo Watershed Development Project, Sunarno and Sutadji, 1981.

3.53 Bench terraces are not well suited to shallow, highly erodible soils including limestone soils on steeper slopes. On marl and other heavy-textured limestone soils, backsloping terraces may increase erosion when surface water becomes concentrated along the back of the terraces. On some soils, increased percolation of water due to terracing may create mass instability, producing infrequent but catastrophic landslides. Bench terraces must, therefore, be designed to fit specific requirements. Heavy rainfall requires a design that allows efficient drainage without causing erosion, while under drier conditions the terraces should be constructed to retain maximum moisture. Agronomic requirements also need to be taken into account in terrace construction. For example, certain high-value crops, such as potatoes, cabbage, tobacco and onions, require well-drained soils. Finally, even on well-constructed terraces excess drainage water can concentrate, particularly during the early part of the wet season. To avoid erosion caused by rapid runoff, well-designed and constructed waterways are critical, especially on

heavier, more erodible soils. As noted earlier in the section, where bench terraces are not appropriate, a variety of other conservation packages can be considered.

Other Soil and Water Conservation Measures

3.54 The most important factor in minimizing soil erosion is the maintenance of continuous ground cover. This is more effective than any physical conservation measure in reducing erosion and soil loss. With no ground cover, erosion will proceed on upland slopes, whether or not they are terraced. Since an estimated 30-40% of total annual erosion on cropland occurs during the first two months of the wet season, when soils are unprotected, cropping systems should be designed to maintain maximum continuous vegetative cover, even during the dry season.

3.55 Intercropping of seasonal crops (e.g., cassava, maize, and peanuts) will increase both the amount and duration of soil cover, particularly during the early phase of crop growth. Improved ground cover in afforested areas may be created by maintaining long-duration canopies through suitable intercropping and by planting legumes and other cover crops. Mulches can also be used to provide ground cover during the dry season. These may consist of organic material brought onto the plot, such as rice straw or forest litter, or they may be the residues of the crops on the plot. Mulching also improves soil and water temperature and hence enhances crop growth, but there are reports of increased incidence of weeds and of insect attack on the crops grown in mulch.

Reforestation

3.56 Mature forests are effective in reducing soil loss (Table 3.16), but pressure on agricultural land is so great on Java's watersheds that it is unrealistic to assume large-scale reforestation of land currently under dryland cultivation. Moreover, vegetative cover other than forest cover can be even more effective under certain conditions. Although natural forests tend to have low rates of surface erosion, this is primarily a function of the ground cover, that is, the shrubs, herbs and grasses, and the litter beneath them. In certain reforestation schemes, erosion may be higher under trees than from bare soil because of the concentration of runoff between trees. Teak forests and most eucalyptus forests have little undergrowth and are particularly prone to erosion.

Table 3.16: SOIL LOSS AND RUNOFF BEFORE AND AFTER REFORESTATION

	Before Reforestation		After Reforestation	
	Soil loss (mm)	Runoff coefficient (%)	Soil loss (mm)	Runoff coefficient (%)
Tapan	21	80	0.6	20
Pidekso	14	75	0.4	25

Source: FAO Upper Solo Watershed Development Project, Sunarno and Sutadji, 1981.

3.57 To date, agroforestry or forage-based packages for the steeper slopes have not been economically attractive to small farmers and have met with only limited success. For example, the Forestry Department's Reforestation Program is aimed at rehabilitating state forest land degraded through encroachment for agriculture and for fuel wood and fodder collection. Where slopes are over 40%, the area is cleared by participants who are mainly landless people from neighboring villages. Each participant is allocated a 0.25 ha plot and is expected to plant seedlings supplied by the Reforestation Program. Participants are allowed to cultivate annual crops over a two-year period between the trees to compensate for their labor. This approach has had only limited success, as farmers have had little economic incentive to participate and are afraid that they may lose control over reforested land.

3.58 Recently, the Ford Foundation's Social Forestry Program has attempted to improve the regreening system by negotiating for a longer period for annual cropping by participants, introducing higher-yielding maize varieties and inputs for food production and encouraging participants to experiment with more economically attractive species (e.g., fruit, fodder and fuel wood species) that they will continue to cultivate after annual cropping has been phased out. Under this system, farmers maintain the right to harvest crops they plant. As this program has been expanded, a crucial problem has been to develop the appropriate mix of species to ensure participants a steady income flow during the critical transition period in which annual cropping is phased out.

Off-farm Conservation Works

3.59 The average cost of check dams, constructed by MPW in Solo, is Rp 2,895 per cubic meter (m^3) of storage (Annex 3A, Table 2). These dams are designed for a life span of about 10 years, but many are fully silted in as few as three years. Table 3.17 shows the average cost of trapping a cubic meter of silt as a function of reservoir life, assuming a 10% discount rate. Data from the Kali Konto project show even higher costs for check dam construction, averaging greater than Rp 7,000/m^3 of storage (Dwiwarsito and de Graff, 1987). These costs are significantly greater than the costs of removing silt from irrigation systems in East Java which are estimated at Rp 1,100/m^3. Harbor dredging costs, reported by the Directorate of Ports and Harbors, Ministry of Communication, range from Rp 720 to Rp 1,750 per m^3. This suggests that downstream interventions are more cost effective than check dams, if sedimentation control alone is considered.

Table 3.17: COST OF TRAPPING SILT IN CHECK DAMS

Assumed life (years)	Average cost per cubic meter of silt trapped (Rp/m^3)
4	3,359
5	3,535
6	3,723
7	3,924
8	4,138
9	4,368
10	4,614

Source: Bank estimates.

3.60 In calculating benefits, however, a number of other considerations can be taken into account. For example, check dams often provide irrigation to nearby fields and stabilize stream beds in downstream areas. Furthermore, following the siltation of dams, relatively high-quality land is provided behind the check dam. The value of such land in Central Java may exceed Rp 10 million/ha. Analysis suggests, however, that only where land is extremely valuable or high maintenance costs incurred, can such benefits justify these structures (Magrath 1990). Once again, however, no data are available on the value of the original bottom land relative to the salvaged land behind the dam. Taking all these benefits into account, the program of check dam construction is probably marginally profitable, but greater attention is clearly needed to cost-benefit analysis. Profitability could also be improved if greater attention were given to more careful vetting of alternative sites and designs.

3.61 To improve the effectiveness of major conservation works, improved planning and coordination are required. The recently approved Indonesian Integrated River Basin Development and Watershed Management Project sponsored by MPW is trying to bring about interministerial cooperation on improving management of the catchment areas of four major dams on Java: Selorejo (Brantas Basin), Wonogiri (Bengawan Solo Basin), Kedung Ombo (Jratunseluna Basin) and Jatigede (Cimanuk). It is intended that the lessons learned from better integration of management activities in these four locations can later be applied to other catchment areas.

3.62 In summary, engineering structures, such as check dams, silt traps and other works can play a role in minimizing the off-site cost of erosion. This is especially true given the time lags between the installation of improved farming systems and discernible reductions in sediment loads. However, much more emphasis is needed to improve the siting of these works to ensure that the benefits of reducing sedimentation warrant the costs of construction and to improve technical standards while reducing costs. Raising standards of road construction and planning could play an important part in reducing the off-site costs of erosion. Collaboration between the Ministries of Public Works and Forestry and with local governments on these issues should continue and receive greater support from Government.

IV. WATER QUANTITY ISSUES ON JAVA

Introduction

4.1 The development of Java's water resources has been a major factor in economic growth. Although most of Java is well endowed with rainfall, surface water and groundwater, shallow watersheds cause rapid runoff of surface water in the rainy season, and some coastal areas in Java experience water shortages in dry seasons. The water supply/demand balances in several basins are also becoming critical. In addition, pollution in the downstream areas of almost all the north coast rivers has reduced the availability of raw water of adequate quality for municipal and industrial purposes. Hence, continued development of several large cities is now dependent on their ability to find alternative sources of water. This chapter discusses issues related to water quantity in Java, and Chapter V covers issues related to water quality. Water resource problems are generally less serious in the outer islands and solutions developed for Java, and applied to the outer islands, could help address and ameliorate such problems in the future.

A. Java's Water Resources

Available Water Resources

4.2 Average rainfall in Java varies from 1,500-8,000 mm, with an island average of 2,650 mm. Rainfall decreases from the south to the north and from west to east. Rainfall distribution is shown in Map 21068. The heaviest rainfall occurs on the southwest coast, while the driest part of the island is along the central north coast. Over 80% of all rainfall occurs within a six-month period from December to May, and the remaining 20% occurs mainly in July, August and late November (Table 4.1). Therefore, although there is a relatively high level of annual rainfall in Java, there is significant variability from year to year and from place to place, which contribute to seasonal and locational shortages. The impact of these shortages is compounded by the fact that Java's watersheds are extremely shallow. Most of Java's rivers are less than 50 km long, and shallow catchments, combined with deforestation and rural development, have contributed to more rapid runoff and increased variability in river flows.

4.3 The usable water resources of Java are mainly surface water flows. The total average rainfall amounts to 352 billion cubic meters (Bm^3), and about 50% (175 Bm^3) flows through the river system as surface flows. However, because of the rainfall pattern and the catchment configuration it is difficult to use most of this water and, on average, only about 126 Bm^3 is usable. The balance (49 Bm^3) is generally not "divertible" or usable, unless expensive dams and reservoirs are constructed. Surface water resources also vary considerably with the amount of annual rainfall and in a dry year, surface water is considerably reduced. For example, for a once-in-five-year dry year, the surface water resources are reduced to 78 Bm^3. This means that firm water resources are only about 45% of average annual water flows. In some areas, available water is already insufficient to meet needs in a dry year in some areas (see also Annex 4, Figure 1).

Table 4.2: WATER RESOURCES IN JAVA BY PROVINCE

Location	Water Resources (Bm^3)	Per Capita Water Resources (m^3/cap/yr)
West Java and Jakarta		
Total	79	1,870
Divertible	61	1,340
Central Java and Yogyakarta		
Total	44	1,480
Divertible	30	1,000
East Java		
Total	52	1,770
Divertible	35	1,120
All Java		
Total	175	1,750
Divertible	126	1,260

Source: Directorate General of Water Resources Development (DGWRD).

4.5 Irrigation and municipal water use is about 60 Bm^3, and 65% of the total water flows into the sea. This water cannot be used at present because flows do not coincide with the times when water is needed. Excess water often overflows the banks of rivers and causes floods on about 6% of Java's land each year. (Flood-prone areas are shown in Map 21068.) Table 4.3 shows the total volume of reservoirs by province. Of the three major provinces, East Java has the lowest regulation capability (2.1%), due mainly to a shortage of good dam sites. There are about 32 dams impounding about 6.9 Bm^3 of water in Java, which is about 3.9% of total annual flow.

4.6 Groundwater resources are small in relation to surface water resources, but they are a very important source of domestic water supply on much of the island and of industrial water supply in urban areas. The Jakarta area, for example, uses about two million cubic meters (Mm^3) per day of groundwater which supplies more water and serves more people than the piped water supply systems. In total, however, groundwater extractions on Java are relatively small, about 8.75 Bm^3 per year.

Current Water Demand

4.7 Present Water Use. Present water use on Java does not vary significantly from that in most developing countries. Water is required for: (a) irrigated rice and non-rice crops; (b) aquaculture in fresh and brackish water ponds and in rivers and lakes; (c) municipal water supply for drinking

Table 4.1: WATER DISCHARGE AND REQUIREMENTS IN JAVA IN AVERAGE AND DRY YEARS (m^3/sec)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Mean discharge												
Average	9,346	10,177	10,019	8,382	5,902	3,115	2,233	1,555	1,752	2,629	5,195	7,428
Dry year	4,166	4,536	4,466	3,736	2,630	1,388	995	693	781	1,172	2,316	3,311
Mean Requirements												
Irrigation	2,840	2,840	2,840	2,840	2,840	2,840	1,988	852	852	852	1,988	2,840
M&I /a	101	101	101	101	101	101	101	101	101	101	101	101
Total	2,941	2,941	2,941	2,941	2,941	2,941	2,089	953	953	953	2,089	2,941
Balance in an Average Year												
	6,405	7,078	7,528	5,441	2,961	174	144	602	799	1,676	3,106	4,487
Balance in a Dry Year												
	1,224	1,595	1,524	795	-311	-1,553	-1,094	-260	-172	218	226	369

/a M&I - municipal and industrial.

Source: Bank staff estimates based on data from the Directorate General of Water Resources Development (DGWRD).

4.4 The distribution of water resources also varies by province. West Java has 44% of Java's total resources, while East and Central Java have about 30% and 26%, respectively. Table 4.2 gives the water resources by province and per capita per year. Although average available water is 1,750 m^3/capita/year, the maximum divertible is 1,340 m^3/capita/year in West Java, 1,000 m^3 in Central Java and and 1,120 m^3 East Java. Therefore, in spite of high rainfall, the total water resource per capita on Java (1,750 m^3/capita/year) is surprisingly low when compared to other countries. For example, China with 10 times the population of Java and far less rainfall on average, has a resource level of 2,800 m^3/capita/year. This is due to the fact that rivers in China are up to 4,000 km long and have very large catchment areas.

and for urban, industrial and commercial use; (d) flushing and low-flow maintenance; (e) hydropower generation; (f) inland navigation; and (g) recreational uses. Except for hydropower generation and recreation, all other uses of water are out-of-stream uses.

Table 4.3: STORAGE RESERVOIRS ON JAVA

Location	Annual flow (Mm^3)	Reservoir volume (Mm^3)	Regulation of annual flows /a (%)
West Java			
Citarum	5,500	3,615	66.0
Cisanggarung	23	36	155.0
Other	73,477	0	0.0
Subtotal	79,000	3,651	4.6
Central Java			
Kedung Ombo	730	615	84.2
Wonogiri	900	630	70.0
Wadaslintang	473	408	86.3
Mirca	2,940	156	5.3
Small Dams	8,770	321	3.7
Others	30,187	0	0.0
Subtotal	44,000	2,130	5.8
East Java			
Brantas	7,020	350	5.0
Solo	7,945	700	9.0
Small Dams	1,000	40	4.0
Other	36,035	0	0.0
Subtotal	52,000	1,090	2.1
Total Java	175,000	6,871	3.9

/a The regulation % is defined for flows at dam.

Source: Directorate General of Water Resources Development (DGWRD).

4.8 Irrigation Water Use. Irrigation is by far the largest water user. About 50% of water for rice grown on Java is from rainfall, the balance is from irrigation schemes of different types. The average use of irrigation water varies from 8,000-12,000 m^3/crop/ha, depending on the rainfall level,

the crop type, and the extent of the water control facilities. Java has 2.8 million ha (22% of its total area) under irrigation. Rice is cropped almost twice a year in most irrigated areas, with an additional non-rice crop grown using residual moisture. Cropping intensities increased from about 130% in 1970 to 165% in 1985 for rice (1.7% growth rate), and from about 60% to 70% for non-rice crops.

4.9 Water use is estimated to have increased as much as 15 Bm^3 between 1970 and 1985 (a 2.1% annual increase) which amounts to 19% of firm water resources of 78 Bm^3. Demand started to climb sharply in 1976 when high-yielding varieties with short maturation periods of 105 days were introduced on a large scale. (Traditional varieties mature in 160-180 days.) Since most of the production gains were due to increased cropping intensities during that part of the year when monthly rainfall declines (April to July), the demands on water resources were significant. Present irrigation areas and surface water uses in Java are summarized in Table 4.4. The 59 Bm^3 of irrigation water used represents about 48% of the divertible resources available and 77% of the dry-year or firm flows.

Table 4.4: IRRIGATED AREA AND ESTIMATED SURFACE WATER USE ON JAVA /a

Location	Irrigated area (ha)	Water use (Bm^3)
West Java (including Jakarta)	951,500	22.4
Central Java	873,300	18.3
East Java	956,700	18.6
Total	2,781,500	59.3

/a Derived from detailed calculations on eight catchments covering 1.35 M ha of irrigated area.

Source: Directorate General of Water Resources Development (DGWRD).

4.10 Efficiency in irrigation is measured by the percent of total flows within the system which are used for crop production. This is important since more efficient systems permit more water to flow to a greater number of users. When combined with storage, an efficient system also permits irrigation on a uniform basis over a longer period of time. As in most countries, however, irrigation water is not used efficiently in Indonesia. Average efficiencies on larger schemes in Java barely exceed 30%, although large systems are designed for efficiencies of about 50% and traditional systems may reach 65% efficiency. Recent measurements indicate that even in the dry season in East and Central Java, efficiencies only range from 10-35%, averaging about 25% over large areas. In the Brantas river basin where there is a significant shortage of water across sectors, the efficiency of irrigation water on medium schemes is estimated to vary from 10% to 25%.

4.11 Water Use for Aquaculture. Water use for aquaculture is increasing at a rapid rate. In the past, water for aquaculture was derived from the drainage waters of irrigation schemes. However, since there is concern about fish poisoning from residual pesticides and fertilizers in irrigation waters, many aquaculture schemes now receive a special allocation of water which has not been used for irrigation. Aquaculture areas include about 86,000 ha of brackish water ponds, 27,400 ha of freshwater ponds, and about 66,000 ha of sawah. Total water used for aquaculture is estimated at 900 Mm^3 per year, or about 0.85% of usable water resources.

4.12 Municipal Water Use. The use of surface water by municipalities is minor compared to agricultural use, but its importance is growing. A breakdown of urban water use in the three Java provinces and Jakarta is given in Table 4.5. The water used for municipal purposes in rural and urban areas is about 1.26 Bm^3, about 1% of the usable water resources and about 2% of the water used for agriculture.1/ Despite the relatively low requirements for municipal water, competition for water is intense during the dry season when unregulated river flows are small and water pollution makes it difficult to adequately treat raw water. This is particularly true for the water supplies for Bandung, Bogor, Cimanuk, Semarang, Surabaya, and Tenggarang.

Table 4.5: MUNICIPAL WATER USE IN JAVA (1987)

Province	Urban areas		Rural areas	
	m^3/sec	Mm^3	m^3/sec	Mm^3
West Java	4.67	147.6	5.80	183.0
DKI Jakarta	6.75	213.4	0.76	24.0
Central Java	4.00	128.2	5.29	167.2
East Java	6.24	197.2	6.33	202.1
Total	21.66	686.4	18.18	574.3

Source: Directorate General Cipta Karya (DGCK).

4.13 About two thirds of municipal water is from rivers and about one quarter from springs (Table 4.6). Most spring sources are small and have been completely exploited. Groundwater is about 9.7% of the municipal supply. Although East Java relies more on groundwater, the total amounts used are still small. In urban areas where river water is highly polluted (e.g., around Jakarta, Bandung, and Indramayu), the general public and industry make intense use of groundwater without assistance of the city water enterprises.

1/ Figures on water use for urban areas have been calculated on existing water supply schemes; for rural areas, on all existing schemes and from water use from unprotected sources.

For Jakarta, groundwater supplies almost 80% of municipal water. About two million m^3 are drawn per day,2/ almost four times as much as the piped water supplied by the local water supply authority (PDAM). This withdrawal of groundwater has depleted Jakarta's aquifers so severely that much of the shallow groundwater along the coast is saline (Annex 4, Figure 2). Since wells are a primary source of water for the city's poor, many of whom live in the older urban areas near the coast, the situation is serious.

Table 4.6: WATER SOURCES FOR EXISTING MUNICIPAL WATER SUPPLY

Province	Groundwater	Springs	River	Total	Total annual use (Mm^3)
		m^3/sec			
Local Water Supply Authorities (PDAM)					
West Java	0.15	1.04	9.73	10.92	344.40
Central Java	0.74	1.49	0.96	3.19	100.54
East Java	0.84	2.51	3.50	6.84	215.71
Water Supply Boards (BPAM)					
West Java	0.04	0.30	0.66	1.00	31.38
Central Java	0.13	0.17	0.40	0.70	22.01
East Java	0.36	0.04	0.20	0.60	18.98
Total	2.25	5.54	15.45	23.24	733.02
Percent	10	24	67	100	na
No. of systems	23	51	22	96	na
Percent	24	53	23	100	na

Source: Directorate General Cipta Karya (DGCK).

4.14 Industrial Water. Industries rely primarily on ground water as their source of supply. In West Java surveys show that almost 65% of industrial water is from private wells and another 25% is private abstractions from rivers and lakes. Only 10% of the water used comes from town or city supplies. However, with the worsening of water pollution in the river systems and the deterioration of groundwater quantity and quality in some areas, future supplies will have to be derived from city water systems. For major cities, projections for industrial water demand are assumed to be 50% of the total municipal supply, while for small towns they are assumed to be 25%.

2/ Estimate of ground water extraction vary widely by different researchers because of incomplete data. The value of 2.0 Mm^3 is in the upper range of estimates

4.15 Rural Water Supply. About 60% of water for domestic uses in rural areas is from shallow wells. Other water sources include open streams, piped water, springs, rainwater collection, and hand pump systems. By the start of Repelita IV in 1984, about 27% of Indonesia's rural population (38 million people) had access to protected water, and only about 4% had access to safe water. This is a lower number than in most developing countries and is possible, in part, because of high rainfall which flushes wastes and stagnant water. Rural water use is estimated at about 575 Mm^3 annually.

Future Water Demand

4.16 Agricultural Uses. Future demands for irrigation water will depend largely on the growth of rice production and efficiency improvements in irrigation. The demand for rice is based on assumptions about population and income growth, and income elasticity for rice. Earlier studies indicated an increase in demand for rice of about 3.5% p.a. in the 1990s. However, more recent trends suggest that the increase may be lower (2.8%), due mainly to lower economic growth rates in the late 1980s than previously anticipated. Assuming the lower growth rate, the demand for rice would be 25 million, 30 million and 38 million tons for the years 1985, 1990 and 2000, respectively.

4.17 If Java were to maintain a 60% share of Indonesia's rice production, it would have to increase water-use efficiencies from 25% to 50%, increase cropping intensity from 165% to 200%, and increase yields from 4.2 tons/ha to 6.0 tons/ha by the year 2010. On the assumption that these goals are technically possible, an effort was made to calculate total water demand, based on a computer model that derives water requirements for two cropping patterns. The model requires that the irrigation system be broken into upstream and downstream areas. Part of the drainage water from upstream areas is reused downstream. The model was run on 13 catchments with detailed water and irrigation data. Aquaculture needs were included within projected requirements. The catchment areas analyzed, which cover 1.33 million ha, were found to require 31 Bm^3 of water in the year 2010 for agriculture and aquaculture (Table 4.7). However, since the total irrigated area for all systems on Java amounts to 2.78 million ha, the area's total water requirement is estimated at about 63.7 Bm^3 in the year 2010. As a result of the assumption that the water-use efficiency of irrigation systems will be increased, this is relatively close to the amount now used. Sensitivity to this assumption is discussed later in this section.

4.18 Municipal and Industrial Water Requirements. Future projections of water supply for cities will depend on the growth of city populations. The urban population is now projected to grow at a 60% higher rate than the rate of overall population of Java and to increase from 25 million in 1986 to 53 million by 2010. In fact, there will be more people in Java's cities in the year 200 than there were in all of Java 50 years before. To serve this population, urban water supply services will have to be considerably expanded.

Table 4.7: IRRIGATION WATER REQUIREMENTS PER RIVER BASIN IN YEAR 2010 /a

Name	Irrigated area considered ('000 ha)	Total annual water requirements (Bm^3)
Teluk Lada	31	0.76
Banten	55	1.23
Cibeet-Jakarta-Cisadane	190	4.35
Citarum	190	4.58
Cimanuk	90	2.17
Cisanggarung	42	0.92
Pemali Comal	130	2.97
Kuta Bodri	22	0.52
Jratunseluna	108	2.42
Bangawan Solo	274	6.44
Serayu	97	2.17
Kedu Selatan	55	1.28
Citanduy	50	1.16
Total	1,334	31.17

/a Assumes that cropping intensities for rice increase from 165% to 200% and that efficiency in water use increases from 30% to 50%.

Source: Bank staff estimates.

4.19 The future demand for water for municipal and industrial uses will depend on the targets for water supply that Government can meet within its budget. Assuming that current targets are met and water supply service is available for 80% of rural and 85% of urban dwellers by the year 2010, supply for small and medium cities would have to be increased at 8.7% p.a. and for large cities at 6.8% p.a. These projections are extremely optimistic, but municipal water supply represents a small portion of the total demand. Water for industry is also included within these requirements. These future industrial water requirements do not reflect the need for cooling water which is an in-stream use and does not require high quality water. It is also expected that all water for municipal and industrial needs will eventually be from river water, as spring and groundwater sources will become more limited. Using these estimates, and assuming that about 30% of municipal and industrial water is returned to the river, the net demand for water would be about 3.4 Bm^3, about 4% of the firm water resources and only 6% of the requirement for irrigation water.

4.20 Flushing Requirements. Since waste water treatment is virtually absent in Indonesia, a short-term solution to waterborne pollution is flushing city waterways. In Jakarta, this requires a dry season maximum of 28 m^3/sec or an annual average of 14 m^3/sec, equivalent to 400 Mm^3 annually. This short-term solution has two drawbacks.

(a) Flushing does not basically solve the problem of pollution, it only carries the pollutants to another location. In the case of Jakarta, flushing merely adds to the pollution of Jakarta Bay. Therefore, in the long run, waste water treatment is unavoidable.

(b) The cost of bringing flushing water to cities is high. This applies particularly to Jakarta, since the required amounts of water will have to come from nearby rivers either to the east (Jatiluhur) or the west (Cisadane). Tapping either of these rivers will require large capital investments in infrastructure.

4.21 Total Water Needs. Total water needs are summarized in Table 4.8, which shows that irrigation and aquaculture needs are about 95% of future requirements and municipal demands are only about 5%. Municipal uses are very important, however, for urban and industrial growth and economic development. Future projections assume significant efficiency improvements in the delivery of irrigation water and in reducing losses in piped municipal water systems.

Table 4.8: PRESENT AND PROJECTED WATER USE IN JAVA FOR YEAR 2010 (Bm^3) /a

	Water use in 1986				Water use in 2010			
JAVA	Agri-culture	Urban water	Rural water	Total	Agri-culture /b	Urban water	Rural water	Total
DKI Jakarta	0.10	0.21	0.02	0.33	0.00	1.26	0.00	1.26
West	22.40	0.15	0.18	22.73	21.50	0.58	0.27	22.35
Central	18.30	0.13	0.17	18.60	20.11	0.32	0.27	20.70
East	18.60	0.20	0.20	19.00	22.05	0.38	0.21	22.64
Total	59.40	0.69	0.57	60.66	63.66	2.55	0.74	66.95

/a Urban water includes municipal and industrial use, and rural mainly human use and some industry.
/b Assumes 200% cropping intensity and 50% efficiency in irrigation water use by 2010.

Source: Bank staff estimates.

B. Water Supply and Demand Issues

Calculating Water Supply and Demand

4.22 For 13 of the 21 major river basins on Java, a water balance analysis was performed using a computer model. As noted earlier, the irrigation system was divided into upstream and downstream areas, and part of the water used upstream and discharged was assumed to be reused downstream. The division of upstream or downstream areas was based on the location of diversion weirs and the size of irrigation command areas. In most river basins, about 20-30% of the upstream water was found to be reused downstream. Using this model, the

total demands on water resources for the year 2010 (including irrigation, aquaculture, and municipal and industrial water) were calculated for each of the 13 basins. The water available was defined monthly for each basin.

4.23 Based on these water balances, a rough characterization of the basins in terms of shortages and surpluses of water could be derived. The results are given in Table 4.9. For each area, the percent shortfall between annual requirements and availability in a one-in-five-year dry year is given. The overall shortage for a dry year, based on the model studies for the 13 catchments, is 7.2 Bm^3 or about 10% of firm water resources, but in some catchments shortages are more substantial.

Table 4.9: PERCENT SHORTFALL IN WATER IN A DRY YEAR

River basin	Shortfall without dam (%)	Shortfall with dams (%)	Water balance /a without dams (with dams)
Teluk Lada	0	0	surplus
Banten	5	5	marginal shortage
Cibeet-Jakarta-Cisadane	14	5 /b	severe shortage (marginal)
Citarum	2	2	surplus
Cimanuk	16	0 /b	severe shortage (surplus)
Cisanggarung	18	14	severe shortage
Pemali Comal	17	11	severe shortage
Kuta Bodri	0	0	surplus
Jratunseluna	34	21 /c	very severe shortage
Bangawan Solo	9	9	shortage
Serayu	10	10	shortage
South Kedu	10	0 /c	shortage (surplus)
Citanduy	0	0	surplus
Average	10	7	shortage

/a 5% shortfall = marginal shortage.
5-10% shortfall = definite shortage.
10-20% shortfall = severe shortage.
20+ shortfall = very severe shortage.
/b Dams contemplated (Jatigede and Parangbadak).
/c Dams being built or close to completion (Wadaslintang and Kedung Ombo).

Source: Bank staff estimates using water balance model.

4.24 This analysis reinforces the picture that moving from western to eastern Java, water becomes more scarce. In West Java there is generally a

surplus of water, and even the large requirements by DKI Jakarta (40 m^3/sec for drinking water and, on average, 14 m^3/sec for flushing) can be met. In East Java, demands exceed water resources and shortages occur. In addition, the north coast catchments suffer from severe shortages. Map 21069 shows water shortage areas particularly in the months May through September.

Table 4.10: TOTAL WATER DEFICITS FOR SELECTED CATCHMENTS IN JAVA IN A DRY YEAR (2010)

River basin	Irrigation area ha	Deficits in Mm^3 Without efficiency improvements E = 30%	With efficiency improvements E = 50%	With efficiency improvements E = 50% & Dams
Bengawan Solo	274,00	1,522	564	564
Jratunseluna	108,000	1,928	888	534
West Semerang	122,000	13	0	0
Pemali Comal	130,000	1,445	528	528
Cisanggarung	42,000	356	186	186
Cimanuk	90,000	1,029	354	0
Cibeet-Jakarta Cisadane	190,000	1,942	293	293
Banten	55,000	367	66	66
Serayu	197,000	1,058	217	217
South Kedu	55,000	234	124	0
Citanduy	50,000	98	0	0
Teluk Lada	31,000	18	0	0
Total	1,244,000	10,010	3,220	2,388

Source: Bank staff estimates based on DGWRD data.

4.25 This analysis presupposes that overall irrigation efficiency for water distribution will be improved from the present level of 30% to 50%. If these efficiencies are not realized, then the analysis shows that the shortages will be greatly aggravated (Annex 4, Figure 3). For the 13 catchments, a simulation was performed with 30% efficiency and under these circumstances shortages increased 300%, i.e., from a 2.4 Bm^3/year to 10 Bm^3/year (see Table 4.10). Overall for Java, without efficiency improvements, shortages become 22 Bm^3/year, or 38% of the firm water resources. Improving the water-use efficiency of irrigation reduces shortfalls by two thirds, but dams reduce shortfalls by only 10%. Therefore, a failure to improve irrigation efficiency would have serious consequences for some river basins. For example, the Serayu basin would have deficits almost all year in a dry year if water requirements increased as projected but efficiency improvements were not undertaken.

