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DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

THE CITANDUY RIVER BASIN DEVELOPMENT PROJECT

CITANDUY UPPER WATERSHED MANAGEMENT PROJECT

FEASIBILITY REPORT

SUBMITTED BY

PRC ENGINEERING CONSULTANTS, INC.
DENVER, COLORADO, U.S.A. BANJAR, WEST JAVA, INDONESIA

JANUARY 1980

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JANUARY 1980

ABBREVIATIONS AND LOCAL TERMS

Kabupaten	-	District/Regency
Bupati	-	Chief of District/Kabupaten
Kecamatan	-	Sub-district (Administrative Unit)
Camat	-	Chief of Kecamatan
Desa	-	Village (West Java)
Kepala Desa	-	Chief of Villge/Desa
Kelurahan	-	Sub-village (West Java)
Lurah	-	Chief of Sub-village
BAPPENAS	-	National Planning Board
BAPPEDA or BAPPEMKA (old)	-	District Planning Board
BIMAS	-	Mass guidance for agricultural intensification with government credit at low interest rates
INMAS	-	Mass guidance for agricultural intensification without government credit
BULOG	-	National agency for price control, stock and distribution of rice
DOLOG	-	Provincial agency administering BULOG program
CRIA	-	Central Research Institute of Agriculture-Bogor
Penyuluh Pertanian Lapangan (PPL)	-	Agricultural Extension Agent
Petugas Lapangan Penghijauan (PLP)	-	Greening Field Officer
Lembaga Pusat Penelitian Pertanian (LP3)	-	Agricultural Research Institute
Lembaga Penelitian Tanah (LPT)	-	Soil Research Institute
Pusat Penelitian dan Pengembangan Peternakan (P4)	-	Central Research and Animal Husbandry Development

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Note : Appendices are in separate volume

EXECUTIVE SUMMARY

CITANDUY UPPER WATERSHED MANAGEMENT PROJECT

Introduction

The Soil and Water Conservation planning studies for the Citanduy River Basin has been in progress for over a decade. A Citanduy River Basin Development 'Master Plan' and 'Feasibility Report', published in May 1975, presented a plan for the water conservation phase of development. The plan identified conservation works such as Dams & Reservoir, Irrigation & Drainage systems and protection works in the basin and proposed a plan for implementation. Parts of this plan is currently being implementation.

Following the Master Plan, the soil conservation studies for the Citanduy Upperwatershed were begun in 1977 with the implementation of the 'Panawangan Pilot Watershed Project'. This study termed 'The Citanduy Upper Watershed Management Project' focuses on the total watershed as the planning and management unit. The program for the 350,000 ha Citanduy Watershed was developed with a particular awareness of the people problems created by a 1979 watershed population of 2.2 million people (639 people/km^2). The Upper Watershed Program emphasizes the potential improvement in economic and social conditions of the upland farmers through an integrated system of extension education, demonstration farms, farmer incentives, farm credit, and increased availability of technology and technical inputs to upland farmers. Soil losses from upland erosion will be reduced by a system of conservation farming practices, bench terracing and other conservation measures, erosion proffing of critical road and trail sections, and a continuation of the "greening" program.

Evaluation of the proposed integrated Upper Watershed Management project indicates that it is technically feasible, economically and financially justifiable, and institutionally and socioculturally acceptable. In a word, the Upper Watershed Project plan is sound.

Upper Watershed Description

The Citanduy Watershed is located on the south east coast of the Island of Java, about 300 km southeast of the capital city, Jakarta. In line with the "one river, one plan" concept put forth by the Minister of the Environment, Dr. Emil Salim, the Upper Watershed area is defined as being all areas lying above the lowland rice fields, or those areas subject to erosion. As a gener-

alization the Upper Watershed area amounts to about 245,000 ha, or 70 percent of the watershed area, but the integrated Watershed Management Project was developed for the entire watershed without including any specific inputs to the areas either not subject to erosion or with low erosion rates.

The Watershed includes lands in the Tasikmalaya, Ciamis, Kuningan, and Majalenka Districts of West Java, and the Cilacap District of Central Java. For evaluation, planning, and implementation purposes, the 350,000 ha Watershed was also divided into five subbasins: Upper Citanduy (21.1%), Cimuntur (17.2%), Cijolang (13.7%), Cikawung (20.0%), and Ciseel-Lower Citanduy (28.0%).

