THE FEASIBILITY STUDY ON UPLAND PLANTATION AND LAND DEVELOPMENT PROJECT AT CITARIK SUB-WATERSHED IN THE REPUBLIC OF INDONESIA

MAIN REPORT

OCTOBER, 1993

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

PREFACE

In response to a request from the Government of the Republic of Indonesia , the Government of Japan decided to conduct a feasibility study on Upland Plantation and Land Development Project at Citarik Sub-Watershed and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Dr. Kinji Hachiya five times during the period from February 1992 to September 1993.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia, and conducted field survey at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

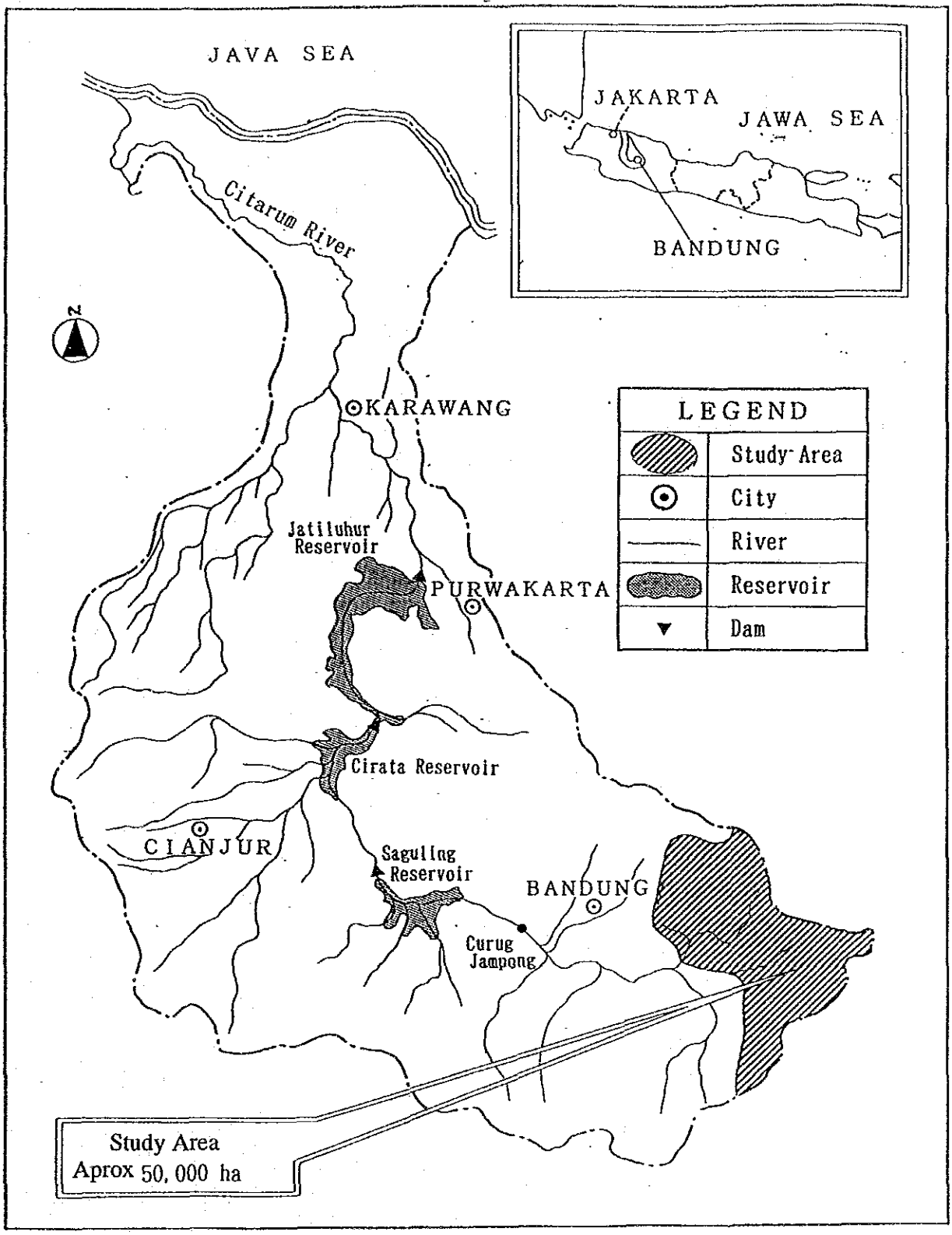
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

October, 1993

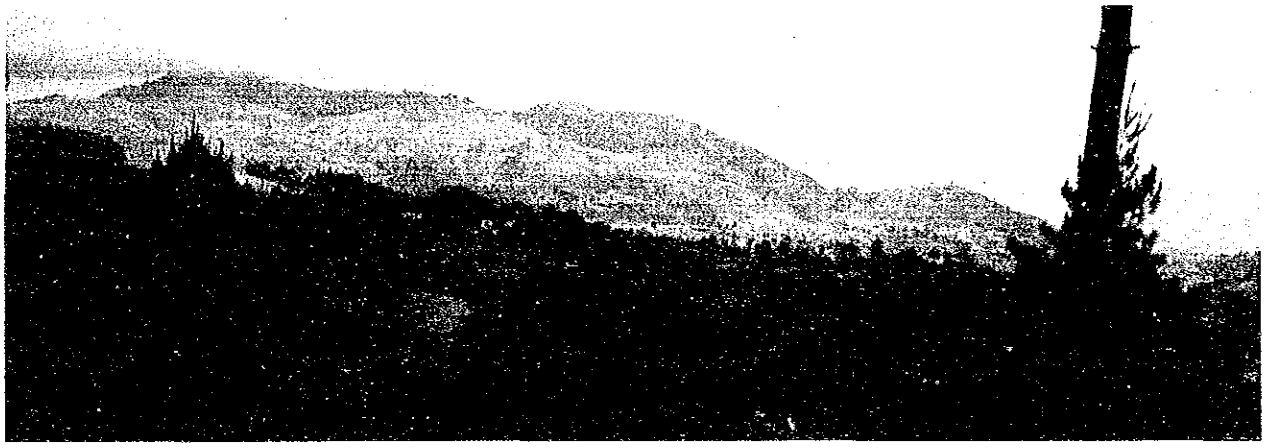
Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency



Location of Study Area

In general, the land use of slopes in the Study Area downwardly changes from forest to dry crop fields and paddy fields with scattered villages.

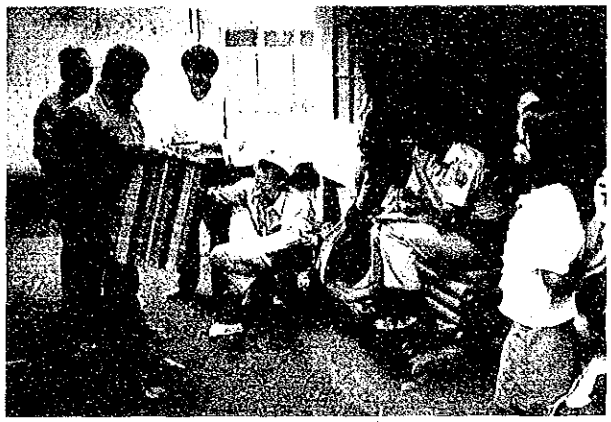


Dry crop fields which are suffering from serious soil erosion are found to occupy large areas or reaching ridges.

Trees are occasionally found in dry crop fields.

Small torrents have been paid little attention in terms of soil conservation.

Multi-purpose trees are planted around houses to create home gardens.



Local inhabitants were interviewed to determine suitable measures to encourage their participation in the Project.

In national forests (this forest is under the jurisdiction of the Sumedang Forestry Office), the Tumpangsari system, in which the forest bed is used as a dry crop field in the early years of afforestation, can be observed.

Terracing and the planting of fruit and other trees in dry crop fields can be observed at the demonstration plot and at other sites.

Here, a gully plug using gabions is used to prevent further soil erosion in the valley head area.

Check dams in the Study Area serve for the deposit of sediment discharged from sub-watersheds, and contribute to agricultural activities such as pisciculture and paddy farming.

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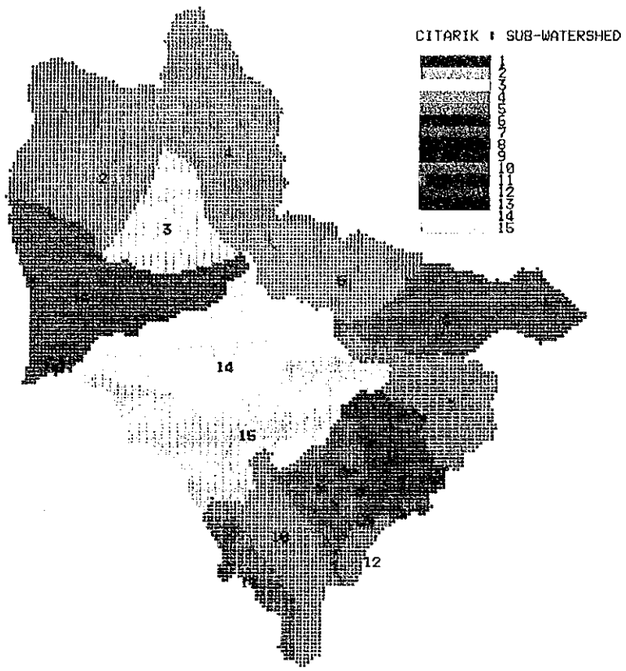

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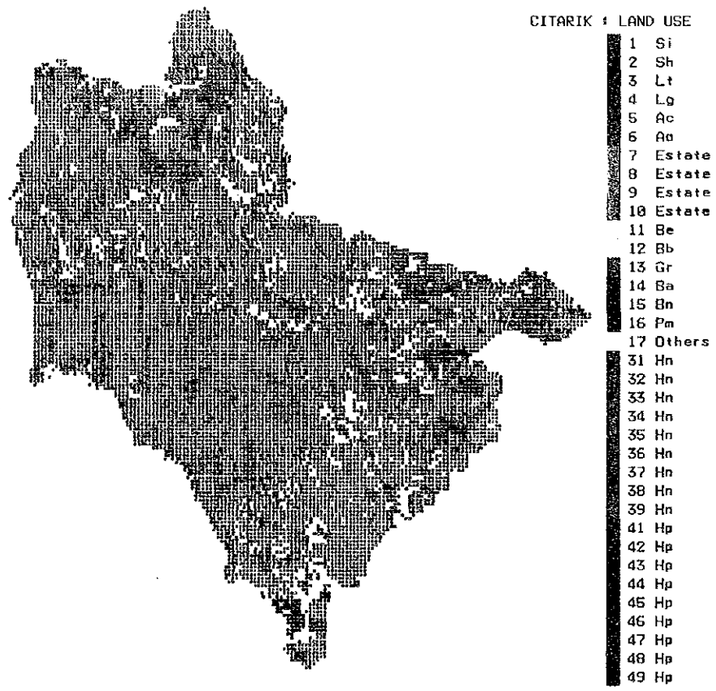

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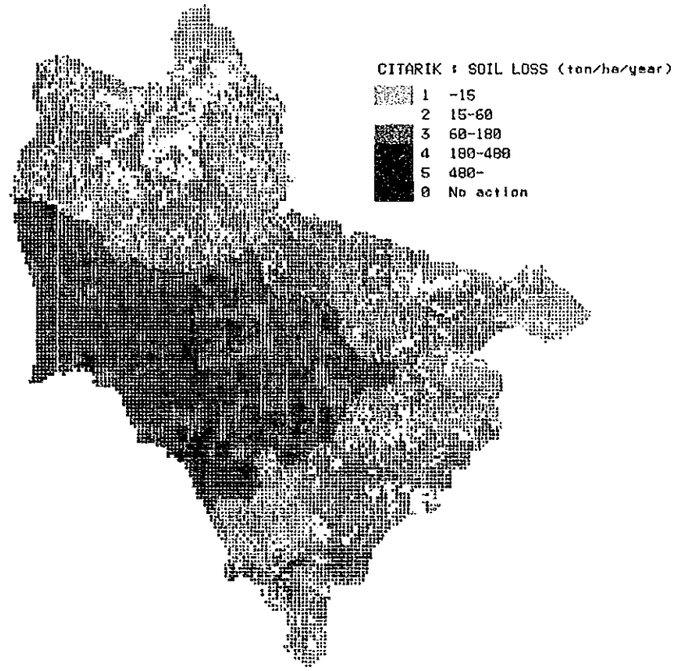

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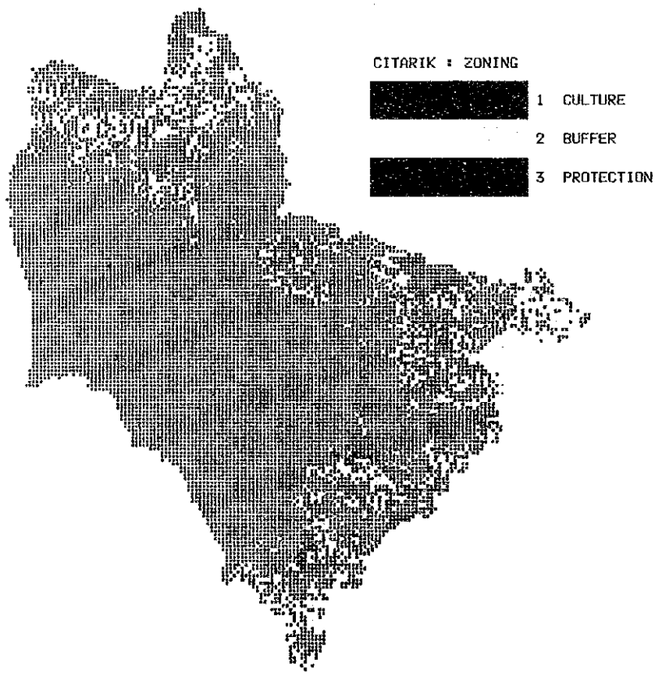

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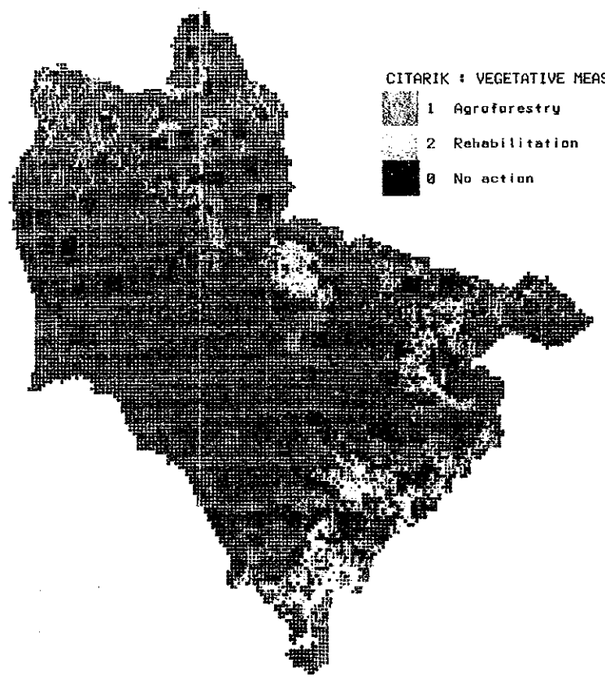

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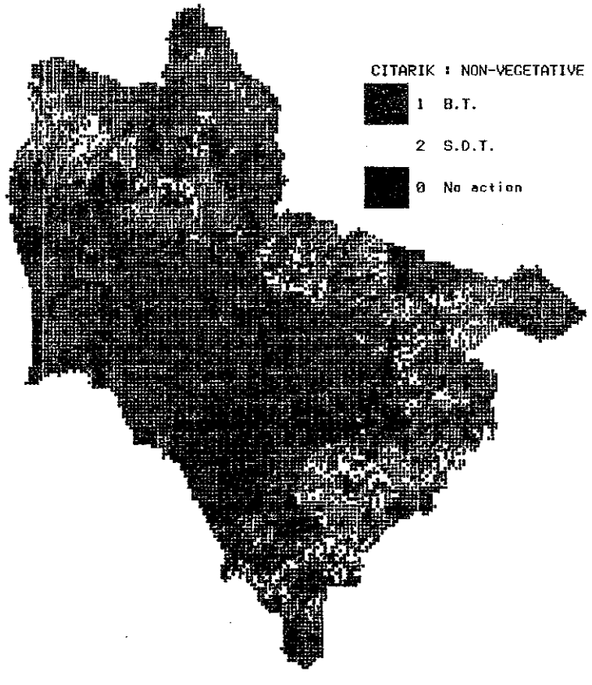

SUMMARY

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1. Study Objectives

In January, 1989, the Government of Indonesia requested the Government of Japan to conduct the present study (the Study) to constitute a feasibility study for the Upland Plantation and Land Development Project for the Citarik Sub-Watershed and to transfer upland plantation and land development planning techniques applicable to other watersheds to the Indonesian side.