Problem Areas

4.26 Efficiency in the Use of Agricultural Water. The preceding analysis indicates that the main constraint to increasing cropping intensity and production is the inefficient use of water for irrigation purposes. For a flood irrigation system, like most systems in Indonesia, the maximum efficiency achievable is about 50%, which requires efficiencies of 90% at intake, 70% efficiency in the operation of the system, and 80% efficiency in on-farm use. However, average efficiencies in the larger schemes hardly exceed 30% in the wet and dry seasons. A comparison of achievable efficiencies and the present situation in Java is shown in Table 4.11.

Table 4.11: EFFICIENCY COMPARISONS (%)

Type of Efficiency	Maximum achievable	Indonesian levels	Percentage of achievable
Intake	90	20-70 /a	22-78
System Operations	70	45-65 /b	64-92
On-farm Use	80	65-80 /b	81-100
Overall	50	6-36 /c	11-72

/a Based on IIMI studies in East and Central Java.
/b Estimated, based on several World Bank appraisals 1981-85.
/c Average efficiency is about 25%.

Source: IIMI Studies, 1987.

4.27 The largest discrepancy in efficiencies involves inflow regulation, due to lack of proper control structures and improper management of inflows. This is a serious problem. If too much water is diverted into a system, particularly in drier periods, surplus water stands in fields and downstream users suffer. If too little water is taken, end-users within the system experience shortages. Recent measurements indicate that even in the dry season, East and Central Java efficiencies vary from 10-35%, averaging about 30% over large areas. In the Brantas River, where there is a significant need for water downstream for the city of Surabaya, inflow efficiencies of upstream irrigation systems on medium schemes (6,000-10,000 ha) are only 23-45%, which is 25-50% of what is achievable (Annex 4A, Table 1). Part of the water transmitted through the irrigation system and not utilized does reappear in downstream areas, but some is lost to evaporation or directed away from important downstream users.

4.28 Efficiency of Municipal Water Use. Despite the low level of service for urban water supply systems on Java, unaccounted for water varies from 20-65% for piped water. This is due both to physical losses in the distribution system and disconnection of or tampering with metering devices to avoid or reduce payment. Table 4.12 shows that for some local water authorities about 40% of the water treated and supplied cannot be accounted for, and for Jakarta alone almost 50% of treated water is not accounted for.

Considerable effort will have to be made to ensure that unaccounted for water is reduced in the existing municipal water supply systems.

Table 4.12: UNACCOUNTED FOR WATER BY PROVINCE AND JAKARTA AND SURABAYA

West	Central	East	DKI Jakarta	Surabaya	Unaccounted for water
Number of Water Systems					%
5	2	3	-	-	10-20
7	5	1	-	-	21-30
5	3	3	-	1	31-40
-	-	-	-	-	40-50
-	-	-	1	-	over 50

Source: Directorate General Cipta Karya (DGCK).

4.29 Efficiency in Groundwater Use. At present, groundwater abstraction is undertaken mainly by the private sector for residential and industrial use. In theory, licenses are issued for groundwater abstraction, the rate of abstraction is metered, and charges on water use are leveled by the municipality. In practice, however, the situation is difficult to monitor. Unlicensed wells are common and tariffs on groundwater abstraction are both low and undercollected. Underpricing, in turn, leads to considerable waste by private users. This is particularly serious in coastal areas where aquifers cannot recharge at adequate rates, so current use lowers the water table, increases the price of abstraction, and causes the salinization of subsurface water.

4.30 Potential for Water Reuse. Some cities in Asia and elsewhere reuse waste water for agricultural and other non-potable purposes. As practiced informally, such reuse can pose some danger to croplands, crops and agricultural workers. However, planned reuse with appropriate safeguards would be worthy of consideration in those regions of Indonesia that face increasing scarcity of water due to competing demands or contaminated sources. Water for reuse would have to be collected and treated at costs which should be compared with the cost of other potential water sources.

C. Improving Water Resource Management

4.31 Although municipalities use only a small amount of water when compared to agriculture, these uses are extremely important, and the general tendency has been for municipal and industrial water supply to put pressure on the "historical" rights of irrigated agriculture. Within urban areas the use of publicly supplied piped water versus privately abstracted groundwater also poses important trade-offs and investment decisions. Therefore, water allocation issues will have to be addressed in Java to ensure optimal agricultural production and sustainable industrial and municipal development.

4.32 Four measures are suggested to resolve efficiency and allocational issues:

(a) Efficiency can be improved through water pricing to reduce waste and to provide funds for operation and maintenance.

(b) Water resource management can be improved by strengthening institutions involved in water control and by improving cross-sectoral coordination.

(c) New mechanisms such as integrated river basin planning and management agencies can be introduced.

(d) Dams can be built to increase storage capacity.

The following sections describe current water management, and then consider various options for improvement.

Water Pricing

4.33 The Cost of Surface Water. Water costs a certain amount to capture, deliver and distribute. Users who do not appreciate these costs are apt to waste the resource they receive, reducing growth and productivity. Water is currently the most subsidized of all agricultural inputs in Indonesia, with farmers paying only a fraction of either the costs or the incremental benefits from irrigation water. In 1985, the average operation and maintenance (O&M) and annualized capital costs of a medium-sized irrigation project, including tertiary O&M costs, were estimated at about Rp 187,000 per ha (US$113)3/ and total farmer payments in 1985/86 amounted to less than 13% of the total cost. The implicit subsidy was therefore about Rp 165,000 (US$100) per ha. Since there are approximately 4 million ha of government-financed irrigation works (in both Java and the other islands), the cost of the irrigation subsidy in 1986 amounted to about Rp 660 billion (US$400 million) for Indonesia. Of this amount, approximately Rp 50 billion was for O&M and the rest for annualized capital costs. For Java, the subsidy for irrigation water was about Rp 440 billion or Rp 7.3 per m^3 of irrigation water delivered. A recent analysis of the budget for Central Java (Table 4.13) indicates that financial subsidies were about Rp 173,500 per ha, which tallies well with the overall national estimate of subsidy at Rp 165,000 per ha.

3/ More recent estimates indicate that the total weighted average cost of irrigation for all systems is currently about Rp 343,000/ha/year. This implies an implicit subsidy for irrigation water of Rp 1.3 trillion for all GOI-financed systems. Even using the more conservative estimate of Rp 262,000/ha/year (the marginal benefits to farmers from irrigation), the subsidy is around Rp 1 trillion.

Table 4.13: IRRIGATION SUBSIDIES FOR CENTRAL JAVA

		Rp/ha/p.a.
(a)	Capital investments	
(i)	Rehabilitation	25,000
(ii)	New Schemes	150,000
	Subtotal	175,000
(b)	O&M payments	
(i)	Central Government	10,000
(ii)	Provincial Government	2,500
	Subtotal	12,500
(c)	Payments by farmers to Provincial Government	
(i)	Land Taxes (IPEDA)	10,000
(ii)	Farmer Contribution	4,000
	Subtotal	14,000
(d)	Total Financial Subsidies (a + b - c)	173,500

Source: Bank Staff estimates from various documents 1978-1982.

4.34 Strong arguments can be made for subsidies on equity grounds, but funding shortages in Indonesia have led to poor operation and maintenance of irrigation systems. This, in turn, has reduced the area irrigated and the number of farmers that benefit, and is costly to the economy and to farmers at the margins of the system. For example, as a result of the shortfalls in O&M funding, the performance of several recently constructed systems has rapidly deteriorated with adverse effects on agricultural productivity; and it is now estimated that over Rp 2 trillion would be needed to restore the irrigation network to a condition amenable to normal O&M. Under the Bank-assisted Irrigation Subsector Project, user fees will be introduced to cover the cost of O&M, but these are not linked to the volume of water used. Thus, while system efficiency may be improved through better maintenance, incentives for efficient water use have not yet been established. Therefore, in areas where water shortages occur, experimentation with economic incentives for water conservation may be desirable.

4.35 Appropriate pricing of groundwater is even more urgent since groundwater is only a partially renewable resource and current abstractions limit future options. Appropriate charges are required for drilling and abstraction and closer scrutiny of abstraction rates is required. In this case, both

efficiency and equity concerns argue for higher rates to urban and industrial users who can afford deep wells in order to subsidize low-income families who no longer have access to traditional water sources because of the salinization of shallow aquifers.

The Institutional Framework for Water Resource Management

4.36 Surface Water. The Ministry of Public Works (MPW) is charged with the overall planning, development and management of surface water resources in Indonesia and may assist the provinces in all related matters. MPW is empowered to collect data on water quantity and quality, make policies on water resources use, advise on water management and regulate waste water. Within MPW, the most important agencies for surface water management are the Directorate General of Water Resources Development (DGWRD) and its Directorate of Irrigation (DI). In addition, MPW is assisted by the following provincial and local-level institutions.

(a) The Provincial Irrigation Service (PRIS) in each province is responsible for planning and design, irrigation construction, operation and maintenance, and logistics for both rivers and swamps. Its district-level offices have administrative and technical responsibility for 70,000-100,000 ha of irrigated area. PRIS offices are responsible for providing data on water availability, water requirements, and land use to the Irrigation Committee at the respective level.4/

(b) Irrigation Committees, made up of MPW, provincial and local government officials, and agricultural services staff, coordinate water distribution at the provincial, district, and often subdistrict levels. The provincial-level committee provides guidance and makes policies for carrying out projects, while the district-level committee makes decisions regarding cropping patterns, planting dates, etc. Committees do not control their financial resources, which come from the Government, and do not have working secretariats, so they are frequently unable to enforce their decisions and instructions.

(c) Water Users Associations (WUA) are based on the self-help principle. A typical WUA has a membership of 100-200 farmers, who are supposed to receive technical guidance on system design and O&M from the PRIS and instruction on water use from the agricultural extension service. In practice, however, only about 15% of the existing WUAs are active, 20% are semi-active, and the rest are inactive. WUAs often lack the expertise to operate and maintain the tertiary irrigation systems, and farmers, finding the services of little benefit, are often reluctant to contribute to the WUA, especially as there are no sanctions for nonpayment.

4/ Operation and maintenance (O&M) for the main irrigation system is carried out, under instruction from the district irrigation committee, mostly by sections (each covering 20,000-40,000 ha), and by subsections (4,000-6,000 ha each) headed by a member of the PRIS field staff.

4.37 Groundwater. The Directorate of Environmental Geology (DEG) in the Ministry of Mines and Energy is responsible for evaluating groundwater resources nationwide, for groundwater mapping and for issuing licenses for groundwater abstraction. However, as noted, many private users circumvent licensing requirements and aquifers are being overdrawn. The Directorate is anxious to address this problem, but it faces jurisdictional problems in relation to municipalities, and it has little enforcement authority and limited staff outside of Jakarta and Bandung. In addition, the work of the Directorate is only weakly linked to that of the Directorate of Irrigation, which is responsible for surface water management.

Integrated Water Resource Planning and Management

4.38 While many aspects of irrigation management within a single scheme have been reasonably well defined, the more complex problem of managing water quantity and quality across different irrigation schemes, between rural and urban sectors within a river basin, and among surface, groundwater and coastal water resources has received inadequate attention to date. The overall responsibility for surface water planning and management within a river basin has been given to the Ministry of Public Works, but can be delegated to other bodies, such as state enterprises or the provincial governments. Since 1967, MPW has supported integrated water resources development programs and 12 river basin assessments have now been carried out on Java.5/

4.39 There are several potential advantages to the river basin or regional approach to water resource management: coordination is improved, the interests and needs of competing users can be cared for, both in planning and operations, and water can be more efficiently allocated among competing uses. The river basin approach can also be implemented under a variety of institutional settings: (a) working within existing arrangements, in which government departments perform the necessary functions, albeit with improved coordination and concern for the needs of other users; (b) introducing new forms of coordination among existing agencies, such as a steering committee or perhaps junior minister; and (c) establishing a single enterprise with the needed powers for planning, construction, management, operation, monitoring and compliance.

4.40 Several phases or steps that may be helpful in moving towards integrated water resource planning and management on a river basin or regional scale can be distinguished.

(a) Phase I. Build and strengthen existing institutional arrangements and improve water resource planning and coordination at the provincial level.

5/ The Government of Japan was the first donor to accept the above approach with the integrated development of the Brantas and Solo rivers. The World Bank later assisted with the Jratunseluna interrelated river basins study and the Cimanuk study. More recently, AID supported the approach with the South Kedu river basin project.

(b) Phase II. Create an interministerial committee with central and local government representation to oversee and coordinate the activities of various agencies engaged in water resource planning and management.

(c) Phase III. Set up interministerial boards with strong provincial government participation to guide the development of river basin or regional entities with responsibility for water resource planning and management.

(d) Phase IV. Strengthen the river basin entity and increase its links to provincial and local governments. Central government representatives would serve in an advisory capacity. In selected cases, such an entity could become a River Basin Enterprise (RBE).

These phases or steps are not mutually exclusive. Different river basins might require different solutions, and at any time, river basins might be at different phases of development. Over time, however, there would be an evolution towards an entity which is increasingly comprehensive and autonomous.

4.41 Water resource planning and management for most river basins have not yet entered Phase I, but some basins are moving in that direction. The main emphasis is on coordination between central and local agencies, and on developing the capacity for integrated water resource planning in DGWRD. Over the medium-term, as water resource management moves toward Phases II and III, effective interministerial boards may emerge which would coordinate the management of water resources between the many central and local agencies involved. As these boards become increasingly dominated by local governments, provincially-based river basin enterprises could be formed particularly in basins where competition among water users is most intense. In parallel with this process, farmer participation and responsibility must be strongly encouraged.

Improving Existing Arrangements

4.42 New institutional arrangements and coordinating mechanisms take time to develop. In the short run, sectoral agencies with strong foundations, good technical staff and historical functions will have to be relied upon as much as possible. DGWRD will have to play a major role in coordinating integrated water resource planning. It will also have to take into account municipal needs and water quality. Both are within its legal mandate, but have not received due attention in the past. Local institutions and related sectoral agencies also need to be strengthened to provide the inputs needed for planning, management and operations. Specific steps to improve the performance of existing institutions are as follows.

4.43 To improve the water-use efficiency of irrigation, the PRIS should have a water resource center or a "water operations" division to estimate crop areas and water requirements, field application and conveyance losses, and water inflows and outflows throughout the system. To do this, the PRIS needs more staff with higher technical capabilities who can follow operational guidelines and standardize data collection and water scheduling practices for

better water management at the subdistrict and village levels. To date, this work has been carried out by central government staff and consultants. The provincial agricultural services which are responsible for advising farmers on water matters also need staff upgrading.

4.44 The body most suited to integrated water management at the local level, the Irrigation Committee, is currently only charged with matters related to irrigated agriculture, and most committees are very weak. The committee's effectiveness could be increased if (a) it were provided with a secretariat with a permanent staff and adequate budget and (b) its functions were extended to the day-to-day management of all water use in each subsystem. Such an extension of function would fit Government's present policies of decentralization. At the same time, the provincial BAPPEDAs (as well as BAPPENAS) would need to develop capabilities to review and help integrate investments in the water resources sector as a whole.

4.45 To improve water-use efficiency, Government also gives priority to an integrated policy for the development of water-user associations, including better representation of farmers in the preparation of cropping and irrigation schedules. The Bank-assisted Irrigation Subsector Project, with assistance from Ford Foundation specialists in community organization, aims at turning over most irrigation systems serving fewer than 150 ha to WUAs within Repelita V. WUAs would also be established at the system/district level in pilot areas for the introduction of irrigation service fees.

4.46 In municipal areas, improved coordination is required between those enterprises associated with municipal water supply (PDAMs), surface water quality (MPW), and groundwater abstraction (DEG). Master plans which inventory resources, project demand and promote efficient use through appropriate incentives and user charges are required in many cities. Development of such plans is particularly urgent in cities where groundwater resources are being depleted by overuse.

4.47 Institutional development will also require a parallel effort to improve water resource planning. Such planning should weigh the benefits, costs and environmental impacts of alternative water uses, then design physical systems and policy measures to optimize the net benefits while maintaining (or improving) environmental quality. To carry out such planning, guidelines from the central government are needed to harmonize sectoral concerns. Such guidelines would help ensure that water resource plans prepared for basins and regions:

(a) are consistent with and flow from national plans and development objectives;

(b) are prepared on a common basis (regarding such parameters as discount rates and time horizons) yet reflect local and regional differences;

(c) meet the needs of multiple users in an optimal way, adequately taking trade-offs into account;

(d) are comprehensive in their concern for upper watersheds, rivers, estuaries and bays, groundwater and surface water, and the needs of rural and urban populations; and

(e) respect and foster Government's policy for devolving development responsibilities to provincial and local governments.

The guidelines for planning should also prescribe a mechanism for optimally allocating funds to the water resources sector, setting out economic, social and environmental criteria for judging alternatives and for prioritizing.

Table 4.14: ILLUSTRATIVE ECONOMICS OF RIVER BASIN APPROACH (for Solo, Brantas and Citarum)

Item	Expenditures (Rp billion)	Revenue Sources: GOI subsidy (Rp billion)	Revenue Sources: Local or user finance (Rp billion)
Present levels of expenditure for O&M and capital works	62.1	48.8	15.5
Needed expenditure and sources under present arrangements	136.8	121.3	15.5
Expenditures and revenue sources under a River Basin Enterprise	121.3	56.3	65.6
Savings	15.5	-	-
Subsidy reduction	-	75.0	-
Additional income	-	-	40.1

Source: Bank estimates based on existing operating costs and estimated pollution charges from developed countries adapted to Indonesia.

River Basin Entities

4.48 There are institutional and economic advantages to water resource management on a river basin or regional basis.6/ An analysis of the cost of integrated water resource management under a state enterprise indicates that there could be a significant reduction in the level of central government subsidies for three large basins (Brantas, Solo and Citarum). The analysis shows that even with increased services related to pollution control and water

6/ A regional approach is desirable in certain areas where several rivers serve one region, as in the Jabotabek region.

supply for urban areas, the subsidy from the central government could be reduced by more than half (Table 4.14). The economies of scale are derived from reduced staff numbers and lower operating costs for irrigation, water supply, hydropower and water quality control. Additional income would be mainly from pollution charges and water supply charges for urban areas.

4.49 At present there is only one river basin entity in Indonesia, the Jatiluhur Authority. The Jatiluhur Authority does not have comprehensive legal powers, is a weak form of state enterprise, and is not multisectoral, i.e., it has only a limited mandate for hydropower, flood protection, industrial wastes and coastal water quality. It manages major irrigation infrastructure, such as the Curug pumping station and the irrigation and water supply canals, but leaves the actual management of irrigation water to the provincial government.

4.50 Current opinion within DGWRD is that legally constituted river basin authorities, like the Tennessee Valley Authority in the United States and Damodar Valley Authority in India, cannot be duplicated in Indonesia because of strong opposition from local governments. Instead, the proposed river basin entities would be intermediate organizations linking central and local government authorities throughout the river basin area. DGWRD has several project offices organized along river basin lines which are managing and operating irrigation and flood control projects. Although their current operations are limited and exclude municipal and industrial water supply and water pollution control, these project offices comprise the rudiments of a basin entity. Several could continue to function with central government support and take on an expanded role in water quality control.

4.51 Under the present constitution, responsibility for water resource management can be delegated to a state corporation (such as a Perum) with the objective of providing public services as a public utility operating without subsidies. At present, one river basin project office (Brantas) and one semi-autonomous basin enterprise, the Jatiluhur Authority, are under consideration for conversion into a genuinely autonomous entities. Both basins are in water-short areas with some of the highest levels of pollution in the country. Both river basins also have multipurpose operations for power, raw water supply, flood control and irrigation.

4.52 Mandates for river basin entities (RBEs) may vary in accordance with needs and local realities. One possibility is a relatively weak mandate and structure where the RBE would be directed by a steering committee. It would be responsible largely for operations and coordinating the activities of sectoral agencies within the central, provincial and local governments to ensure that multipurpose needs are met. It would have a small technical staff and use the technical units of existing government departments for analysis, monitoring and enforcement.

4.53 Under a stronger mandate, the RBE could be provided a firm legal basis, directed by a board comprised of one or more ministers and the provincial governor and managed by a managing director. It would have responsibility for water resource planning, design, construction, management and operations and have a comprehensive technical staff relocated from other agencies

to perform these tasks. It would also have the authority to borrow and impose user charges and the power to set standards, issue licenses and enforce compliance regarding location of infrastructure, raw water abstraction, waste discharges and other concerns.

4.54 In both cases, basic operating functions would include:

(a) wholesale supply of surface water for irrigation, industry, municipalities, hydropower, waste assimilation/dilution/disposal and other uses, with due consideration to efficiency and environmental quality;7/

(b) operations for drainage and flood control;

(c) allocation and control of groundwater abstraction, with due consideration to conjunctive surface/groundwater use and water quality protection, and using DEG for monitoring and technical support;

(d) issuance of standards, licenses and permits for surface and groundwater abstraction and liquid waste disposal; the imposition of tariffs or fees for water use and waste disposal;

(e) monitoring of water quantity and quality;

(f) advice to provincial and local governments on land use and zoning to optimize water resource use and protect water quality;

(g) review water resource development plans of other agencies to achieve economic, social and environmental objectives.

Secondary areas of operation could cover watershed management, navigation, fisheries, and recreation.

4.55 Financial Autonomy and Water Charges. There are two financial principles fundamental to an autonomous river basin entity.

(a) Charges levied should contribute to the costs of water resource management and pollution control. Income should be sufficient to maintain the assets, make adequate allocation for depreciation and cover the costs of servicing loans. This in turn will enable authorities to borrow in their own right to finance new investment. Financial projections for prospective entities for Brantas and Jatiluhur indicate that sufficient revenues can be generated for power, municipal and irrigation water supply and waste disposal charges to at least cover operating costs. (Flood protection costs should, for practical reasons, be recovered from property taxes on improved land).

7/ The operations of power plants, irrigation distribution systems and municipal and industrial treatment and distribution systems would remain with the user entity.

(b) Individual charges should reflect the economics of supply. If available quantities are limited, tariffs should by set at levels which encourage efficient water use for the benefit of all users. Wastewater treatment and/or disposal charges and fines should discourage the uneconomic disposal of waste and help ensure that ambient environmental quality standards are achieved.

4.56 Since investments in the water sector are long-term, detailed financial projections for prospective RBEs should be prepared. These should take into account water resource plans as well as pollution control activities, together with other specific obligations (e.g., hydroelectric generation, irrigation schemes, raw water treatment plants). The financing of urban flood control, capital expenditures and operating costs should be recovered from local authorities benefiting from the schemes. In general, the basin entities will undertake new schemes or maintain existing schemes at the request of the local clients, allocating costs commensurate with benefits. Cost-sharing among users would in particular affect irrigation water, for which there is now no charge.

4.57 The Bank recognizes that institutional change will be difficult; that it is not generally desirable to create new agencies; that change must be carefully considered, discussed, derived from consensus, and phased. But this analysis suggests that the present institutional structure requires reconsideration. The success of river basin entities in other countries suggests that the approach in Indonesia, properly executed, would help to solve the pressing need for municipal and industrial water for the country's two largest cities, Jakarta and Surabaya; would reduce central government subsidies for many completed water resource development works; and would help reduce water pollution around waterways and rivers.

Dams and Reservoirs

4.58 Dams involve enormous capital investment and high social and environmental costs. Therefore, measures to improve the water-use efficiency and ensure appropriate allocation are far more cost-effective. Nevertheless, the analysis carried out in this report provides an argument for dams in highly selected cases. Where appropriately planned and managed, dams can be used to alleviate water shortages, protect downstream areas from flooding, and provide power and other needs.

4.59 Alleviation of Water Shortages. The water balance model used in this report suggests that the construction of additional reservoirs could potentially relieve water shortages in some critically short areas. For example, the Parangbadak reservoir on the Cisadane River, the Jatigede reservoir and the Kedung Ombo reservoir are able to change the water balance from a shortage to marginal shortage or surpluses if accompanied by increased irrigation efficiency. In other areas, little more can be gained by new reservoirs (Table 4.9). In Brantas (East Java), for example, only 6% of water flows are currently unregulated, so virtually all improvement must come from increased efficiency in water use or from costly interbasin transfers.

4.60 Protecting Flood-Prone Areas. In addition to supplying water for municipal and industrial use, dams can also reduce flooding. It is of

interest that the areas with the greatest water shortages in Java are also the most flood-prone. On average, about 5% of Java is subject to severe river floods. 8/ Annual direct damages due to floods amount to about US$150 million and annual investments in flood mitigation on Java have averaged about US$30-40 million during Repelita III and IV. The major problem is high surface flows in the wet season due to high rainfall and little natural storage in the catchments. During the dry season, the river flows are reduced to negligible amounts and cause local shortages. Map 21068 shows the major flood-prone areas subject to high flood damages. All are either close to major cities or transportation links. The only solutions for reducing floods are to contain the water through levees or to build artificial storage, e.g., dams for flood control. Government has not focused on flood control measures to date. Such projects have had low priority since they are not within a productive sector.

4.61 Multifunctional Use. If dams are proposed in the future, it will be necessary to give far more attention to the multipurpose use of reservoirs. Currently, reservoirs are primarily used for power generation (operated by PLN, the state electric company) or for irrigation and drinking water supply (operated by MPW). True multipurpose operation does not occur. Although hard to quantify, current operational policies and methods could be improved significantly, with important benefits for the nation. In a nationwide 1983 survey, PLN listed potential hydropower sites, including about 30 "promising" sites in Java. However, the criterion used in this selection was cost per kWh. It is now necessary to add the benefits for public water supply, irrigation and flood control as criteria and to review environmental and resettlement costs carefully in order to determine what sites, if any, should be developed for multipurpose operation. For the northern part of West Java, this will be carried out in the framework of the Cisadane-Cimanuk Integrated Water Resources Development Project. A similar study is recommended for Central and East Java.

8/ Flood-prone areas cover 671,000 ha, including 26,000 ha in DKI Jakarta, 256,000 ha in East Java, 223,000 ha in Central Java and 166,000 ha in West Java.

V. WATER QUALITY ISSUES ON JAVA

A. Sources and Extent of Water Pollution

Sources of Water Pollution

5.1 One of the most important and least appreciated benefits of water is its ability to flush, diffuse and degrade human and industrial waste. This capacity has been recognized for millenia and is used by all societies. However, failure to manage this process can lead to pollution levels which exceed the capacity of water to handle them. The main sources of water pollution in developed and developing countries are generally from agriculture, erosion, and domestic and industrial effluents.

5.2 Indonesia is fortunate that agricultural chemicals are not a major contributor to water pollution. A detailed evaluation of runoff of agricultural chemicals, including pesticides and fertilizers, was made in 1983 as part of the environmental impact assessment (EIA) of the Bali Irrigation Project. This showed that while pesticide runoff in Java had generated very severe ecological damage over the years when "hard" (nondegradable) pesticides were used in government subsidized programs, little damage had been reported since the Government introduced degradable pesticides in the early 1970s. The Bali assessment, the 1986 Segara Anakan Phase I report and the 1986 Jatigede EIA all confirm that neither pesticide nor fertilizer runoff has resulted in significant impairment of river water quality. However, "hard" pesticides are still available on the market and continued monitoring of their use is important.

5.3 Silt runoff from upper watershed erosion due to road construction, human encroachment, deforestation and removal of surface protective cover can cause major problems in the downstream lowlands. These problems include increased turbidity which damages aquatic life, increased water treatment costs, increased siltation with resulting flooding and navigation hazards, and dredging costs for removal of deposited silt. Quantification of these effects, carried out in conjunction with the watershed management section of this report, suggests an annual cost to the economy ranging from US$25-90 million.

5.4 Organic pollution from human waste and garbage is a major problem. Western-style, waterborne domestic sewerage systems are rare and limited in scope in Indonesian cities. Moreover, water supplies are generally inadequate to support large flush-based systems, and the high cost of these systems limits their use to higher-income groups. Adequate treatment of waste water to render it acceptable for discharge is even rarer, although some cities (e.g., Jakarta) require large waste producers, such as hotels and office blocks, to install on-site treatment facilities. Even then, improper design and operation of such facilities often results in the discharge of large volumes of pollutants into surface and groundwater.

5.5 The principal means of waste disposal is on-site septic tanks or pit-leaching systems in higher-income areas, or direct discharge into drains and water courses in poorer areas without adequate toilet facilities. However, accumulated sludge from pits and septic tanks may not be removed, reducing

Table 5.1: SELECTED EFFECTS OF TOXIC CHEMICALS ON HEALTH AND THE ENVIRONMENT

Chemical	Carcinogen /a	Teratogen /b	Other	Environmental effects
Cadmium	X	X	Suspected causal factor in many human pathologies: tumors, renal dysfunction, hypertension, arteriosclerosis, weakened bones (Itai-itai disease)	Toxic to fish, accumulates in aquatic organisms
Copper			Gastrointestinal irritant, liver damage	Toxic to fish
DDT	X	X	Tremors, convulsions, kidney damage	Reproductive failure of birds and fish, accumulates in aquatic organisms, magnifies in food chain
Lead	X	X	Convulsions, anemia, kidney and brain damage	Toxic to domestic plants and animals, magnifies in food chain
Mercury		X	Irritability, depression, kidney and liver damage, Minamata disease	Reproductive failure in fish, inhibits growth of and kills fish, methylmercury biomagnifies
Polychlorinated biphenyls (PCBs)	X	X	Vomiting, abdominal pain, temporary blindness	Liver damage in mammals, kidney damage and eggshell thinning in birds, suspected reproductive failure in fish

/a Cancer-causing.
/b Inducing birth defects.

Source: U.S. Council in Environmental Quality, State of the Environment, 1982 (Washington, D.C. pp. 120-21).

effectiveness and causing overflow. Collected sludge is, in any event, often improperly discharged into water courses by public agencies and private contractors. Improper disposal of solid waste in water courses is also a serious pollution problem, reflecting the weak development of garbage collection services, especially in congested low-income areas.

5.6 In some urban areas, industrial pollution is almost as pervasive as pollution from human and municipal waste, and its consequences may be more serious. A 1983 study of the Tangerang industrial zone found serious pollution at all 10 monitoring locations. The most alarming finding was the high concentration of heavy metals and other toxic materials in a number of sampling stations along the river. These included excess chromium, primarily used in metal alloys and metal plating; cadmium, used in protective plating and bearing metals; high mercury levels at all locations and more than 100 times the allowable level at one location; and selenium, a nonmetallic element used in the electronics industry for the production of computer wafers. Further observations at the outlet streams of factories indicated that most firms lacked appropriate waste water treatment.

5.7 Table 5.1 provides an overview of the effect of toxic chemicals on human health and the environment. Toxic substances such as organic and inorganic chemicals and heavy metals are especially dangerous, as these pollutants are not fully removed by standard municipal water treatment facilities. Traces of these toxicants can become concentrated in the food chain, potentially exposing human beings to long-term poisoning and chronic disease that may be revealed over time. Analysis of fish and shellfish taken from the Jakarta Bay indicated that World Health Organization (WHO) standards for heavy metals were exceeded in 76% of the samples for cadmium, 51% for copper, 44% for lead, 38% for mercury and 2% for chromium. PCB and DDT in the Bay's waters reach 9 parts per billion, and 13 ppb respectively, exceeding the limit of 0.5 ppb considered to be the threshold of pollution.1/ An emerging concern also involves the long-term effects of the use of chlorine as a disinfectant in public water supply. The greater the pollution, the higher the amount of chlorine required, but such use produces chemical residuals including chloroform, a known carcinogen.