Time and budget constraints did not permit the development of a complete soil and water conservation development program for management of the Citanduy Watershed, and the proposed five-year project is designed as a transition between the Panawangan Pilot Watershed Project and a complete watershed management program that would solve the upper watershed problems of the Citanduy River Basin. This approach provides the gradual transition necessary to train a technical staff and establish the necessary demonstration farms, bench terracing program, soil conservation structures, and program acceptance among the farmers. If this initial five-year project succeeds, the long-term integrated Watershed Management Program plan would be prepared, using the accumulated data and experience from the initial phase of the program.

It should be recognized that this initial project will not achieve dramatic changes in the Upper Watershed condition, or make the streams run clear, but it can greatly improve the economic situation for the upland farmer and can stem the rapid deterioration of the upper watershed areas. Because the transitions in this proposed plan begin from the present situation, the plan can be implemented in the near future if funds are made available.

Watershed Problems

The soil erosion problems of the Upper Watershed are quite evident, as is the high sediment load of all the main tributaries. The natural ecosystem of the Watershed has been disrupted by deforestation, uncontrolled agricultural development, and many other unwise practices.

What is not generally understood is that these are "people problems" with economic, technical, and physical limitations to their solution. The major problem is that the upland farmer's present farm productivity and size of operation are so limited that neither the physical nor the economic conditions for a conventional conservation program exist. Furthermore, population pressures are causing additional areas of forest and plantation land to be cleared for agricultural production, and because most of this land is unsuitable for upland crop production, it will erode and ultimately be abandoned or returned to forestry.

The analysis of critical areas of the Watershed indicates that 8,686 ha of forest land and 50,828 ha of upland areas are under private or local government control. This 59,514 ha of critical area comprises 17.0 percent of the total Watershed area. Unfortunately, the term "critical area" is poorly defined; quality of base maps and aerial photographic coverage are insufficient; therefore, these seemingly precise numbers can only be considered a generalization.

Erosion of roads, trails, and exposed cutbank areas is recognized as a major source of downstream sediment. This erosion often makes the roads and trails virtually impassable, thereby causing transportation costs to increase greatly.

Project Features

One of the Project's major features is an organization plan designed to provide unified management through the existing central governmental organizations so that efficiency is increased and the interagency conflicts that obstruct assistance to the farmer are reduced. Of course, the Government of Indonesia must choose whether or not to implement the suggested organization.

The integrated watershed management, or multiple-use planning, approach suggested for the Citanduy Upper Watershed attempts to consider all resources and problems and to maximize long-term economic returns while maintaining the Watershed's land and water resources for use by future generations. This approach is the key to: (1) efficient use of limited funds and trained manpower, (2) maximum use of available resources (physical, human, economic), (3) coordination of government

programs to reach specific objectives, and (4) increased land productivity while protecting the land and water resource from damage.

The Project proposal recognizes as essential to the Project's success the necessity of training and retraining the professional staff (both in Indonesia and abroad); the training of farmers and farm families; and even the conservation education of children in the school system. This training should emphasize the interdisciplinary approach to planning and will specifically teach the conservation farming methods for upland crop production.

Project Plan

The proposed integrated Watershed Management Plan was developed by considering three main factors: (1) the existing level of land and water resource development; (2) the existing social structure and infrastructure; and (3) the resources available for accomplishing the improvement program. Thus the Project measures concentrate on the problems of the upland farmer to the exclusion of specific improvements in the forest and plantation areas of the Upper Watershed. Generally, the forest and plantation area problems are related to encroachment and use for upland farming and these areas are government owned and have specific improvement programs and budgets that are scheduled or are being implemented.

The proposed program for conservation and watershed development is based on the concept that primary control of soil problems is best exerted by vegetative and other soil conservation measures including some structural measures. Therefore, all primary efforts at improvement in watershed condition are based on better vegetative cover through revegetation activities and encouragement of conservation farming methods. To this end, the project budget includes 474.5 million Rupiah for central and satellite nursery production of trees, planting stock, and seeds within the conservation works of the improvement program. The need for improvement in upland crop production and plant cover is also the primary reason for including a major upland research experiment station in the project, at an estimated cost of 377.5 million Rupiah.

Specific conservation measures budgeted in the proposed project include:

Description	Units	Number
Detailed Soil Surveys	ha	6,562
Critical Area Surveys	ha	59,500
Upland Demonstration Farms	no.	150
Bench Terracing Program	ha	4,375
Other Conservation Measures (budgeted but not scheduled by type of measure)		
Road and Trail Erosion Proofing	km	73
Reforestation and Greening Program	ha	42,809

The estimated cost of the above conservation measures is 3,382.8 million Rupiah.