In response to this request, the Government of Japan sent the Contact Mission to Indonesia is March, 1991, followed by the Preliminary Study Team in September, 1991, and concluded the Scope of Work (S/W). The Study has now been completed for the Citarik sub-watershed lying in the northwestern part of Java island with the purpose of contributing to assisting watershed control and rural village development in Indonesia.

2. Soil and Water Conservation Projects in Indonesia

The priority of implementing soil and water resources conservation projects in Indonesia is given to those watersheds with a high ranking of urgency among the country's numerous watersheds. Thirty-nine watersheds have been selected in the 5th 5-Year Plan which calls for the implementation of an integrated watershed management plan.

The Citarum watershed, which includes the Study Area, is ranked 6th in terms of priority in this 5th 5-Year Plan due to strong pressure for the extensive use of land and soil following the advancement of urbanization, population increase and the excessive use of farmland, etc. The Study Area is considered to be the most important area in the upper reaches of the Citarum watershed in terms of soil and water resources conservation because of intensive land use and the seriousness degree of soil erosion.

3. Current Conditions of Study Area

(1) Study Area

The Citarik sub-watershed, i.e. the Study Area, is located some 30 km east of Bandung in the uppermost reaches of the Citarum watershed and covers some 50,000 ha. Flat paddy fields and their surrounding areas in the Study Area have been omitted from the scope of the Project, resulting in a Planning Area of some 30,000 ha.

(2) Natural Conditions

The climate of the Citarik sub-watershed is classified as Type B in the classification scheme proposed by Schmit and Ferguson. This type of climate is characterised by a low ratio of dry months (monthly rainfall of 60mm or less) vis-a-vis wet months (monthly rainfall of 100mm or more) of 14.3% - 33.3%.

The bedrock in the Study Area and surrounding areas generally belongs to either the Miocene or Pliocene series and consists of tuff sandstone, conglomerate, breccia, shale and limestone, etc.

Fluvisols are predominantly distributed throughout the Bandung plain with the presence of gleysols. Latosols are widely found in the mountains and piedmont areas. These latosols are classified into brown latosols and dark reddish brown latosols.

Based on the aerial photograph interpretation results, the dominant types of land use in the Study Area are paddy fields (38.6%), dry crop fields (24.7%) and forests (15.6%).

(3) Social Environment

The Study Area spreads over the areas of jurisdiction of Bandung City, Bandung District and Sumedang District while the Planning Area consists of 13 sub-districts. As of 1991, the Study Area has a population of 797,605 with 184,688 households and a population density of 1,723 persons/km^2.

In terms of employment, agriculture is the main employment sector in the Study Area. However, employment data for the last 10 years suggest that there is a trend of the long-term decline of the agricultural sector coupled with a rise of the manufacturing sector.

(4) Soil Erosion

The surface erosion volume was calculated using the Universal Soil Loss Equation (USLE) method, giving an annual soil erosion volume per unit area in the Study Area of 203 tons/ha/year and a total annual soil erosion volume of 10,180,000 tons/year.

(5) Sedimentation Volume of Saguling Dam

There are 3 hydroelectric dams in the lower reaches of the Study Area, i.e. Saguling dam, Cirata dam and Jatiluhur dam, of which Saguling Dam is the uppermost located. According to a survey by the State Electricity Public Corporation (PLN), the annual

sedimentation volume of Saguling dam is estimated to be an average of 3,408,000m^3, meaning that the annual sedimentation volume per ha of the catchment area is 14.9 m^3/ha.

The survey results on the sedimentation volume of the existing check dam indicate that the annual soil discharge from the Planning Area is 16.9 m^3/ha with a total annual soil discharge to Citarum river from the Planning Area of 555,000 m^3/year, accounting for some 16% of the annual sedimentation volume of Saguling dam.

(6) Local Agriculture

1) Farmland Ownership and Farmland Size

Seventy percent of the farming households fall in the farmland size category of 0.10 - 0.50 ha. The fact that most target persons of the Project are small farmers indicates the necessity and likely effectiveness of organizing coordinated actions to prevent soil erosion.

Owner-farmers, mainly cultivating their own lands, account for less than 30% of the total while half of the people employed in the agricultural sector are tenant farmers and farm labourers who cultivate the others' lands besides theirs. These tenant farmers and farm labourers earn their livelihood mainly through the cultivation of rented land, labour for wages and/or the Maro system whereby the landlord and tenant farmer split the harvest fifty-fifty.

2) Agricultural Production

The types of agricultural land in the Study Area include irrigated paddy fields, rain-fed paddy fields and dry crop fields and rice is grown throughout the year on irrigated paddy fields. In the case of dry crop fields, ordinary crops are grown using either the inter-cropping or mixed cropping methods while vegetables are grown using the single cropping method. Planting is mainly conducted in the rainy season.

While the Study Area accounts for only some 10% of the total land area of the Bandung and Sumedang Districts, it plays a very important role in agricultural production because of the high proportions of the main crops grown in the area vis-a-vis the overall production volumes of these 2 districts.

3) Farm Management and Organizations Assisting Farming

The average annual income from crops per ha in the Study Area is 1.75 million Rp although the figure varies from area to area. With an average annual agricultural production cost of 1.25 million Rp/ha, the net annual income is approximately half a million Rp.

There is a total of 320 farmers' groups in the Study Area which are engaged in various activities, including the production of seedlings and bamboo craftwork.

(7) Forestry

Forests in West Java Province account for some 22% (1.02 million ha) of the total land area of 4.63 million ha. Although the forest coverage is said to be as high as some 74% for the whole of Indonesia, the coverage of Java island of some 23% is much more modest.

National forests in the Study Area are managed by 3 forest district offices (Kesatuan Pemangkuan Hutan: KPH). The North Bandung KPH and South Bandung KPH are responsible for forests in Bandung City and the Bandung District while the Sumedang KPH is responsible for those in the Sumedang District.

The forest management of private land is predominantly conducted by a group of small landowners. The DEPHUT encourages planting on private land to facilitate the supply of industrial materials and to promote land rehabilitation programmes.

Seedlings are mainly produced in the Study Area by farmers' groups except those for planting in national forests. Each sub-district has one or 2 nurseries, the size of which is 0.1 - 0.5 ha each.

(8) Road Conditions

Trunk roads in the Study Area include provincial roads between Bandung and Sumedang and between Bandung and Garut and district roads between Cicalengka and Majalaya and between Rancaekek and Majalaya. Village roads branch off from these trunk roads, forming a developed village road network.

The provincial and district roads in the Study Area appear to be in generally good condition in terms of paving, slope protection and the provision of gutters.

As many village roads in the mountain areas run along the ridgeline, large cut faces are seldom found except in parts of national forests. Consequently such soil retaining works as slope revegetation are almost non-existent.

Most of the gutters have been created by natural scouring and the construction of proper gutters and/or falling works is required for soil conservation purposes.

(9) Social Forestry Conditions

1) Development of Forests

Most private forests (Hutan Rakyat) in the Study Area have been developed and are managed for timber production purposes. As firewood is generally collected from farmland in the vicinity of the main dwelling, few forests for firewood production exist.

2) Agroforestry

Mixed gardens are found on midslopes throughout the Study Area and are generally terraced in the traditional manner. As in the case of dry crop fields, food crops are planted in mixed gardens as inter-crops or mixed crops together with several species of fruit and/or timber trees. Home gardens, one of the traditional forms of agroforestry in Indonesia, are found in and around domestic premises in the Study Area.

(10) Spread of Soil and Water Conservation Measures

1) Enlightenment and Guidance

Activities to spread soil and water conservation measures in the Study Area are conducted by the Agricultural Extension Centres at Cicalengka, Tanjungsari and Cilengkrang, all of which are controlled by the Bandung Branch of the SBRLKT Citarum. A senior regreening extension worker is stationed at each of these centres to supervise the work of field regreening extension workers. The main activities of the extension workers are the improvement of the knowledge of farmers of the technical aspects of the land rehabilitation and soil conservation project (RLKT), assistance to help farmers understand their role in the implementation of the RLKT and the provision of technical guidance, assistance to help farmers understand the necessity for and expected role of agroforestry and the production and supply of seedlings, etc. The targets of these activities are achieved through meetings with farmers and the active use of demonstration plots.

2) Education and Training

The education and training of farmers in the Study Area to promote soil and water conservation measures are mainly conducted through seminars and visits to the demonstration plots at the Agricultural Extension Centres. However, the present efforts are still deemed inadequate in view of the strong requirement for the provision of education and training for local inhabitants regarding the importance of soil conservation and local development.

3) Demonstration Plots

The demonstration plots are designed to improve soil and water conservation measures, to increase the yield of agricultural products and to encourage neighbouring village communities to adopt measures to achieve the 2 preceding objectives. The demonstration plots are attracting much attention and fostering hope on the part of the local inhabitants. Twenty-four demonstration plots have been established in the Study Area with a presidential special budget since 1981 and have been very much participated in by local farmers.

4. Basic Project Concepts

(1) Principles of Upland Plantation and Land Development Project

1) The Project intends not only the prevention of soil loss but also the promotion of local agriculture and forestry to achieve local development. It is necessary for these 2 targets to be well-balanced in the planning of the Project.

2) In the planning of soil conservation measures, a realistic target must be introduced for each zoning category employed by the DEPHUT for the purpose of national land conservation to reflect the actual state of sediment discharge while taking the social and economic conditions and opinions/preferences of farmers in each locality into consideration.

3) In view of the current forms of land ownership and land use, the adoption of social forestry techniques is important in the implementation of soil conservation measures in order to encourage the participation of local inhabitants.

4) New nurseries should be established to ensure a smooth supply of the required number of seedlings for the envisaged forest development, agroforestry and roadside planting.

5) The road conditions in the Planning Area, particularly in mountain areas, are generally poor, causing sediment discharge. The active improvement of the existing roads is necessary by means of paving, slope protection and gutter construction, etc.

6) In order to facilitate a proper understanding of the Project on the part of local inhabitants, the Project should plan the recruitment of new extension workers and the provision of the necessary equipment and materials in addition to the construction of a training centre and demonstration plots.

7) The participation of farmers should be emphasised at the project implementation stage. Coordination between project-related organizations should be properly planned as the Planning Area extends over one city and 2 districts.

8) From the viewpoint of environmental conservation, the Project has such favourable elements as the conversion of dry crop fields and other land where no soil conservation measures are applied to forests or agroforestry fields and the adoption of civil engineering measures to prevent sediment discharge. The continuous monitoring should be incorporated to the plan.

9) Both financial and economic analyses should be conducted on the Project contents to determine the feasibility of the Project.

(2) Farmland and Forest Land Conservation Measures

As part of the Project's planning process, the soil erosion risk, current land use and local socioeconomic conditions, etc. for each zoning category used in Indonesia for the purpose of national land conservation were examined and 4 alternative plans were prepared. These 4 plans were then examined in terms of the required scale of changes in land use, preventable volume of soil loss and estimated project cost.

Alternative Plan	Main Feature	Soil Loss Control Rate (%)*	Estimated Project Cost (million Rp)	Conservation Cost (Rp/ton)
1	Minimum conversion of farmland to forest	48	10,826	2,238
2	Emphasis on civil engineering measures to be introduced for dry crop fields with high soil loss risk	68	24,059	3,532
3	Equal emphasis on civil engineering measures and vegetative measures	81	28,463	3,510
4	Emphasis on conversion to forest	87	11,358	1,305

* Soil loss control rate = (soil loss before the Project – soil loss after the Project) ÷ soil loss before the Project x 100

Alternative Plan 3 has been selected as the soil and water conservation measure to be adopted under the Project because of its good balance between the 2 targets, i.e. the prevention of soil loss and local development, as well as its cost effectiveness. Consequently the matrix given below has been prepared to detail the contents of Alternative Plan 3.

Matrix of Conservation Measures Envisaged by Plan 3

Zoning / Soil Erosion Hazard Ranking	Protection Zone						Buffer Zone						Cultivation Zone					
	Rank 1		Rank 2 & 3		Rank 4 & 5		Rank 1		Rank 2 & 3		Rank 4 & 5		Rank 1		Rank 2 & 3		Rank 4 & 5	
Current Measures / Land Use/Vegetation Categ.	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works	Vegeta-tion	Civil Works
Dry Crop Field (with terraces)	Improv-ement 1	-	Agro 1	-	Forest 1	-	Improv-ement 1	-	Improv-ement 1	-	Agro 1	-	Improv-ement 1	-	Improv-ement 1	-	Improv-ement 1	-
Dry Crop Field (without terraces)	Improv-ement 1	Terrace 1	Agro 1	Terrace 1 & 2	Forest 1	-	Improv-ement 1	Terrace 1	Improv-ement 1	Terrace 1	Agro 1	Terrace 1 & 2	Improv-ement 2	-	Improv-ement 1	Terrace 1	Improv-ement 1	Terrace 1
Mixed Garden (CD: ≥71%)	Status quo		Status quo		Forest 2	-	Status quo		Status quo		Status quo		Status quo		Status quo		Status quo	
Mixed garden (CD: 21~70%)	Status quo		Agro 2	-	Forest 3	-	Status quo		Status quo		Agro 2	-	Status quo		Status quo		Status quo	
Shrub	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-
Grassland	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Agro 1	-	Agro 1	-	Agro 1	-
Quarry	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-	Forest 1	-

Note:
Vegetative measures includes the following:
Improvement 1: field farming improvement making use of terraces
Improvement 2: field farming improvement without making use of terraces
Agro 1: conversion of land use through the introduction of agroforestry
Agro 2: improvement with planting
Forest 1: uniform afforestation
Forest 2: upgrading planting lightly
Forest 3: upgrading planting heavily

Civil work will be selected according to the type of terraces. The type of terraces differs depending on the land slope.
Terrace 1: when the slope is 20 - 30%, bench terraces will be established
Terrace 2: when the slope is more than 30%, small dike terraces will be established

(3) Conservation of Torrents

The overall objective of soil erosion control is to contain soil erosion below the allowable level. According to a report compiled by Wood and Dent, 0.55mm of soil (5.5 m^3/ha/year) is created annually in the humid tropical zone. This value is considered to be the allowable soil erosion volume for the Project and any surplus sediment discharge during the project period above the allowable volume will be deposited in torrents.