Extent of Pollution

5.8 Table 5.2 shows pollution levels in selected rivers in Java. The most excessive pollutant is human excreta as indicated by fecal coliform, which in places exceeds conventional standards by 1,000 times and more. The BOD (biochemical oxygen demand) and COD (chemical oxygen demand) also exceed conventional standards in all provinces. Map 21264 summarizes the findings of the Institute of Hydraulic Engineering and the Ministry of Health on water quality in the eight major river basins in Java. They show that significant dry season pollution, represented by BOD levels of 3-6 mg/liter, exists in five of the eight river systems in Java, and serious pollution (over 6 mg/liter) occurs in the Bandung/Jakarta/Jabotabek region (Citarum and Jabotabek Rivers), in the Surabaya region (Surabaya River) and around the cities of Solo and Semarang. Surabaya River pollution has seriously impeded the functioning of the main Surabaya water treatment plant, and pollution in the Banjar canal, the raw water supply for Jakarta's water treatment plant at Pejompongan, is so severe that, combined with less than adequate plant operation, piped water in Jakarta must be boiled before use.

1/ USAID, Natural Resources and Environmental Management in Indonesia (Jakarta, 1987).

Table 5.2: POLLUTION LEVELS IN SELECTED RIVERS IN JAVA

	Units	Norm/a	West Java	Central Java	East Java	Problem magnitude
pH value	High	9.0	8.2	8.1	8.1	
	Low	5.0	7.1	7.6	7.6	
Dissolved O_2	High mg/liter	9.0	7.2	7.0	6.7	
	Low mg/liter	4.0	2.6	6.3	4.4	*
BOD	High mg/liter	6.0	36.0	6.8	14.4	***
	Low mg/liter	0.0	1.4	2.2	2.9	
COD	High mg/liter	10.0	17.9	84.7	28.7	***
	Low mg/liter	0.0	6.5	10.9	21.2	**
Fecal coliform	High MPN/100ml /b	2.0	1,700.0	9,200.0	8,600.0	****
	Low MPN/100ml /b	0.0	970.0	130.0	110.0	****
Copper (Cu)	High mg/liter	1.000	0.013	0.026	0.009	
	Low mg/liter	0.000	0.000	0.003	0.003	
Chromium (Cr)	High mg/liter	0.050	0.004	0.037	0.009	
	Low mg/liter	0.000	0.000	0.000	0.000	
Cyanide	High mg/liter	0.050	0.000	0.000	0.000	
	Low mg/liter	0.000	0.000	0.000	0.000	
Lead (Pb)	High mg/liter	0.100	0.051	0.005	0.007	*
	Low mg/liter	0.050	0.000	0.000	0.000	
Free ammonia	High mg/liter	0.500	1.593	0.655	0.588	**
	Low mg/liter	0.010	0.020	0.100	0.133	
Nitrate	High mg/liter	10.000	0.949	1.401	1.500	
	Low mg/liter	5.000	0.209	0.783	0.384	

/a Based on MPE's category B of ambient water quality for treated surface water used for drinking.
/b MPN = most probable number.

* Minor
** Moderate
*** Significantly polluted
**** Serious pollution

Source: Institute of Hydraulic Engineering (IHE).

5.9 The extent and impact of water pollution along Java's north coast is heightened by industrial concentration in the area. Java contains 60% of Indonesia's population, 76% of manufacturing, and 80% of medium- and large-scale industry (Table 5.3). One third of all medium- and large-scale industry is in the Jakarta-Bandung corridor. This concentration of industry, population and pollution from industrial and domestic sources is straining the carrying capacity of the region's ecosystems.

Table 5.3: REGIONAL DISTRIBUTION OF MEDIUM AND LARGE SCALE INDUSTRIES (%)

Province	Number of firms	Employment	Value added
Java	80.1	78.8	76.4
Sumatra	11.0	12.3	13.5
Bali/NTT	2.7	1.2	0.4
Kalimantan	3.1	5.5	6.8
Sulawesi	2.6	1.8	2.3
Maluku and Irian Jaya	0.5	0.6	0.7
Outer Islands	19.9	21.2	24.6

Source: Central Bureau of Statistics.

5.10 The impact of water pollution is also magnified by the following factors.

(a) Physical Factors. As noted earlier, some of Java's lower basins suffer dry season water shortages which reduce the amount of water available to dilute and flush wastes from the system, thereby concentrating pollutants in water courses. In addition, Java's north coast rivers flow outward over the very shallow Sunda Shelf (average depth, 50 meters), which results in slow dispersion of wastes, and allows tidal action to push pollutants back into coastal wetlands and city waterways.

(b) Social Factors. The major portion of Java's urban population is located along the north coast, and many of the poorest people live in the older sections of cities close to the coast where surface water pollution is greatest. Moreover, salinization and pollution of groundwater aquifers is increasingly common, and low-income people are most affected as they have limited access to and are least able to afford piped or purchased water.

Cost to the Economy

5.11 The lack of data makes quantifying the cost of pollution and making a cost-benefit analysis of pollution control difficult. However, some fragmentary data are available. For example, the heavy pollution of raw water sources to the Jakarta treatment plants is necessitating the construction of a US$40 million pipeline from the West Tarum canal to the Jakarta water treatment facility, and the eventual cost of supplying raw water to Jakarta from distant sources is estimated at US$1 billion. The cost of boiling water to make it safe for consumption is estimated in preliminary studies at US$20-30 million per year in the Jakarta area alone.

5.12 Other pollution costs, as yet unquantified, are sickness among the work force and lost production due to waterborne diseases, the cost of medicines and hospital care, the impact on fishing and tourism due to coastal pollution, the reduction in property values along coastlines and water courses, the corrosion of pipes and sewers by water containing industrial wastes, and industrial stoppages due to inadequate raw water supplies. These data can be quantified and would, no doubt, show very large costs to the economy from water pollution. Even without quantification, however, virtually all countries, including Indonesia, have realized that pollution at high levels entails unacceptable social costs.

B. Water Supply and Sanitation

Background

5.13 Water quality and pollution control have historically involved three basic operations: (a) furnishing the community with adequate water supply of acceptable quality (especially safe drinking water); (b) collecting and removing human excreta and other wastes from the community (usually by use of subsurface disposal units or discharge into the nearest drainage channel or waterway); and (c) improving the quality of discharged water and protecting waterways. This involves the treatment of sanitary and industrial waste before discharge; disposal of solid wastes in planned disposal sites (rather than dumping them into the drainage system); and control of wastes reaching the waterways from noncommunity sources (industries and mining, runoff of agricultural waste and watershed erosion).

5.14 In industrialized countries, the provision of safe water was initially of primary importance, followed later by a concern for the removal of human waste from household areas, usually through sewerage systems that carried wastes to nearby water courses. Community concerns about water pollution from sewerage are relatively recent, since it is usually downstream users who are affected. In the United States, for example, while sanitation has been a concern for about 100 years, water quality control has been an issue for about 50 years. In developing countries of Asia today, many of which lack sewerage systems, the priority today is to provide safe water and manage the removal of human waste in congested urban areas. Measures to deal with river pollution have been a second priority. Most Asian cities are making progress on the first, and only some are addressing the second.

5.15 In Java, attention is focused on the provision of safe water and sanitation, as the bulk of the population still lacks these primary needs. There is only a beginning awareness of the need for water pollution control, and this is limited mainly to those regions, such as Jakarta/Jabotabek and Surabaya, in which urbanization and industrialization have produced pollution levels which are impeding community development and damaging rivers, estuaries and coastal waterways.

Water Supply

5.16 At present, Indonesians have limited access to safe water (Table 5.4). In 1980, only 12% of the households in Java had access to piped or pumped water (41% in urban and 4% in rural areas), and in 1986, it was estimated that only about 40% of people in urban and rural areas had access to safe water supplies. This level is very low, even by Asian standards. In India, for example, WHO estimates that 75% of urban residents and 31% of rural residents have access to safe water.

Table 5.4: PRIMARY SOURCES OF DRINKING WATER FOR URBAN AND RURAL HOUSEHOLDS (%)

	Pipe	Hand pump	Wells	Spring	River	Other /a
Urban Households						
DKI Jakarta	30	32	26	-	-	12
West Java	13	12	66	6	1	2
Central Java	23	6	66	3	1	1
D.I. Yogyakarta	11	3	86	-	-	-
East Java	36	6	55	2	-	1
Subtotal	25	14	54	3	1	3
Rural Households						
DKI Jakarta	5	16	70	-	4	5
West Java	2	4	57	28	7	2
Central Java	2	1	63	24	7	3
D.I. Yogyakarta	1	-	75	12	2	9
East Java	2	1	70	19	5	3
Subtotal	2	2	64	23	6	3
Total	7	5	62	18	5	3

/a Rainwater collectors and purchase from vendors.

Source: 1980 Census, Series S, No. 2.

5.17 During Repelita III (1979-84), a basic needs approach to urban water supply was emphasized. About 388 cities with populations between 20,000 and 100,000 were designated as targets for 60% coverage. These targets were to be met by supplying water through new standpipes (50%) and house connections (50%). Midway through Repelita III, Government added 563 subdistrict capitals to its target list for delivery of drinking water through piped systems. These programs were continued in Repelita IV with the objective of 75% coverage by 1989. As Table 5.5 indicates, however, although production capacity has more than doubled since Repelita II, the proportion of urban households with service has been stagnant during Repelita III and IV. This is because urban communities are growing at much faster rates (3-4% p.a.) than the Java population (1.8% p.a.), and because investments in water distribution systems have lagged.

Table 5.5: JAVA URBAN WATER SUPPLY COVERAGE

	Unit	Repelita (five-year plan) I	II	III	IV (est.)
Production capacity	m^3/sec	15.3	20.3	37.7	42.8
Urban areas	Large	68	105	200	388
	Small	nd	nd	390	563
People served	million	nd	nd	12	14
Coverage	%	nd	nd	40	41

5.18 Rural water supply comes from piped water, artesian and dug wells, protected springs, rainwater collection, handpump systems, infiltration and sand filter systems. By 1984, only 27% of the rural population (38 million) had access to some form of protected water supply, and only 4% had access to "safe" water. During Repelita IV the objective was to raise the rural level from 27% to 55%, but this target was not achieved due to insufficient funding, inadequate institutional capacity, and inadequate attention to the role of the community, including its ability to share in the cost.

Sanitation

5.19 The 1981 census indicated that 28% of urban households and 4% of rural households have private toilet facilities with subsurface disposal (mainly septic tanks and pit latrines and a few sewer connections); 15% of urban households and 16% of rural households had private toilet facilities without septic tanks; and 57% of urban and 80% of rural households used shared or public facilities (Table 5.6). In the past decade, urban planners and officials have realized that it would not be economically feasible to install public sewers to serve most urban-dwellers; instead, inexpensive subsurface disposal systems ranging from small bore sewers to pit latrines have been recommended. However, to correct the problem of nonfunctioning subsurface

disposal units, the design and maintenance of such systems will have to be improved so that they function effectively.2/

Table 5.6: TOILET FACILITIES FOR URBAN AND RURAL HOUSEHOLDS IN JAVA BY PROVINCE, 1980

	Private with subsurface disposal	Private without subsurface disposal	Shared, public or other
	%		
Urban Households			
DKI Jakarta	42	12	46
West Java	19	19	62
Central Java	24	13	62
D.I. Yogyakarta	30	17	53
East Java	28	14	59
Subtotal	28	15	57
Rural Households			
DKI Jakarta	23	8	69
West Java	4	5	91
Central Java	3	20	77
D.I. Yogyakarta	6	36	58
East Java	4	23	73
Subtotal	4	16	80
Total	9	16	75

Source: 1980 Census.

5.20 Government's approach to providing water supply, sanitation and drainage in urban areas has been twofold. Conventionally piped water and sewers are provided in city areas where cost recovery can be realized through taxes or user charges. Public taps, pour-flush toilets with pits for disposal, and drainage channels for solid waste disposal measures are being used in the less affluent and more populous areas. The latter comprise the

2/ Indonesia is participating in UNDP's global research on low-cost sanitation techniques. The twin-leaching pit latrine, which requires little maintenance and uses minimal water for flushing, thereby minimizing pollution risks to surface and groundwaters, is being tested in several Indonesian cities. Although not suited to high-rise areas nor to areas with a high water table, it does remedy, at low cost, some problems associated with existing septic tank and open drain systems.

sanitation component of the Kampung Improvement Program (KIP) and represent about one third of total KIP project investments. (See Annex 5, Table 2 for a breakdown of KIP expenditures in Java's urban areas.)

5.21 In rural areas, human wastes are the primary source of polluted drinking water. Shallow wells are particularly vulnerable. Two surveys conducted by the School of Sanitation, Jakarta, showed that a high proportion of wells used for water supply contained fecal coliform bacteria. Such contamination can be prevented by properly locating and constructing latrines, training health workers and educating the public. However, higher investments and improved institutional arrangements are needed for this purpose.

C. Key Issues in Water Supply and Sanitation

Institutional Arrangements

5.22 In the past, the Directorate General Cipta Karya (DGCK) carried out important, centrally funded urban infrastructure programs for water supply, drainage, solid waste management and sanitation, under the Kampung Improvement Program (KIP). However, recent legislation (KEPRES 14/1987) devolved responsibility for the provision of urban infrastructure to the cities and other local governments which fall administratively under the Ministry of Home Affairs (MHA). Under the Government's new Integrated Urban Infrastructure Development Program (IUIDP), central government assistance to local governments is to be based on acceptable (a) expenditure programs, (b) revenue generation plans, and (c) institutional development plans. In theory, such plans must make adequate provision for waste disposal and water pollution control expenditures and for related institutional development.

5.23 Since local governments are generally ill-equipped to develop and implement such programs, technical assistance to local governments will be provided by DGCK under the guidance of an interagency coordinating team (Tim Koordinasi). In close collaboration with the Directorates of Regional Development, the Local Administration in the Ministry of Home Affairs, and the Ministry of Finance, DGCK's Directorate of Water Supply will provide assistance to local governments for major water supply development, including rehabilitation and institutional development. DGCK's Directorate of Environmental Sanitation will also assist cities with human and solid waste and urban drainage programs. At this point, however, neither directorate has sufficient staff, expertise or resources to meet these new demands.

Constraints to Adequate Sanitation Programs

5.24 Design and Technical Constraints. Recent attempts to deliver conventional sewerage systems have been fraught with installation difficulties and problems in achieving adequate operation and maintenance (O&M) or appropriate levels of cost recovery. Therefore, a key factor in Government's ability to provide adequate sanitation and to address pollution control problems is the selection of adequate technology, accompanied by appropriate funding and delivery arrangements. Since low-cost sanitation systems cost about one-tenth that of sewerage systems, the choice of technology also has important investment and maintenance implications for the government.

5.25 Low-cost facilities, limited mainly to public toilet/bathing/laundering facilities, have had a mixed reception to date. The ongoing UNDP project on low cost technology for human waste disposal suggests that low-income communities are willing to participate in the implementation and funding of a mix of individual, joint and public toilet facilities, if community organizations are appropriately involved. Local management and the participation of NGOs such as the Indonesian Women's Movement (PKK) have been key features of successful community-based approaches.

5.26 Program effectiveness had also been limited by diffuse institutional arrangements. At the center, the Ministry of Heath is responsible for programs and projects for simple rural water supply and sanitation schemes, while more technically complex schemes such as piped water supplies are assisted by DGCK. In the regions, local government and community health centers are responsible for simple water supply systems and sanitation, but the capacity of local government to plan, implement and maintain rural water supply and sanitation facilities is limited. Therefore, the technical capacity of the Ministry of Health's Directorate General of Communicable Disease Control and Environmental Health needs to be built up in order to strengthen assistance to local governments and better attract donor support for sectoral development. This effort also needs to be better coordinated with the programs of DGCK.

5.27 Expenditure Priorities. Urban programs are now dominated by water resource expenditures, while those that are more poverty-focused (public health, sanitation and KIP) are in decline. One-third of all public expenditures on urban infrastructure is currently for water supply, reflecting an average annual growth in real terms of 14% since 1984; and urban-related flood protection and drainage account for 18% of expenditures and have been growing at 22% annually. Both have had strong donor support.

5.28 On the other hand, the sanitation subsector, dealing broadly with the problem of large-scale human waste disposal, is lagging badly, thereby contributing unnecessarily to water pollution and negating the health benefits of improved water supply. Although sewerage expenditures have grown steadily (13% p.a.) and are now Rp 30 billion p.a., or 4% of the total, this is from a small base and its impact is limited. Furthermore, high-cost sewerage has only limited applicability in Indonesia at this time. Lower-cost, on-site disposal technologies have greater promise, but public expenditures on them are negligible. The KIP program, once the flagship of Government's efforts on urban poverty alleviation and a potentially powerful means of improving environmental conditions in low-income areas, has been declining at about 4% p.a. (Table 5.7). KIP expenditures now total about Rp 55 billion p.a. or only 6.5% of the total. Solid waste management expenditures, already minimal at Rp 18 billion p.a. (2% of the total), are also declining by 6% p.a.

5.29 Funding contraints in the rural sector are even more severe. At present, some 90% of external technical assistance and capital funding for water supply and sanitation is directed at the urban subsector. Given the number of rural people (some 125 million nationwide), the limited coverage of water supply and sanitation in rural areas and the pivotal contribution of these services to improved human health, and government should vigorously pursue external support for water supply and sanitation in rural areas.

Table 5.7: REAL ANNUAL GROWTH RATES IN URBAN EXPENDITURES (% p.a.)

	84/85	85/86	86/87	87/88	88/89	Average
Development expenditures	23.4	-1.9	-20.1	78.4	-6.9	9.9
Water supply	21.8	15.7	-18.1	101.4	-18.4	13.7
Sewerage and sanitation	25.4	23.6	25.5	51.4	-34.9	13.8
Drainage/flood protection	-7.8	33.4	-21.0	164.2	4.0	21.7
Solid waste	-28.7	-40.2	-25.4	153.1	-9.0	-6.2
KIP	-36.5	33.7	-48.7	47.4	-25.0	-4.3
Roads	115.8	-45.5	-16.8	9.8	13.9	4.1
Planning and engineering	-16.8	128.6	-16.2	40.8	-17.2	13.2
Operations and maintenance	8.1	16.1	-12.7	12.2	17.0	7.6
Total	19.7	2.0	-18.3	61.0	-2.6	9.4

Source: Directorate General Cipta Karya (DGCK).

5.30 Financial Constraints. A continued increase in urban expenditure in Repelita V will depend largely on the ability of local governments to mobilize funds locally, to borrow from the central government for this purpose, and to channel central government funds effectively. The current estimate of urban expenditures including O&M for the final two years of Repelita IV (FY87/88 and FY88/89) is about Rp 1.5 trillion (US$900 million) or about 8% of public capital expenditures, more than a 75% increase over the plan's first three years. This large gain was made possible by substantial increases in foreign aid and complementary budgetary funds from the central budget. BAPPENAS estimates that annual urban expenditures in Repelita V will average Rp 900 billion (US$545 million), thus maintaining expenditures at about the same level in real terms as in the past two years. Although still insufficient in relation to the need, this is, nevertheless, a credible effort towards achieving urban sector goals at a time of serious resource constraints.

5.31 As the resource positions of the central and local governments improve toward the end of Repelita V, the stage should be set for another increase in real urban expenditures to deal with the backlog of services required. By that time, implementation capacity should also have improved. Expenditure by subsector should reflect the recommended change in priorities towards sanitation and waste management and water quality control; and their share in urban expenditures should rise from about 6% to at least 8%. With due emphasis on low-cost technologies, the increases in sanitation expenditures can be kept within manageable limits, and substantial improvements in sanitation should be possible with the resources available in Repelita V (1989-94) and beyond.

5.32 Future Directions. To address water quality and human health problems in the urban subsector in Repelita V, the interagency coordinating team and the agencies concerned with strategy should aim to increase local governments' awareness of the need for expanded expenditures on sanitation and provide the direction and the means for implementing substantial sanitation programs. An appropriate agenda for a special working group of the interagency coordinating team, their consultants, and the UNDP project, would be as follows.

(a) The roles and capacities of central, provincial and local governments in promoting sanitation should be clarified, and DGCK's directorates should be strengthened to allow them to play a meaningful supporting role.

(b) Private sector contributions and NGO involvement in the delivery of suitable programs should be expanded, and mechanisms to do this should be explored.

(c) Appropriate technologies for large-scale, low-cost programs should be promoted; and arrangements for operation and maintenance should be improved.

(d) Priorities should be determined. Large cities such as Jakarta, Surabaya and Semarang and low-income communities, in general, warrant special attention.

5.33 For the rural subsector, Government should build up local capabilities to plan, implement and operate water supply and sanitation programs and facilities, while also building up the Ministry of Health's ability to guide local governments. Community involvement in planning, constructing and operating sanitation programs is needed and can be used to encourage the community to share in costs. Handpump effectiveness can be improved with greater attention to manufacturing quality control, and adequate maintenance arrangements (manpower training, spare parts and community payment system). Finally, additional external resources should be sought for the rural subsector.

D. Industrial Pollution

Surabaya: An Illustrative Case

5.34 Surabaya, Indonesia's second largest city (population 3 million), vividly illustrates the environmental effects of concentrated urban and industrial growth on water quantity and quality. Water availability in the Surabaya area has become a critical problem, and current river flow is insufficient to satisfy demand. Although industrial water is only about 10% of the water demand during the dry season, by 1977 shortages of raw water were so obvious that the Governor of East Java issued a decree imposing a moratorium on the futther development of industries using water from or disposing wastes into the Surabaya River. By the early 1980s, pollution of the Surabaya River had reached such a magnitude that the river had become virtually anoxic and was untreatable by conventional methods.

5.35 The Bank-assisted East Java Water Supply I Project included a detailed study to determine the extent of river pollution, identify the major causes of pollution and recommend a program of abatement. The study found that in spite of the heavy use of the Surabaya River for domestic waste, 80% of the river's pollution was caused by industries located along the lower Brantas and Surabaya Rivers.3/

5.36 Of the more than 70 industries initially investigated, the study found that responses to the legislation governing industrial waste discharges was mixed, ranging from no apparent action at all to provision at one factory of sophisticated pretreatment facilities. Of the 28 firms selected for detailed analysis, it was found that only four (14%) complied with the provincial standard for biochemical oxygen demand (BOD) and 11 (30%) with the standard for chemical oxygen demand (COD).

5.37 An examination of the 28 firms also revealed that four major polluters (22% of the sample) contributed 94% of the total BOD load from industrial sources. The majority of the remainder consisted of minor polluters and two thirds of all industries were responsible for only 1.2% of the industrial BOD load. The study also estimated that if the four problem firms were to comply with the waste water limits specified in the East Java legislation, the total industrial pollution load would be reduced by 75%. To this end, the study recommended an extensive schedule of monitoring and enforcement. The four "gross violators" were to be monitored weekly and the additional 11 firms, which were classified as potential polluters or "medium-scale" polluters, were to be monitored monthly.

5.38 Compliance by the four firms identified in the study was achieved in late 1987 through direct intervention by the Governor's office. One firm, a pulp and paper mill, installed a pollution treatment facility which allowed the recovery of low-grade pulp from its waste water. This recycling of the firm's waste has generated sufficient revenues to offset the installation and operating costs of the waste treatment facility. A second firm, a sugar mill, has diverted its waste water flow into a nearby irrigation channel, thereby lowering the pollution load in the Surabaya river. One firm invested in a waste water treatment facility designed by a local entrepreneur, but the system was inadequate. A treatment system recommended by a foreign consultant has now been put in place. The fourth plant installed treatment facilities in late 1987. In spite of these initiatives, in a very dry period in October 1987, pollution levels were higher than the water treatment plant could handle, and it became necessary to flush the Surabaya River at a cost of about US$1 million. Within two weeks of flushing, river quality had again deteriorated to the previous level.

3/ Industries located along this corridor include pulp and paper mills, monosodium glutamate (MSG) manufacturers, dyeing, sugar mills, tile manufacturers, coconut oil mills, and metal fabrication plants.

Table 5.8: INDUSTRIAL POLLUTION OF JAVA'S NORTH COAST

River	Point	Industrial	Municipal	Industrial waste
		----- COD tons/day -----		% of total
West Java				
Cisadane	Tangerang	75.0	62.0	55
Banjir	Pejompongan	4.0	8.7	31
Sunter	Pulogadung	2.0	4.6	30
Bekasi	Cileugi	3.4	11.2	23
Citarum	Jatiluhur	42.0	68.0	38
Cimanuk	Tomo	14.0	7.0	67
Citanduy	Cikawung	29.0	40.0	42
Central Java				
Serayu	Banyumas	21.0	41.0	34
Progo	Sentolo	5.0	31.0	14
East Java				
Solo	Babat	79.0	44.0	64
Surabaya	Tawangsari	7.0	18.0	28
Brantas	Mojokerto	12.0	4.0	75
	Average			46

Source: IHE Monitoring Data.

5.39 Although this example centers on Surabaya, industry is a major contributor to the degradation of water resources throughout Java. Statistics summarized in Table 5.8 indicate that industrial waste constitutes about 50% of the aggregated pollution load in major river basins. Given the current projections of industrial growth in Indonesia for the next several decades (about 8.5% p.a.) and the current trend of concentrated growth on Java, the situation is likely to deteriorate unless corrective actions and measures are undertaken. While the situation on Java is the most critical, the current trends of industrial growth and insufficient abatement techniques are leading to a similar situation on some of the outer islands.

The Legal Framework for Environmental Protection

5.40 Early Efforts. In 1977, the deterioration in water quality on Java and the increase of water-related diseases prompted the Ministry of Health (MOH) to issue guidelines (173/77) on water quality and discharge limits on industrial waste water. The decree was based upon WHO guidelines issued in the early 1970s. The MOH decree had three categories of water (drinking, irrigation and aquaculture) with appropriate standards for each. In a number of provinces, the MOH decree was modified in a provincial decree which set water standards for the province. These provincial decrees were enacted in all provinces on Java, some provinces in Sumatra, and in East Kalimantan. The MOH decree was binding by default in those provinces which did not establish separate guidelines.

5.41 These decrees were subsequently supplemented by two regulations on water usage: Law 11/1974 and Presidential Decree 22/1982. These two regulations were primarily intended to improve and protect the quality of irrigation water and they empowered the Ministry of Public Works (MPW) to monitor ambient water quality and particular point sources. To date, monitoring for MPW has been carried out mainly by the Institute of Hydraulic Engineering (IHE) in Bandung.4/ The two laws governing water usage also empower the provinces to enforce standards with civil penalties and to charge firms for water usage and waste water discharge. However, neither power has been exercised, and it is generally agreed that water standards are too strict for immediate application. As a result, enforcement of the standards has been virtually nonexistent.

5.42 In response to the impetus from provincial authorities to control the activities of industrial enterprises, the Ministry of Industry (MOI) also issued a decree in 1978 to regulate industrial firms. This decree required each industrial firm to file a report explaining the technology used in the production process and provide a list to MOI detailing the toxic and dangerous substances used or stored at the production facility. Each enterprise was also required to install a system of waste disposal. This decree placed responsibility for environmental management under the relevant Director General in MOI.

5.43 The MOI decree has had two effects on environmental management of the industrial sector. First, the requirement for each firm to have a system of disposal for toxic and dangerous substances has been interpreted as a requirement to install a waste water facility. This has enabled the appropriate licensing authority (MOI, the Investment Coordinating Board [BKPM], or the provincial government) to insist that firms have a waste water treatment facility prior to obtaining an operating license. However, there is insufficient technical knowledge in most institutions to assess whether the proposed technology is appropriate or adequate, and there is no requirement that the pollution control mechanism be sufficient to meet acceptable standards. Second, the institutional arrangements specified in the decree have led to a fragmentation of authority over environmental matters within MOI. Compliance with the other requirements of the decree has been minimal.

5.44 Recent Legislation. In 1982, the legislature enacted "The Basic Provisions for the Management of the Living Environment" (Law 4/1982). Intended as the cornerstone of environmental law in Indonesia, it serves as an umbrella for more detailed implementing regulations and decrees. Among its provisions: (a) the role of the State Ministry for Population and Environment (MPE) as the coordinating ministry for the environment was codified; (b) the provinces and, therefore, the provincial governors, were given executive power over provincial environmental matters; (c) an environmental impact analysis (EIA) was mandated for each project with environmental implications; and (d) environmental protection was to be guided by new quality standards. Each department or nondepartmental agency was made responsible for environmental matters in its particular sector or area, i.e., the Ministry of Industry was responsible for environmental affairs in the industrial sector.

4/ Monitoring is also carried out by the Ministry of Health and by laboratories at the request of a provincial government.

5.45 Environmental legislation was put on a solid legal basis with the enactment of Law 4/1982, but there is a significant unfinished agenda. Draft regulations on water, air and toxic wastes need to be finalized and enacted as soon as possible. The draft water quality guidelines should begin to be used as a benchmark for control of existing industries and as a standard for evaluating and regulating the impact of new firms. The civil penalties prescribed under Law 4/1982 should also be enforced and, if necessary, the license of violators should be cancelled (penalties are not currently used). Existing regulations need to be enforced to convince industries of the Government's commitment to sound environmental practices. Concurrent with a revived program of enforcement, the effort to develop more appropriate, enforceable and comprehensive legislation will need to continue at the national level.

5.46 More recently, Government Regulation 29/1986 was passed which describes a process and an organizational framework to enable central government departments to undertake work on environmental analysis. The new regulations and decrees require that each industrial activity, existing and proposed, complete a preliminary environmental impact report (for proposed activities) or evaluation report (for existing activities). If the industrial activity is deemed to have significant environmental impact, then a full environmental impact assessment is required. For new industrial activities, the decree requires that reports be completed prior to initial operation; for existing industrial enterprises utilizing dangerous or hazardous substances in the production process, these reports must be completed by June 5, 1990; and all other firms must submit reports by June 5, 1992.

5.47 Coordination of these reports across sectors and within subsectors is the responsibility of MPE. Pursuit of these objectives within a period of five years will be an enormous undertaking and will be impossible to accomplish without significant technical support. Under this legislation, line agencies and the provincial governments are also required to establish commissions to evaluate environmental reports. However, the law and its implementing decrees are unclear as to the division of responsibility among the involved institutions, partly for this reason few agencies have set up the full complement of institutions to date.

Industrial Pollution Control

5.48 To reduce industrial pollution greater attention is needed to:

(a) environmental concerns in industrial licensing;

(b) the Ministry of Industry approval process;

(c) the monitoring of water pollution;

(d) the creation of industrial estates and centralized waste treatment facilities;

(e) the targeting of polluters and key polluting subsectors for analysis, technical support and control; and

(f) the possible establishment of a system of effluent charges.

These points are elaborated below. To address the problem adequately, however, these steps must be linked together in a program of pollution monitoring and control.