(4) Incentives for Farmer Participation and Support Activities

As financial assistance is strongly requested by farmers, a subsidy for the purchase of equipment and materials and assistance in kind are believed to be strong incentives for farmer participation. It is desirable that the establishment of farmers' groups be made a precondition for official support for farmers. The assistance should, in fact, be of 2

types, i.e. technical support and management support. The actual support for farmers will be materialized through the mobilization of regreening extension workers and agricultural extension workers, recruitment of specialist consultants, cooperation with related organizations, provision of training courses, preparation of brochures and the introduction of a reward system vis-a-vis farmers and extension workers. In particular, extension activities should be strengthened as these activities constitute the grass-root efforts of the government.

(5) Project Implementation System and Implementation Schedule

It is essential to secure the cooperation and understanding of local farmers for the successful implementation of the Project. As farmers will increasingly play a central role at the management and maintenance stage of the Project, the project implementation plan should feature good coordination between the local offices of government organizations, strengthening of the extension activities and the active encouragement of farmer participation. The overall project implementation schedule and project period must be formulated based on a comprehensive review of all work involved in the Project.

(6) Project Evaluation

1) Financial Analysis

As farmers have been found to be unfamiliar with the procedure to use financial institutions, to have little security for loans and to be highly reluctant to commit themselves to the risks associated with loans, the Project's implementation as a subsidized project is deemed appropriate. There will be no direct financial benefit for the government, which is the project implementation body. Therefore, no financial analysis from the government perspective has been conducted in the present report for the case of the Project's implementation as a subsidized project. Instead, the financial analysis is conducted here from the viewpoint of promoting both agricultural and forestry development. The financial analysis for individual farmers has been substituted by the agricultural income and expenditure balance per unit area due to the difficulty of identifying income from the other products.

2) Economic Analysis

The economic analysis examines the feasibility of the Project for Indonesia as a nation. The same analysis method as that for the financial analysis is used except in the case of economic prices which are adjusted market prices.

(7) Environmental Care

It has been decided to prepare an environmental care plan so that the environmental assessment of limited subjects can be conducted to further emphasise the environmental care taken by the Project as an environmental conservation project.

5. Work Plan

(1) Farmland and Forest Land Conservation Plan

The following farmland and forest land conservation plan has been prepared based on the matrix of the farmland and forest land conservation measures described in 4. (2).

1) Establishment of Terraces

Terraces will be established depending on the land conditions and soil erosion rank to prevent soil erosion at dry crop fields.

a) Bench terraces (teras bangku) will be introduced for dry crop fields with a slope gradient of between 10% and 30%. These bench terraces will be accompanied by waterway works (saluran pembuangan air).

b) Small dike terraces (teras gulud) will be introduced for dry crop fields with a slope gradient of between 30% and 40%.

2) Forest Development

The main purposes of forest development are the planting of new trees to prevent soil erosion at farmland and forest land with a high soil erosion rank and to increase the production of timber and firewood to achieve a stable life for local inhabitants. The Tumpangsari system will be adopted with a wide planting distance between trees to increase the cash income from agricultural products.

a) Forest Development: Type 1 Forests

Uniform afforestation will be conducted at land which is currently dry crop fields, shrub, grassland or quarries and which is designated to become Type 1 forests in the conservation measure matrix.

b) Forest Development: Type 2 Forests

The light planting of trees will be conducted to convert those mixed gardens with a crown density of 71% or more and which are designated to become Type 2 forests in the conservation measure matrix into forests.

c) Forest Development: Type 3 Forests

Those current mixed gardens with a crown density of 21% - 70% will be upgraded through heavy planting to Type 3 forests as designated in the conservation measure matrix.

3) Introduction of Agroforestry

Agroforestry practices, such as mixed gardens with trees and crops combined to use the land for a long period of time for perpetual production, will be introduced with a view to contributing to soil conservation and the improvement of local life.

a) Type 1 Agroforestry

In the case of dry crop fields and grassland which are designated to become Type 1 agroforestry areas in the conservation measure matrix, a new type of land use combining agriculture and forestry will be introduced.

b) Type 2 Agroforestry

Those current mixed gardens with a crown density of 21% - 70% will be upgraded to Type 2 agroforestry areas through the planting of fruit trees and shade trees.

4) Improvement of Dry Fields

Dry crop fields, including newly terraced fields, will be upgraded to ensure dry farming with a high soil conservation performance by means of the appropriate selection of species and improved planting methods.

a) Type 1 Improved Dry Fields

Improvement work will be conducted for existing terraced and newly terraced dry crop fields. Intercropping and mixed cropping are planned in view of better soil conservation and also to disperse the risk.

b) Type 2 Improved Dry Fields

Dry crop fields for which the construction of terraces is not planned will also be improved. While the planting method will be basically the same as that for Type 1 improved dry fields, contour planting will be adopted for crops.

5) Conservation of Environment of Settlements

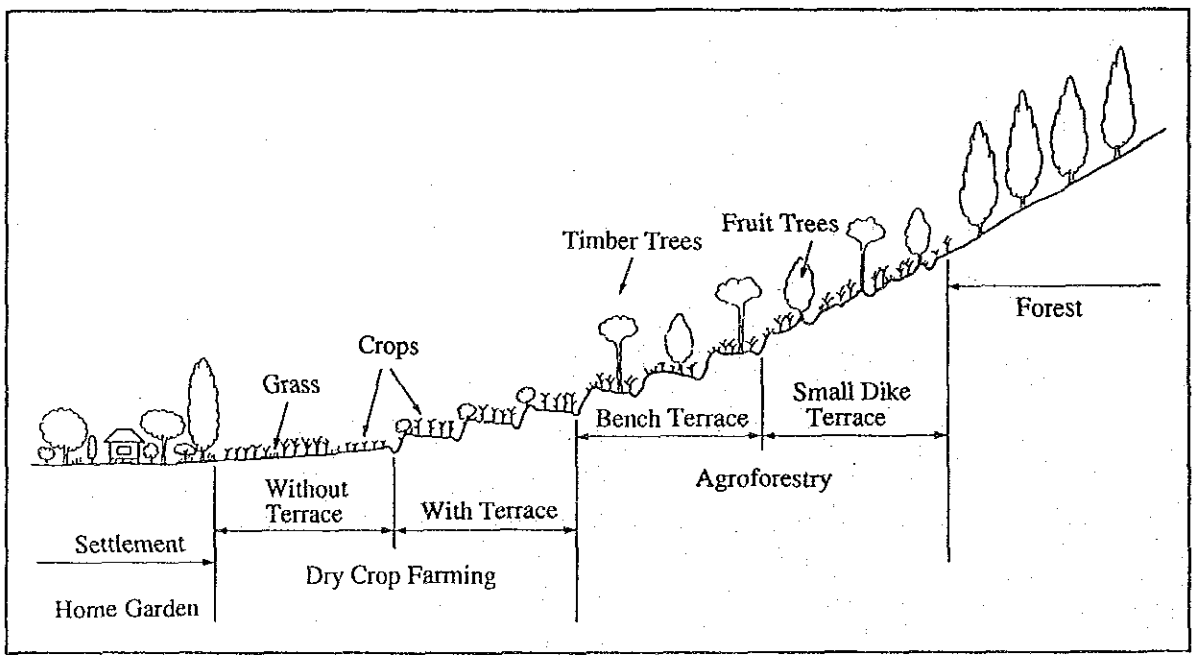
The total area of settlements, including housing sites and domestic garden sites, in the Planning Area is 2,340 ha (7.0% of the total area). With an average annual soil erosion volume of 382.5 tons/ha, this area constitutes a critical source of sediment discharge. Reduction of this sediment discharge by means of the following measures is, therefore, important, in view of environmental conservation.

a) Absorption wells will be constructed for selected densely populated settlements.

b) Such fruit trees as jack fruit will be planted in home gardens.

c) Low height hedges consisting of such short tree species as Gliricidia maculata and Calliandra calothyrsus will be created around housing areas.

The following illustration shows the typical farmland and forest land conservation plan described above.



(2) Torrent and Bank Conservation Plan

Control of the sediment discharge at torrents aims at containing the sediment discharge from farmland and forest land to torrents to 5.5 m^3/ha/year or less by means of implementing the farmland and forest land conservation plan.

1) Torrent Conservation

The construction of check dams, small check dams and gully plugs is planned to conserve torrents.

2) Bank Conservation

a) Revetment work will be introduced for those banks suffering from heavy erosion to prevent the collapse and lateral erosion of such banks due to flowing water.

b) Trees will be planted on banks to stabilise bank slopes and to prevent sediment inflow from farmland to torrents.

(3) Infrastructure Plan

1) Road Construction and Improvement

a) Construction of New Roads

Work/access roads to the demonstration plots and check dams will be constructed in time for the construction of the latter. Community roads used for the transportation of goods and other purposes will be constructed in mountainous areas which currently have a low road density.

b) Road Improvement

In regard to those roads with poor surface conditions, earth roads will be upgraded to gravel roads while gravel roads will be repaired. In the case of the steep sloping sections of gravel or earth roads, the present gravel surface and earth surface will be upgraded to an asphalt surface and gravel surface respectively.

Revegetation with grass will be conducted for those slopes which have become bare and which have a potential risk of soil erosion. Simple dug gutters will be introduced at the sides of roads where there is serious scouring to facilitate drainage. Falling works will be constructed at changing

points in the topography to reduce the flow speed of drained water in order to prevent undesirable soil erosion.

c) Roadside Planting

Roadside planting will be considered taking the conditions of settlement distribution and farmland use, etc. into account.

2) Nursery Development

Nurseries will be established to produce seedlings to ensure soil conservation, increased employment opportunities for local inhabitants and reinforcement of the activities of farmers' groups.

a) In addition to providing a sufficient quantity of seedlings, the production of excellent seedlings with a high survival rate will be aimed at.

b) The nurseries to be established under the Project will be of a moderate size to permit their construction and maintenance by local inhabitants. The sites will be fixed in view of easy management, convenience of use and functioning as focal points for soil conservation efforts.

(4) Extension Plan

1) Promotion and Guidance

The extension facilities, equipment and materials will be consolidated to respond to the widening scope of extension activities following the establishment of new farmers' groups with the implementation of the Project.

2) Extension Facilities

a) The size of the new training centre will be modest to prevent its maintenance and administration work following the completion of the Project from becoming an intolerable burden. The training centre will incorporate broad features so that its activities are not confined to soil and water conservation training.

b) A new demonstration plot will be established to encourage farmers' participation in soil and water conservation projects and their understanding of soil conservation technologies/techniques and also to display various soil

conservation methods. Farmer participation will be encouraged from the design stage so that local opinions are properly reflected.

3) Supporting Services for Farmers

In order for farmers to find soil conservation measures sufficiently attractive, it is necessary for local farmers to find agriculture financially rewarding following the adoption of conservation measures. Supporting services to cover both the technical and managerial aspects of agriculture should, therefore, be provided in addition to other measures, including incentives in the form of financial support and assistance in kind. Moreover, reinforcement of the extension activities and appropriate administrative coordination at the local government level are essential to improve the effects of these supporting services and measures.

(5) Management Plan

1) Management Organizations

As various local agencies will be involved in the implementation of the Project, coordination between these agencies at the local government level will be of crucial importance for the successful implementation of the Project. The implementation system must be carefully planned and must emphasise the provision of supporting services for farmers and coordination between local administrative organizations.

2) Project Implementation Schedule

Given the envisaged work volume, implementation system and both the availability and activities of farmers' groups, etc., it has been decided to complete the entire Project in 7 years.

(6) Work Volume and Annual Project Implementation Plan

The annual work volume by project item is outlined in the table below.

Implementation Schedule of Main Project Items

Item	Unit/ financial year	Schedule of Main Project Items								
		0	1	2	3	4	5	6	7	Total
[Advance Preparation before Project Implementation]	unit	1								1
[Farmland & Forest Land Conservation]	ha									
Bench Terraces (incl. Small Dike Terraces)	ha		776	1,554	1,942	1,942	1,554			7,768
Forest Development (Types 1, 2 & 3)	ha		322	646	807	807	646			3,228
Agroforestry (Types 1 & 2)	ha		308	614	768	768	614			3,072
Improved Dry Fields (Types 1 & 2)			782	1,566	1,957	1,957	1,566			7,828
Settlement Environment Conservation	unit									
Absorption Wells			176	352	440	440	352			1,760
[Torrent & Bank Conservation]	unit									
Check Dams (incl. Small Check Dams)	unit		22	27	32	32	32	32	32	209
Gully Plugs	m		200	280	320	320	320	320	320	2,080
Revetment Works			1,600	3,200	4,000	4,000	3,200			16,000
[Extension]	unit									
Demonstration Plots	unit		10	10	10					30
Training Centre	unit		1							1
New Extension Facility			1							1
[Infrastructure]	m									
New Roads	m		14,160	14,160	14,160	14,160	14,160	3,800	3,800	74,400
Road Upgrading	m^2		25,990	25,990	25,990	25,990	25,990			129,950
Slope Protection (Revegetation)	m		24,461	24,461	24,461	24,461	24,461			122,305
(Gutters)	unit		48,921	48,921	48,921	48,921	48,921			244,605
Nurseries			12							12

Note: Advance preparation includes coordination, detailed design and procurement preparation.

(7) Project Cost

1) Preconditions of Cost Estimate

The preconditions of the cost estimate are: (i) the project implementation period is 7 years, (ii) the year of project commencement is 1994, (iii) the annual inflation rate is 8.0% for Indonesia and 5.0% for outside Indonesia, (iv) the base year is 1992 and the exchange rates are 1 US$ = 2,050 Rp and 1 US$ = 125 yen.

2) Project Cost Estimate

The project cost for each project year is estimated based on the work plan. The base cost for the entire project is 59,842 million Rp. With the physical contingency (8.0%) and price contingency (based on annual inflation rate of 8.0%) added, the total project cost is 90,718 million Rp. The amount to be borne by the Indonesian government, given as the sum after deducting the farmers' direct labour cost from the base cost, is 45,722 million Rp.