5.49 Licensing. For new industrial projects, environmental impact is examined at two stages of the approval process. During the approval of the location license (Izin Lokasi) the provincial governor's office determines the suitability of the location for the particular industrial use, and at the second stage a nuisance license is issued. These are the most important points for ensuring that new industrial activities are environmentally sound and comply with environmental regulations. Theoretically, all aspects of the environmental impact of the firm are examined and incorporated into a nuisance license that controls water usage, and air, water and noise pollution. The intention is for most relevant government agencies and departments to participate in the approval process. In practice, however, specific environmental requirements are only beginning to be incorporated into the license review, and once the license is issued, compliance and environmental consequences are rarely monitored. Licensing procedures can be improved under existing conditions, but mechanisms for monitoring remain to be developed.

5.50 MOI Approval. Government Regulation 29/1986 specifies the organizational framework for environmental analysis, and recent work by the Canadian-assisted EMDI project has identified a number of problems in MOI which must be overcome for the process to be effective.5/

(a) Funding. Annual financial needs are far more than current allocations.

(b) Manpower. Effective management will require trained manpower and expertise currently in short supply.

(c) Cross-sectoral coordination. Environmental management in the industrial sector must occur in the regions and include numerous other agencies. Appropriate arrangements for coordination at the provincial level remain to be worked out.

The support provided by EMDI has been extremely useful in clarifying issues and objectives. It should be continued and backed by additional financial resources.

5.51 At present, MOI reviews investment applications and EIAs for domestically financed projects, while the Investment Coordinating Board (BKPM) approves externally financed activities. With the limited skills in environmental management in Indonesia today, strict delineation of institutional mandates is important. At the national level, closer cooperation is needed between the BKPM and MOI to ensure a consistent stance towards the regulation of industry and the environmental impact assessment process. Establishment of a separate institutional apparatus in BKPM for examining the environmental impact of investment proposals duplicates efforts

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5/ Environmental Management Development in Indonesia (EMDI) is a joint project of the MPE and the School for Resource and Environmental Studies, Dalhousie University, and is supported by the Canadian International Development Agency (CIDA).

underway at MOI. It is therefore recommended that BKPM use MOI for evaluation of individual applications and EIAs.

5.52 Monitoring Industrial Pollution. After an industry begins operation, there is little systematic monitoring of effluent discharges. Ambient water quality is monitored at the national level by IHE and at the provincial level by laboratories of the Ministry of Public Health, but facilities, manpower and funding are spread too thinly to be effective. Moreover, no effort is given to relating changes in water quality to particular point sources. Without this link, and without a systematic program of monitoring of industrial firms, the licensing control exercised by the province, MOI or BKPM is ineffective in addressing problems of water pollution, as firms have no incentive to adhere to established guidelines.

5.53 The most experienced and best managed water quality laboratory in Indonesia is the Environmental and Water Quality Laboratory in IHE in Bandung. This laboratory has also developed training modules for laboratory technicians as well as for sampling and analysis and has a capability for in-house training of laboratory technicians. However, it has had to restrict its work since 1984, because of underfunding and reorganization. There is need to develop and strengthen provincial government programs in monitoring and control and if issues related to IHE's function could be resolved, the agency could take the lead in this effort. IHE should also be established as the national quality control and reference laboratory for water analyses.

5.54 Industrial Waste Treatment Facilities. The development of industrial estates with centralized waste water treatment facilities provides a cost-effective solution for waste water management. One industrial estate in Surabaya, (P.T. SIER), is an excellent example of a cost-effective water treatment program for a group of industries. First, the industrial estate specifies minimum standards for each firm's waste water; firms exceeding these levels must invest in pretreatment facilities. After meeting these minimum standards, there is a graduated system of effluent charges for both the quantity and quality of the industrial discharges. The revenues collected from these charges fund the operation of the laboratory and treatment plant. The water discharged from the industrial estate is in full compliance with East Java provincial standards. IHE has also designed and implemented several pilot-scale industrial waste treatment systems and a partially completed treatment plant for an industrial zone in Bandung. Given the centralization of industry, MOI should give increased attention to supporting the development of similar facilities in other areas of industrial concentration. This should be done for both large- and small-scale industries.

5.55 "Pollution Busters." Evidence that only a minority of firms cause a major portion of industrial pollution suggests that a program to identify and eliminate major polluters should have high priority for immediate support. Major elements of a "pollution-busting" program would include identification of major polluters, analysis of appropriate technical interventions and their costs and benefits, and provision of credit to modify existing practices. To carry out such a program, Government would have to identify the appropriate enforcement institution, and technical support would be required to pollution control technologies which would be used by polluting industries. It would also be possible to identify the most significant polluting industrial sectors and to develop appropriate approaches to pollution control in these sectors.

For example, a project to review the petrochemical industry and finance pollution abatement has already been proposed by the Bank.

Pollution Monitoring and Control

5.56 The central government has firmly established the principle of devolution of powers to provincial and local-level government, and enforcement of environmental regulations is clearly the responsibility of the provincial governors. Within this structure, however, actual responsibilities for pollution monitoring and control remain to be specified. A number of organizational options are possible.

(a) Pollution monitoring for water, air and toxic wastes could be carried out by the line agencies with support from IHE and other appropriate laboratories. Data could be compiled by the provincial environment offices (BKLH) and forwarded to the provincial governor's office for information and action. This arrangement is not thought feasible since line agencies lack technical skill and equipment and BKLH is not positioned, nor staffed for the responsibility.

(b) Pollution could be monitored by the line agencies and the data forwarded to a Pollution Management and Control Agency (PMCA) created by the province. This agency would have technical staff to evaluate data and make recommendations to the governor and in due course would be given enforcement responsibilities.

(c) Responsibility for pollution monitoring and control could be given to River Basin Entities in provinces where they exist. This arrangement has the advantage of ensuring high-quality staff and possible self-financing. However, only the largest river basins are likely to have RBEs, and under these arrangements the control of air pollution and toxic waste disposal would be weak.

(d) Pollution control could be given over to a pollution management enterprise, functioning under provincial authority, but with both revenue generating and enforcement responsibilities. This would ensure high-qualify staff and provide the basis for a future agency with regulatory and enforcement authority. While such an agency may be difficult to set up, the P4L laboratory (Applied Research and Development Laboratory for Urban and Environmental Matters) in DKI Jakarta appears to have the potential for expanding functions and responsibilities along these lines.

5.57 Numerous discussions have taken place during the past several years concerning the most appropriate institutional arrangements for a pollution monitoring and control agency. Some guiding criteria have been drawn up during preparation of the proposed Bank-assisted Jabotabek Urban Development II Project to assist policymakers in deciding the preferred option. These are included in Table 5.9. One option that satisfies the criteria well is a public enterprise directly reporting to the provincial governor, which has full powers to implement a system of escalating pollution charges and to provide financial assistance for pollution abatement.

Table 5.9: SELECTED CRITERIA FOR A POLLUTION MONITORING AND CONTROL AGENCY

1. Mission

   - to give pollution control first priority

2. Operational Flexibility

   - to adapt easily to future trends or extend its area of jurisdiction
   - to extend its cover to air and noise pollution, public nuisance and hazardous waste

3. Strategic Positioning in Provincial Government

   - to allow direct access to senior provincial government officials

4. Financial Flexibility

   - to recover costs and be self-financing
   - to apply a system of disincentives through charges
   - to apply an incentive system by redistribution of charges to industry or urban settlements to improve pollution abatement facilities

5. Suitable Salary Scale

   - to attract and retain qualified staff

6. Capabilities

   - to implement an industrial monitoring and control program
   - to implement an analytical quality control program

7. Enforcement Powers

   - to exercise the necessary authority and legal powers
   - to control and enforce conditions for effluent discharge
   - to impose an effluent charging system

8. Transfer of Powers

   - to limit the number of transfers of powers from other agencies

Source: Jabotabek Urban Development II Project.

5.58 Foreign experts may be useful in the process, but Indonesian industrial, academic, and governmental professionals are best positioned to decide the course and design an implementation program. Once a concensus has been reached on the general framework, additional financial support will be required to set up and implement such a program.

VI. INSTITUTIONAL AND POLICY CHANGES IN SUPPORT OF SUSTAINABLE DEVELOPMENT

A. Institutional Arrangements for Environmental Management

6.1 In 1986-87, UNDP supported research on the institutional aspects of environmental management in Indonesia (INS/85/027). Since the Bank did not independently evaluate institutional options, this chapter draws heavily on the UNDP's Environmental Sector Review, Phase II (Kismadi and Graybill, et al., 1988). This section reviews broad issues related to the institutional arrangements for environmental management, followed in the next section by more detailed recommendations on the structure and functions of MPE.

Opportunities for Environmental Management

6.2 There are many possible institutional arrangements for environmental control and management, including the following models:

(a) A strong centralized agency with regulatory and enforcement authority across several sectors. Many developed countries have such agencies (e.g., the U.S. Environmental Protection Agency), but only a few developing countries have had success with models based on litigation and a responsive legal system.

(b) Environmental protection functions located within technical ministries. Many Latin American countries have placed environmental protection in ministries of health or urban planning, and Thailand has located its environmental protection agency within the Office of Science and Technology. Such arrangements tend to focus on one sector to the neglect of others.

(c) Environmental management functions located within the national planning agency. This arrangement is used in India and is being considered in several other Asian countries. Its advantages relate to bureaucratic coordination and budget allocation.

(d) Free-standing ministries without enforcement functions. Generally such ministries have strong advocacy functions and high visibility, but limited budgets and power. They rely heavily on internalization of environmental functions in implementing agencies to be effective.

No one arrangement is best for all countries. Further, the UNDP report indicates that a major factor in the success of any institutional arrangement is continuity over time. In most countries, major changes in organizational arrangements have a deleterious effect on institutional growth.

6.3 Indonesia has an institutional model similar to that in (d) above. The State Ministry for Development Supervision and Environment was formed in 1978. With adoption of Repelita IV in 1983, it was modified, assigned new responsibilities, and called the State Ministry for Population and Environment (MPE). As a state ministry, MPE has no line responsibilities. Its primary roles are to (a) coordinate the formulation of Government policies on population and the environment; (b) develop regulations for implementation by national and local government institutions; (c) provide technical advice and

assistance to line agencies; (d) monitor the environmental performance of departments and provinces; and (e) coordinate the development of environmental awareness and participation.

6.4 Indonesia is not unusual in having a state ministry for environmental protection. It is, however, a pioneer in attempting to internalize environmental functions into line agencies and regional governments. A major instrument for doing this is Regulation 29/1986 which institutes an environmental impact assessment (EIA) process in major line agencies and provides the institutional framework for doing so. Environment institutions are also being formed at the provincial level. If Indonesia is successful in this effort to broaden and decentralize environmental responsibilities and concerns, this will be a significant achievement and its example may serve as a model for other countries.

The Role of the State Ministry for Population and Environment (MPE)

6.5 In the absence of direct implementation responsibilities, MPE's main objective is to ensure that each line agency takes environmental considerations into account. This is an ambitious task and while MPE has had many successes, it is limited by its lack of official authority over other ministries, lack of influence over the budget process which generates priorities for line agencies and by its organizational structure, shortages of technically trained staff and small budget.

6.6 To address these problems, the UNDP report has recommended formation of a "super MPE." This could be done by expanding agency powers in the direction of a full coordinating ministry, such as the Ministry of Economic and Financial Coordination and Development Supervision (EKUIN), with broad policy-making and regulatory functions and powers to intervene in the management of line agencies where necessary. To do this, a super MPE would have to include the participation of key directors general and have a significantly expanded staff and budget. While this recommendation could have a significant impact on environmental management in Indonesia, the UNDP report does not assume that the proposal will be adopted, and subsequent recommendations are colored by the assumption that policy influence, staff and budget resources will remain limited.

6.7 In the absence of a super MPE, the UNDP report recommends that a direct relationship be established between MPE and EKUIN and that closer links be forged with the Minister for Efficient Use of State Apparatus who monitors line agency functions and performance. Such contacts already occur, but could be formalized. Other recommendations intended to enhance MPE's coordinating power, in the absence of an increase in authority, would be an annual consultation of all ministers concerned with environmental affairs and regular meetings with all ministries. To some extent these already occur.

6.8 Equally important, but not covered in the UNDP report, are specific steps to strengthen MPE's influence over the budget process. There are several ways to do this:

(a) by expanding MPE's formal role in the budgetary process in BAPPENAS;

(b) by assigning to MPE critical coordinating functions, e.g., the responsibility for developing a pollution monitoring and control

framework, and the authority to submit integrated budget proposals to BAPPENAS for this purpose; and

(c) by giving MPE a role in mobilizing external resources for environmental protection.

MPE's ability to influence financing will be a major factor in strengthening its status and effectiveness with the line agencies.

Environmental Management in Line Agencies

6.9 Table 6.1 provides a partial listing of agencies with a major role in managing environmental matters. In the past, line agencies carried out their mandates, many of which have a positive environmental impact, without explicit reference to the environment. However, Presidential Decree 29/1986 established a process and an institutional framework for carrying out environmental impact assessment (EIA). In so doing, it has created both problems and opportunities.

6.10 Briefly, the EIA process begins with the screening of investment proposals in each line agency to determine which projects should be exempted from scrutiny, which projects have adverse environmental impacts for which mitigating measures can be readily prescribed, and those with significant adverse impact that require detailed assessment. The full EIA process applies to the latter. This involves the preparation of terms of reference which define the scope and nature of the analysis that should be undertaken by the project sponsors, a detailed environmental assessment report, and an environmental management plan for mitigating the project's negative effects. Also, the project sponsors must prepare an environmental monitoring plan for determining whether the project is complying with the requirements in the management plan.

6.11 In each line agency the institutions legally required to oversee the EIA process consist of:

(a) the environment commission, a high-level body intended to evaluate the environmental implications of projects and to make recommendations on the acceptability of these projects to the minister;

(b) the secretariat, which supports the commission and records its deliberations;

(c) the technical team, which is intended to analyze the environmental effects of specific projects and draft recommendations for consideration by the commission; and

(d) the environmental coordinator's office, which is intended to facilitate communication among the various participants and to oversee monitoring.

Although required under the new legislation, these organizations have only been set up in a few agencies to date.

Table 6.1: PARTIAL LIST OF INDONESIAN AGENCIES WITH ENVIRONMENT AND NATURAL RESOURCE MANAGEMENT RESPONSIBILITIES

Government agency	Environmental support responsibility
Ministries	
Ministry of Agriculture	Renewable resources in agriculture, fisheries, animal husbandry; pesticide regulation
Ministry of Communications	Noise pollution, pollution by transport modes
Ministry of Education and Culture	Environmental education, environmental study centers
Ministry of Finance	Budget for environmental management projects, programs and institutions
Ministry of Forestry	Forest protection, production, reserves and conservation, research, regreening and reforestation
Ministry of Health	Sanitation, food quality, pesticides, hazardous substances management
Ministry of Home Affairs	Supervision of municipal and provincial agencies dealing with environment; land registration and demarcation
Ministry of Industry	Industrial pollution control; hazardous substances management
Ministry of Justice	Codification of environmental law; enforcement
Ministry of Manpower	Occupational safety
Ministry of Mines and Energy	Nonrenewable resources management, environmental geology (including groundwater), pollution control
State Ministry for Population and Environment	Coordination of environmental and population affairs
Ministry of Public Works	Water supply and management, human settlements, city planning, water and air quality, energy management
State Ministry for Research and Technology	Research on ecology, oceanography, natural resource inventory, supervision of research, technology development
Ministry of Trade and Cooperatives	Trade in protected animals and plants
Ministry of Transmigration	Environmental planning for transmigration settlements

Source: State Ministry for Population and Environment.

6.12 The most serious concerns about the EIA process center on the fact that there are many projects to be taken into account, but little implementation capacity. Institutional arrangements are not yet in place, agency staff are not fully familiar with their functions and may be uncommitted to the process, and few consultants are qualified to undertake the work. Since this is the first major piece of environmental legislation in Indonesia, the danger exists that delays and high expectations may reduce the credibility of MPE. To address this problem, the UNDP report recommends that the implementation of PP29/1986 be carried out in phases, with each sector initially assessing in detail only a few high impact projects with potentially significant impacts. The report also recommends that a separate division be created in MPE to guide, supervise and manage the development of the environmental impact assessment process. The Bank strongly supports these recommendations.

6.13 On the positive side, the UNDP report points out that the line agency environment commissions can be used to provide a broader perspective than that entailed by EIA assessment. It argues that the line agency commissions should have a broad mandate to identify environmental issues in each sector and to develop appropriate strategies for addressing them. Since the commissions include high level staff, this would be a major departure from the past practice of assigning environmental matters to a small unit within the line agencies. If followed, this recommendation could significantly enhance attention to environmental issues.

Environmental Management in the Provinces

6.14 The Indonesian administrative structure has been characterized by strong sectoral line agencies and a relatively high degree of centralization of development planning and investment. This pattern has been due to, and perpetuated by, shortages of trained manpower at the regional level and by the absence of a strong independent means of revenue generation in most provinces. Policy-planners are aware of this situation and in recent years Government has gradually been decentralizing decision-making and encouraging local-level revenue generation.

6.15 The provincial government is now responsible for environmental management at the regional level. The authority vested in the provincial governor is wide-ranging: to set standards, to license and check new projects, to monitor adherence to environmental laws and to enforce the laws. The main planning and coordinating agency at the provincial level is the BAPPEDA which works directly under the governor. This agency is organized along the lines of BAPPENAS, e.g., with subsections for economic analysis, infrastructure and agriculture, among others. BAPPEDAs coordinate sectoral agencies in the preparation of development plans and budgets, and they help resolve implementation problems. The BAPPEDA also has an increasingly important role to play in natural resource management, but to do so effectively better cross-sectoral coordination will be required at the provincial level, particularly in land and water management and in pollution control.

6.16 A unit dealing with environmental matters has recently been established by presidential decree in each provincial governor's office. This agency, called the Bureau for Population and Environment (BKLH), is a low-level (third echelon), nonoperational (i.e., advisory and data collecting) group which reports to an assistant secretary in the governor's office. BKLH

has no enforcement power and the manpower and budgets allocated to this bureau are minimal. Its main task has been the preparation of a provincial environmental report which describes current problems and lists the steps being taken to resolve them.

6.17 In many provinces (including all on Java), the provincial governor has also established an interagency coordinating team to assist and supplement BKLH and some have established a provincial environment commission to review EIAs. The coordinating team contains all agencies with expertise or a legitimate interest in environmental matters, and it includes the agencies in charge of licensing activities which affect the environment. Agencies within this group have the responsibility to evaluate standards, monitor environmental activities and recommend corrective actions. In practice, however, the group has no executive authority and little technical capacity. The provincial environment commissions, which are intended to review EIAs carried out by line agencies, have similar membership and some similar functions.

6.18 The UNDP report gives little attention to the BKLHs and none at all to the functions of the provincial coordinating team and the provincial environment commissions. However, there is growing recognition that the low-level BKLHs will have only a limited role in decision-making as currently structured. One possibility for strengthening the BKLH would be to incorporate it directly into the BAPPEDA, with formal recognition of its coordinating role on environmental matters. Whether or not this is done, BAPPEDAs have now been in existence for about a decade and it would be timely to review their structure in order to assess whether it adequately addresses the most pressing cross-sectoral problems related to environment and development. It might be possible to expand the roles of the provincial coordinating team or provincial environment commission to provide cross-sectoral coordination on environmental matters, but this would require new institutional arrangements and administrative support. Therefore, improving the capacity of the BAPPEDA to take environmental matters into account would appear to be more feasible and effective.

B. Strengthening the State Ministry for Population and Environment

UNDP and Bank Recommendations

6.19 During Repelita IV, MPE had four assistant ministers, heading divisions for: (a) development of the natural environment; (b) development of the built environment; (c) harmony of environment and population; and (d) population. There were difficulties with this arrangement. The divisions had little relationship to MPE's major tasks (policy planning, the preparation and evaluation of standards and regulations, etc.); the categories were overlapping (few environmental issues do not affect population and the natural and built environments); and, as a result, each division's objectives were diffuse. In addition, MPE suffered as a result of its inability to attract sufficient technically trained staff; and the budget for all MPE functions, about US$2 million annually, also fell far short of the resources required.

6.20 The UNDP report made a number of recommendations to strengthen MPE. Specifically, it recommended that new divisions be created for:

(a) policy analysis and planning;

(b) guidance and supervision of the EIA process;

(c) regional planning and environmental management;

(d) population and public affairs; and

(e) information management.

Subsequent Bank analysis supported reorganization along these lines, with the addition of a division to establish the institutional arrangements for pollution monitoring and control. Bank experience did not augur well for a free-standing division for information management.

Recent Developments

6.21 Since this report was drafted, the anticipated restructuring of MPE has taken place. Briefly, the reorganized MPE will be guided by a priorities and planning committee directly under the minister and consisting of all expert staff and assistant ministers. This is consistent with recommendations made by both UNDP and the Bank. This committee will be assisted by a permanent policy analysis unit and a high-level policy analysis team. The tasks of the policy analysis team are to:

(a) identify policy priorities and develop policy recommendations;

(b) develop and supervise the work on natural resource economics;

(c) initiate and supervise environmental audits;

(d) develop sectoral, cross-sectoral and regional initiatives;

(e) supervise recruitment and training; and

(f) prepare routine and development budgets.

External support for the work of this team is being sought.

6.22 In addition, MPE will have four divisions, each headed by an assistant to the minister, with support staff, for the following: population; natural resource management; the management of environmental degradation; and support systems for institutional coordination, community participation, information and communications. Their mandates are as follows.

6.23 The major tasks of the Division for Population are to:

(a) analyze population dynamics by evaluating policies on population development and planning, and on population in relation to the environment;

(b) monitor quality of life indicators;

(c) prepare socioeconomic assessments related to population distribution and human settlements; and

(d) assess the impacts of development on women and vulnerable groups.

This provides a coherent focus for a rather broad program.

6.24 The major tasks of the Division for Natural Resource Management are to:

(a) develop policies, procedures and planning tools for spatial planning, resource allocation, and resource management;

(b) give guidance on the maintenance of biological diversity to agencies having responsibilities for the management of critical ecosystems, such as national parks and protected areas, watersheds and coastal zones; and

(c) coordinate the assessment of environmental functions and the development of environmental standards.

This division contains a large number of topics, some overlapping with other divisions, and care should be given to defining its focus and consolidating some functions with those of other divisions.

6.25 The Division for Management of Environmental Degradation is primarily responsible for:

(a) further implementation of the environmental impact assessment process through central and regional commissions;

(b) establishing appropriate mechanisms for pollution monitoring and control with an emphasis on water and air pollution and the establishment of enforcement mechanisms; and

(c) control of hazardous and toxic substances and wastes.

This division could potentially establish or form the nucleus of a pollution monitoring and control agency in Repelita V.

6.26 The Division for Support Systems for Institutional Coordination, Community Participation, Information and Communications is in charge of:

(a) coordination and development of environmental information systems;

(b) guidance to regional environmental institutions including NGOs, university environmental studies centers and promotion of community participation; and

(c) coordination of environmental manpower and skill development.

This division has an important role in raising awareness and promoting environmental education and human resource development.

6.27 This reorganization is broadly consistent with the recommendations of both UNDP and the Bank and it covers most essential functions. Given staffing constraints, however, care must be taken to have each division focus on a few critical activities such as EIA development and the proposed spatial planning legislation. The mandate of the division for Management of Environmental Degradation is particularly demanding and some tasks may be beyond MPE's current capacity. This, in turn, argues for a major effort to set up an independent agency for pollution monitoring and control which can be adequately empowered and staffed to carry out functions related to this task.

Ongoing Issues and Needs

6.28 Staffing Constraints. MPE faces serious constraints in recruiting technically qualified full-time staff at the higher echelons. There are several reasons for this. MPE is small, and as a relatively new agency in a very new field, it cannot be expected to have a cadre of trained people rising through the ranks. It must turn outward for qualified staff and attract them from either the private sector or other ministries. In both areas, MPE is at a disadvantage; official pay scales are low in relation to the private sector, and individuals in long-established ministries often enjoy financial "perks" provided in association with project management, which they cannot receive in an agency like MPE which has few implementing responsibilities. There is also an added risk for staff transferring to a relatively new agency and losing seniority in a more established sector. Some individuals with strong environmental concerns are prepared to work with MPE, but only if they can do so while maintaining their other teaching or line agency affiliations. The result is a core group of part-time officials, working at low pay and under considerable pressure.

6.29 If MPE is to function effectively, this situation must change. Some method must be found to make the incomes of senior staff comparable to those in other line agencies and to ensure that the incentives are adequate to attract the caliber of staff needed on a full-time basis. It is possible that donor agencies with strong environmental interests might provide funds for MPE overheads, including staff salaries. In the past, donors have paid honoraria to government officials for work in support of their programs. This practice might be formalized, although it raises equity concerns in BAPPENAS. In spite of the problems entailed, however, this issue must be a key concern of any donor attempting to strengthen MPE.

6.30 Staff Training. Worldwide, few people have technical training in environmental disciplines, and the situation is acute in Indonesia, which has a general shortage of trained people in all sectors. Under the circumstances, there is an urgent need to provide in-service and advanced training to MPE staff. Recognizing this as a high priority, a Canadian-supported team called EMDI 1/ is undertaking assessment of human resources in environmental fields for MPE. The study is intended to:

(a) identify environmental programs in MPE and important line agencies and evaluate current staff levels and qualifications;

1/ The Environment Management and Development (EMDI) Team supported by the Canadian International Development Agency (CIDA) has provided a major portion of technical support given to MPE in Repelita IV.

(b) determine needed technical and managerial skills;

(c) assess in-country and overseas training capacity; and

(d) provide a framework for overall human resource development.

Additional support for subsequent phases of this work is being sought.

6.31 Although formal training will be necessary, there is an even more critical need to develop the means to manage limited staff and resources effectively. To do this, some type of management-by-objectives exercise is needed. Such an approach would help higher-echelon staff identify concrete objectives and the means to carry them out, and, would involve mid- and lower-level staff in defining both agency objectives and the approaches to be followed in realizing them. Where most staffing constraints are insurmountable, this approach is more useful than a static and somewhat theoretical manpower needs assessment. At this point, tackling the problem with existing staff is more important than studying long range needs which will change rapidly.

6.32 Internalizing MPE Responsibilities. As noted earlier, a major task for MPE during Repelita V will be to ensure that environmental concerns are incorporated into the work of the line agencies and provinces. Considerable external support will be needed to develop EIA procedures in key line agencies and to expand environmental awareness and concerns beyond the EIA process. Such support is being provided in a somewhat uncoordinated fashion by ADB, CIDA, USAID, and the Bank, and it would be useful to bring key agencies and donors together to discuss common approaches to the problem.

6.33 The biggest challenge, however, lies at the provincial level. There is an emerging consensus that BKLHs are at too low a level to have any major impact on provincial planning and that alternative institutional arrangements are needed. This could be in the form of strengthening the BAPPEDAs' mandate for sound environmental management, or further developing and expanding the environmental commissions. Since BAPPEDAs already provide planning and coordinating functions, strengthening the BAPPEDA's role on environmental issues appears most promising. In any case, however, the identification and development of appropriate provincial-level mechanisms for environmental management should be a major objective of MPE in Repelita V.

6.34 Enhancing the Effectiveness of the MPE Network. In addition to strengthening MPE, it will also be important to support the work of allied organizations, including the university-affiliated environmental studies centers (ESCs) and environmentally oriented NGOs. Both are potentially important in formulating the policies of MPE and in disseminating key messages to the public. Fifty-two universities have created environmental studies centers, and six, mostly in Java, have acquired sufficient technical competence to be important institutes within their universities. UNDP, the Bank and CIDA have provided support to selected environmental studies centers, but under the current austerity conditions, considerably more funds are needed to maintain a core program, even in the best institutes.

6.35 MPE has also encouraged the work of environmentally oriented NGOs. The main umbrella organization for these groups is WAHLI, the Indonesia Envi-

ronmental Forum. CIDA and USAID have reviewed the NGO activities and concluded that they need more access to better information to be effective. This function should be met by MPE and adequate staff resources need to be dedicated to this task. Both the country and MPE would also benefit if additional funds were available through MPE to support activities proposed by capable, environmental NGOs.

6.36 Donor Support. MPE currently has an annual budget of about US$2 million which is insufficient to cover priority activities. With EMDI support, MPE has identified a number of priority needs, among them:

(a) core support for MPE, particularly for policy analysis, staff training and institutional development;

(b) technical assistance for the development of pollution control standards, licensing procedures, laws and regulations;

(c) technical and financial support for improving environmental management within the line agencies;

(d) support to the provinces for developing environmental institutions. Such support may be possible in connection with bilateral regional development efforts; and

(e) support to the private sector through loans and projects to help meet environmental standards and regulations.

6.37 To date, Canada has provided the strongest support for institutional and human resource development in MPE. In Repelita V, CIDA is committing significant additional resources to strengthen MPE, to support environmental studies centers and the work of environmental NGOs and to improve coastal resource management. Many other donors are also supporting environmentally related activities in the line agencies and in specific projects. The Bank, for its part, is considering a technical assistance loan to MPE for economic and policy analysis, the development of pollution monitoring and control mechanisms, and land resource management. Support may also be provided to develop environmental capacity in the provinces and to strengthen the regional environmental studies centers.

C. Policies for Sustainable Development

What is Sustainable Development?

6.38 Recent thinking has converged on sustainable development as the main unifying concept for environmental management. The Global Possibilities Conference (1985) identified the critical transitions needed for sustainable development (i.e., demographic, energy, resource utilization and political) and the World Commission on Environment and Development (1987) endorsed the concept of sustainable development and elaborated on its meaning. Bank staff have further refined the concept as applied to development projects (Warford 1985, 1986).

6.39 Sustainable development does not negate economic growth, but differs from previous concepts of development in its recognition that world resources are finite. It suggests that wasteful use of existing resources today will cause an unnecessary sacrifice of income and wealth in the future. Commitment to this view implies that some resources should be allocated to exploring these limitations and assessing their implications for policy. The concept of sustainable development also recognizes that forest, land and water resources have important ecological functions which can be measured only partly in economic terms, and it suggests that new knowledge may significantly increase their future economic value. It therefore encourages the commitment of manpower and funds to protect these resources and preserve future options.

6.40 The concept explicitly acknowledges the strong incentives for both individuals and governments to maximize immediate gain. This is true in countries at all levels of development and is particularly true in developing countries which have pressing economic and social problems. For this reason, the concept encourages broad development of awareness about natural resource utilization and an approach to decision-making that ensures broad participation. Finally, the concept encourages looking beyond immediate preoccupations in order to detect unsustainable practices in their early stages when they are easier and less costly to address. This implies moving from micro-level to macro-level analysis where national policies are established, intersectoral conflicts resolved and incentives established that affect private behavior.