Project Cost Estimate

(Unit: million Rp)

Project Item	Base Cost (A)	Total Cost (B)	Farmers' Contribution (C)	Government Contribution (A-C)
1. Farmland and Forest Land Conservation				
1) Terraces	3,599	5,046	0	3,599
2) Forest Development	8,189	11,411	3,571	4,618
3) Agroforestry	8,188	11,409	3,209	4,979
4) Improved Dry Fields	15,064	21,069	7,340	7,724
5) Settlement Environment Conservation	755	1,052	0	755
2. Torrent and Bank Conservation	5,292	7,860	0	5,292
3. Extension	4,709	6,312	0	4,709
4. Infrastructure	4,441	6,182	0	4,441
5. Environmental Care	950	1,173	0	950
6. Management	8,656	12,329	0	8,656
Sub-Total	59,842	83,998	14,120	45,722
Physical Contingency	0	6,720	0	0
Total	59,842	90,718	14,120	45,722

Note: The values of sub-total and total do not correspond to the sums of the other values as those are rounded.

6. Financial and Economic Analyses

(1) Financial Analysis

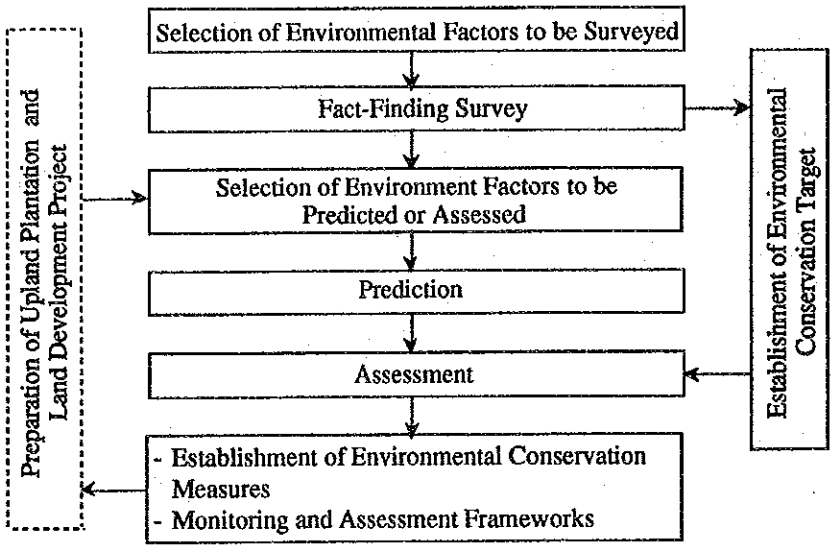
The financial analysis of the proposed changes to crops in the Planning Area concludes that the increment on the NPV will be 21,737 million Rp based on a real discount rate of 10%. The resulting internal rate of return will be 20.1%.

(2) Economic Analysis

The benefits and costs were adjusted to economic prices using the benefits and costs used in the financial analysis for farmland and forest land development. While the transfer items were withdrawn, the benefits accruing from the deferment of dredging work at Saguling dam were added. The resulting net benefit from the Project will be an incremental NPV of 12,751 million Rp on the NPV in 1992 (economic discount rate of 13.5%) with an internal rate of return of 21.1%, confirming the feasibility of the Project.

7. Environmental Care Plan

The environmental care plan has been formulated in accordance with the general steps of environmental care shown below. Forecasting and assessment constitute part of the planning process.



(1) Environmental Forecasting and Assessment

Environmental forecasting and assessment were conducted for several environmental factors in the Planning Area.

1) Natural Environment

a) Deterioration of Soil Fertility

No similar project has so far reported serious damaged caused by the deterioration of soil fertility following the construction of terraces. It is assumed that any serious decline of soil fertility can be effectively prevented by the sufficient use of lime and fertilizer as anticipated in the case of the Project.

b) Changes in Surface Water Flow Regime

Because of the expected increase of both the infiltration capacity and retained water volume and also because of the prolonged travelling time for the surface water to reach the downstream, the Project should have positive effects in terms of flood control. The negligible change of both the evapotranspiration volume and general runoff coefficient means that the

Project will not have any serious impact on the water supply volume. Given these observations, it is highly likely that the environmental conservation targets of the Project will be fully achieved.

c) Water Pollution, Deterioration of Water Quality and Eutrophication

Measures envisaged by the Project to prevent turbid water include the construction of check dams and small check dams prior to the construction of terraces. Appropriate decisions on the timing of check dam construction and on check dam sites and the introduction of diversion channels are important to achieve the environmental conservation targets.

With regard to pesticides, the use of pesticides with a low toxicity or residual toxicity is planned. Indirect measures include (i) reduced dependence on external input in terms of the physical cycle system as in the case of reduced fertilizer use due to the introduction of agroforestry, (ii) reduced consumption of pesticides due to the avoidance of monoculture and diversification of the ecosystem and (iii) reduced migration quantities of nitrogen and phosphorous due to the decrease of soil discharge.

2) Social Environment

a) Transformation of Economic Activities and Friction with Local Inhabitants

It is assumed that the local work force will be used as much as possible for construction work under the Project. Most construction work for civil engineering structures, including terraces, and buildings is planned to be conducted during the dry season for soil conservation. As the dry season is an off-farming season, there will be few clashes of interest between the Project-related work and farming.

b) Changes of Social Structure due to Grouping, etc. and Reform of Existing Systems and Customs

According to the results of the questionnaire survey, farmers participating in such activities have not experienced any harmful effects on farming due to the establishment of farmers' groups. Consequently, it can be argued that the establishment of farmers' groups will not result in any damage to the local communities.

(2) Principles of Monitoring and Assessment

Monitoring will be conducted for the following environmental factors for which quantification is deemed necessary because of their grave implications vis-a-vis the objectives of the Project and for which long-term, homogeneous data is required to identify the likely environmental impacts. SBRLKTs are considered suitable organizations to bear the responsibility for monitoring.

Item	Method	Frequency
[Natural Environment]		
- sediment discharge	- establishment of soil erosion volume at fixed plots	monthly
- river flow regime	- measurement of runoff and sediment transportation volume by hydrological stations	daily
- river water quality	- testing of water quality items near hydrological stations	monthly in principle
[Social Environment]		
- crop yield	- survey on yield of standard crops at fixed plots	every harvest
- farmers' group activities	- detailed study of farmers' groups participating in Project	monthly

It is necessary for the assessment of the project implementation results to be regularly conducted together with analysis of the collected data and the assessment results must be fed back to the local areas together with the opinions of the farmers' representatives and instructions from higher organizations.

8. Recommendations

(1) The Project is judged to be suitable from the technical, economic and social viewpoints and the Project's early implementation is highly desirable.

(2) Given the fact that implementation of the Project involves many government departments and offices as well as one municipality and 2 districts, coordination between all related organizations from the preparatory stage and the establishment of an appropriate implementation system are essential. In particular, prior coordination at the provincial level is highly desirable for the smooth implementation of the Project.

(3) The national forests located in the upper reaches of the subject sub-watersheds perform an excellent function in terms of soil and water conservation. While the Project is mainly concerned with private land in the middle and lower reaches, work in these national forests should be conducted with full understanding of the objectives of the Project.

(4) The active participation of local inhabitants should be sought right from the preparatory stage, i.e. detailed design stage, to facilitate their understanding of and cooperation for the Project taking the local conditions into proper consideration.

(5) The Project is a type of environmental conservation project and includes an environmental care plan to emphasise its environmental features. This environmental care plan should be fully implemented to ensure a high degree of perfection of the Project.

(6) The implementation of active monitoring of soil loss, changes in crop yields and impacts on local inhabitants, etc. is recommended in view of establishing a smooth implementation method for similar projects in other areas in the future.

(7) The Upland Plantation and Land Development Project is still at the feasibility study stage where the suitability of the Project is under examination. More concrete implementation programmes should be prepared to reflect the actual conditions of the subject areas, including the historical changes of various conditions in such areas.

CONTENTS

SUPPORTING REPORT

A 1 S/W and M/M
A 2 List of Study Team Members and Main Interviewees on Indonesian Side
A 3 Formulation of Thematic Maps
A 4 Soil Erosion Test
A 5 Conditions of Check Dams in Study Area
A 6 USLE Method to Estimate Soil Loss
A 7 Rainfall Data
A 8 Survey on Torrent Devastation
A 9 Production on Principal Crops in 1991
A10 Interview Survey
A11 List of Crops Referred to in Report

B 1 Criteria for Conservation Measure Matrix

C 1 Suitability of Tree and Crop Species in Planning Area
C 2 Estimated Transition of Sedimentation Volume and Remaining Capacity of Saguling Dam
C 3 Data for Cost Estimate

D 1 Forecast of Post-Project Yields
D 2 Data for Financial Analysis
D 3 Data for Economic Analysis

E 1 Hydrologic Survey
E 2 River Water Quality in Study Area
E 3 Supply of Agrochemicals (Pesticides) by P.T. Pertani at Kab. Bandung

PLANNING MAP

Upland Plantation and Land Development Planning Maps (17 sheets)

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

THE FEASIBILITY STUDY ON UPLAND PLANTATION AND LAND DEVELOPMENT PROJECT
IN THE REPUBLIC OF INDONESIA

Abbreviations	English Name	Indonesian Name
ADB	Asian Development Bank	ADB
AMDAL	Analysis of Environmental Impacts	Analisis Mengenai Dampak Lingkungan
BAKOSURTANAL	Coordinating Agency for National Surveys and Mapping	Badan Koordinasi Survey dan Pemetaan Nasional
BAPEDAL	Environmental Impact Management Agency	Badan Pengelolaan Dampak Lingkungan
BAPPEDA Tk.I	Provincial Planning Board	Badan Perencanaan Pembangunan Daerah Tingkat I
BAPPEDA Tk.II	District Planning Board	Badan Perencanaan Pembangunan Daerah Tingkat II
BAPPENAS	National Development Planning Agency	Badan Perencanaan Pembangunan Nasional
BMG	Meteorology and Geophysics Agency	Badan Meteorologi dan Geofisika
BPN	National Land Agency	Badan Pertanahan Nasional
BPP	Extension Center	Balai Penyuluhan Pertanian
BRLKT	Land Rehabilitation and Soil Conservation Centre	Balai Rehabilitasi Lahan dan Koservasi Tanah
BTP-DAS	Watershed Management Technology Centre	Balai Teknologi Pengelolaan Daerah Aliran Sungai
BULOG	National Food Procurement Agency	Badan Urusan Logistik
Bupati	Chief of District	Bupati
Camat	Chief of Sub-District	Camat
DAS	Watershed	Daerah Aliran Sungai
DEPHUT	Ministry of Forestry	Departemen Kehutanan
DINAS Pertanian I	Provincial Agricultural Service	DINAS Pertanian I
DINAS Pertanian II	District Agricultural Service	DINAS Pertanian II
DPMA	Research Institute for Water Resources Development	Pusat Penelitian dan Pengembangan Pengairan
Demoplo	Demonstration Plot	Unit Percontohan Usaha Pelestarian Sumber Daya Alam
Desa	Village	Desa
INPRES	Presidential Instruction	Instruksi Presiden
JICA	Japan International Cooperation Agency	JICA
KANWIL	Provincial Office of a Ministry	Kantor Wilayah
KPH	Forest District Office (Perum Perhutani)	Kesatuan Pemangkuan Hutan
KUD	Village Cooperative	Koperasi Unit Desa
Kabupaten	District	Kabupaten
Kecamatan	Sub-District	Kecamatan
Kotamadya/Kodya	City	Kotamadya/Kodya
LKMD	Village Institution for Community Development	Lembaga Ketahanan Masyarakat Desa
NPV	Net Present Value	NPV
OECF	Overseas Economic Development Fund	OECF
PHPA	Directorate General of Forest Protection & Nature Conservation	Direktorat Jenderal P H P A
PKK	Women Organization	Pembinaan Kesejahteraan Keluarga
PLN	State Electricity Public Corporation	Perusahaan Umum Listrik Negara
PLP	Field Regreening Extension Worker	Penyuluh Lapangan Penghijauan
PMP	Senior Regreening Extension Worker	Penyuluh Madya Penghijauan
PPL	Field Agricultural Extension Worker	Penyuluh Pertanian Lapangan
PPM	Senior Agricultural Extension Worker	Penyuluh Pertanian Madya
PPS	Agricultural Extension Specialist	Penyuluh Pertanian Spesialis
PU	Ministry of Public Works	Departemen Pekerjaan Umum
Perum Perhutani	State Forest Authority	Perum Perhutani
REPELITA	Five Year Development Plan	Rencana Pembangunan Lima Tahun
RRL	Directorate General of Reforestation & Land Rehabilitation	Direktorat Jenderal Reboisasi dan Rehabilitasi Lahan
S/W	Scope of Work	-----
SBRLKT	Land Rehabilitation and Soil Conservation Sub Centre	Sub Balai Rehabilitasi Lahan dan Koservasi Tanah
TGHK	Forest Land Use by Consensus	Tata Guna Hutan Kesepakatan
USLE	Universal Soil Loss Equation	United Soil Loss Equation
WB	World Bank	WB

CHAPTER 1 INTRODUCTION

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1.1 Background of the Study

In January, 1989, the Government of Indonesia requested the Government of Japan to conduct the present study (the Study) to constitute a feasibility study for the Upland Plantation and Land Development Project for the Citarik Sub-Watershed and to transfer upland plantation and land development planning techniques applicable to other watersheds to the Indonesian side.

In response to this request, the Government of Japan sent the Contact Mission to Indonesia in March, 1991, followed by the Preliminary Study Team in September, 1991, and concluded the Scope of Work (S/W). The Preliminary Study Team identified the background of the Study as follows.

① The subject watershed is suffering from soil erosion due to rainwater and surface runoff because of the particular topographical, soil and land use conditions, causing damage downstream ranging from sedimentation at a dam for power generation and the flooding of paddy fields as well as residential areas. The systematic implementation of a forest (headwater forest) development project and watershed conservation measures is urgently required.

② Given the present land use and land ownership conditions, the employment of a large-scale afforestation method is difficult. The adoption of social forestry, through which assistance is provided for the afforestation efforts of local inhabitants for their own benefit to eventually create headwater forests, is more viable and preferable.

③ The establishment of demonstration plots is necessary to increase the awareness of local inhabitants of the need for and beneficial effects of social forestry and watershed conservation in order to encourage local inhabitants (small farmers) to follow the demonstrated activities.

④ Social forestry in Indonesia means tumpangsari, agroforestry, silvo-pastral and silvo-fisheries, bee-keeping and mushroom growing, etc. It is essential to plan the best mix of these components to suit each locality.

⑤ The development of infrastructure, which is also intended to assist local development in a broader sense, is essential in view of the effective adoption of social forestry and watershed conservation practices and increase of the income of local inhabitants.

The implementation of the Upland Plantation and Land Development Project, which will be conducted at privately owned land and which is part of an appropriate local development scheme, will not only promote the economic growth of the forestry sector but will also contribute to soil and water conservation in the subject area and its downstream areas. The Project is also expected to help improve the lives and welfare of local inhabitants.

1.2 Study Objectives

The Study intends the preparation of the Upland Plantation and Land Development Project for the Citarik Sub-Watershed and a feasibility study for the Plan in order to assist watershed control and rural village development.

1.3 Study Area

(1) Study Area Details

The Citarik sub-watershed, which is the Study Area, is located in the uppermost reaches of Citarum watershed and some 30km east of Bandung in the northwest of Java island as shown in Fig. 1-1. The Study Area extends over 50,325 ha of land where one city and 2 districts are located with a population of 797,605 and an annual population growth rate of 1.98% (1991). Farmers account for 39% of the employment figures, followed by factory and office workers at 31%. The percentage of those engaged in farming has slightly declined in recent years due to the progress of urbanisation and the establishment of factories. The elevation of the Study Area ranges from 660m to 2,000m and the topography is generally steep except in areas used for paddy fields.

The mean annual rainfall is 2,123mm and the dry season lasts from June to September. The mean annual temperature is 22.9°C with little temperature fluctuation throughout the year. According to the findings of the Study, the land use breakdowns are 15.6% for forests, 38.6% for paddy fields and 24.7% for dry crop fields. Forests are mainly distributed in the peripheral areas and mountain top areas of the Study Area. Natural forests account for 4.2% while man-made forests

account for the remaining 11.4%. The dominant species of man-made forests are Pinus merkusii and Swietenia mahogani. Ploughed fields, which are the main targets for soil conservation, are widely distributed from the gentle slope areas to steep slope areas. However, adequate conservation measures, including the use of the terraced cultivation method, are seldom observed.

(2) Planning Area

Flat paddy fields and surrounding areas in the Study Area have been omitted from the scope of the Project as these areas present few problems, such as soil loss, etc., from the viewpoint of watershed conservation and also because the soil and water conservation activities of the Ministry of Forestry (Departemen Kehutanan: DEPHUT) only deal with dry land.

While national forests, which account for most of the forests in the Study Area, are under the jurisdiction of the Perum Perhutani, they are included in the Planning Area in view of their important watershed conservation functions of preventing sediment runoff to downstream areas and ensuring a water supply for local inhabitants.

Consequently, the Planning Area covers 33,388 ha of land, the details of which are given in Table 1-1. The relative location of the Planning Area within the Study Area is shown in Fig. 1-2.

Table 1-1 Planning Area Details

Category	Area (ha)	Ratio (%)
Planning Area	33,388	66
Area Outside Planning Area	16,937	34
Study Area	50,325	100

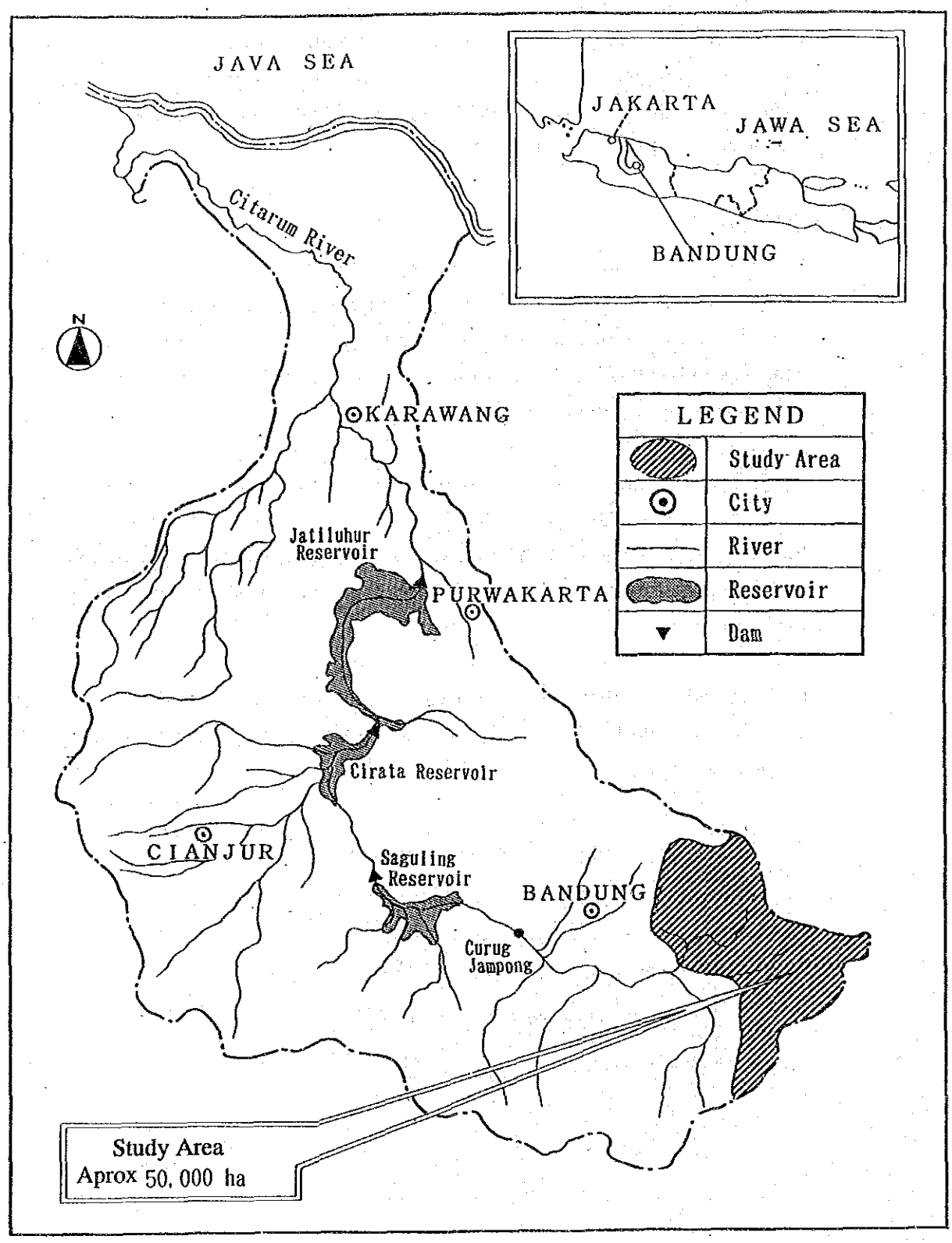


Fig. 1-1 Location of Study Area

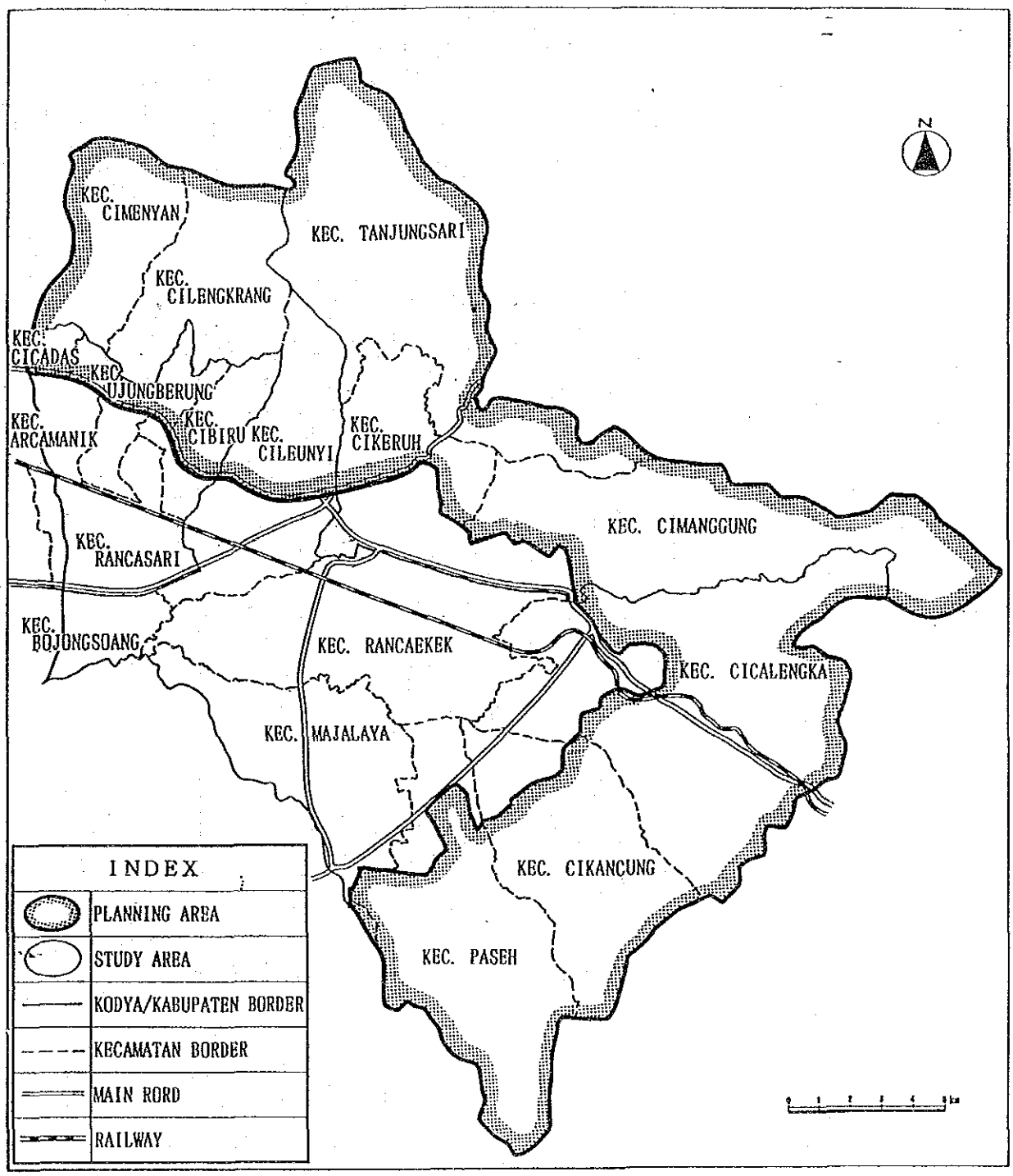


Fig. 1-2 Location of Planning Area

(3) Classification of Watersheds

Several rivers, including Citarik river and Cikeruh river, originating in the Study Area flow into Citarum river, the region's main river. The Study Area has been divided into 15 sub-watersheds as shown in Fig. 1-3 and Table 1-2 to establish basic units in order to identify the sediment runoff conditions as well as the local socioeconomic conditions, including farming, and to monitor the sediment runoff. These sub-watersheds will also act as basic units for implementation in the case of the Project reaching the actual implementation stage.

Table 1-2 Sub-Watershed Areas

Classification		Sub-Watershed Number	Area (ha)
Study Area	Planning Area	1	2,255
		2	3,524
		3	2,443
		4	6,213
		5	2,909
		6	4,097
		7	2,758
		8	2,590
		9	2,226
		10	2,466
		11	1,381
		12	526
		Sub-Total	33,388
	Areas Outside Planning Area	13	5,607
		14	5,277
		15	6,053
		Sub-Total	16,937
	Total		50,325

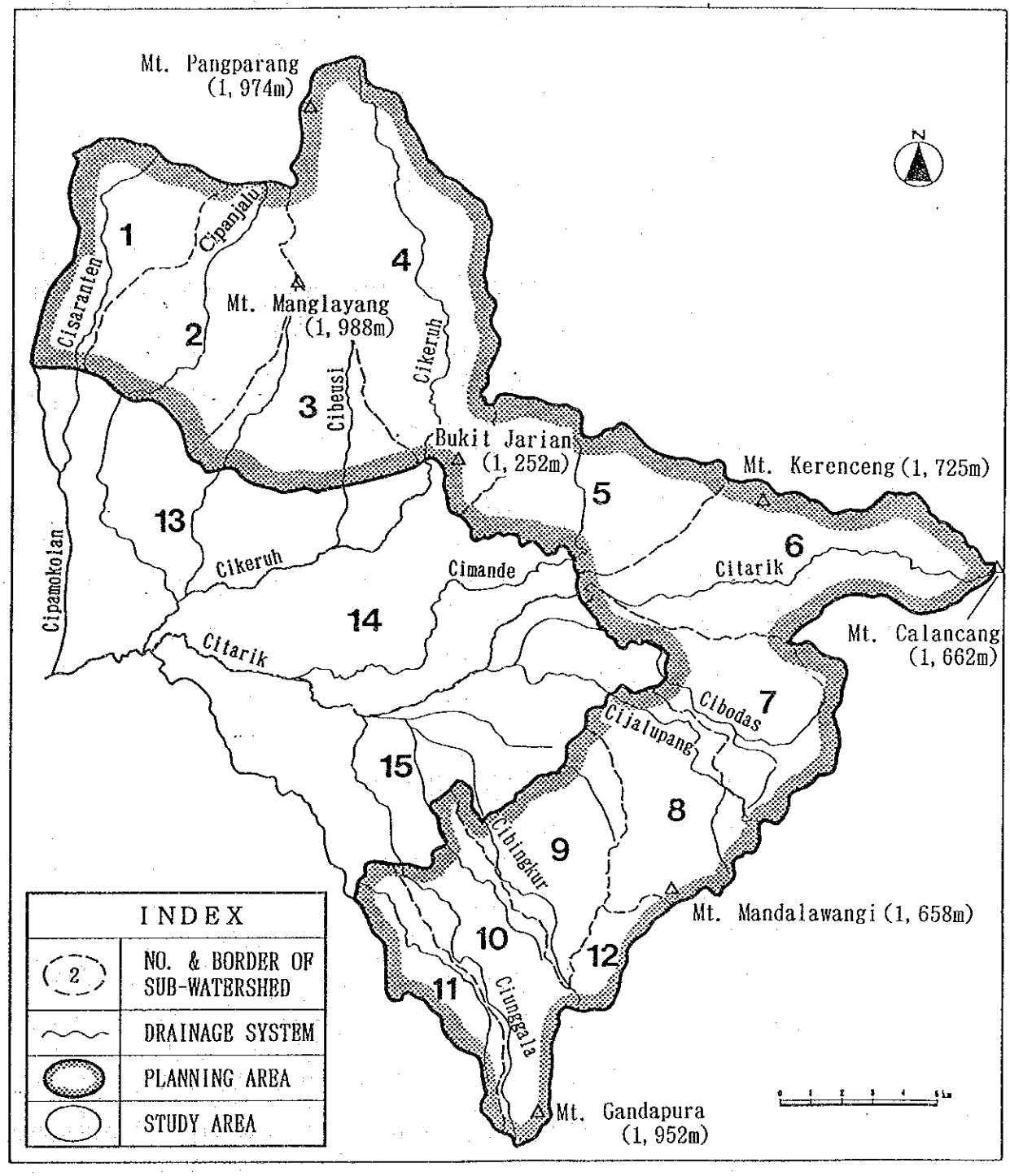


Fig. 1-3 Location of Sub-Watersheds

1.4 Study Contents

The Study was conducted for a period of 3 years, from financial year 1991 to financial year 1993. The flow chart of the Study is shown in Fig. 1-4 and the study contents for each year are outlined below.