6.41 Indonesia has had a longstanding commitment to the concepts of environmental protection and sustainable development. For example, the General Guidelines for State Policy in 1973 emphasized that "exploitation of natural resources should be executed by a comprehensive policy which takes into account the needs of future generations." Indonesia has also had a ministry concerned with environment since 1978, and its minister of environment contributed substantially to the conclusions of the World Commission on Environment and Development.2/ The importance of environmental concerns in Indonesian development policy has been reiterated on the occasion of World Environment Day 1987, in the Jakarta Resolution on sustainable development announced by ASEAN Ministers on October 30, 1987, and in recent speeches by leading economic planners. Sustainable development was the special topic at the donor consortium meetings (IGGI) at the Hague in June 1988; and environmental management is also a major theme in the recently approved State Guidelines for Repelita V (1989-94).

6.42 In spite of these favorable conditions, however, Indonesia like all other countries faces a number of environmental problems. This report has focused on four of the most important:

(a) Deforestation. Deforestation is occurring at high rates, threatening the supply of raw wood material and secondary forest products and reducing ecological services such as the protection of watersheds and preservation of important natural habitat.

2/ World Commission on Environment and Development. Our Common Future, (Oxford University Press, 1987).

(b) Land Degradation. In the outer islands, marginal land best left under forest cover is being converted to agriculture; in Java, good agricultural land is converted to urban use; and in upper watersheds soil erosion levels are high.

(c) Water Shortages. Due to deforestation in the uplands, increasing water demand and increasing surface water pollution, there are surface water shortages in dry years in Java, and groundwater resources around major coastal cities are being overdrawn.

(d) Water Pollution. Rapid urbanization and industrialization along Java's north coast have produced levels of water pollution which are unacceptably high and threaten urban and industrial growth.

Of these issues, the Bank regards problems of deforestation and water pollution as the most urgent, but it recognizes that steps taken to improve land resource management will address both problems of deforestation and land degradation, and steps to improve water resource management will address both water shortages and water pollution problems.

Improving Efficiency in Resource Utilization

6.43 A major theme of this report is that many resource conflicts in Indonesia can be resolved by increasing the potential of existing resources through intensification and greater efficiency of resource use. This contrasts with past policy which has been characterized, to some extent, by a frontier philosophy, one which assumes that conflicts can be resolved by continually expanding the resources used. This philosophy is understandable in a country endowed with ample natural resources, but Indonesia is at a turning point. Resources such as forests, land and water are now becoming scarce and must be managed more effectively if the benefits derived from such resources are to be sustained. Among the tools for improved efficiency are appropriate pricing of resources and more intensive use, as indicated in the sectors reviewed.

6.44 Forestry. Forests, as currently managed, are only partially renewable. This reinforces the need to use the resource as efficiently as possible and to achieve maximum revenue generation from those resources used. Among the areas where efficiency improvements are required are the following:

(a) Log extraction. Logging as currently practiced damages significant amounts of standing timber, due, in part, to the fact that the concessionaire is less interested in future values from the timber left than in immediate gain.

(b) Timber Recovery. After initial selective logging, very little timber is recovered from areas which are cleared for agricultural development. If the timber in conversion forest is not recovered, the total national output will be significantly less than it might otherwise be.

(c) Timber processing. Sawmilling in Indonesia recovers about 43% of the log compared to 55% in comparable developing countries. Thus,

improvements in sawmilling operations alone would increase saw-timber exports and associated revenue generation by 28% from the same volume.

(d) Plantation Development. Appropriately sited plantations could produce 10 times more low-grade timber than an equal area under natural forest, thus providing timber for domestic construction and preserving more valuable tropical hardwoods for more specialized functions. But investment in plantations is not now attractive to concessionaires who have access to an almost cost-free resource in the natural forest.

6.45 Each of these issues is related to an underpricing of timber from the natural forest. To address this problem, this report suggests that stumpage prices should be raised through new taxation measures and timber resources should be managed on a sector-wide basis. As with oil, government should seek to increase its share of rents (profits) and maximize revenue generation. Technical innovations are also needed to improve production in natural and plantation forests and organizational changes are required to improve forest management, forest protection and land classification. As noted in the text, Government has recently taken significant steps to address these issues, although royalties on some processed manufactures such as plywood may still be too low.

6.46 Forest degradation also results where smallholders have no stake in sustainable management of the forest. As noted, forest dwellers cannot extract timber from the forest and they are forbidden from establishing perennial crops in areas in permanent forest categories. Under the circumstances they have little stake in the efficient utilization of standing forests and strong incentives to clear the land for short-term gains. Recognizing smallholder rights to forest products and developing the means to market them would not only increase the intensity of forest utilization, but ensure the broader sharing of benefits, which will be necessary for smallholders to support sustainable forest management.

6.47 Land. Land suitable for agriculture and once thought to be a limitless resource in the outer islands is now becoming scarce; and good land is subject to competing claims, even though only a fraction of the land is under agricultural production. Land in Java is also under pressure for agriculture and for urban and industrial development. In both cases resource conflicts can be eased if efficient land use through intensification is encouraged.

(a) In the outer islands there are 25-30 million ha of land under long-fallow production systems and 3-6 million ha under low-intensity tree crops. For many areas, technologies exist which would permit yield increases to meet crop production targets if security of tenure was assured and there was adequate access to credit and extension.

(b) To meet equity objectives while promoting land intensification, mechanisms must be developed to transfer land, particularly to the landless. This can be done by facilitating the growth of land markets, and by providing credit for land purchase and agricultural development.

(c) There is also considerable scope for improving agricultural production and reducing land degradation caused by soil erosion and by improving technologies for use in marginal lands, such as in most of the outer islands, in the upper watersheds of Java, and in swampy areas. Again, this will require increased attention to research and extension and to land tenure arrangements which provide incentives for good soil management.

(d) Urbanization represents the ultimate form of land intensification and is inevitable along Java's north coast. But tools such as spatial planning, zoning and taxation can be used to limit the conversion of critical areas and to channel development onto appropriate land. Again pricing and institutional changes are also required.

6.48 To achieve more efficient land use, smallholders must have a strong stake in sound land utilization, economic incentives must be provided for sound land management, and improved cross-sectoral coordination and institutional change are required. To identify problems and solutions, this report recommends a review of land use policy to be carried out by the new National Land Agency. It also recommends the development of a capacity in the provincial planning offices (BAPPEDAs) to deal with land use issues. This will require the decentralization of data from line agencies to the BAPPEDAs and significant manpower development at the provincial level. Establishing the institutional framework for improved land resource management should be a major objective of the Government in Repelita V.

6.49 Water. Appropriate pricing and improved management are necessary to improve the use of water resources.

(a) Water for irrigation is the most subsidized of all agricultural inputs. However, efforts recently initiated to promote cost recovery are not linked to the volume of water used and will have little effect on water conservation. To improve water allocation, incentives for conservation should be developed and provincial and local-level management should be improved.

(b) Control of municipal water use is complicated by leakages through tampering and partial payment, which lead to low cost recovery and wasteful use. Groundwater levies are also low and erratically applied outside of Jakarta. This provides incentives to extract water, which lowers the water table and causes saline intrusion.

(c) In many countries, financial measures are used to reduce pollution, i.e., the polluter pays. This essentially recognizes the cost to the economy of mitigation and provides financial incentives for cleanup. To support similar measures in Indonesia new institutional arrangements would be required.

6.50 Several options exist for improving water resource management across sectors. One is to upgrade existing institutions such as Irrigation Committees. Another would be to establish River Basin Entities, particularly in areas with water shortages. The main task of RBEs would be to evaluate existing surface and groundwater resources; to assess the water demand for

agricultural, urban and industrial use; and to develop management and pricing mechanisms to allocate water resources efficiently. RBEs could also produce operating income for water resource management and pollution control by setting water charges to reflect the economics of supply. Expected benefits from river basin management include financial self-sufficiency, development of new water supplies, and increased attention to municipal water supply and waste treatment. RBEs could also play a role in pollution control.

6.51 The management of urban and industrial pollution requires urgent attention. To address these problems, this report recommends the formation of a Pollution Monitoring and Control Agency (PMCA) which either initially, or in the long run, would have enforcement authority and the ability to charge polluters and channel funds into appropriate mitigatory measures. MPE could play a catalytic role in forming PMCA by coordinating line agencies with related interests.

6.52 One possible way to focus line agency attention on the efficiency of resource use would be to encourage them to prepare natural resource audits which would discuss what is known about existing stocks and their utilization. These audits could also explore ways of intensifying resource use. Such a program has been proposed in the UNDP report. The proposed first phase would include only selected agencies and would consist of desk studies to identify gaps in the data base and to isolate major problems. In a proposed second phase, the data would be evaluated in financial terms. (Details are available in the UNDP report, Vol. 3).

Poverty, Participation and the Environment

6.53 Recent environmental literature recognizes the strong links between poverty and environmental degradation and it highlights the need for broad participation in defining and sharing development benefits if sound environmental management is to be achieved. This report identifies several instances of unsound resource use where local people do not directly benefit from existing policies. For example, shifting cultivators have few incentives to manage the forest sustainably, as they cannot realize benefits from doing so; farmers with insecure tenancy have little motivation to invest in soil conservation measures; farmers using irrigation water have few, if any, incentives to use such water efficiently; and urban slum dwellers have little ability and few incentives to manage urban waste in the face of massive pollution by others.

6.54 To address these problems, a broad spectrum of programs is necessary to ensure local-level participation in the design of projects and the distribution of benefits. This is difficult in developed countries and even more so in developing ones. Nevertheless government support to programs for land registration, extension and credit can improve the lives of poor people and projects which significantly increase the incomes of a few beneficiaries should ordinarily take second place to projects with broad income-generating effects.

6.55 In summary, as resources become scarce the emphasis should be on preserving them, not exploiting them for short-term gain. To make this shift, Government will have to allocate adequate financial resources (human and financial) for the sound management of forests, soils and water, and it will

have to develop an appropriate incentive framework to encourage smallholders and others to use their assets in ways consistent with sustainable development. Sustainable development does not suggest that previous patterns of growth were inappropriate for their time or that local people do not care for long-term gains. Rather, it suggests that current practices are no longer sustainable, given the accelerating rate of change in the relationship between population growth and rates of resource depletion. Ensuring sustainable development will therefore require new ways of thinking and acting in the future, and new policies emphasizing long-term growth.

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Contributors to the Report

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5. A preparatory mission was led by Richard Ackermann in May 1987 and a principal mission led by Gloria Davis and Richard Ackermann in August/ September 1987. A draft of the report was discussed with the Government in April 1988 and the final report was cleared with Government in November 1988.

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Definitions of Environmental Terms

Abatement	The method of reducing the degree of intensity of pollution, also the use of such a method.
Air pollution	The presence of contaminants in the air in concentrations that prevent the normal dispersive ability of the air and that interfere directly or indirectly with health, safety or comfort or with the full use and enjoyment of property.
Biological oxygen demand (BOD)	A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. Large amounts of organic waste use up large amounts of dissolved oxygen, thus the greater the degree of pollution, the greater the BOD.
Biodiversity	A characteristic of ecological communities that have a large variety of plant and animal species.
Brackish water	A mixture of fresh and salt water.
Carcinogenic	Cancer-producing.
Carrying capacity	The ability of an area to produce the surplus necessary for its own maintenance. Because external factors fluctuate over time, the carrying capacity also changes.
Dissolved oxygen	The oxygen dissolved in water or sewage. Adequately dissolved oxygen is necessary for the life of fish and other aquatic organisms and for the prevention of offensive odors. Low dissolved oxygen concentrations generally are due to discharge of excessive organic solids having high BOD, the result of inadequate waste treatment.
Ecology	The interrelationship of living things to one another and to their environment or the study of such interrelationships.

Ecosystem	A living (biotic) community (human, plant, animal, marine) in interaction with its nonliving environment. Ecosystems exhibit homeostasis: they contain regulatory mechanisms that tend to maintain equilibrium despite fluctuations in external factors such as temperature or rainfall.
Emission standard	The maximum amount of a pollutant legally permitted to be discharged from a single source, either mobile or stationary.
Environment	The sum of all external conditions and influences affecting the life, development and, ultimately, the survival of an organism.
Environmental services	Beneficial functions performed by natural ecosystems, such as maintenance of water flow patterns, soil protection, breakdown of pollutants, recycling of wastes, support of fisheries and other economically important living flora and fauna, and regulation of climate.
Erosion	The wearing away of the land surface by wind or water. Erosion occurs naturally from weather or runoff but is often intensified by land-clearing practices.
Ground cover	Grasses or other plants grown to keep soil from being blown or washed away.
Groundwater	The supply of fresh water under the earth's surface that forms a natural reservoir for human use.
Habitat	The sum total of environmental conditions of a specific place that is occupied by an organism, a population or a community.
Nonrenewable resources	Includes minerals and fossil fuels whose economically recoverable stock is finite. Also referred to as exhaustible resources.
Particulates	Finely divided solid or liquid particles in the air or in an emission. Particulates include dust, smoke, fumes, mist, spray and fog.
Point-source	In air and water pollution, a stationary source of a large individual emission, generally of an industrial nature. This is a general definition; point-source needs to be legally and precisely defined in government regulations.

Pollution	The presence of matter or of energy whose nature, location or quantity produces undesired environmental effects.
ppm	Parts per million. The unit commonly used to represent the degree of pollutant concentration where the concentrations are small. Larger concentrations are given in percentages. Thus BOD is represented in ppm, while suspended solids in water are expressed in percentages. In air, ppm is usually a volume/volume ratio; in water, a weight/volume ratio.
Raw sewage	Untreated domestic or commercial waste water.
Recycling	The process by which waste materials are transformed into new products in such a manner that the original products may lose their identity.
Renewable resources	Natural resources whose stock can be maintained as long as the rate of exploitation does not exceed the rate of regeneration.
River basin	The total area drained by a river and its tributaries.
Runoff	The portion of rainfall, melted snow or irrigation water that flows across ground surfaces and eventually is returned to streams. Runoff can pick up pollutants from the air or the land and carry them to the receiving waters.
Sewage	The total of organic waste and waste water generated by residential and commercial establishments.
Sewerage	The entire system of sewage collection, treatment and disposal. Also applies to all effluent carried by sewers whether it is sanitary sewage, industrial wastes or storm water runoff.
Suspended solids	Small particles of solid pollutants in sewage that contribute to turbidity and that resist separation by conventional means. The examination of suspended solids and the BOD test constitute the two main determinants for water quality performed at waste water treatment facilities.
Watershed	The area drained by a given stream.

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ANNEX 1
Table 1

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Land Within Forestry Department Boundaries /a
(ha)

Province	Park & reserve forest (1)	Protection forest (2)	Limited production forest (3)	Non-convertible production forest (4)	Convertible production forest (5)	Total area with Forest Department boundaries (6) (1+2+3+4+5)
D.I. Aceh	666,800	1,051,400	1,375,700	188,300	192,700	3,474,900
North Sumatra	253,900	1,391,100	1,349,900	531,500	253,700	3,780,100
West Sumatra	599,700	1,206,600	539,700	596,800	437,700	3,380,500
Riau	267,200	741,800	2,764,200	2,772,900	1,754,100	8,300,200
South Sumatra	796,500	774,700	333,000	2,124,000	1,186,500	5,214,700
Jambi	493,000	1,147,500	974,000	-	1,013,200	3,627,700
Bengkulu	249,900	465,500	242,000	34,100	193,600	1,185,100
Lampung	356,000	315,000	-	573,000	-	1,244,000
Sumatra Subtotal	3,683,000	7,093,600	7,578,500	6,820,600	5,031,500	30,207,200
West Java	196,400	229,500	-	547,900	-	973,800
DKI Jakarta /b	15	-	-	1,100	-	1,115
Central Java /b	3,000	65,000	-	605,100	-	673,100
DI Yogyakarta /b	200	3,200	-	13,200	-	16,600
East Java /b	245,300	255,800	-	847,100	-	1,348,200
Java Subtotal	444,915	553,500	-	2,014,400	-	3,012,815
West Kalimantan	1,336,700	2,047,100	2,988,700	1,323,000	1,508,700	9,204,200
Central Kalimantan	729,400	800,000	3,400,000	6,068,000	3,000,000	13,997,400
South Kalimantan	66,000	432,700	200,600	1,330,400	284,700	2,314,400
East Kalimantan	1,968,600	3,643,900	4,826,100	5,513,100	3,500,000	19,451,700
Kalimantan Subtotal	4,100,700	6,923,700	11,415,400	14,234,500	8,293,400	44,967,700
North Sulawesi	326,600	285,400	741,200	230,500	699,400	2,283,100
Central Sulawesi	616,700	1,156,900	1,364,100	1,028,000	335,000	4,500,700
South East Sulawesi	273,400	420,800	827,100	668,900	699,400	2,889,600
South Sulawesi	189,600	2,004,100	993,100	165,000	259,400	3,611,200
Sulawesi Subtotal	1,406,300	3,867,200	3,925,500	2,092,400	1,993,200	13,284,600
Bali	32,000	84,100	5,700	3,900	-	125,700
West Nusa Tenggara	134,800	481,700	222,800	224,100	195,900	1,259,300
East Nusa Tenggara	131,900	677,600	399,000	278,100	2,801,600	4,288,200
Maluku	441,000	1,550,400	2,075,600	1,029,900	436,400	5,533,300
Irian Jaya	8,311,800	8,648,500	4,732,300	7,123,500	11,775,400	40,591,500
East Timor	38,800	435,300	170,500	45,200	10,000	699,800
Eastern Islands Subtotal	9,090,300	11,877,600	7,605,900	8,704,700	15,219,300	52,497,800
Total	18,725,215	30,315,600	30,525,300	33,866,600	30,537,400	143,970,115

/a Based on Forest Land Use by Consensus Up to May 1984.
/b Land utilization design in Java Island based upon the existing forest land use pattern.

Source: Agency for Forest Inventory and Forest Land Use Planning.

ANNEX 1
Table 2

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Forested Area with Forestry Department Boundaries, Sumatra, Kalimantan and Irian Jaya (km2)

Province	Reserves	Protection forest	Limited production	Regular forest	Conversion	Other	Total
D.I. Aceh	8,134	9,238	12,247	2,048	1,559	5,614	38,840
North Sumatra	2,447	8,968	9,599	3,391	1,332	2,641	28,378
West Sumatra	5,086	9,165	3,635	3,766	2,620	1,471	25,743
Riau	3,502	4,483	14,702	16,691	19,799	1	59,178
South Sumatra	4,581	4,660	1,503	12,371	4,389	8,066	35,570
Jambi	5,326	1,746	3,281	9,417	4,577	3,307	27,654
Bengkulu	2,940	3,761	1,969	208	912	1,481	11,271
Lampung	2,671	715	0	1,129	996	1,057	6,568
Sumatra	34,687	42,736	46,936	49,021	36,184	23,638	233,202
West Kalimantan	13,497	19,544	17,291	11,908	9,958	14,808	87,006
Central Kalimantan	3,349	7,421	29,511	48,039	23,561	0	111,881
South Kalimantan	247	3,326	1,953	9,023	2,051	1,359	17,959
East Kalimantan	16,054	29,791	52,940	41,341	38,457	168	178,751
Kalimantan	33,147	60,082	101,695	110,311	74,027	16,335	395,597
Irian Jaya	61,721	95,083	41,759	70,441	77,940	2,639	349,582
Total	129,555	197,901	190,390	229,773	188,151	42,612	978,382

ANNEX 1
Table 3

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Percent Area Within Forestry Boundaries No Longer Forested

Province	Reserves	Protection forest	Limited production	Regular forest	Conver-sion	Other	Total
D.I. Aceh	3	5	20	26	49	68	32
North Sumatra	4	45	46	37	65	90	61
West Sumatra	7	27	29	36	38	82	38
Riau	15	37	24	8	58	100	40
South Sumatra	37	50	49	42	65	84	65
Jambi	13	12	13	17	42	81	43
Bengkulu	8	12	18	29	45	83	45
Lampung	33	76	na	72	85	93	81
Sumatra	16	33	30	29	58	84	51
West Kalimantan	7	13	44	23	39	69	41
Central Kalimantan	25	5	7	18	47	100	27
South Kalimantan	60	35	18	34	59	87	52
East Kalimantan	4	1	1	7	22	95	9
Kalimantan	9	8	14	17	36	76	26
Irian Jaya	15	13	9	9	19	79	16
Total	14	17	18	18	37	81	31

Source: LRD RePPProt Studies.

ANNEX 1
Table 4

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Rates of Timber Extraction, Year 2000

	1986/87 base line	Low growth with efficiency	Low growth scenario	High growth with efficiency	High growth scenario
Finished Product					
Sawn wood:					
Local	4.80	7.26	7.26	7.26	7.26
Export	2.60	3.18	3.18	5.15	5.15
Subtotal	7.40	10.44	10.44	12.41	12.41
Plywood:					
Local	1.06	2.10	2.10	2.10	2.10
Export	4.24	6.41	6.41	8.39	8.39
Subtotal	5.30	8.51	8.51	10.49	10.49
Roundwood Equivalents					
Sawn wood:					
Local	11.2	13.20	16.88	13.20	16.88
Export	6.0	5.77	7.39	9.36	11.97
Subtotal	17.2	18.98	24.27	22.56	28.86
Plywood:					
Local	2.0	3.89	3.89	3.89	3.89
Export	7.9	11.88	11.88	15.55	15.5
Subtotal	9.8	15.76	15.76	19.43	19.43
Total Extraction					
Local	13.1	17.09	20.77	17.09	20.77
Export	13.9	17.65	19.27	24.91	27.52
Total	27.0	34.74	40.04	41.00	48.29

Assumptions Used in Calculating Growth and Efficiency

Timber product	Low growth with efficiency	Low growth no effici. change	High growth with efficiency	High growth no effici. change
Sawn Wood				
Local % p.a.	3.00	3.00	3.00	3.00
Export % p.a.	1.44	1.44	5.00	5.00
Efficiency of conversion	55%	43%	55%	43%
Plywood				
Local % p.a.	5.00	5.00	5.00	5.00
Export % p.a.	3.00	3.00	5.00	5.00

Source: FAO and World Bank calculations.

ANNEX 1
Table 5

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Comparison of Forest Management Systems at Discount Rates of 6% and 10%

Management system	6% discount rate				10% discount rate			
	Total DPV	Rank	Post-harvest DPV	Rank	Total DPV	Rank	Post-harvest DPV	Rank
Natural Forest Management								
Selective logging	2,409	5	299	3	2,177	5	67	2
Commercial harvest	2,593	3	43	4	2,553	2	3	4
Selective logging with IDM	2,746	2	636	1	2,203	4	93	1
Clear Felling and Plantation Management								
Pulpwood	2,926	1	376	2	2,562	1	12	3
Sawtimber - 10 year rotation	2,419	4	-131	5	2,278	3	-272	5
Sawtimber - 20 year rotation	2,165	6	-385	6	2,130	6	-420	6
Plantation Establishment on Bare Ground								
Pulpwood	376	7	-	-	12	7	-	-
Sawtimber - 10 year rotation	-131	8	-	-	-272	8	-	-
Sawtimber - 20 year rotation	-385	9	-	-	-420	9	-	-
Assuming 1% p.a. Price Increase								
Selective logging	2,705	2	595	2	2,245	3	135	1
Commercial harvest	2,690	3	140	3	2,560	1	10	2
Sawtimber - 20 years	3,300	1	750	1	2,519	2	-31	3
Sawtimber on bare ground	750	4	750	1	-31	4	-31	3

Source: Sedjo, Roger. "Incentives and Distortions in Indonesian Forest Policy." Paper prepared for FAO/World Bank, 1987.

ANNEX 1
Table 6
Page 1

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Priority Conservation Areas for Management and Protection

Reserve	Province	Area	Status	MP/a
Sumatra (A = Aceh, N = North Sumatra, W = West Sumatra, R = Riau, J = Jambi, B = Bengkulu, L = Lampung, S = South Sumatra)				
Gunung Leuzer	A	8,080	TN	Y
Jabung	-	30	CA	N
Singkil Barat	A	650	CA	N
Dolok Sembilan	N	339	SM	N
Kerinci Seblat	W,B,J,S	9,114	TN	Y
Kambang Lubuk Niur (ext. to Kerinci)	W	1,000	SM	N
Taitai Batti	W	965	SM	Y
Kerumatan (Baru)	R	120	CA	N
Siberida	R	120	CA	N
Tg. Datuk & P. Bakung	R	550	CA	N
Berback	J	300	SM	N
Bukit Besar	J	300	SM	N
Banyuasin/Musi River Delta	S	900	CA	N
Barisan Selatan	B,L	3,650	TN	Y
Way Kambas	L	1,235	TN	Y
Bentayan	-	193	SM	N
Java-Bali (W = West Java, C = Central Java, E = East Java, B = Bali)				
Gunung Gede-Pangrango	W	150	TN	Y
Gunung Halimun	W	400	CA	Y
Ujung Kulon	W	761	TN	Y
Kepulaun Seribu	W	1,100	TN/TL	Y
Meru Betiri	C	500	TN	Y
Baluran	E	250	TN	Y
Bromo Tennger	E	580	TN	Y
Gunung Kani-Kelud	E	776	CA	N
Bali Barat	B	570	TN	Y

Source: Based primarily on MacKinnon. MacKinnon, K. "Review of the Protected Areas System in the Indo-Malayan Realm"; IUCN/CNPPA, Gland. 1986.

Reserve	Province	Area	Status	MP/a
Kalimantan (W = West Kalimantan, C = Central Kalimantan, E = East Kalimantan, S = South Kalimantan)				
Gunung Palung	W	300	CA	Y
Gunung Bentuang/Karimun	W	6,000	CA	N
Danau Sentarum	W	800	SM	Y
Gunung Nuit Becapa	W	1,400	CA	N
Tanjung Puting	C	3,750	TN	Y
Bukit Raya	C	1,100	CA	N
Bukit Raya Extn	W,C	5,900	CA	N
Bukit Raya (Extn B. Raya)	W	1,000	CA	N
Sungai Kayan Mentarang & Ulu Kayan Mutlak	E	16,000	CA	N
Ulu Sembakung (Extn to Kayan Mentarang)	E	5,000	CA	Y
Muara Sebuka	E	1,327	CA	N
Kutai	E	2,000	TN	Y
Barito Basin/Alabia Polder & Amuntai	S	3,000	SM/CA	N
Sangkilirang	E	1,000	TN	N
Lesser Sundas or Nusa Tenggara (Represented are the islands of Lombok, Sumba, Sumbawa, Flores, Alor, Wetar, Timor and Tanimbar. Locations of the reserves are spelled out for each entry. Wetar and Tanimbar are included in the Maluku Unit.)				
Gunung Rinjani	Lombok	400	SM	Y
Komodo	W. Flores	340	SM/TN	Y
Ruteng Forest	Flores	300	CA	N
Gunung Olet Sangenges	Sumbawa	350	CA	N
Tambora Utara	Sumbawa	800	SM	N
Gunung Wanggamati	Sumba	60	SM	N
Gunung Mutis	W. Timor	150	SM	N
Danau Ira/Lalore/P.Yaco	E. Timor	250	SM	N
Sulawesi (N = North Sulawesi, S = South Sulawesi, C = Central Sulawesi, SE = Souteast Sulawesi)				
Tangkoko Dua Saudara	N	43	CA	Y
Dumoga Bone	N	3,000	TN	Y
Morowali	C	2,000	CA	Y
Rawa Aopa/Watumohae	SE	1,500	SM/TN	N
Lore Kalamanta (L.Lindu)	C	2,290	SM/TN	Y
Marisa	N	940	CA	N
Gunung Latimojong	S	300	SM	N
Kepulauan Togian	C	to 200 m isobath	TL	N

ANNEX 1
Table 6
Page 3

Reserve	Province	Area	Status	MP/a
Maluku (H = Halmahera, B = Buru, S = Seram/Ambon, BS = Banda Sea, K = Kai Islands, A = Aru Islands)				
Lolabata	H	1,890	SM	N
Gunung Sibela	H	400	CA	N
Gunung Kelapet Muda	B	1,450	SM	N
Manusella	S	1,890	TN	Y
Wae Bula	S	600	CA	N
Gunung Api	BS	80	CA	N
Pulau Manuk	BS	100	SM	N
Gunung Arnau (Wetar)	BS	450	CA	N
Yamdena (Tanimbar)	BS	600	CA	N
Kai Besar	K	370	CA	N
Pulau Kabroor	A	1,700	SM	N
Aru Tenggara	A	2,000	SM/SL	N
Irian Jaya				
Lorentz		21,500	CA/TN	N
Mamberamo-Foja		14,425	TN	N
Pegunungan Arfak		637	CA	Y
Pengunugan Tamrau Utara		2,657	CA	N
Pengunungan Tamrau Selatan		2,479	CA	N
Wasur		4,310	SM	N
Rawa Biru		40	CA	N
Cyclops		325	CA	Y
Jayawijaya		8,620	CA	N
Bintuni		4,500	CA	N
Teluk Cenderawasih		SL+	SM/SL	Y
Jamursba-Mandi-Medi Beaches		24 km	CA	N

/a Management Plan completed: Y=yes, N=no.

Notes: Areas of reserves are expressed in square kilometers; some boundary revisions will be necessary; SL = sea level and reserve area are yet to be determined; the turtle nesting beach is measured in kilometers with area to be determined later.

Conservation areas are classified as follows:

TN	Taman Nasional	= National Park
TL	Taman Laut	= Marine National Park
CA	Cagar Alam	= Strict Nature Reserve
SM	Suaka Margasatwa	= Wildlife Reserve
SL	Suaka Laut	= Marine Reserve

Land Acquisition and Land Registration

1. Land acquisition for development projects is one of the most difficult problems facing Government. It has been cited as a major reason for delays in implementation by the World Bank. In fact, the difficulty of acquiring land in settled areas is a major reason why government agencies look to forested land for development purposes. Complicated land markets also pose problems for smallholders, who find it difficult to identify land and obtain secure title to it. When underutilized land cannot be purchased, they turn to forested land. Thus, to reduce smallholder pressure on the forests, land acquisition procedures must be improved.

Government Acquisition of Land

2. Acquisition with Compensation. The Government acquires land for roads, buildings and development projects through a district land release committee. Government agencies seeking land apply to the Governor who submits the request to the land release committee. This committee, which includes local-level officials and the village head in which land is located, is intended to facilitate land transfer where adat rights are involved and to ensure that both the purchaser and the local people are treated fairly. The committee examines the site, consults with the user and intended user, considers the quality of land, access, buildings, and productive crops and determines the amount of compensation.

3. The land release committee is entitled to receive 1.5% of the compensation price in large land transactions, or Rp one million (US$600), whichever is less, plus another 1.5% for administrative costs. In practice, their share is often higher. To limit abuses, BAPPENAS has set guidelines for Government acquisition and in recent years the provinces have been required to pay one half the cost of land purchase from their own revenues as an incentive to keep prices down. In some areas the system works reasonably well, but unofficial payments intended to facilitate the work of the committee, particularly where private enterprises are involved, drive up the cost of land and cause serious delays, particularly in rural areas of the outer islands. To reduce such problems, the work of the land release committees should be more carefully supervised and independent mechanisms must be developed for appeal and review of land use decisions.