(1) Study in Financial Year 1991

- Collection and sorting of existing relevant data
- Preparation of Inception Report
- Collection of basic data for preparation of Upland Plantation and Land Development
- Preparation of Progress Report
- Preparation of topographical map (scale: 1/10,000)

(2) Study in Financial Year 1992

- Preparation of land use and vegetation map (scale: 1/10,000)
- Preparation of soil map (scale: 1/10,000)
- Natural and social environment survey
- Watershed conservation survey
- Fact-finding survey on current social forestry
- Survey on means of diffusing social forestry
- Survey on existing infrastructure
- Local opinion survey
- Fact-finding survey on likely environmental impacts of plan implementation
- Financial and economic analyses
- Preparation of Upland Plantation and Land Development Project (Draft)
- Preparation of Upland Plantation and Land Development Project Map (Draft) (scale: 1/10,000)
- Preparation of Interim Report

(3) Study in Financial Year 1993

- On-site verification of and discussions on contents of Interim Report
- Preparation of Draft Final Report
- Preparation of Upland Plantation and Land Development Project
- Preparation of Upland Plantation and Land Development Project Map (scale: 1/10,000)
- Implementation of Technology Transfer Seminar
- Preparation of Final Report

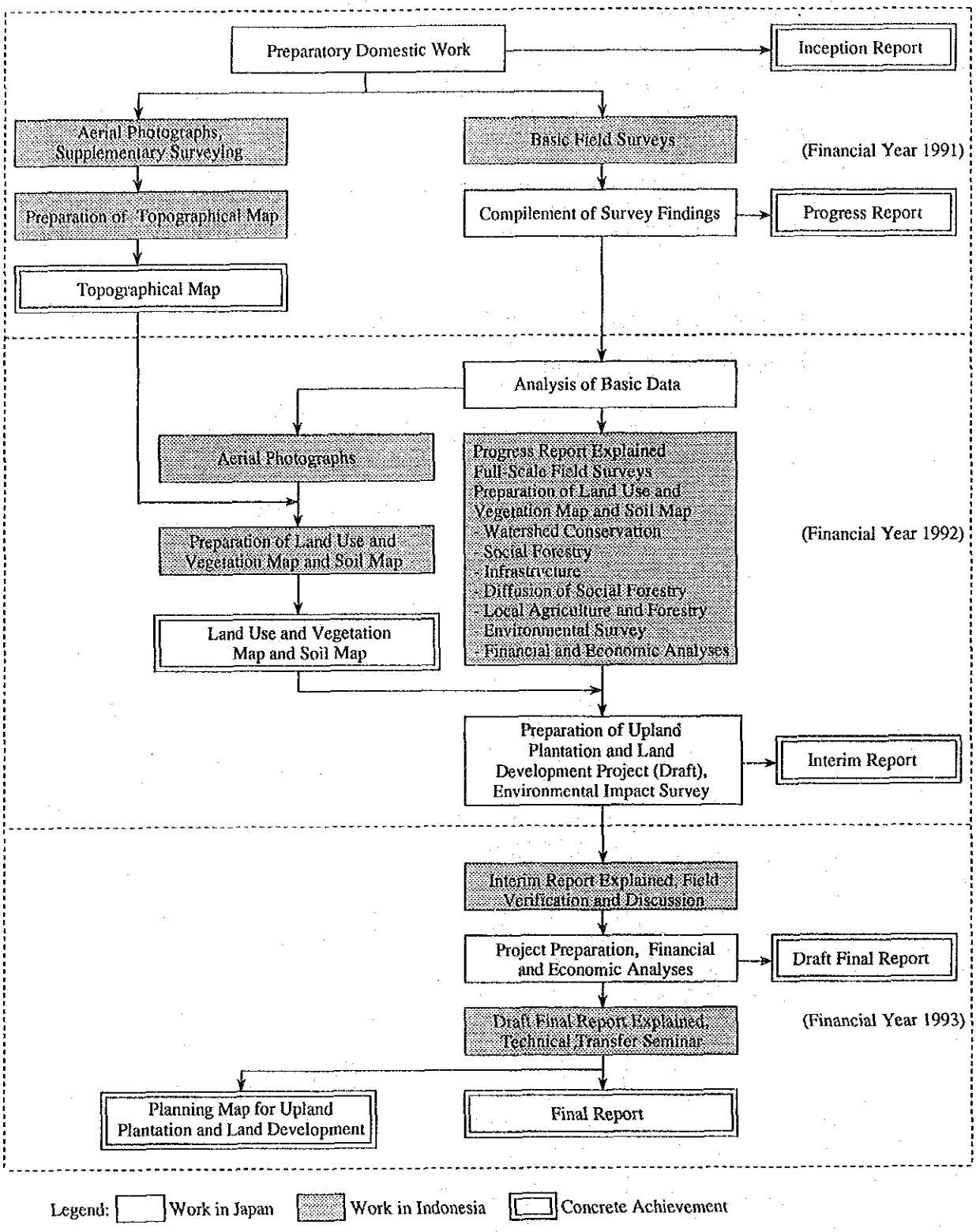


Fig. 1-4 Study Flow Chart

1.5 Technology Transfer

The procedure and method of each type of survey essential for the preparation of the Upland Plantation and Land Development were explained to the counterparts and data collection and compilation methods were taught during on-the-job training to facilitate the transfer of the relevant technologies and techniques.

CHAPTER 2 FORESTS, FORESTRY AND SOIL AND WATER CONSERVATION PROJECTS IN INDONESIA

CHAPTER 2 FORESTS, FORESTRY AND SOIL AND WATER CONSERVATION PROJECTS IN INDONESIA

2.1 Outline of Forests and Forestry

(1) Forest Area and Forest Types

Decisions on the utilisation of national land in Indonesia are made through deliberations by the competent ministries and agencies. The total forest area is said to be some 144 million ha, accounting for approximately 74% of the total national land. This figure, however, does not necessarily indicate the real forest area and includes many former forest sites which have become grassland or denuded land due to shifting cultivation, forest fires and/or conversion to farmland. One FAO estimate puts the actual forest area in Indonesia at some 109 million ha based on interpretation of Landsat data which mainly indicate natural forest areas. This figure differs from the previous figure based on land use classification categories by more than 30 million ha. Different figures for the forest area are compiled in Table 2-1. Indonesia's DEPHUT has been actively conducting a reforestation programme during the 5th 5-Year Development Plan period (1989/1990 - 1993/94) to convert some 20 million ha of waste land to forests.

Table 2-1 Forest Area by Region

(Unit: million ha)

Region	Land Area	Land Use Classification		FAO Estimate	
		Forest Area	Forest Coverage (%)	Forest Area	Forest Coverage (%)
Sumatra	47	30	64	20	43
Java	14	3	23	1	8
Kalimantan	55	45	82	35	63
Sulawesi	20	13	68	10	52
Irian Jaya	41	41	99	34	82
Others	17	12	70	8	49
Total	193	144	74	108	56

Source: DEPHUT and FAO

Forest land is classified into 4 forest management types, i.e. national forest reserves, protected forests, production forests and conversion forests. Production forests are further classified into restricted production forests and ordinary production forests using soil type, slope gradient and rainfall as the main classification indices. Forest land which is designated as conversion forest and

which has already been converted to farmland or something else will be given a new designation other than forest land in the future when the current land use classification is reviewed. The forest management types by area and other information are given in Table 2-2.

In the Java region, which accounts for only some 7% of the total land area but for some 60% of Indonesia's total population, the forest coverage is exceptionally low compared to other regions as shown in Table 2-1. Consequently, there is no conversion forest which has approval to change its status from forest to farmland in the Java region and all forest land on Java island is designated as permanent forest land.

Table 2-2 Forest Management Types by Area

Type	Area (million ha) (share)	Purposes of Use	Work Permitted
Natural Forest Reserves	18.8 (13%)	natural reserves, national parks, conservation of species	felling prohibited
Protected Forests	30.3 (21%)	water conservation, prevention of sediment runoff, national land conservation	felling prohibited
Ordinary Production Forests	33.9 (24%)	timber production	selective felling (only trees larger than 50cm in diameter)
Restricted Production Forests	30.5 (21%)	timber production, national land conservation	selective felling (only trees larger than 60cm in diameter)
Conversion Forests	30.5 (21%)	conversion to farmland and others	clear felling
Total	144.0 (100%)		

Source: DEPHUT

(2) Outline of Forestry Production

Indonesia's 5th 5-Year Development Plan constitutes the final stage of the first long-term development plan which commenced in 1969 and is believed to be particularly important as a link to ensure future development under the next long-term plan.

Based on this understanding, vigorous activities have been conducted in the forestry sector. The following targets have been upheld during the current 5-Year Development Plan period to further advance the achievements made during the 4th 5-Year Development Plan period.

① Increased forest product production volume and improved efficiency of the use of raw wood to foster the forestry industry.

② Consolidation of an appropriate balance between forest production and the conservation of the ecosystem as well as the environment.

Table 2-3 shows the important plan targets. In addition to a substantial increase of timber production from the actual production level in the past, the implementation of industrial reforestation is intended to convert some 300,000 ha of waste land and grassland a year into forests. Active support has also been given to revegetation projects which are designed to change privately-owned farmland to forests.

Table 2-3 Main Components and Targets of 5th 5-Year Development Plan

		Target	Remarks
Production Volume	Logs	157 million m^3	104 million m^3
	Sawn Timber	49 million m^3	32 million m^3
	Plywood	35 million m^3	25 million m^3
			(actual achievement between 1984 and 1988)
Reforestation	Industrial Reforestation	1.5 million ha	subject areas are forest land under land use classification
	Non-Industrial Reforestation	0.5 million ha	
Revegetation	Demonstration Plots	2,500 plots	subject areas are non-forest land (farmland, etc.) under land use classification
	Assistance in terms of Seedlings, etc.	3.65 million ha	
	Sengonisasi Activity	0.18 million ha	

Source: 5th 5-Year Development Plan (Forestry Sector)

2.2 Soil and Water Resources Conservation Measures in Indonesia

(1) Outline

Many achievements have been made in the forestry sector in the past through various activities in which the DEPHUT has played a central role. Nevertheless, a close look at the current conditions of forest land in Indonesia reveals such difficult problems as illegal trespassing, illegal felling and shifting cultivation which cause soil erosion and flooding in many areas. The DEPHUT or, more precisely the RRL, has actively introduced measures to promote reforestation and the recovery of soil fertility. Measures to combat soil erosion and flooding have been given top priority. Watersheds where the introduction of such measures is deemed urgent have been selected and ranked in terms of action priority. 39

watersheds are selected in the 5th 5-Year Development Plan and the plan calls for the implementation of an integrated watershed control plan through coordination between the competent ministries and agencies for the 11 top ranking watersheds where the conditions are critical in terms of the soil and water conservation requirements. Table 2-4 outlines the 39 watersheds selected for improvement in the 5th 5-Year Development Plan.

(2) Organization

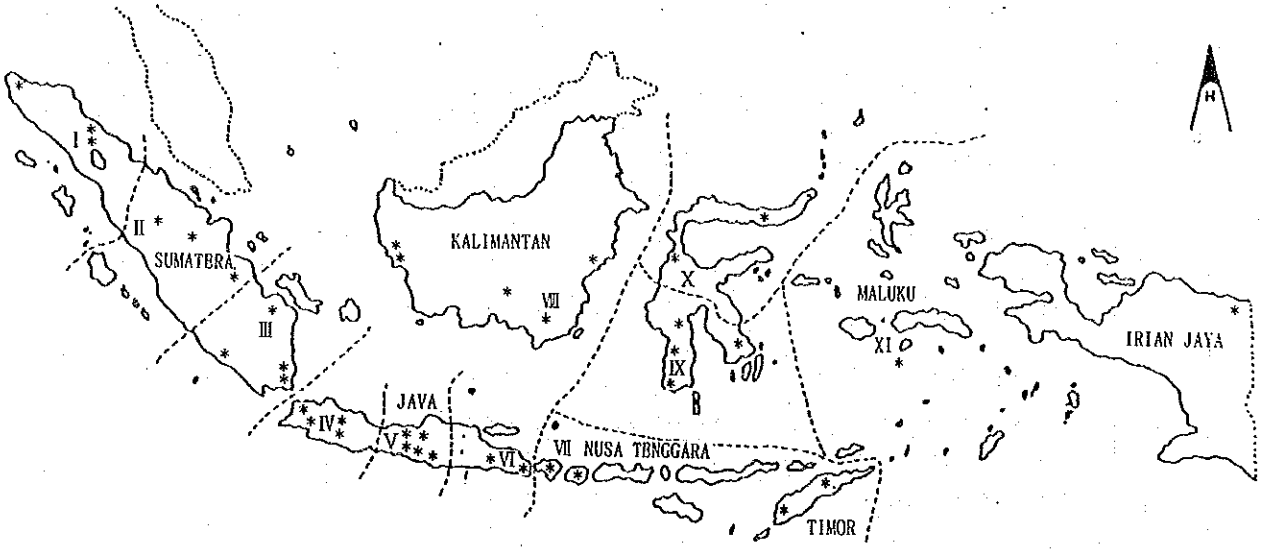
The central agency responsible for the planning and implementation of soil and water conservation measures in Indonesia is the RRL. Eleven land rehabilitation and soil conservation centres have been established so far throughout Indonesia to be directly responsible for the actual work. In addition, 39 sub-centres are conducting various activities in their own areas of responsibility.

The Centre for Watershed Management Technology is located in Surakarta in Central Java Province and conducts technical surveys and research. Fig. 2-1 shows the geographical area of jurisdiction and the location of the land rehabilitation and soil conservation centres.

Table 2-4 Priority Ranking of Watershed Conservation Work

Rank	Watershed		Risky Area (ha)	Timing to Implement Improvement Work
		Surveyed Area	Area Requiring Conservation	5th 5-Year Development Plan
1	Asahan Barumun	752,500	497,000	454,000
2	Solo DS	84,600	84,600	84,600
3	Jratun Seluna	91,700	91,700	91,700
4	Saddang DS	207,200	182,200	182,200
5	Brantas DS	102,900	102,900	102,900
6	Citarum DS	166,700	166,700	166,700
7	Cimanuk DS	92,100	92,100	92,100
8	Citanduy Cisanggarung	134,700	134,700	134,700
9	Billa Walanae DS	202,300	177,300	177,300
10	Ciliwung Cisadane CMD	94,400	94,400	94,400
11	Serayu Luk Ulo DS	93,600	93,600	93,600
12	Way Seputih DS	299,800	175,200	142,600
13	Palu Poso DS	531,200	229,000	128,200
14	Way Sekampung DS	153,700	153,700	153,700
15	Indragiri Kampar Rokan	358,700	279,600	214,000
16	Ciujung Teluk Lada	91,800	91,800	91,800
17	Jeneberang Kelapa DS	174,900	164,900	116,200
18	Wampu Ular DS	238,200	178,200	138,200
19	Krueng Aceh Jambu Aye	419,100	173,200	117,300
20	Pemali Comal DS	61,600	61,600	61,600
21	Barito Riam Kanan	281,800	271,800	251,800
22	Sampean DS	90,800	90,800	90,800
23	Komoro Laklo Sue	137,400	80,100	63,700
24	Batanghari DS	194,000	129,000	94,000
25	Dodokan Moyo Sari	288,800	212,200	136,100
26	Benain Aissesa Kambaneroe	1,750,400	425,000	289,300
27	Agam DS	153,100	103,100	103,100
28	Opak Oyo Progo	59,700	59,700	59,700
29	Wae Hatu Merahh Apu DS	635,800	225,000	121,100
30	Ketakun DS	555,900	265,000	155,500
31	Sampara Wonco Timoro	548,900	267,000	187,500
32	Musi DS	579,500	475,000	419,700
33	Bone Bolango Tondano	400,000	195,100	108,600
34	Kapuas DS	1,064,400	567,400	473,000
35	Blega Saroka	112,200	112,200	112,200
36	Unda Anyar DS	83,800	83,800	83,800
37	Baliem Memberamo DS	282,600	282,600	282,600
38	Mahakam Berau	691,800	601,600	601,600
39	Kahayan DS	925,600	315,900	315,900
	Total of 39 Watersheds	13,188,200	7,986,700	6,787,800

Source: 5th 5-Year Development Plan (Forestry Sector)



Area	Headquarters	Area	Headquarters
I	Medan	VII	Denpasar
II	Padang	VIII	Banjarbaru
III	Palembang	IX	Ujungpandang
IV	Bandung	X	Menado
V	Solo	XI	Ambon
VI	Malang	*	Sub-Centers

Source: DEPHUT

Fig. 2-1 Geographical Area of Jurisdiction and Location of Land Rehabilitation and Soil Conservation Centres

2.3 Status of the Study

(1) Citarum Watershed

The Citarum watershed is ranked 6th in terms of priority in the 5th 5-Year Development Plan as shown in Table 2-4. This watershed has 3 well-known hydropower stations (Saguling, Cirata and Jatiluhur) which together meet some 60% of the electricity demand of Java island and Madura island.