4. Land Acquisition without Compensation. Although government institutions regularly pay compensation for the land required for roads, offices and other infrastructure, they do not pay cash for land used for development projects such as transmigration and NES.1/ In theory, the local people also benefit from the employment and infrastructure which these projects provide, and they can become project participants. This policy reflects Government's view that land is a resource to be used for the good of all people, their concern that cash compensation will increase the cost of land to projects and local people, and the problem of ensuring the appropriate distribution of cash compensation.

1/ Compensation is paid for buildings and productive trees and plants, but not for the land itself.

5. In recent years, however, land has come to have a real monetary value in many areas. Under these conditions, Government's reluctance to pay cash compensation forces development projects into increasingly remote areas and incurs a significant cost in terms of access and forest conversion. To reduce this problem, Government must reassess its position on cash compensation for land and rely more on land markets to obtain reasonable agricultural land. Where cash compensation is involved, Government is well aware that mechanisms must be developed to ensure that compensation goes to the appropriate beneficiaries.

Smallholder Land Acquisition

6. General. There are many benefits to land registration including security of tenure and access to credit. For purposes of this paper, however, the most important reason for an active program of land registration is to permit land transactions. Land has a value related to what it can produce. Where land markets function effectively and arrangements are in place for land purchase and land transfer, land can be upgraded and put into production by those who have the desire, skills and capital. People with claims to such land can be adequately compensated if they choose to sell.

7. Any discussion of land registration needs to be informed by several important social factors. First, not all people are equally prepared to participate in land transactions. Of the 12-14 million families in the outer islands, a million families or so are still relatively isolated from the cash economy. Therefore, any effort to accelerate land titling would be wise to defer registration in such areas, except when specifically requested by the local people. Second, culturally appropriate mechanisms for legal entitlement which recognize the primacy of the community need to be developed. Agrarian law permits registration of community land, but this is not common. A program to do so would be well received in the outer islands since it could (a) provide protection against expropriation to local people and (b) permit transfers agreed by the community, without providing individual titles which could be permanently alienated. Third, not all families have equal access to capital, and any land registration system will only be useful and equitable if parallel programs for credit and/or land purchase are developed which permit poor as well as wealthy people to find land.

8. Land Registration Programs. Indonesia's land registration system provides land titles primarily upon request for documentation of land transfer. About 8 million parcels of land have been officially registered since 1960; but most of these have been in urban areas, and fewer than 10% of rural households are thought to have land title. Recently Agraria has accelerated land titling through the Prona Program (Proyek Operasi Nasional) and some 900,000 titles were issued under all programs in 1985/86. This is a significant accomplishment, but the program has been slowed by recent budget limitations.

9. The most important constraints to land registration are the complexity of the process and the number of steps involved. Table 1 lists the procedures for obtaining title to adat land. Not only are these procedures beyond the administrative capacity of the average rural smallholder, but each step requires official and unofficial payments which frequently exceed the value of the land itself. Under the circumstances, few smallholders are prepared to initiate the process, and they are likely to request title only in conjunction with development projects or a subsidized one-step program, such as Prona. As recent shortages of funds have slowed the Prona program, consideration should be given to attracting external support for this effort.

Table 1: PROCEDURES FOR OBTAINING TITLE TO ADAT LANDS

Procedure
1. Applicant obtains official documents.
2. Applicant files for land title. The application must include: (a) information on the chronological/historical status of land, certified by the village head; (b) a rough sketch of land parcel showing boundaries agreed by the village head; (c) information on land ownership verified by subdistrict head; and (d) certification of tax payment, verified by subdistrict head.
3. The District Agraria Office carries out a field check to identify any adverse claims.
4. The land is officially surveyed and a map prepared.
5. Upon completion, the map and documents are posted in the office of the village head and the subdistrict for 60 days to permit complaint.
6. District (or subdistrict) Office of Agraria prepares a letter of recommendation if no complaints are made.
7. The letter of recommendations is sent to the provincial Office of Agraria for a letter of decision (for non-adat land, the latter is forwarded to Jakarta).
8. The applicant is informed of decision and required to pay fees for the completion of the process.
9. The certificate of title is issued, and a copy is provided to the applicant.

Source: MacAndrews, Colin. "Land Policy in Indonesia," p. 36, 1986.

10. A second serious constraint to the land registration process is reliance on government institutions to carry out the work at all levels. Agraria staff process applications, carry out the cadastral surveys and do land titling. Efforts to encourage Agraria to accept surveys already done by transmigration officials, for example, have only recently been successful. To facilitate development generally, and to reduce delays in development projects, a program to speed and simplify the work of Agraria and to privatize some survey and mapping aspects of the land registration process should be given high priority. Without a responsive land registration system, land markets are distorted, prices are raised, and increased pressure is placed on marginal lands and forest resources.

11. Capital for Land Purchase. As noted, there is a reasonable amount of cleared land available in the outer islands at a price of about US$40-100/ha. In general, however, Indonesian smallholders with household incomes of US$500 annually, barely enough for subsistence, do not have sufficient funds to purchase 2-3 ha. Therefore, to facilitate land transfer, mechanisms must be available to provide capital for land purchase, either through development programs such as transmigration or through standard credit systems.

12. The World Bank's Transmigration Sector Review argues that while more general credit mechanisms for land purchase are being developed, the Ministry of Transmigration should develop a facility to provide funds for land purchase to spontaneous settlers whether from the inner or outer islands. Initially funds from such a facility might be made available to nongovernmental groups (religious organizations, veterans groups and the like), which would guarantee repayment. Loans could be limited to purchases of previously cultivated land in areas where agricultural settlement was to be encouraged and such factors could be taken into account in land titling by Agraria.

13. In the longer run, however, capital must be available to individual smallholders for land purchase through normal credit mechanisms. In the past, Government has been reluctant to provide credit for land purchase on the grounds that smallholders might not repay. However, even if land purchase and land registration cost $200-250/ha and smallholder loans of 2 ha were encouraged, Government's financial outlay for settlement under smallholder credit schemes would be less than one tenth that under transmigration. To facilitate the development of appropriate programs along these lines, Agraria should take a much stronger role in identifying constraints to the development of local land markets and take the needed steps to overcome them. This should include working with development projects and state and commercial banks to mobilize capital for land purchase. Agraria would also be expected to certify that land being registered is unforested and suitable for agricultural production.

ANNEX 3A
Table 1

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Maximum and Minimum Discharge Rate (in m^3/sec) and Ratio QMAX/QMIN for Selected Rivers on Java

River		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Ciujung	Qmax	637	436	651	516	522	697	712	772	nd	1,277	---	---
	Qmin	23.2	24.4	28.0	21.0	10.8	10.3	26.4	12.8	nd	25.3	---	---
	Qmax/Qmin	27.5	17.9	23.2	24.5	48.3	67.7	26.9	60.3	---	50.4	---	---
Cimanuk	Qmax	157	154	254	119	166	119	186	96	130	148	227	226
	Qmin	2.68	7.30	7.60	4.70	3.01	3.20	6.32	4.20	3.20	3.40	3.55	3.40
	Qmax/Qmin	58.6	21.1	33.4	25.3	55.1	37.2	29.4	22.9	40.6	43.5	63.9	66.5
Citarum	Qmax	---	269	323	364	247	290	302	nd	284	276	268	
	Qmin	---	18.7	12.5	13.0	2.6	3.2	nd	nd	4.8	8.0	3.8	---
	Qmax/Qmin	---	14.4	25.8	28.0	95.0	91.0	---	---	49.2	34.5	70.5	
Serayu	Qmax	---	728	1,789	1,503	1,850	1,757	1,946	1,430	2,270	1,475	1,680	1,165
	Qmin	---	106	85.8	42.4	26.0	29.4	59.3	38.2	57.8	96.3	18.6	21.0
	Qmax/Qmin	---	6.9	20.8	35.4	71.2	59.8	32.8	37.4	39.3	15.3	90.3	55.5
Citanduy	Qmax	162	400	277	501	448	408	361	339	107	461	501	---
	Qmin	5.5	5.8	3.4	2.1	1.2	1.5	5.9	2.4	1.3	5.1	0.8	---
	Qmax/Qmin	29.3	70.4	82.4	239	373	272	60.7	144	80	91	626	---
Cisanggarung	Qmax	250	356	357	368	1369	360	370	430	314	392	407	389
	Qmin	2.9	17.1	17.1	12.5	3.4	2.1	9.7	5.3	1.0	6.6	2.0	19.9
	Qmax/Qmin	347	324	476	460	1,538	36,000	411	1,433	inf.	461	13,567	1,341
Solo	Qmax	1,820	1,768	2,395	2,655	1,946	1,306	1,982	2,132	1,715	1,556	1,670	1,286
	Qmin	2.9	17.1	17.1	12.5	3.4	2.1	9.7	5.3	1.0	6.6	2.0	19.9
	Qmax/Qmin	865	208	223	258	427	1,783	299	259	---	465	2,620	---
Madiun	Qmax	519	540	600	474	606	624	751	757	540	526	524	---
	Qmin	0.6	2.6	2.7	1.8	1.4	0.35	2.5	2.9	nd	1.13	0.2	---
	Qmax/Qmin	865	208	223	258	427	1,783	299	259	---	465	2,620	---
Brantas	Qmax	640	630	568	732	553	440	532	608	510	665	550	494
	Qmin	18.5	23.4	51.0	64.7	35.0	68.0	49.0	22.8	13.0	6.0	28.8	31.4
	Qmax/Qmin	34.6	26.9	11.1	9.8	15.8	6.5	10.9	26.7	39.2	110.8	19.1	15.7

Source of Data: DPMA, Bandung, courtesy of Dr. Badruddin and coworkers (September 1987).
Data for the following gauging stations was used for compilation of the Table:

Ciujung : Rangkas Bitung
Cimanuk : Leuwidaun
Citaraum : Leuwidaun
Serayu : Rawalo
Citanduy : Cijolang-Cikadi
Cisanggarung : Pasuruan
Solo : Napel
Madiun : Madiun-Nambangan
Brantas : Kertosono

ANNEX 3A
Table 2

CONSTRUCTION COSTS, CAPACITY AND COST PER CUBIC METER
FOR CHECK DAMS IN CENTRAL JAVA

Watershed	Location	Capacity (000 m^3)	Cost (million Rp)	Cost per m^3 (Rp 000)
Keduang	Semen 1/Ngadirojo	80	283	3.531
Keduang	Semen 2/Ngadirojo	80	283	3.531
Keduang	Banjaran	87	350	4.023
Tirtomoyo	Banaran 1/Nguntoronadi	54	236	4.368
Tirtomoyo	Banaran 1/Nguntoronadi	54	236	4.368
Klampok	Konggojati/Tirtomoyo	115.5	50	450
Tirtomoyo	Batant 1 /Tirtomoyo	80.3	248	3.298
Tirtomoyo	Batant 2 /Tirtomoyo	80.3	248	3.298
Tirtomoyo	Batant 3 /Tirtomoyo	80.3	248	3.298
Tirtomoyo	Tirtomoyo /Tirtomoyo	50.5	211	4.170
Tirtomoyo	Taman 1 /Tirtomoyo	80.3	323	4.019
Tirtomoyo	Taman 2 /Tirtomoyo	80.3	323	4.019
Tirtomoyo	Jobot /Tirtomoyo	56	314	5.160
Baratbanyu	Ngerjo 2 /Tirtomoyo	41.9	88	2.088
Bengawan Solo	Begendo /Giriwoyo	124	209	1.678
Bengawan Solo	Cerme /Giriwoyo	88	116	1.313
Bengawan Solo	Sambirejo /Giriwoyo	64	120	1.875
Lanang	Pasang /Giriwoyo	77	145	1.803
Lanang	Nglaban /Giriwoyo	52	95	1.827
Alang	Pramoon /Pracimantoro	32	112	3.500
Alang	Kedung Padas/Gr. tontro	28	96	3.428
Alang	Xcanding /Giritantra	32.3	68	2.093
Jimba	Banarcan /Pracimantoro	24	88	3.508
Dungprahu	Kedungringin/Pracizantoro	49	120	2.447
K. Bencungan	Bringin /Wuryantoro	-	-	-
Total		1,618.7	4,686	2,895
Average		64.7	187	

Source: Department of Public Works, Solo.

Land and Water Management in Indonesia
Methodology for Calculating Costs to the Economy of Soil Erosion in Java

Introduction

1. Soil erosion is analogous to the depreciation of man-made assets. Unlike the depreciation of capital assets, however, the effects of soil erosion are not reflected in conventional measures of economic welfare. Efficient markets seldom exist for soil resources, because of the pervasive influence of externalities on the true costs of soil erosion, and because systems of national accounts are biased to treat natural resource as free goods. As a result, policymakers do not have the information required to weigh adequately the benefits and costs of alternative soil conservation policies. To attempt to overcome this, a study of the costs of soil erosion on Java was undertaken by the World Resources Institute in conjunction with the World Bank as an input to the Review of Land and Water Management Issues in Indonesia. This annex summarizes the methodology used for this calculation. Additional details can be found in Magrath and Arens (forthcoming).

2. Soil erosion is a physical process which induces economic effects. The detachment of soil and its deposition elsewhere lowers the agricultural potential of a site and sets in motion a sequence that results in a lower economic value of its resource base. In addition, the deposition of eroded material at downstream locations (e.g., irrigation systems, reservoirs, ports and harbors) imposes other costs. Estimating on-site costs requires a methodology that links the physical process of soil loss with the economics of agricultural production. Calculating off-site costs requires identifying affected sites and valuing the impact of sedimentation on the subsequent provision of goods of services from them.

3. Calculating On-Site Costs: The basic requirements for calculating the on-site costs of resource degradation are understanding the physical process of change, understanding the impact of those processes on the production of valued goods and services, and understanding the ways in which economic activity adjusts to these changing circumstances. For this study, these requirements were met by developing three linked models: physical dimensions of erosion, quantitative impact of erosion on yields, and economic impact of productivity decline.

4. To satisfy the first requirement a (geographic information systems) model was used to integrate data on soil type, topography, rainfall intensity and land use to estimate levels and distribution of erosion. Based on small plot and area studies from Java and other tropical countries, the model tries to reflect the impact of the major factors that contribute to soil erosion. The model allows for 5,500 possible combinations (24 soil types x 11 rainfall erosivity patterns x 5 (and uses x 5 provinces). Table 1 summarizes the models predictions for soil loss by broad land use category for the provinces of Java.

Table 1: PREDICTED SOIL LOSS BY REGION AND LAND USE
(million metric tons)

Land Use	Java	West Java	Central Jogyakarta	East Java	Java
Tegal	367.4	150.1	24.7	103.3	645.6
Forestland	5.6	3.9	-	5.4	14.9
Degraded Forest	30.0	1.3	-	2.7	34.0
Sawah	1.1	0.6	.1	0.6	2.4
Total	404.2	156.0	24.8	112.0	697.0

5. To estimate the erosion-induced consequences for crop yield, the second model focused on rainfed agricultural land (tegal).1/ While it is widely accepted that erosion lowers agricultural productivity, there is little agreement on exactly how erosion is related to productivity and the quantitative impact of erosion on yields. Erosion involves changes in the availability and relative concentration of nutrients for plant growth, changes in soil structure which influence root growth and influence water availability. Weathering of subsoil, however, may partially reverse the negative effects of erosion. Few explicit studies of erosion-yield relationships are available for the soils of Indonesia, so experimental data on similar soils in other countries were used as a basis for predicting erosion-yield relations. The loss in yield, based on erosion produced, in the model depended both on crop and soil type and ranged in severity from 0-12% per year. The weighted average annual losses predicted for Java were 6.8% per year for erosion-sensitive crops such as maize, soybeans or dryland rice and 4.4% per year for relatively insensitive crops such as cassava. See Table 2.

6. A final set of calculations, involves an economic model of farmer response to declining productivity. Productivity loss due to erosion can have several effects on farming systems; profits can fall as the result of lower output without major changes in mix of farm activities, farmers can be induced to make sometimes radical changes in the mix of crops and the level of input use, and in the extreme, erosion may lead to complete abandonment. In the uplands of Java all three of these impacts are seen and have been reported by numerous observers.

1/ Due to frequent exposure of the soil surface, tegal is highly susceptible to erosion and because of the value of output is also likely to suffer the greatest losses.

Table 2: AREA AND SEVERITY OF ESTIMATED EROSION-INDUCED PRODUCTION LOSSES ON TEGAL ON JAVA

	Annual Product Loss As a Fraction of Current Total Production /a (%)									
	0.0	0.01	0.02	0.03	0.05	0.06	0.07	0.08	Average Loss (%)	Total Area (00 ha)
	Area (00 ha)									
West Java	5,118.6	32.4	267.8	4,168.0	4,511.0	6,686.1	1,438.1	3,514.5	4.4	25,634.4
Central Java	1,898.1	15.4	1,205.0	2,183.4	1,712.2	2,009.2	1,647.7	609.3	4.1	11,258.2
Jogyakarta	186.7	0.0	258.7	2.1	468.7	1,176.9	0.0	0.0	4.7	2,093.0
East Java	1,841.1	446.1	1,294.3	2,668.8	3,304.0	3,913.9	136.0	0.0	3.8	13,604.5
Total	9,042.5	493.9	3,025.8	9,002.3	9,995.9	13,686.1	3,219.9	4,123.8	4.2	52,590.2

7. The overall impact of erosion-induced losses lowers farm profitability progressively, and gradually leads to the adoption of less and less profitable crop(s). The ability to switch to less demanding, albeit less profitable crop mixes, is a way to avoid some of the costs of erosion. In order to take this cropping systems selection process into account for the four regions of Java, farm-level data from a variety of sources were used to develop sets of enterprise budgets representative of the range found in Java's uplands. These budgets were used to estimate the change in net income as yield declines due to erosion.

8. Table 3 summarizes the cropping systems used to represent land use in each region, gives estimates of their relative occurrence, current profitability, and the impact of a percentage decline in productivity.

9. The estimated cost of a 1% loss in productivity as shown in Table 3 is a function of both current productivity and the structure of production Costs. The higher the output, the greater the loss. However, in addition, the importance of fixed costs relative to variable costs also influences the costs of productivity losses. In cropping systems with relatively large variable costs, farmers are more able to shift resources to other enterprises and thereby reduce the costs of erosion.

Table 3: MAJOR FEATURES OF MODEL RAINFED CROPPING ENTERPRISES ON JAVA

	Crops	Estimated proportion of tegal (%)	Estimated current net income (Rp/ha)/a	Estimated cost of a 1% productivity decline (Rp/ha)
West Java				
I	Cassava, corn, upland, rice and legumes	58	139,496	4,309
II	Cassava, corn and upland rice	27	49,531	3,616
III	Pure stand cassava	15	1,279	1,563
Central Java				
I	Intercropped corn and cassava	57	6,698	800
II	Corn, cassava and legumes	43	10,183	937
Jogyakarta				
I	Intercropped corn and cassava	57	8,220	1~,011
II	Intercropped corn, cassava and legumes	43	11,279	1,047
East Java				
I	Intercropped corn and cassava (level ~@al)	30	298,327	4,926
II	Intercropped corn and cassava (terraced hillsides)	30	58,130	2,876
III	Pure stand cassava (level tegal)	20	145,005	3,746
IV	Pure stand cassava (terraced hillsides)	20	27,806	1,816

/a Net income defined as returns to land and management.

Source: Adapted from Roche, 1984, Central Bureau of Statistics, and data provided by the Agroeconomic Survey, Bogor.

Table 4: PRODUCTIVITY DECLINES AND CAPITALIZED COSTS DUE TO SOIL EROSION ON RAINFED AGRICULTURAL LAND (TEGAL)

Province & Cropping System	Proportion of Tegal (1)	Area /a (00 ha) (2)	Production Loss (%) (3)	Production Loss (Rp/ha) (4)	Total Cost (Rp 000,000) (5)=(4x3x2)	Cost (Rp 000,000) 5:1	Total cost (5)	Capitalized cost
West Java								
I	.58	8,353	4.4	4,309	15,837	158,370	9,598	95,980
II	.27	3,808	4.4	3,616	6,059	60,590	3,672	36,720
III	.15	2,115	4.4	1,563	1,455	14,550	882	8,820
Total Tegal	1.00	14,402	4.4			233,510		141,520
Central Java								
I	.57	7,787	4.1	800	2,554	25,540	1,547	15,470
II	.43	5,874	4.1	937	2,257	22,570	1,367	13,670
Total Tegal	1.00	13,661	4.1			48,110		29,140
Jogyakarta								
I	.57	1,119	4.7	1,011	532	5,320	322	3,220
II	.43	845	4.7	1,047	416	4,160	252	2,520
Total Tegal	1.00	1,964	4.7			9,480		5,740
East Java								
I	.30	5,232	3.8	4,926	9,794	97,940	5,933	59,330
II	.30	5,232	3.8	2,876	5,718	57,180	3,464	34,640
III	.20	3,488	3.8	3,746	4,965	49,650	3,008	30,080
IV	.20	3,488	3.8	1,816	2,407	24,070	1,458	14,580
Total Tegal	1.00	17,440	3.8			228,840		138,630
Total						519,940		315,030

/a Based on Central Bureau of Statistics.

10. The loss of soil productivity and its associated cost is calculated on a single year basis. The total value of that cost to the economy also depends on the duration of the productivity loss and on the social rate of discount. In this study a 10% discount rate was assumed. Table 4 shows how the estimates of productivity losses, cropping system predominance and value of productivity loss are combined to produce an overall estimate of the capitalized on-site cost of erosion.

11. Calculating Downstream Costs. As noted, the deposition of soil at downstream locations frequently reduces the benefits from investments in infrastructure such as reservoirs and irrigation systems. In principle, it would be possible to extend the erosion model described above by specifying transport functions to relate erosion from upper catchments with the delivery of sediment to various receiving sites. However, given the difficulties of adequately specifying these relationships and the fact that data are available on the actual quantities of sediment accumulating in specific locations, such a modelling approach was not employed. Instead, an effort was made to identify major categories of potential damage and to locate whatever evidence was available on their economic significance.

12. The deposition of silt in irrigation channels results in either higher operation and maintenance (O&M) expenditure or lower operating efficiencies resulting in decreased returns to irrigation investments. Studies by the World Bank and others have shown that increased spending on O&M yields high rates of return. There are few definitive data on the costs of siltation of irrigation systems. The few analyses available irrigational O&M costs specify

categories such as wages, equipment, and supervision but not functional composition of O&M works (i.e., silt removal, weeding, etc.). At this time, there are no available data on the physical volumes of silt either accumulating in or removed from irrigation systems.

13. It is possible, however, to approximate the cost of siltation by analyzing total O&M costs and apportioning some fraction to silt removal. A further complication is that current levels of O&M spending are inadequate and fail to maintain irrigation systems in good condition. Based on studies of World Bank-supported irrigation projects and subsector economical analysis, it is estimated that silt management costs between 15% and 50% of the total recommended level of O&M expenditure. For Java, this amounts to Rp 13 - 43.5 billion per year.

14. Further downstream, eroded soil can obstruct ports and harbors, limiting the transport of goods or necessitating dredging. To determine these costs, data were obtained from the Directorate of Ports and Harbors of the Ministry of Communications. These indicated that dredging costs range between Rp 800/m^3 and Rp 1750/m^3 depending on the type of and location of work. Applied to the 1.2 million m^3 dredged in 1985/86, this amounts to US$1.4-3.4 million.

15. Siltation of reservoirs is often listed as one of the important off-site consequences of soil erosion on Java. Developing an estimate of the economic costs of this process again requires data on the physical dimensions of soil movement, on the consequences of siltation on the production of valued outputs such as hydropower and irrigation water, and on the prices of those outputs.

16. An inventory of the major dams and reservoirs on Java, based on data provided by the Ministry of Public Works and World Bank energy sector work, indicates that total installed capacity for irrigation and hydroelectric generation amounts to approximately 278,000 ha of command area and 2.7 million mwh. Extrapolating the estimated effects of sedimentation 2/ from a sample of reservoirs for which data are available suggests that the capitalized value of lost services amounts to Rp 26-124 billion per year.

17. Other Costs: It has not been possible to gather sufficiently complete data on the costs of all of the consequences of upland soil degradation. This should not at all be taken to imply that they are unimportant. Among the costs that have been left out are flooding and irregularity of stream flow that results from deforestation and other forms of poor land use. In addition to the difficulty of obtaining complete data on the extent and cost of flooding, a complete examination of flooding due to erosion costs would have to consider the relationship between land use changes and the frequency and severity of flooding. Similarly, the costs of interrupted stream flows which have caused temporary plant closures on Java, are also difficult to value. In industrial applications, a wide variety of responses to irregular water flows is possible

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2/ Which are assumed to be linear functions of reservoir capacity.

and the time available for this study has not allowed for their systematic analysis. Based on available information, these costs, and others such as pesticide and fertilizer pollution from runoff, and damage to coastal fisheries are clearly important on Java. Future research, which could follow the approach used in this paper, could more correctly document and qualitatively estimate these costs.

18. Summary: Table 5 summarizes total on- and off-site costs of soil erosion as estimated in this paper. For Java, as a whole, these amount to Rp 580.1-710.6 billion (US$352-430 million) which is slightly less than 5% of total agricultural GDP. Over 80 percent of these costs are the on-site costs of declining soil productivity. In addition to these costs, important and probably quite large costs related to soil erosion have not been quantified.

19. This estimate needs to be considered as a provisional one, subject to significant uncertainties. The models developed to estimate erosion and its impact on crop yield, while based on the best available information, indicates the type of additional agronomic and soils research needed to provide policymakers with useful information.

Table 5: TOTAL ESTIMATED COSTS OF SOIL EROSION ON JAVA
(Rp billion)

	West Java	Central Java	Jogyakarta	East Java	Java
On-Site Off-Site	233.5	48.1	9.5	228.8	515.8
Irrigation System Siltation	2.8--9.4	1.3--4.4	0.2--0.8	2.0--8.8	13.0--43.4
Harbor Dredging (1984/85)	0.8--1.5	0.2--0.5	--	1.5--3.7	2.3--5.7
Reservoir Sedimentation	14.8--88.1	5.8--28.9	--	6.2--28.5	28.8--123.6
TOTAL	261.7-312.5	56.4-79.9	9.7--10.3	238.5--267.6	557.9-688.4

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Foreign-Assisted Projects in Java Watersheds

1. Two FAO/UNDP assisted projects provided the initial technical assistance and training to develop strategies and approaches for watershed management during 1973-82 in the Upper Solo basin. The projects had an independent management team working closely with agriculture, forestry and provincial authorities. The second project concentrated particularly on developing methods for securing farmer participation, since the "top-down" approach in the first project was unsuccessful in ensuring maintenance of soil conservation works.

2. The Citanduy Project, which started in 1982 in parts of Central and West Java, is partly funded by USAID and focuses on upland extension and agricultural research; improved upland conservation technologies; model farms for demonstration purposes and upland farming credit programs. The lead agency is the Ministry of Agriculture (MOA). Difficulties have arisen in the project from the rigid application of a standard conservation approach, for example, using the same type of bench terracing on volcanic and sedimentary soils. Soil surveys, land evaluation and planning are now being carried out in order to develop appropriate techniques to be applied to different conditions. Sustainability is also an important issue, as some model farms operated successfully for the first two years, while inputs were supplied by the project, but afterwards failed when farmers tried to continue without the necessary inputs.

3. The IDA-assisted Yogyakarta Rural Development Project started in 1979 under provincial authorities. The project was to test and introduce new agricultural technologies and soil conservation measures for upland farming; to expand income-generating activities in agriculture, fisheries, livestock and small-scale industries; to develop low-cost technologies for rural road construction; to improve health care and to provide drinking water. The project has been successful in introducing better cropping systems and other rural development activities. Soil conservation work has been less successful, especially the construction and maintenance of waterways and necessary structures in newly terraced areas.

4. The Upland Agriculture and Conservation Project (UACP) is being implemented in two districts in Central Java within the Jratunseluna watershed, and two districts in East Java within the Brantas watershed. Started in 1984, its purpose is to increase farm production and incomes, while minimizing soil erosion, through the expansion and improvement of institutional capacities to introduce improved upland farming practices and by

experimenting with alternative approaches to upland farming. It is funded jointly by USAID, GOI and the World Bank. The lead agency is the Ministry of Home Affairs (MOH), with the relevant provincial BAPPEDAs and sectoral agencies (MOA, MOF and MPW) playing important roles. Difficulties have included weak management and coordination, slow recruitment of consultants, lack of detailed soil maps, and inability to design and implement site-specific conservation works.

5. The Kali Konto Project in East Java is conducted under the auspices of the Directorate General for Reforestation and Land Rehabilitation. This Netherlands Government-funded project began as an effort to establish a systematic approach to forest management in a watershed context. During the first two stages of the project, attention was focused on forest lands, and the forest utilization patterns in this catchment are perhaps the best documented on the whole of Java as the result of this intensive multi-year effort. Despite the technical merits of the project, however, unusually heavy reliance on foreign consultants has limited institutional development.

6. The Ford Foundation in conjunction with GOI has recently initiated another approach to upland soil conservation and agricultural development through its social forestry program. This approach involves the development of new arrangements between upland farmers and forestry officials regarding the management of state forest lands. The objective is not only to raise farmers' incomes through seasonal and tree crop production, but also to stop continued forest degradation and deforestation that exacerbates problems of upland soil erosion. During 1987, the existing pilot project sites of 600-700 ha across three provinces of Java are being expanded to 39 sites covering some 2,000 ha.

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

KEPAS -- A New Style of Agricultural Research and Development

1. KEPAS was created in Indonesia in 1983 in response to a growing awareness of sustainability issues in agricultural development. By 1981, Indonesia was self-sufficient in rice production, but leading administrators and scientists were becoming concerned by the "second generation" problems that were affecting the stability, sustainability and equity of agricultural development. Not least among these were the devastating and widespread attacks on rice of the brown planthopper. A seminar on these topics in 1981 was followed by two intensive workshops that brought together scientists from the Agency for Agricultural Research and Development (AARD), universities and donor agencies, together with observers with similar concerns from Thailand and the Philippines. The first workshop focused on the social and ecological consequences of further lowland intensification, while the second took marginal lands (critical lands, alang-alang lands, swamplands) as its theme.1/

2. Both workshops identified broad questions and priorities for research and, perhaps more important, the style and composition of the workshops proved popular. They included a wide range of disciplines and staff from both government agencies and universities; moreover, the participants were encouraged to contribute as individuals with skills and expertise rather than as representatives of their agencies or departments. As a consequence, the Kelompok Penelitian Agro-Ekosistem (KEPAS) was created under the leadership of Dr. Ibrahim Manwan. It is coordinated by AARD and funded by AARD and the Ford Foundation.

3. The first official KEPAS workshop was held in 1983 in Kalimantan and carried out an agroecosystem analysis for four villages in the swampland transmigration areas. An important outcome was a set of research priorities which became the basis of the World Bank's Swamps II project, probably the first time the agenda of a major Bank research project had been determined by Indonesian scientists rather than outside consultants.

4. The success of this workshop was then quickly followed by a workshop on the Uplands of East Java held at Malang. A combined team from Brawijaya University and the Malang Research Institute for Field Crops carried out a rapid rural analysis (RRA) of four villages representing a range of soil types and cropping patterns and socioeconomic conditions. The workshop then collectively analyzed these data using the techniques of agroecosystem analysis and arrived at a consensus on the key research questions. A second output of the workshop was a preliminary typology of upland agroecosystems, and the refinement of this typology has become the subsequent principal focus of the Uplands Working Group set up by KEPAS after the workshop.

1/ KEPAS 1984. "The Sustainability of Agricultural Intensification in Indonesia." Agency for Agricultural Research and Development, Jakarta, Indonesia.

5. KEPAS is now based at the Central Research Institute for Field Crops at Bogor. It has a small staff of three scientists together with a consultant based at Malang who is guiding the upland working group. In a relatively short time KEPAS has achieved a considerable reputation both in Indonesia and internationally for the successful way it has been able to make a reality out of the often sought goal of multidisciplinary analysis and research. It is developing considerable expertise in such techniques as agroecosystem zoning, agroecosystem analysis and rapid rural appraisal. In its recent work in East Java with the extension department it is also demonstrating how this approach can begin to influence not only research, but also practical development on the ground.

Rapid Appraisal Techinques For Sustainable Development

6. Deciding which innovations and interventions are appropriate in the uplands of Java, in both the short and long term, requires careful analysis and a genuine dialogue among policymaker, development specialists, extension and research workers and farmers themselves. However, this is not solely a case of ensuring that analyses are careful, insightful and multidisciplinary in nature, difficult though this is. Conditions in the uplands are serious and immediate. There is not time for long-term, detailed academic studies before action can be taken. The need is for methods of analysis and experimentation that are powerful and quick, and inexpensive.

7. Over the last 10 years, a large number of such methods have been developed under the general headings of rapid rural appraisal and agro-ecosystem analysis.

8. Rapid rural appraisal (RRA) may be defined as a systematic, but semi-structured activity carried out in the field by a multidisciplinary team and designed to acquire quickly new information on, and new hypotheses about, rural life. A key feature of RRA is the use of several different sources of, and means of gathering, information. "Truth" is approached through the rapid build-up of diverse information rather than via statistical replication. Secondary data, direct observation in the field, semi-structured interviews, and the preparation of diagrams all contribute to a progressively accurate analysis of the situation under investigation. Very broadly there are four principal classes of RRA, which ideally follow one another in the sequence of development activity:

(a) exploratory RRA: to obtain initial information about a new topic or agroecosystem and produce initial development hypotheses;

(b) topical RRA: to investigate in more depth the initial hypotheses;

(c) participatory RRA: to involve villagers and local officials in decisions about further actions based on the topical or explanatory RRAs, e.g., farmer-managed trials;

(d) monitoring RRA: to monitor progress in trials and implementation.

Major centers of work in RRA in Southeast Asia are at Khon Koen University and in the Northeast Regional Office of Agriculture, Khon Koen in Thailand. But familiarity with RRA techniques is also present among many members of the KEPAS group.

9. Agroecosystem analysis (AEA) is a form of exploratory RRA. It takes as its focus any level in the hierarchy of agroecosystems, from farms, through villages and watersheds to whole regions. The analysis begins with a field visit and the production of summaries of the information so obtained in the form of a wide diversity of diagrams. These are then analyzed in a workshop by a multidisciplinary team to produce initial hypotheses for development of the agroecosystem. The proposed innovation and interventions are assessed for the potential impacts on productivity, stability, sustainability and equitability, and for their costs and feasibility. The outcome is a preliminary research and development plan.

10. AEA was first developed at the University of Chiang Mai in Thailand in 1978 but has also been applied on several occasions over the past seven years in Indonesia by the KEPAS group. Published AEA reports include those on the uplands of East Java, the swamplands of Kalimantan, the drylands of West Timor and the coastal brackish agroecosystems in Java.

Notes:

1. Conway G.R. and McCracken J.A. (in press). Rapid Rural Appraisal and Agro-ecosystem Analysis in Altier, M.A. and Hecht S.B. (eds.) Agroecology and Small Farm Development. CRC Press Inc., Florida.

2. Conway G.R. 1985 Agro-ecosystem analysis. Agricultural Administration, 20, 31.

3. Conway G.R. 1986 Agro-ecosystem Analysis for Research and Development, Winrock International, Bangkok.

4. Khonkaen University, 1987. Proceedings of the International Conference on Rapid Rural Appraisal, Khon Kaen, Thailand September 2-5, 1985.

5. Alton C.T. and Craig I.A. 1987 The Rapid Assessment Technique (RAT): A procedure for identifying farmer problems and development opportunities, Northeast Rainfed Agricultural Development Project (NERAD, Kohn Kaen, Thailand).

6. KEPAS 1985. The Swampland Agroecosystem of Kalimantan Agency for Agricultural Research and Development, Jakarta, Indonesia.

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Credit for Uplands Development

1. At present, neither the availablity of rural credit nor its allocation is adequate. Despite an implicit agricultural credit subsidy of about Rp 132 billion (US$80.3 million) annually that provides loans to farmers at 12% a year, public liquidity credits are estimated to meet only 15% of the demand for credit by farmers, and the other 85% is obtained informally at an interest rate of around 60% p.a. Indications are that small farmers in particular must rely on high-cost, informal sources of funds. In addition, new liquidity credits declined by 6% in real terms annually between 1981 and 1985. Of the total liquidity credits available to agriculture in 1985, more than 50% went to sugar production. Given that (a) sugar production accounts for only 3.3% of the value of total crop production; (b) sugar is not a staple food; (c) consumers are paying prices well in excess of the world price; and (d) Indonesia does not have a comparative advantage in sugar production, the credit resources allocated to sugar should be reallocated to increase the flow of liquidity credit to other rural sectors.

2. Moreover, the increase in net benefits after 10 years of investment supported by credit is three and four times greater, respectively, for terracing and agroforestry when compared to the net benefits of farms that do not adopt soil conservation measures. A Citanduy study concluded that, because the need for credit is general and widespread and currently inadequate to meet the diverse needs of the entire rural population, the rural banking system should be funded to expand loans to farmers, traders and light industry. After two years in the lending program, borrowers could pay back their funds at market or near-market interest rates.

3. Given the diverse credit needs of rural upland populations, it is unclear whether making more multipurpose and multi-term loans available will be sufficient or whether some form of subsidy for rural credit is required. In recent years, GOI appears to have moved away from subsidized programs for specific crops (e.g., BIMAS) toward more general credit programs at market interest rates (e.g., KUPEDES). The operations of KUPEDES and other commercial-rate lending schemes have, to some extent, demonstrated that a successful credit program can be designed to reach low-income groups with small loan sizes, even at market interest rates and in the absence of collateral. It requires accessibility of bank offices and simple lending procedures. Other arguments against maintaining subsidies for rural credit include concerns that (a) low and fixed lending rates on most agricultural and rural lending do not provide sufficient incentives for banks to lend to these sectors; (b) state banks lending to the rural sectors need to increase their interest income and reduce their arrears and operating costs to maintain their financial viability; (c) low rural interest rates are a disincentive to savers; and (d) certain subsidized and liquidity credit financed priority programs (e.g., tree crops) may distort the capacity of producers to become financially viable.

4. It is estimated that a 100% increase in liquidity allocations to agriculture (excluding sugar) and the removal of interest rate subsidies of 20% to the average market rate would actually decrease the weighted average interest rate paid by farmers, as many farmers would be able to switch from informal sources of credit that charge even higher interest rates. In addition, removal of differential interest rates in rural areas may result in greater use of institutional credit for agricultural purposes if there is a scarcity of available credit. For example, in the Citanduy Farm Credit Program the interest rates charged to agricultural activities (24%) are lower than for nonagricultural activities (36%). If the rate of return on investment in the nonagricultural activities is higher, then there would be a greater demand for credit at the higher interest rate and, obviously, concentration of credit supply in these activities would be efficient for lenders. If this supply is limited, this would tend to reduce the support of credit for soil conservation activities. Thus, increasing the general availability of formal credit for both agricultural and nonagricultural activities at similar rates to upland rural areas on Java is required for more balanced development and more widespread adaption of conservation farming. Making this credit available at market or near-market interest rates may reduce problems of efficiency and distortion. Further analysis is required, however, to determine the optimal interest rate structure for rural credit in the uplands, especially for financing soil conservation investments in long-term improvements in farming systems.

ANNEX 4
Table 1

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Irrigation Efficiency of Waru-Jayeng Irrigation Scheme

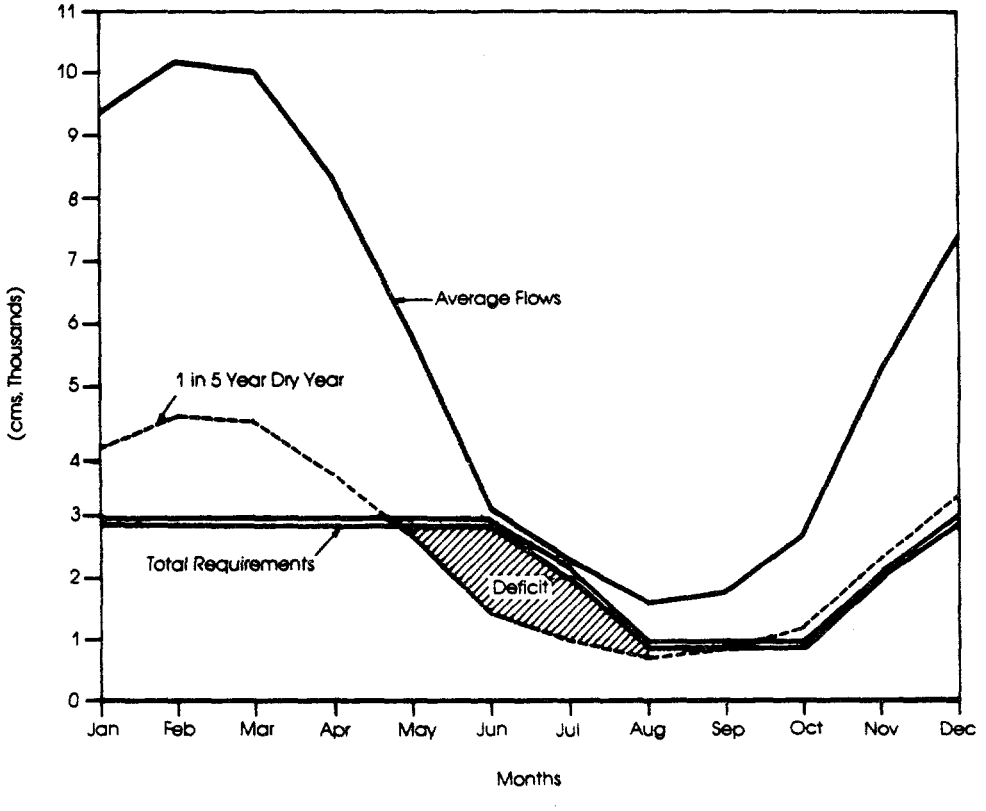
Offtake location	Area (ha)	Wet season paddy crop supplied (l/s ha)/a	Wet season paddy crop efficiency/b (%)	Dry season 1st mixed crop supplied (l/s ha)/a	Dry season 1st mixed crop efficiency/b (%)	Dry season 2nd mixed crop supplied (l/s ha)/a	Dry season 2nd mixed crop efficiency/b (%)
B2	288	1.28	65	0.96	47	0.90	31
B3	659	3.69	23	2.12	34	2.50	21
B4	831	2.43	24	1.29	27	1.65	31
B14	(175)	(1.91)	-	(0.75)	-	(0.60)	-
B15	865	1.26	68	0.89	75	1.00	40
B17	101	1.25	66	1.24	52	1.45	28
B16	(346)	(1.44)	-	(1.20)	-	(0.80)	-
B19	229	1.23	76	1.18	70	0.97	34
B21	877	1.64	57	1.14	42	1.28	31
B20	(213)	(1.21)	-	(1.29)	-	(1.17)	-
A99	137	1.00	77	0.66	31	0.66	65
B23	270	1.24	69	(1.22)	NA	1.23	30
B24	638	1.81	54	1.09	48	1.23	23
B25	739	1.87	50	1.68	34	1.59	20
Total	5,634	1.91	45	1.29	38	1.43	23

/a 1/s = liters per second.
/b Efficiency: seasonal plant water requirement divided by total seasonal water supplied.

Source: IIMI, 1986.

ANNEX 4
Figure 1

INDONESIA
ISSUES IN SUSTAINABLE DEVELOPMENT
River Flows & Water Demands on Java



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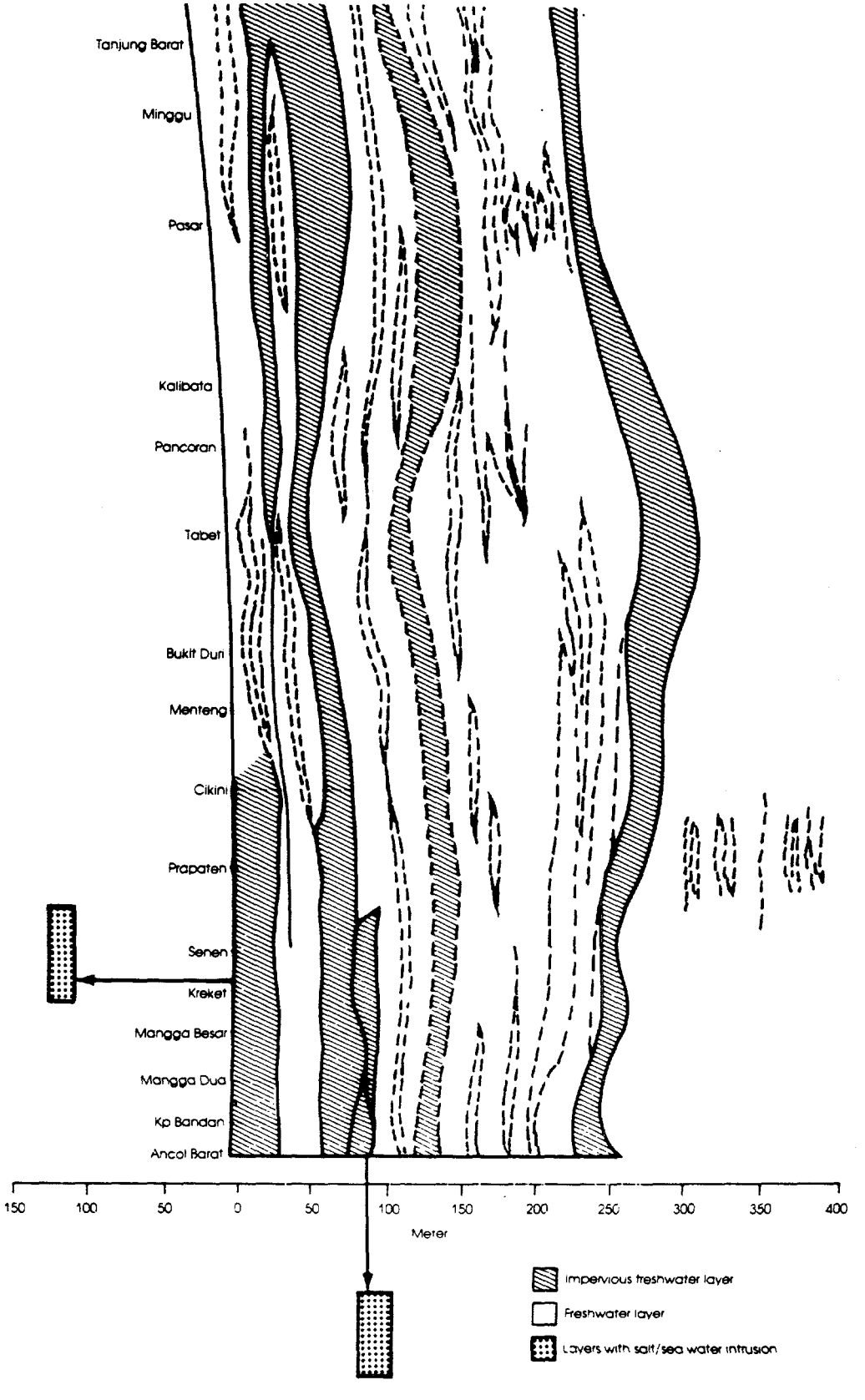
ANNEX 4
Figure 2

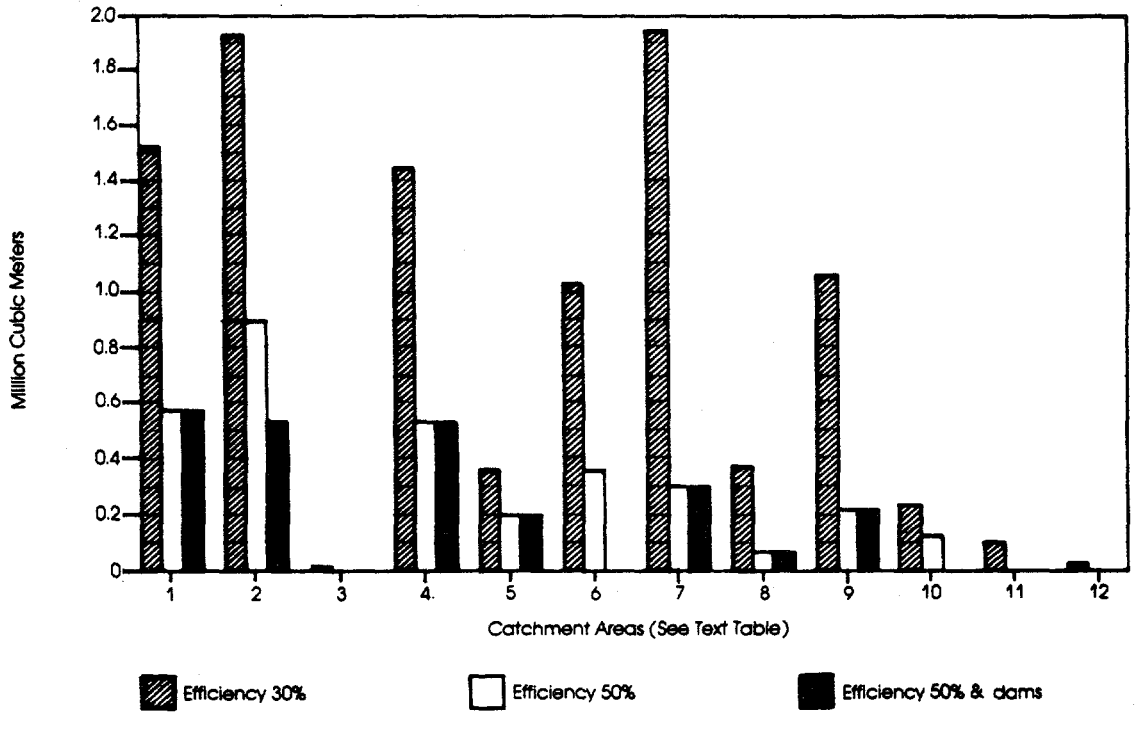
INDONESIA
ISSUES IN SUSTAINABLE DEVELOPMENT
Extent of Seawater Intrusion under Jakarta



ANNEX 4
Figure 3

INDONESIA
ISSUES IN SUSTAINABLE DEVELOPMENT

JAVA
Water Deficits and Efficiency Improvements in Java



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SUMMARY OF EXISTING SITUATION ON COMMUNITY WATER SUPPLY IN JAVA

Primary Sources of Drinking Water for Urban and Rural Households

	Pipe		Pump		Well		Spring		River		Others /a		Total	
	(000)	(%)	(000)	(%)	(000)	(%)	(000)	(%)	(000)	(%)	(000)	(%)	(000)	(%)
Primary Source of Drinking Water for Urban Household by Province, 1980														
DKI Jakarta	323.5	30	348.6	32	276.0	26	0.3	-	0.1	-	120.9	12	1,077.4	100
West Java	147.8	13	131.8	12	739.6	66	66.8	6	12.3	1	24.4	2	1,122.8	100
Central Java	219.1	23	54.2	6	6,145.8	66	23.8	3	9.2	1	15.7	1	136.7	100
D.I. Yogyakarta	14.4	11	3.5	3	109.2	86	0.2	-	-	-	0.2	-	127.6	100
East Java	419.5	36	67.6	6	641.4	55	21.3	2	5.6	-	16.1	1	1,171.5	100
Primary Source of Drinking Water for Rural Households, by Province, 1980														
DKI Jakarta	4.7	5	13.9	16	60.4	70	0.2	-	3.3	4	4.2	5	86.6	100
West Java	78.7	2	204.6	4	2,856.6	57	1,375.6	28	364.3	7	98.1	2	4,977.9	100
Central Java	70.1	2	60.4	1	2,731.5	63	1,053.2	24	314.8	7	119.5	3	4,349.5	100
D.I. Yogyakarta	5.5	1	2.9	-	350.1	75	55.2	12	7.9	2	43.4	9	464.9	100
East Java	104.0	2	79.1	1	3,704.7	70	998.3	19	299.2	5	132.9	3	5,307.1	100

/a Includes e.g. collection of rain water (Riau, West Kalimantan), purchase from water vendor (Jakarta).

Note: Totals may not add due to rounding.

Source: (1980 Census, Series S, No. 2) Ref. 55

ANNEX 5
Table 2

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Illustrative Costs and Standards of Kip with Sanitation Emphasis

	Basic cost per ha (constant 1982 prices) (Rp '000)	(%)
A. Costs /a		
Access		
Roads, side drains, bridges	1,890	21
Footpaths, side drains	2,070	23
Main drainage	1,080	12
Sanitation		
Public bathing & toilet facility (MCK)	2,430	27
Solid waste (under citywide sectoral program)		
Water supply reticulation	900	10
Land for clinics, schools, etc.	630	7
Total	9,000/b	100
(Total in 1984 prices)	(12,150)	

B. Standards

Access: All dwellings within 20 m of paved footpath and within 150 m of paved road. Minimum footpath provision of 150 m/ha.

Drainage: The total capacity of drains is sufficient for the discharge for the whole area. Footpaths drained with open side drains or one covered central drain. Roads have drains on each side.

Sanitation: One MCK Keluarga /a is provided for every seven families or five houses not already provided with private facilities.

Water Supply: A pump or water connection is provided for every MCK.

/a Analysis is based upon poor conditions in unimproved kampungs in Cirebon, Bogor, Tangerang and Bekasi, Surakarta, Ujung Pandang and on average costs to raise conditions to the specified standards within those cities.

Source: Joint Urban Development Consultants, Cibotabek Project, and Bank staff estimates.

ANNEX 5
Table 3

INDONESIA

ISSUES IN SUSTAINABLE DEVELOPMENT

Regional Distribution of Medium- and Large- Scale Industries, 1985
(%)

Province	No. of firms	Employment	Value Added
Aceh	0.4	0.6	1.7
North Sumatra	5.3	5.2	5.1
West Sumatra	0.9	0.7	0.5
Riau	1.0	1.4	1.8
Jambi	0.8	0.8	0.7
South Sumatra	1.3	2.1	2.2
Bengkulu	0.1	0.0	0.1
Lampung	1.3	1.5	1.4
Sumatra	11.0	12.3	13.5
DKI Jakarta	13.9	13.8	18.0
West Java	24.3	23.2	25.7
Central Java	16.8	15.9	10.3
DI Jogjakarta	1.6	1.0	0.4
East Java	23.5	24.8	22.0
Java	80.1	78.8	76.4
Bali	1.9	0.9	0.3
West Nusa Tenggara	0.6	0.2	0.1
East Nusa Tenggara	0.2	0.1	0.0
East Timor	0.0	0.0	0.0
Bali/NTT	2.7	1.2	0.4
West Kalimantan	0.6	1.2	1.6
Central Kalimantan	0.6	0.9	0.7
South Kalimantan	1.1	1.4	1.7
East Kalimantan	0.8	2.0	2.8
Kalimantan	3.1	5.5	6.8
North Sulawesi	0.6	0.3	1.5
Central Sulawesi	0.3	0.3	0.1
South Sulawesi	1.2	1.1	0.7
Southeast Sulawesi	0.5	0.1	0.0
Sulawesi	2.6	1.8	2.3
Maluku	0.3	0.5	0.3
Irian Jaya	0.2	0.1	0.4
Maluku & Irian Jaya	0.5	0.6	0.7

Source: Industrial Census, 1985.

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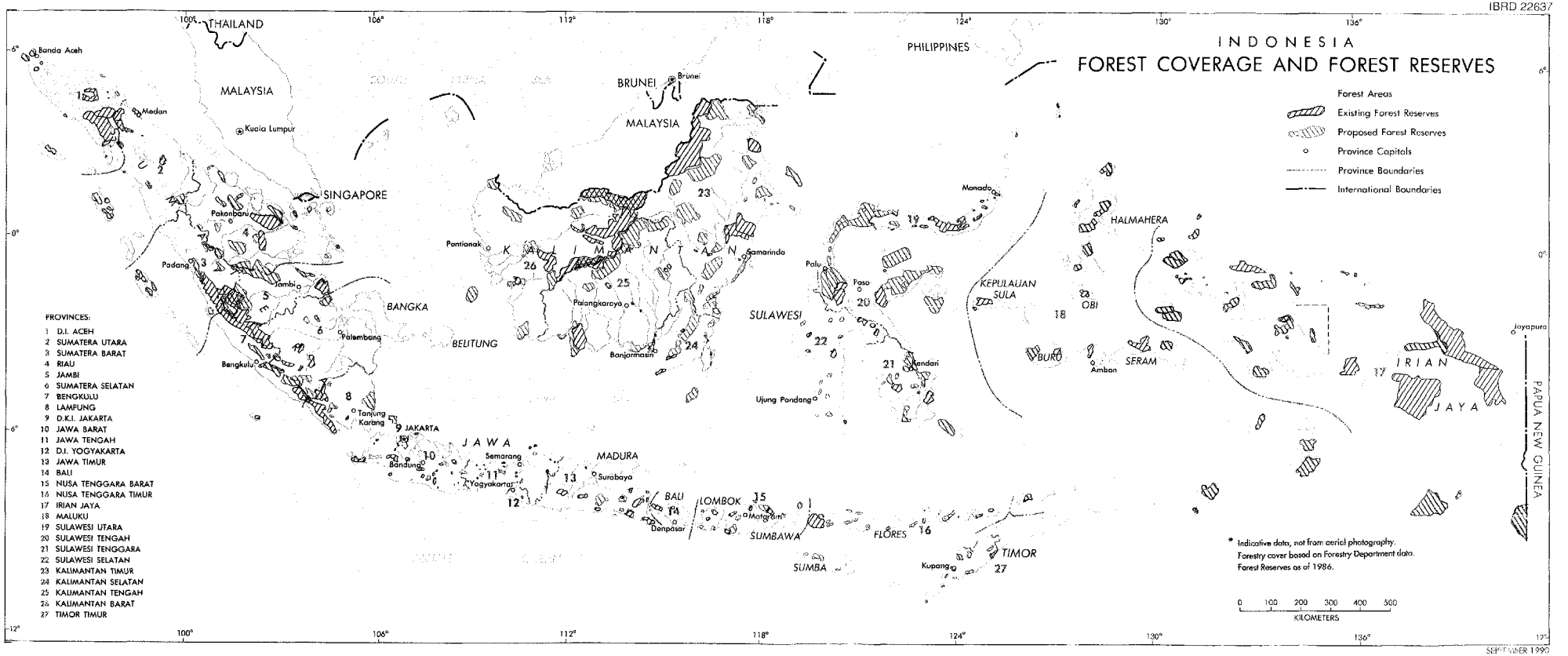
FOREST COVERAGE AND FOREST RESERVES



Forest Areas
- Existing Forest Reserves
- Proposed Forest Reserves
- Province Capitals
- Province Boundaries
- International Boundaries

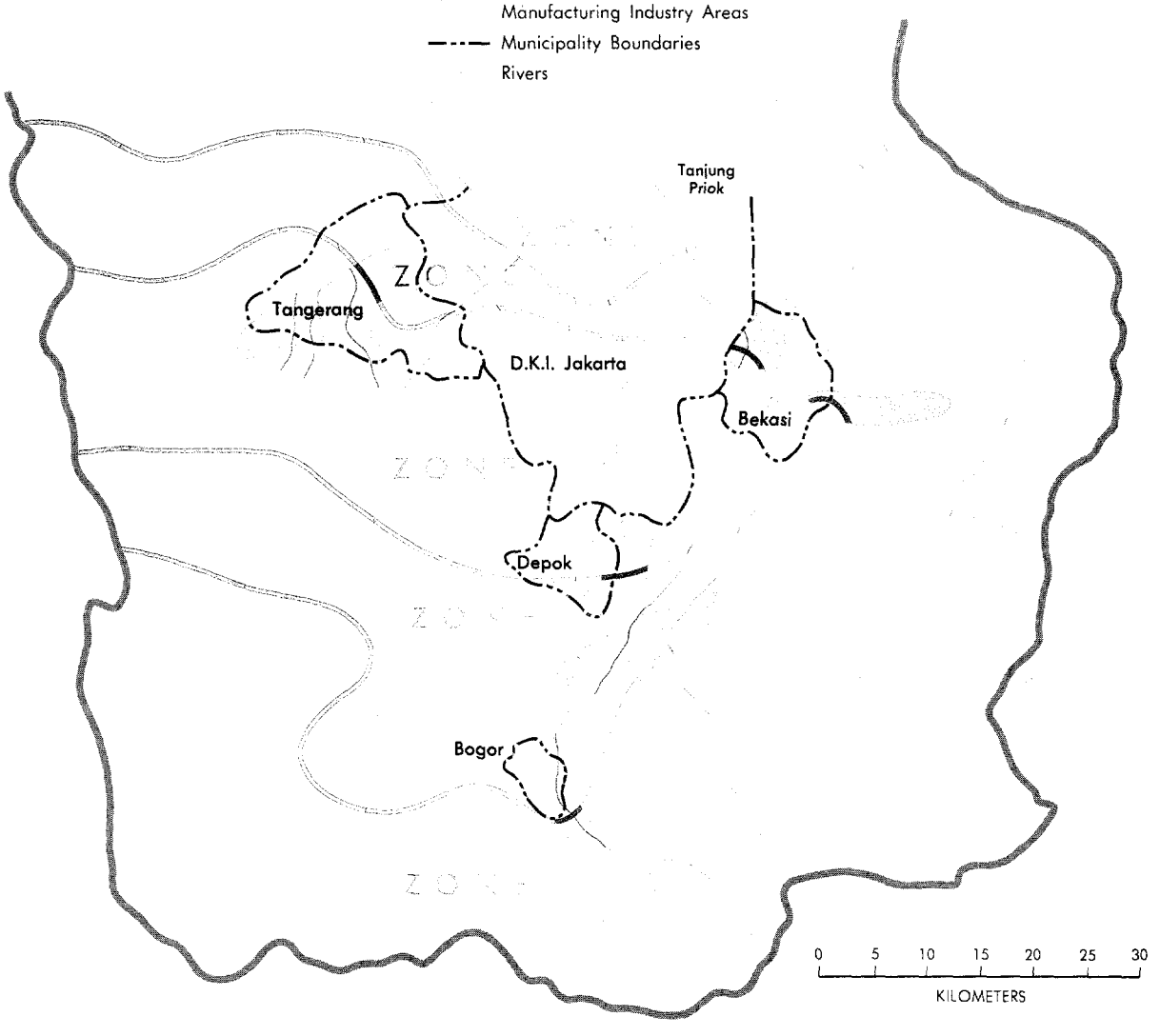
PROVINCES:
1 D.I. ACEH
2 SUMATERA UTARA
3 SUMATERA BARAT
4 RIAU
5 JAMBI
6 SUMATERA SELATAN
7 BENGKULU
8 LAMPUNG
9 D.K.I. JAKARTA
10 JAWA BARAT
11 JAWA TENGAH
12 D.I. YOGYAKARTA
13 JAWA TIMUR
14 BALI
15 NUSA TENGGARA BARAT
16 NUSA TENGGARA TIMUR
17 IRIAN JAYA
18 MALUKU
19 SULAWESI UTARA
20 SULAWESI TENGAH
21 SULAWESI TENGGARA
22 SULAWESI SELATAN
23 KALIMANTAN TIMUR
24 KALIMANTAN SELATAN
25 KALIMANTAN TENGAH
26 KALIMANTAN BARAT
27 TIMOR TIMUR

* Indicative data, not from aerial photography.
Forestry cover based on Forestry Department data.
Forest Reserves as of 1986.