Citarum river flows through Bandung which is the densely populated capital of West Java Province with many industries. In view of the importance of Citarum river from the viewpoint of public wealth and industrial development, the document jointly signed by the Minister of Home Affairs, Minister of Forestry

and Minister of Public Works in 1984 at the beginning of the 4th 5-Year Development Plan clearly stated their preference that the Citarum watershed be afforded top priority for development. In particular, it was pointed out that the upper reaches of Saguling dam had a large river regime coefficient (maximum discharge rate ÷ minimum discharge rate), implying an unstable discharge rate, high population density and increasing pressure vis-a-vis land and soil due to the increasing conversion of farmland to industrial or residential land. In short, the upper reaches of the Citarum watershed has been an area subject to earnest technical surveys and examination with a view to preparing suitable conservation measures as soon as possible.

(2) Study Area

The Study Area includes the sub-watersheds of Citarik river and Cikeruh river in the upper reaches of the Citarum watershed and mainly consists of steep slope areas in the uppermost areas of these sub-watersheds, spreading from north to east of the Bandung basin, and flat paddy field areas and industrial and residential areas in the lower reaches of these sub-watersheds. The Study Area covers some 50,000 ha and its conservation is given the highest priority in the upper reaches of the Citarum watershed. As of 1991, the population density is more than 1,300/km^2 with an annual population growth rate of nearly 2%. In terms of land ownership, small landowners with 0.1 - 0.25 ha/household account for more than 40% and the average landholding is estimated to be approximately 0.3 ha. The agricultural sector accounted for some 42% of all workers in 1985 but this figure declined to some 39% in 1991, presumably because of changes in the local economic set-up. The accelerated shortage of farmland due to the progress of urbanization is considered to be a major cause of this decline. Given the importance of the Study Area as a drainage basin in the upper reaches of the Citarum watershed and as an outlying mountainous area of the Bandung basin, the implementation of soil and water conservation measures in the Study Area should prove extremely significant for not only the development of sloping land areas where agricultural development is a major concern but also for the development of stable public life in lower land areas.

Under these circumstances, the JICA Team visiting Indonesia in March and September, 1991 agreed with the Indonesian side to select the Study Area as the area most urgently requiring the implementation of soil and water conservation measures.

CHAPTER 3 CURRENT CONDITIONS OF STUDY AREA

CHAPTER 3 CURRENT CONDITIONS OF STUDY AREA

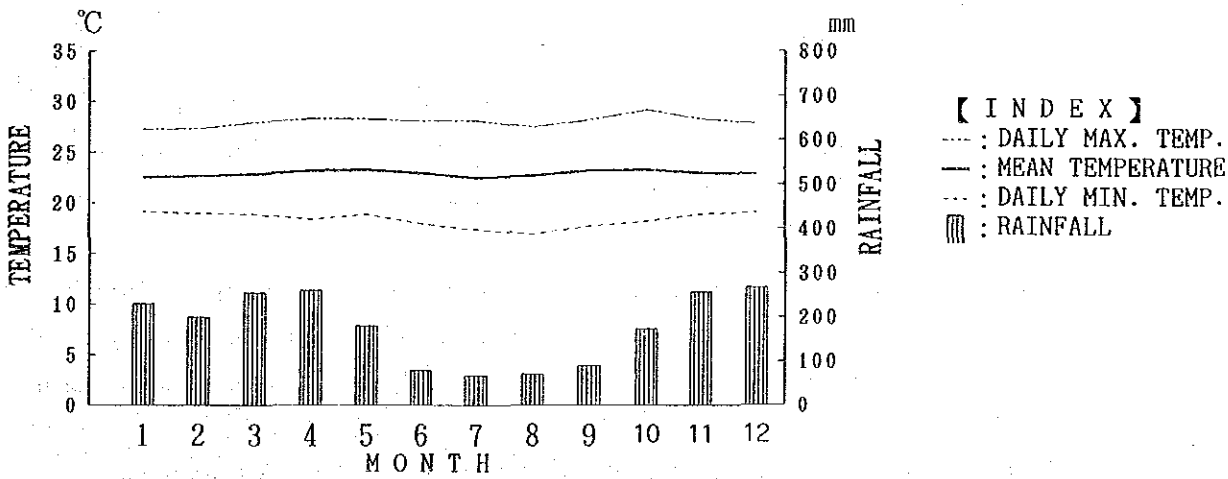
3.1 Natural Environment

3.1.1 Climate

The climate of the Citarik sub-watershed area is classified as Type B of the classification scheme proposed by Schmit and Ferguson. A Type B climate is characterised by a relatively short dry season which lasts for 1.5 - 3.0 months as typified by the low ratio of dry months (monthly rainfall of 60mm or less) vis-a-vis wet months (monthly rainfall of 100mm or more) of 14.3 - 33.3%.

In the Planning Area, however, an Oldeman's Type C2 climate, which implies that the climate is suitable for agriculture, prevails with 5 - 6 months of very wet weather (monthly rainfall of 200mm or more) and 2 - 4 months of dry weather (monthly rainfall of 100mm or less) (Oldeman, L.R., An Agro-Climatic Map of Java, Contr. Centr. Res. Inst. Agric. Bogor, No. 17, 1975).

Fig. 3-1 shows the monthly norms of meteorological parameters recorded by the Bandung Meteorological Station (Station Geofisika Kelas I Bandung, BMG) for the period between 1952 and 1990.



(Modified from "Bandung Meteorological Observations 1991" by BMG)

Notes
- Location: 6°55'S 107°36'E, Elevation: 791m

Source: BMG, "Bandung Meteorological Observations 1991"

Fig. 3-1 Monthly Norms of Meteorological Parameters in Bandung

The monthly norms of the daily maximum and minimum temperatures fluctuate between 16.9°C and 29.2°C. The mean annual temperature is 22.9°C with little monthly fluctuation (less than 1°C). The maximum and minimum temperatures recorded for the past 4 years at the station are 33.0°C (November 9, 1991) and 13.0°C (May 25, 1991) respectively.

In the case of rainfall, the total annual rainfall value of monthly norms is 2,123.0mm with monthly rainfall from June to September of less than 100mm. The annual evaporation is 1,018.0mm and the level of evaporation is relatively high from June to September when there is little rain.

Based on the BMG observation records for 1986, a westerly wind prevails from December to June because of the monsoon wind while an easterly wind prevails from July to November. The mean wind velocity is 1 - 3 knots for both the westerly and easterly winds.

3.1.2 Geology and Topography

The bedrock in the Study Area and surrounding areas generally belongs to either the Miocene or Pliocene series and consists of tuff sandstone, conglomerate, breccia, shale and limestone, etc. As the bedrock is covered by volcanic products, only an extremely small mass and relatively small mass of bedrock is now observed to the southern and western edges of the Bandung plain respectively. No faults are observed in the Study Area.

The bottom of the Bandung basin is characterised by lake sediment which is covered by flood sediment supplied by a large number of large and small rivers flowing into the basin from the surrounding mountainous areas.

The Study Area consists of the northeastern part of the Bandung basin and the northern and eastern mountainous areas surrounding the basin. The elevation gently increases from 661m near Sapan in the flat part of the basin to the piedmont of the slightly elevated mountainous areas (EL 700m) and further to the dividing ridges to the north, east and south. High mountains in the area include Mt. Pangparang (EL 1,974m) in the north, Mt. Kareumbi Barat (EL 1,725m) in the east and Mt. Gandapura (EL 1,952m) while the highest mountain is Mt. Manglayang (El 1,988m).

The mountainous area in the northwestern corner of the Study Area is composed of volcanic breccia, volcanic mudflow deposits and lava. Mt. Manglayang is a relatively young volcano which has the characteristics of a konide volcano and which is composed of tuff sandstone, lapilla, lava and agglomerate. The geological composition of Mt. Kerenceng (EL. 1,725m) is similar to that of Mt. Manglayang except that the upper half of the mountain is covered by newer prodcuts (basaltic and scoriaceous lava). The eastern mountain range is composed of several types of volcanic products. A solid lava foundation is observed at an elevation of approximately 1,000m along Citarik river, forming a large falls (Sinulang falls). A gently sloping dome spreads in the upperstream of the Sinulang falls. Mt. Mandalawang (EL. 1,658m) is composed of vitric tuff containing pumice and lava (either pyroxene andesitic or basaltic) and has an extensive gently sloping midslope. The southernmost mountainous area of the Study Area is composed of old products (andesitic to basaltic lava) from old volcanoes, including Guntur, and is highly eroded. Hardly any fan development is witnessed in the piedmont of the Bandung basin.

No significant mineral resources have been discovered in the Study Area. Andesite, which may be described as the area's only mineral resource, is quarried at open pits along the deeply dissected valleys and is extensively used for road and building construction.

3.1.3 Soil

(1) General

Alluvial soil (fluvisols by FAO/UNESCO classification) is predominantly distributed throughout the Bandung plain with the presence of gley (gleysols by FAO/UNESCO classification). Most areas covered by these soil types are used as paddy fields. In the mountains and their piedmont areas, so-called latosols originating from various types of volcanic products (mainly intermediate rocks) are found and these latosols are classified into brown latosols and dark reddish brown latosols. Despite the fact that the Study Area is located in a volcanic zone, the distribution of andosols is unexpectedly small with andosols observed in flat or gently sloping land in the northeastern area of Mt. Bukit Jarian and headwater areas of high elevation. In the piedmont areas, andosols are only observed at some gentle slopes on ridges. While volcanic ejecta must have once fallen and covered the area, it has likely been eroded due to farming over many years.

(2) Soil Types and Properties

A soil survey was conducted in the Study Area to clarify the local soil types, their properties and state of distribution and a soil map (scale: 1/10,000) was prepared based on the survey findings (see Supporting Report A3.)

Soil in the Study Area can be broadly divided into that associated with mountainous areas and that with the plains. Cambisols originating from pyroclastic deposits is the main soil type in the mountainous areas and andosols originating from volcanic ash are also found in some areas. The dominant soil type in the plains is fluvisols originating from river deposits and gleysols are also present in some areas. The physical and chemical properties of 10 typical soil profiles which were selected from a number of soil profiles surveyed, which were analysed by Soil Research Center in Bogor, are given in Table 3-1 and 3-2. All data on paddy fields, regardless of their being located in either mountainous areas or the plains, are dealt with together as it is judged that paddy fields are not important from the viewpoint of erosion control.

1) Humic Cambisols (Bh)

Soil in the mountainous parts of the Study Area is judged to be humic cambisols as it contains a cambic B horizon and a darkish umbric A horizon. The umbric A horizon of dry crop land on steep slopes is occasionally very thin or non-existent and is judged to be the eroded phase of humic cambisols.

The colour of the humic cambisols is predominantly reddish (2.5 YR, 5 YR) and the soil is clayey, containing little gravel. The soil structure is well developed with moderate permeability. As the soil is characterised by weak acidity and a low C/N ratio, its productivity is high.

The humic cambisols found in the forests of upper mountain areas (elevation of some 1,200m or higher) tend to have a thick A horizon and are rich in humus in the B horizon, possibly because of weak exposure to the accelerated erosion process. Silt loam is sometimes found as shown in the case of Profile No. 1. Soil showing these features is separately classified as high humus-type humic cambisols (Bh(h)).

Table 3-1 Mechanical Composition and Physical Properties of Representative Soil Profiles

Prof. No. * Soil Unit	Horizon	Sampling Depth (cm)	Mechanical Composition (%) Sand 2.0~0.1mm	Sand 0.1~0.05mm	Silt 0.05~0.002mm	Clay 0.002mm>	Texture Class** (Vol.%)	Solid Phase (Vol.%)	Porosity (Vol.%)	Bulk Density (g/cc)	Permeability (cm/h)
1	Au1	1 ~ 5	13.7	5.6	55.7	25.0	SiL	31.3	68.7	0.83	5.13
Bh(h)	Au2	24 ~ 28	16.2		66.5	17.3	SiL	30.6	69.4	0.81	5.20
6	Ap	2 ~ 6	6.0	3.3	16.4	74.3	C	35.8	64.2	0.95	2.98
Bh	Bu1	30 ~ 34	5.2		16.1	78.7	C	36.6	63.4	0.97	4.52
7	Ap	2 ~ 6	4.7	2.8	20.6	71.9	C	35.8	64.2	0.95	11.34
Bh	A	20 ~ 24	7.2		20.2	72.6	C	33.6	66.4	0.89	9.96
8	A	2 ~ 6	12.7	4.4	25.8	57.1	C	32.4	67.6	0.86	10.54
Bh	Bu1	32 ~ 36	4.8		12.8	82.4	C	36.2	63.8	0.96	0.08
10	A	2 ~ 6	10.3	5.4	27.0	57.3	C	36.2	63.8	0.96	6.68
Bh	Bu1	30 ~ 34	5.1		17.6	77.3	C	40.4	59.6	1.07	3.84
5	A	2 ~ 6	5.4	3.7	20.3	70.6	C	34.7	65.3	0.92	6.68
Bh	Bu1	32 ~ 36	6.2		19.7	74.1	C	34.0	66.0	0.90	5.75
2	Au2	7 ~ 11	25.5	11.4	49.2	13.9	L	22.3	77.7	0.59	10.74
Th	AB	30 ~ 34	46.0		42.8	11.2	L	16.2	83.8	0.43	9.37
4	Au1	1 ~ 5	31.2	11.8	45.1	11.9	L	28.7	71.3	0.76	3.59
Th	Au2	30 ~ 34	39.8		40.3	19.9	L	30.6	69.4	0.81	6.77
3	Ap	2 ~ 6	9.9	8.6	56.5	25.0	SiL	32.4	67.6	0.86	12.75
Th	A	18 ~ 22	8.2		34.6	57.2	C	35.8	64.2	0.95	2.23
9	1	2 ~ 6	1.6	0.9	12.3	85.2	C	36.2	63.8	0.96	8.01
Is	2	-	-		-	-	-	-	-	-	-

Note: * Bh(h): High Humus Type of Humic Cambisols, Bh: Humic Cambisols (Common Type), Th: Humic Andosols, Is: Man-made Immature Soils.
** SiL: Silt Loam, C: Clay, L: Loam.

Table 3-2 Chemical Properties of Representative Soil Profiles

Prof. No. * Soil Unit	Horizon	Sampling Depth (cm)	pH (H_2O)	pH (KCl)	C (%)	N (%)	C/N
1	Au1	4~14	5.7	4.7	2.72	0.32	9
Bh(h)	Au2	24~34	5.4	4.6	1.87	0.24	8
6	Ap	4~14	4.8	4.3	2.07	0.17	12
Bh	Bu1	30~40	4.9	4.8	1.21	0.12	10
7	Ap	2~8	5.1	4.5	2.28	0.19	12
Bh	A	25~35	5.1	4.5	1.34	0.15	12
8	A	5~15	5.8	5.0	2.08	0.21	10
Bh	Bu1	40~50	5.6	4.8	1.15	0.12	10
10	A	4~14	5.6	5.0	3.13	0.28	11
Bh	Bu1	30~40	5.6	5.0	1.45	0.12	12
5	A	6~16	5.2	4.6	2.16	0.15	14
Bh	Bu1	40~50	5.2	4.3	0.92	0.07	13
2	Au2	9~19	5.0	4.8	6.58	0.63	10
Th	AB	30~40	5.2	4.8	2.37	0.28	8
4	Au1	4~14	5.3	4.8	3.77	0.39	10
Th	Au2	30~40	6.0	4.9	2.78	0.20	14
3	Ap	3~10	5.3	4.7	2.92	0.22	13
Th	A	16~26	5.4	4.7	1.91	0.14	14
9	I	5~15	5.4	5.0	0.22	0.02	11
Is	II	50~60	5.3	5.0	0.23	0.02	12

Note*: See Table 3-1.

2) Humic Andosols (Th)

Despite the location of the Study Area in a volcanic zone, volcanic ash is found only on flat land or gentle slopes in small areas. The soil originating from volcanic ash in the Study Area has a well developed, darkish umbric A horizon and, therefore, is classified as humic andosols. The soil sometimes contains a buried A horizon or a clayey layer originating from the weathered bedrock in the lower sections of the profile.

This generally loamy soil is characterised by high porosity, low bulk density and moderate permeability. As in the case of humic cambisols, it has high productivity due to weak acidity and a low C/N ratio.

3) Paddy Soil

As described earlier, paddy fields command low priority in the Project and, therefore, it has been decided to treat all soil found in paddy fields under the heading of paddy soil even though this soil type is not used by the FAO/UNESCO classification.

There are 2 types of paddy fields, i.e. the so-called terraced paddy fields found on mountain slopes and the common paddy fields found on the plains or lowlands of the valley bottom. The soil of the former is clayey due to its association with cambisols while the soil of the latter shows a wide variety of soil texture, from coarse to fine, due to its association with fluvisols.

4) Man-Made Immature Soil

This type of soil is found at land where cutting, banking and/or reclamation, etc. have taken place. The term "man-made immature soil" is used here due to the difficulty of determining its genetic origin. It is found at quarries for construction materials or brick materials and also at (mainly reclaimed) industrial and housing land. The soil of graveyards is also included in this type for convenience.

The soil at quarries is composed of different pyroclastic materials and reclaimed land is also composed of similar materials. This type of soil has no horizon differentiation and a poor humus content. The soil structure is not developed and the permeability is rather low.

(3) Soil Distribution

The mapping units described below were used in the examination of soil distribution and the coverage and ratio of each unit are given in Table 3-3.

1) Cambisols Complex I

This complex is mainly composed of high humus-type humic cambisols areas (approximately 90%) and small areas of lithosols and rocky areas which are found on steep slopes.

This complex is distributed in steep mountain areas with a high elevation where natural forests are often found undisturbed.

2) Cambisols Complex II

This complex is also composed of high humus-type humic cambisols areas (approximately 95%) and small lithosols areas which are found on steep valley walls.

This complex is widely distributed in mountain areas with a high elevation. While the conversion of natural forests to man-made forests is very evident in these areas, it is advisable to avoid large-scale clear felling from the viewpoint of soil and water conservation.

3) Cambisols Complex III

This complex is composed of ordinary humic cambisols areas (approximately 95%) and small areas of lithosols on steep valley walls. The soil sometimes appears as chromic cambisols at first glance because of the loss of the A horizon due to surface erosion.

This complex is widely distributed in mountain foot areas and is mostly used for farming purposes.

4) Cambisols-Andosols Complex

This complex is composed of high humus-type humic cambisols and ordinary humic cambisols areas. The composition ratios are some 70% for the former and some 30% for the latter. The cambisols of this complex sometimes have a thin volcanic ash layer at the top.

This complex is found at slightly dissected land around the andosols zone. While cambisols are dominant at dissected slopes, andosols cover gentle slopes. This complex contains some farmland but mainly consists of forests.

5) Andosols

This unit is predominantly composed of humic andosols and is distributed at little dissected gentle slopes in the headwater areas of volcanoes. It is also found at the plateau near Tanjungsari and rolling land near Bojong. The headwater areas are used as forests while other areas covered by this unit are used as farmland.

6) Paddy Soils

Both terraced paddy fields in mountain areas and ordinary paddy fields in the plains are mapped under paddy soils. The latter includes scattered dry crop fields and arboricultural gardens.

7) Man-Made Immature Soils

As described earlier, the soil at quarries, developed land and graveyards is mapped under man-made immature soils. The relevant sites are scattered in each land use category throughout the Study Area. The number of such sites appears to have increased from the time when the aerial photographs were taken and is believed to be still increasing.

8) Housing and Factory Land

Dense housing sites and industrial sites with large factories are indicated on the soil map. The number of large factories is increasing and are mainly invading paddy field areas in the plains.

9) River, Pond and Road

Rivers, ponds, dams roads and railway tracks, etc. are mapped under the single heading of "river, pond and road" although only main rivers, toll roads and reclaimed railway tracks are actually mapped. While a minimum mapping requirement of 0.25 ha is applied for ponds, small ponds linked to each other are mapped as single ponds.

Table 3-3 Land Occupation Share of Soil Mapping Units

Mapping Unit	Land Occupation Share in Study Area	
	(ha)	(%)
Cambisols Complex I	852	1.7
Cambisols Complex II	5,900	11.8
Cambisols Complex III	17,222	34.3
Cambisols-Andosols Complex	1,644	3.3
Andosols	1,244	2.5
Paddy Soils	19,102	37.9
Man-Made Immature Soils	352	0.7
Housing and Factory Land	3,693	7.4
River, Pond and Road	195	0.4

3.1.4 Land Use and Vegetation

The conditions of land use and vegetation in the Study Area are described in this section in accordance with the categories used for the aerial photograph interpretation.

(1) Paddy Fields

Paddy fields are mainly distributed in the central part of the Study Area and are classified into 2 categories, i.e. irrigated paddy fields which have a fairly regular shape with clearly identifiable water channels and which are mainly observed in the plains and rain-fed paddy fields which have an irregular shape without clear water channels. The corresponding coverage of these 2 types of paddy fields in the Planning Area and areas outside the Planning Area are given in Table 3-4.

Table 3-4 Distribution of Paddy Fields

(Unit: ha)

Category	In Planning Area	Outside Planning Area	Total
Irrigated Paddy Field	4,640	13,744	18,384
Rain-Fed Paddy Field	992	0	992

(2) Dry Crop Fields

The farming fields with terraces identified by the aerial photographs are classified as "dry crop field (with terraces). Contour cultivation is conducted or traditional terraces have been established in most dry crop fields. Those which are not recognised as bench terraces on the aerial photographs are classified as "dry crop field (without terraces)".

Land with tree coverage of not more than 20% is also classified as dry crop fields. Sites in national forests where the tumpangsari system is employed are classified as dry crop fields based on the results of the aerial photograph interpretation except those sites which have been confirmed as being otherwise by the field survey. Most dry crop fields are located in the Planning Area.

(3) Mixed Gardens

Land where woody plants, including fruit trees, are planted together with other kinds of farming practice are classified as "mixed garden". These are further divided into 2 sub-categories in accordance with the tree coverage, i.e. mixed gardens with a tree coverage of 71% or more and mixed gardens with a tree coverage of upto 70%. Most mixed gardens are located in the Planning Area.

(4) Estates

The total land area of estates in the Study Area is some 500 ha. While coconut, mulberry and quinine estates are located in limited areas, clove estates are relatively scattered throughout the Study Area.

(5) Shrub

Forest land with a tree height of upto approximately 5m is classified as shrub land provided that the completed planting of trees on this land is not confirmed on the aerial photographs. It must be noted that some sites where the Banjar Harian system is used (only areas immediately around the planted trees are cleared) may be classified as shrub land as the trees cannot be identified on the aerial photographs in the first 1 or 2 years after planting.

(6) Grassland

Land interpreted as natural grassland or uncultivated waste land is classified as "grassland".

(7) Settlement

In addition to proper housing sites, small areas of surrounding land with trees are included in the "settlement" category in order to clearly identify settled sites on the map.

(8) Industrial Facilities

As the Study Area has been experiencing a series of new industrial activities, mainly those of textile factories, it is reasonable to assume that many new factories have been constructed in the last 2 - 3 years.

(9) Forests

Forests of some 7,800 ha are distributed throughout the Study Area, mainly in national forest areas. Forests are divided into either natural secondary forests or man-made forests. The man-made forests of such hardwood species as teak are included in the sub-category of "natural secondary forest" unless they are verified as being man-made forest by the field survey.

With regard to the tree height and crown density, 3 classification classes each are introduced. As shown in Table 3-5, forests with a crown density of more than 71% account for some 66% of the total forest area while forests with a crown density of upto 20% account for a mere 7% of the total forest area.

Table 3-5 Composition of Forests

Sub-Category	Tree	Crown Density (%)			Total
	Height (m)	≦20	21 - 70	71 ≦	
Natural Secondary Forests	≦10	12	0	12	24
	11 - 20	20	652	216	888
	21 ≦	0	332	836	1,168
	Sub-Total	32	984	1,064	2,080
Man-Made Forests	≦10	400	192	204	796
	11 - 20	104	632	1,024	1,760
	21 ≦	28	304	2,840	3,172
	Sub-Total	532	1,128	4,068	5,728
Total		564	2,112	5,132	7,808

Notes: The total area of natural secondary forests comprises 2,076 ha of state land and 4 ha of private land. The one of man-made forests does 5,684 ha of state land and 44 ha of private land.

(10) Others

Land areas which are used in narrow linear form, such as roads, railway tracks and rivers, and very small sites of certain land use descriptions are not calculated and, therefore, are not mapped because they do not show up in the mesh analysis method employed for the Study. The calculation results of areas of the land use/vegetation categories using the mesh analysis method are shown in Table 3-6.

See Supporting Report A3 about the details of preparing the Land Use/ Vegetation map.

Table 3-6 Areas by Land Use/Vegetation Category in Study Area

Category		Area (ha)	Ratio (%)
Paddy Fields	Irrigated	18,384	36.6
	Rain-Fed	992	2.0
Dry Crop Fields	With Terraces	1,128	2.3
	Without Terraces	11,268	22.4
Mixed Gardens	Crown Density: ≧ 71%	596	1.2
	Crown Density: 21 - 70%	820	1.6
Estates		500	1.0
Shrub		1,264	2.5
Bamboo		1,964	3.9
Grassland		548	1.1
Bare Land		68	0.1
Settlement		4,324	8.6
Industrial Facilities		364	0.7
Forests	Natural/Secondary	2,080	4.2
	Man-Made	5,728	11.4
Others		176	0.4
Total		50,204	100.0

Notes:
- Figures are calculation results of the mesh analysis method.
- Figures for estates are the total of coconut palm, mulberry, quinine and clove estates.
- Figures for bare land are the total of man-made bare land and natural bare land.
- Figures for others are the total of fish culture ponds, graveyards and swamps.

3.2 Social Environment

3.2.1 General Conditions of Local Communities

Both the Study Area and Planning Area spread over the areas of jurisdiction of Bandung City, Bandung District and Sumedang District. The Planning Area actually consists of the following 13 sub-districts.

District	Sub-District
Kodya Bandung	Cicadas
	Arcamanik
	Ujungberung
	Cibiru
Kab. Bandung	Cimenyan
	Cilengkrang
	Cileunyi
	Cikancung
	Cicalengka
	Paseh
Kab. Sumedang	Tanjungsari
	Cikeruh
	Cimanggung

(1) Population

The population of and other data on the city and 2 districts in the Study Area for 1985, 1987 and 1991 are given in Table 3-7 based on collected statistical data.

Table 3-7 Population Details of Study Area

	1985			1987			1991		
	Population	No. of Households	Population Density*	Population	No. of Households	Population Density*	Population	No. of Households	Population Density*
Bandung City **	84,898	18,451	1,894	122,693	25,298	3,036	196,685	45,166	3,784
Bandung District	430,557	98,823	1,488	496,647	100,734	1,665	465,918	105,172	1,613
Sumedang District	108,635	27,782	911	119,078	28,536	990	135,002	34,350	1,100
Total	624,090	145,056	1,377	718,418	154,568	1,608	797,605	184,688	1,723

Notes
* Unit: persons/km^2
** Except urban areas of Bandung City.

The population of the Study Area has been steadily increasing with an annual increase rate of the population density of approximately 2%. The population density of the Study Area (1991) of 1,723 persons/km^2 is much higher than the population density of West Java Province of 763.5 persons/km^2 (1990), indicating a high population concentration in the Study Area.

(2) Industries

In terms of employment, the figures provided by the Bandung District authority show that the main employment sector in the Study Area is agriculture. However, data for the 10 year period from 1980 to 1990 suggest that there is a trend of a long-term decline in agricultural employment coupled with a rise of manufacturing and commercial activities (Table 3-8).

Table 3-8 Change of Labour Force Composition in Bandung District (1980 - 1990)

(Unit: %)

Sector	1980	1990
Agriculture	47.8	44.7
Transportation	0.8	0.5
Manufacturing	10.5	12.5
Electricity, Gas and Water	0.1	0.1
Construction	4.2	3.5
Commerce	15.9	18.1
Telecommunications	3.6	3.5
Banking and Finance	0.6	0.5
Public Services	15.6	16.4
Others	0.9	0.2

Source: Format Isian Perencanaan Pembangunan-
BAPPEDA Kab. Bandung

One notable non-agricultural industrial area in the Study Area is Majalaya where there is a prosperous textile industry. Majalaya accounts for some 8.6% of non-agricultural employment in Bandung District and is one of the most important local industrial areas. Nevertheless, a deterioration of production facilities is evident and the quality of such public services as rubbish collection and waste water/sewage treatment in urban Majalaya is worsening.

Such educational institutions as the University of Padjadjaran are concentrated in Jatinagor and the development of the area as a university town is planned. In