0 100 200 300 400 500
KILOMETERS

SEPTEMBER 1990

INDONESIA
JAWA
DEVELOPMENT POTENTIAL ZONE AND WATER FLOW IMPACT



ZONE I AVOID URBAN DEVELOPMENT
- Low lying coastal strip.
- Flat, thus bad drainage.
- Subject to flooding.
- Agriculture suited to fishponds.
- Groundwater saline and undrinkable.
- Poor soil-bearing capacity for building.
- This area encroaching on Zone II as saline intrusion increases in the urban areas.

ZONE II AGRICULTURE INTENSIFICATION/ LIMITED URBAN DEVELOPMENT
- Low lying plains.
- Flat, thus bad drainage.
- Subject to flooding.
- Excellent for rice growing, especially if irrigated.
- Groundwater fresh but easily polluted.
- Poor soil-bearing capacity.

ZONE III MAJOR URBAN DEVELOPMENT/ AGRICULTURAL INTENSIFICATION
- Higher lands rising from coastal plains.
- Reasonable gradient thus good natural drainage.
- Low flood risk.
- Groundwater fresh and leaching soils limit pollution.
- Poorer agriculture.
- Reasonable soil-bearing capacity.

ZONE IV LIMITED URBAN DEVELOPMENT/ AGRICULTURE INTENSIFICATION
- Steeper sloping zone.
- Good natural drainage.
- No flooding.
- Limited groundwater and no deep aquifers.
- Reasonable agriculture due to more rainfall.
- Reasonable soil-bearing capacity.

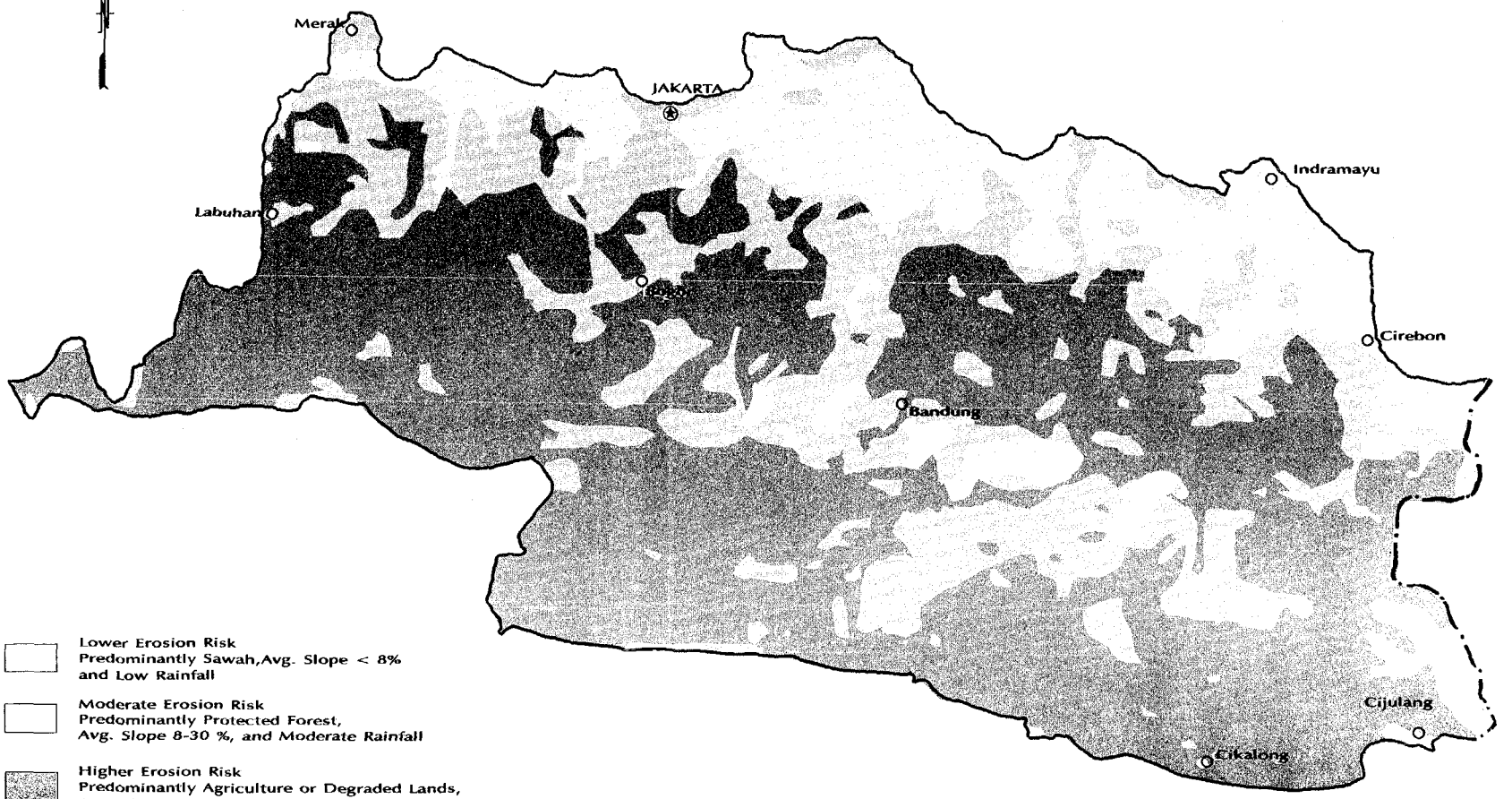
ZONE V UPLAND FOREST PLANTATIONS/IRRIGATION AND CONSERVATION, AVOID AGRICULTURE INTENSIFICATION
- Steep mountainous zone.
- Rapid runoff but limited by vegetation.
- Natural forest areas.
- Agriculture limited to complex terrace constuction
- Subject to rapid erosion if forests are cleared.

SEPTEMBER 1990

INDONESIA

JAWA BARAT

PROVISIONAL ESTIMATE OF EROSION RISK
(Based on Soil/Slope Conditions; Rainfall Intensity/Duration and Present Land Use)



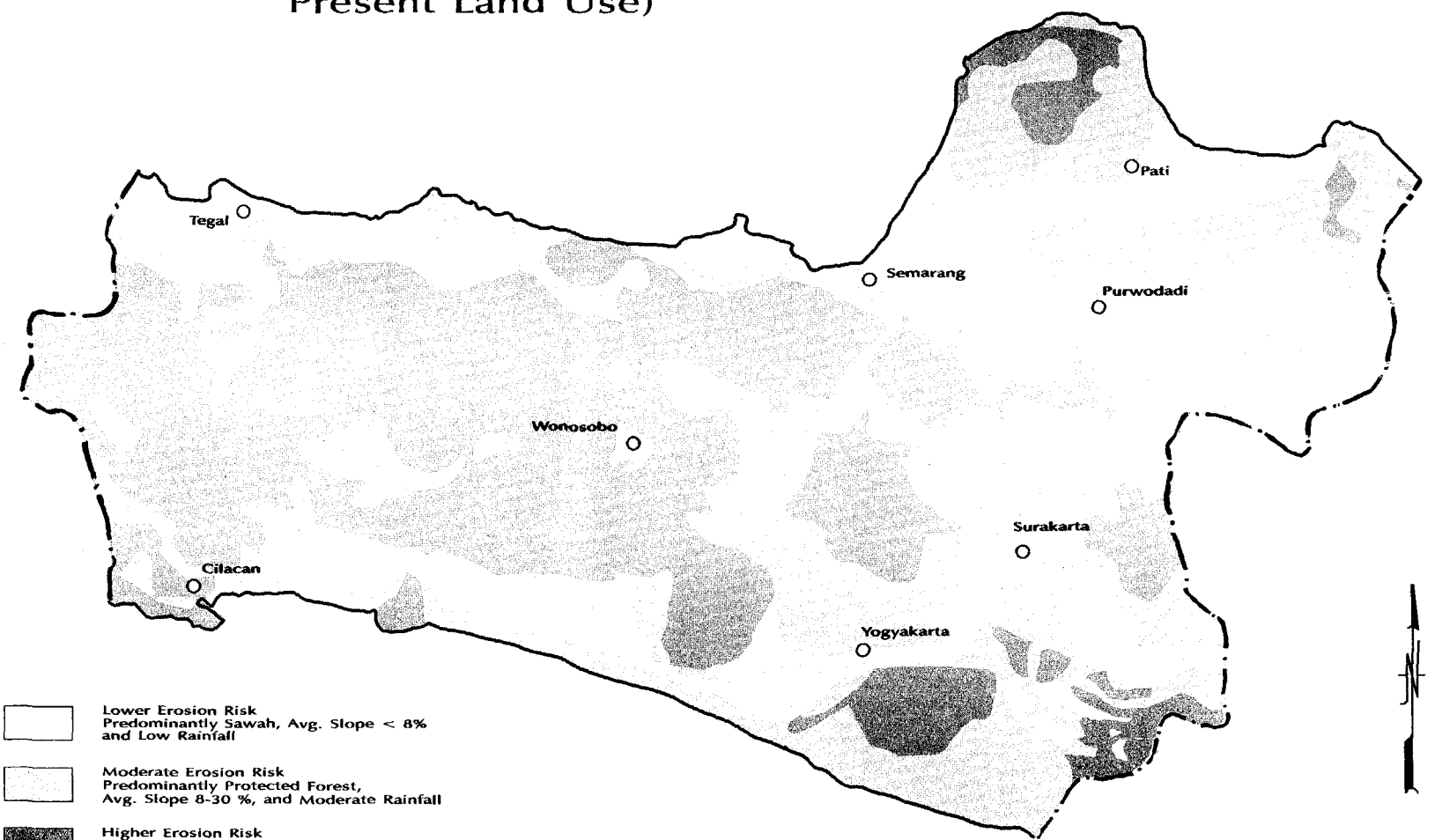
SEPTEMBER 1990

IBRD 22636

INDONESIA

JAWA TENGAH

PROVISIONAL ESTIMATE OF EROSION RISK
(Based on Soil/Slope Conditions; Rainfall Intensity/Duration and Present Land Use)



SEPTEMBER 1990

IBRD 22635

INDONESIA

JAWA TIMUR

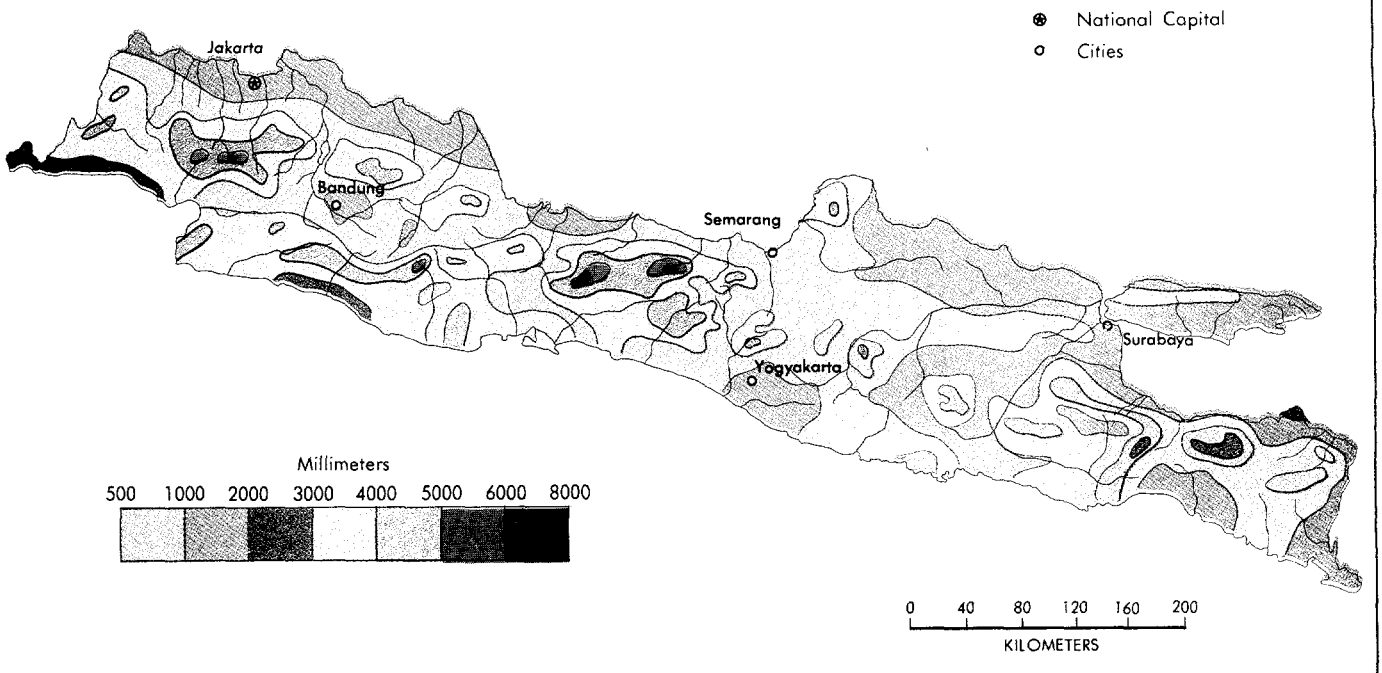
PROVISIONAL ESTIMATE OF EROSION RISK
(Based on Soil/Slope Conditions; Rainfall Intensity/Duration and Present Land Use)

SEPTEMBER 1990

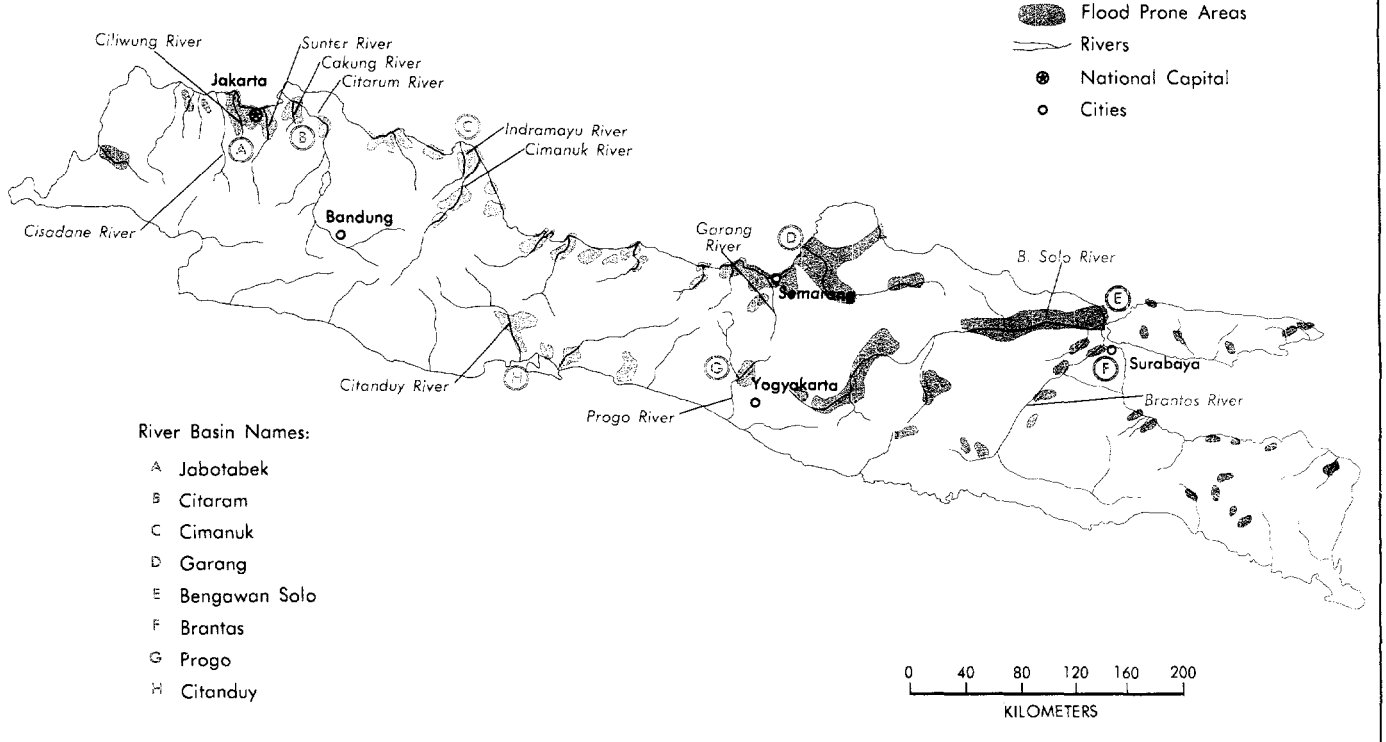
IBRD 22634

INDONESIA
JAWA
WATER RESOURCES MANAGEMENT SECTOR WORK

MEAN ANNUAL RAINFALL

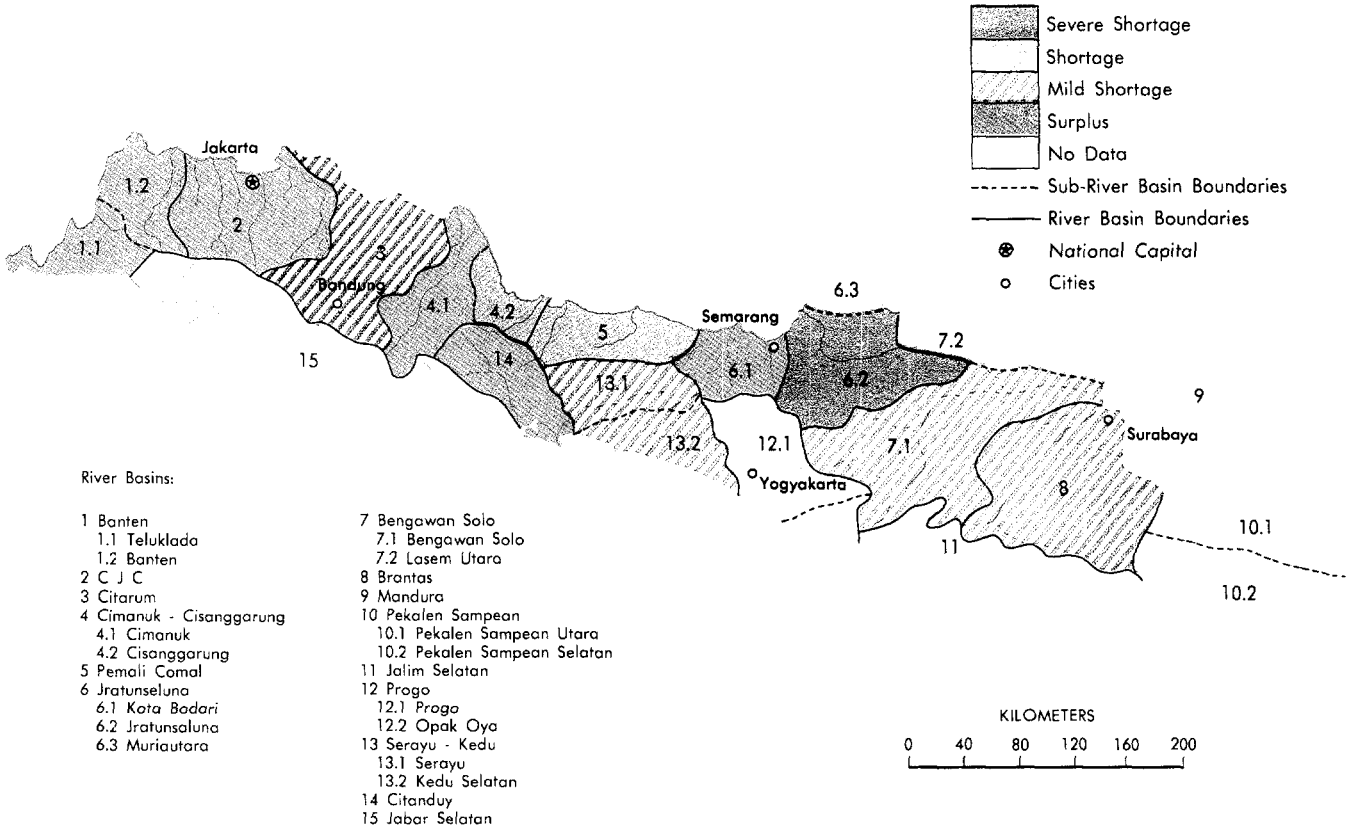


FLOOD PRONE AREAS



SEPTEMBER 1990

INDONESIA
JAWA
WATER MANAGEMENT SECTOR WORK
SUPPLY/DEMAND BALANCES - WITH DAMS



River Basins:

1 Banten
- 1.1 Teluklada
- 1.2 Banten

2 C J C
3 Citarum
4 Cimanuk - Cisanggarung
- 4.1 Cimanuk
- 4.2 Cisanggarung

5 Pemali Comal
6 Jratunseluna
- 6.1 Kota Bodari
- 6.2 Jratunsaluna
- 6.3 Muriautara

7 Bengawan Solo
- 7.1 Bengawan Solo
- 7.2 Lasem Utara

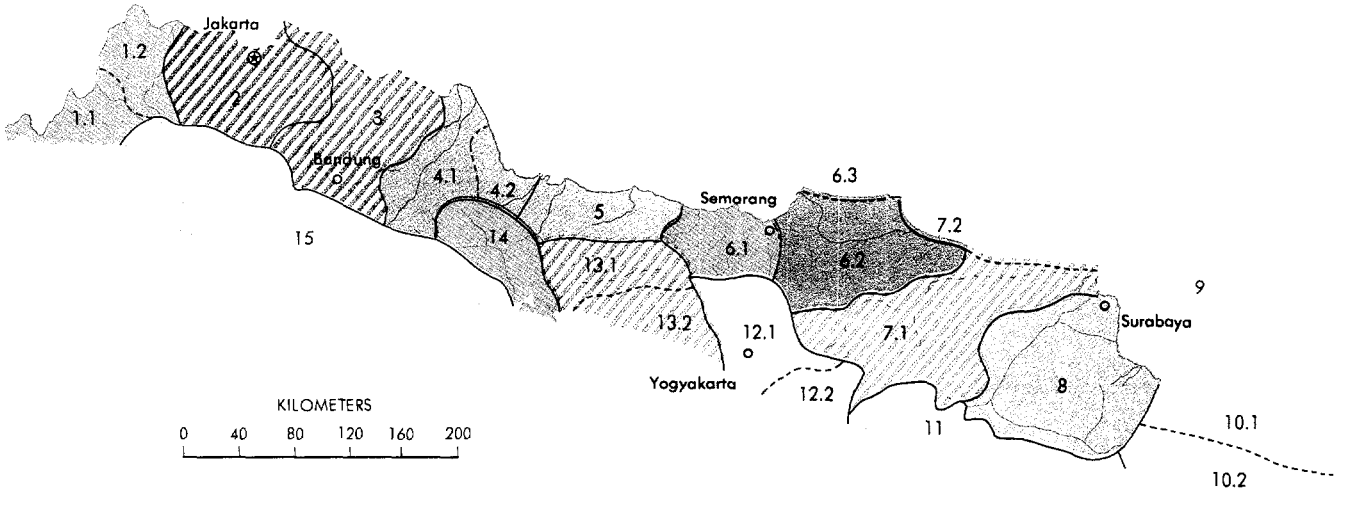
8 Brantas
9 Mandura
10 Pekalen Sampean
- 10.1 Pekalen Sampean Utara
- 10.2 Pekalen Sampean Selatan

11 Jalim Selatan
12 Progo
- 12.1 Progo
- 12.2 Opak Oya

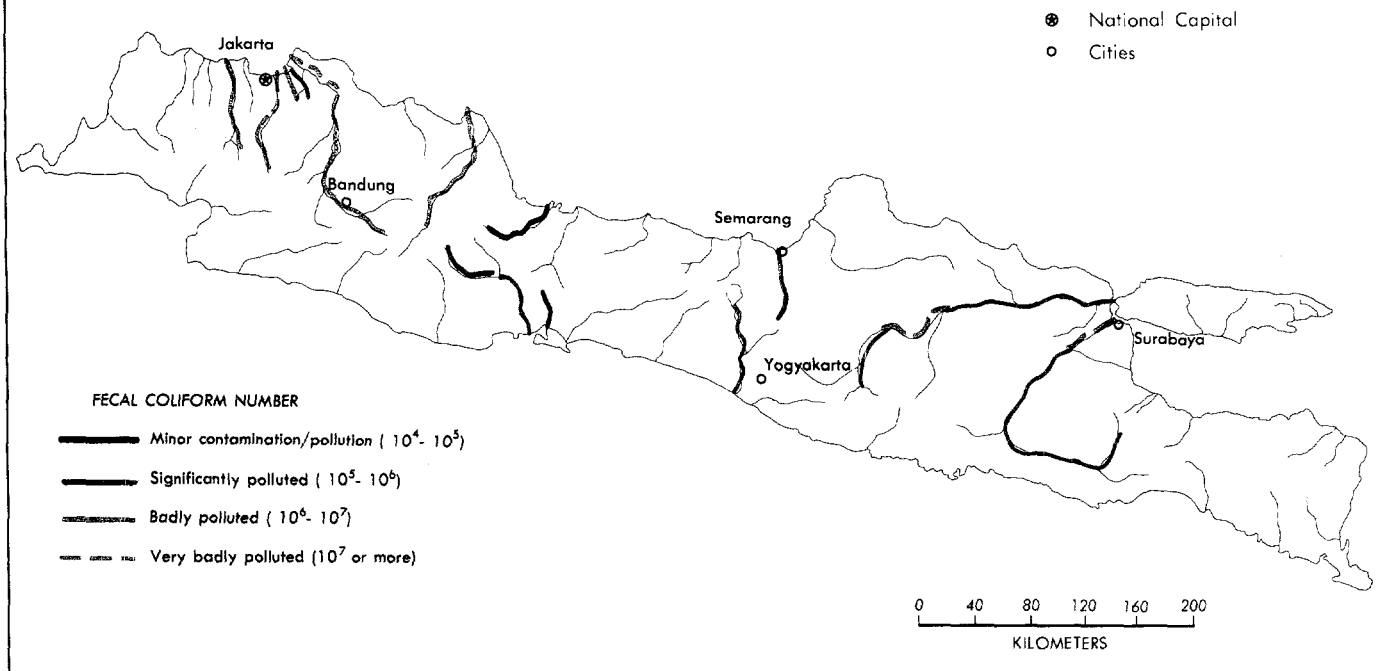
13 Serayu - Kedu
- 13.1 Serayu
- 13.2 Kedu Selatan

14 Citanduy
15 Jabar Selatan

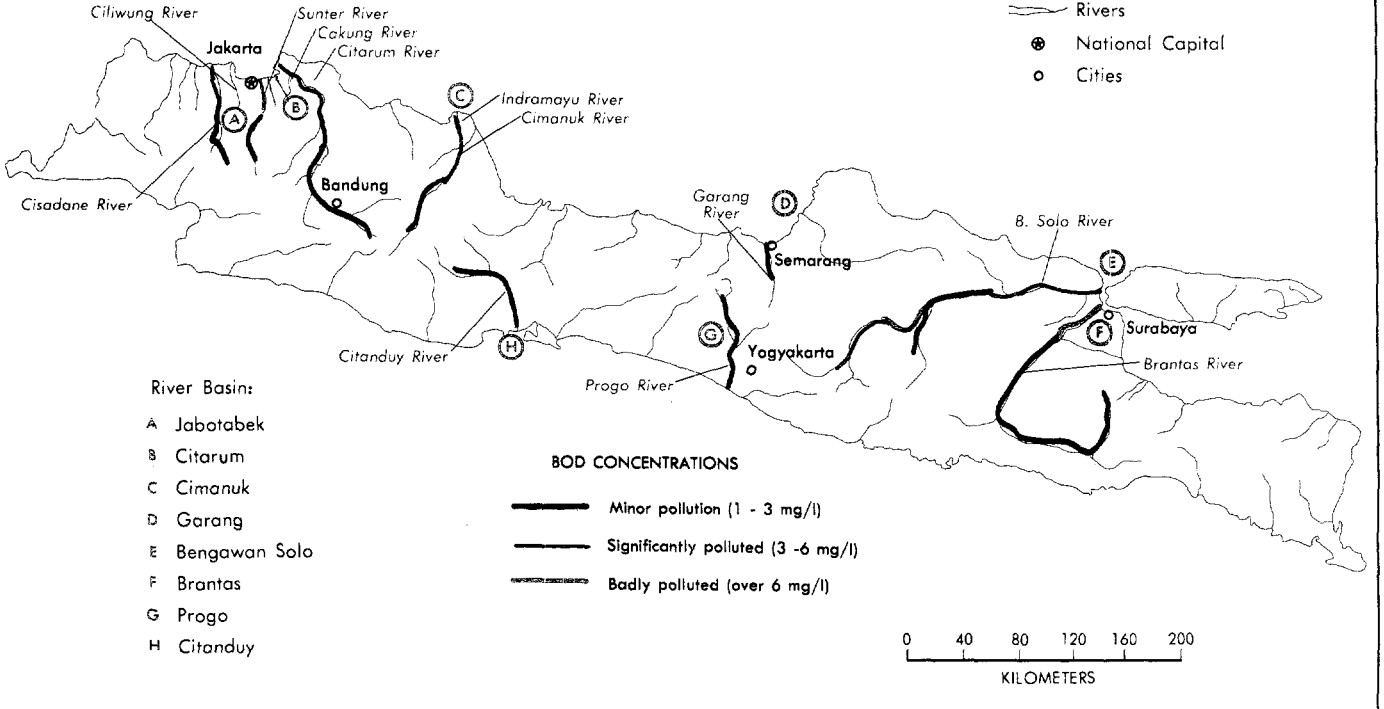
SUPPLY/DEMAND BALANCES - WITHOUT DAMS



INDONESIA
JAWA
AVERAGE DRY SEASON COLIFORM NUMBER



WATER RESOURCES MANAGEMENT SECTOR WORK
AVERAGE DRY SEASON BOD CONCENTRATIONS



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