The project also calls for a major infrastructure development program at an estimated cost of 468.8 million Rupiah, and a farm credit improvement program for upland farmers with an estimated cost of 300.3 million Rupiah, for a total of 768.8 million Rupiah. The project budget also has specific components for consultant services and the foreign training of project staff members.

Project Costs

All costs were based on 1979 Rupiah values and all major features were individually estimated and scheduled for each year of the five-year period. This includes a specific evaluation of the local farmer and village cost of installing Project measures, but not the cost of local contributions to infrastructure development projects. The five-year total cost of Watershed improvements can be summarized as follows:

Description	1979 Price Base million Rupiah	Percent
Administrative and Operational Expenses		
National Level	627.5 1/	5.2
Provincial Level	393.4	3.3
Kapupaten Level	726.2	6.0
Subtotal	1,747.1	14.5
Conservation Works	2,358.9	19.6
Infrastructure Improvements	768.7	6.4
Other costs		
Reforestation and Greening	1,498.3	12.4
Pilot Watershed Demonstration Projects	115.0	0.9
Economic Cost of Fertilizer Subsidy	105.5	0.9
Cost of Consultant Services	867.0	7.2
Foreign Training Costs	104.4	0.9
Subtotal	2,690.2	22.4
Total Project Cost	8,539.9	70.9
Farmer and Village Cost	3,497.0	29.1
Total Cost of Watershed Improvement	12,036.9	100.0

1/ Includes the cost of the Upper Watershed Research Experiment Station estimated at 377.5 million Rupiah.

The total Project cost of 8,539.9 million Rupiah (US $13.7 million) is a measure of the cost to the central Government. Please note that this Project cost is separate from the allocations for current Government programs in the Watershed, except for the "greening and reforestation" program, which is directly concerned with improving Upland Watershed conditions.

The estimated five-year Project cost flows (with domestic and foreign exchange components at 1979 Rupiah values) are:

	Million Rupiah		
Project Year	Total	Domestic	Foreign
1980-81 (1)	1,681.9	1,111.4	570.5
1981-82 (2)	1,732.2	1,219.1	513.1
1982-83 (3)	1,543.8	1,148.9	394.9
1983-84 (4)	1,524.7	1,229.3	295.4
1984-85 (5)	2,057.3	1,767.3	290.0
Total	8,539.9	6,476.0	2,063.9
US $ x 10^3	13,663.8	10,361.6	3,302.2
US $1.00	625 Rupiah		

In addition to these five-year costs, a long-term committment would be necessary to ensure that Project features were properly operated, maintained, and replaced as needed. The estimated OM&R cost for Project measures is 176.9 million Rupiah per year starting in year six. This would include the cost of supervision, inspection, farmer incentives, and government conducted repairs to the installed land treatment and conservation measures.

Unfortunately, the Indonesian and world market rates of inflation were fluctuating rapidly at the time of report preparation. Therefore, the following inflation adjusted cost flows are based on standard Indonesian projections for the domestic component and on the World Bank projections for international rates of inflation. These values should be viewed with caution in estimating cash flow requirements for the proposed Project because of the unstable situation in inflation rates.

The inflation-adjusted five-year project cost flows (with domestic and foreign exchange components) are estimated to be:

Project Year	Inflation Adjusted Prices Million Rupiah			Foreign Component US $ x 10^3
	Total	Domestic	Foreign	
1980-81 (1)	2,075.6	1,431.5	644.1	1,030.6
1981-82 (2)	2,338.6	1,724.4	614.2	982.7
1982-83 (3)	2,290.6	1,789.9	500.7	801.1
1983-84 (4)	2,504.5	2,107.1	397.4	635.8
1984-85 (5)	3,746.4	3,333.2	413.2	661.1
Total	12,955.7	10,386.1	2,569.3	4,111.3
US $ x 10^3	20,729.1	16,617.8	4,111.3	

US $1.00 = 625 Rupiah

The inflation-adjusted price estimate for the Project of 12,955.7 million Rupiah (US $20.7 million) is 152 percent of the cost estimate at 1979 Rupiah values. The estimated foreign exchange component of the Project budget is low (19.8 percent of inflation adjusted values) because the Project is deliberately labor intensive and because vehicle or construction equipment costs are kept at a minimum.

Project Benefits

The evaluation of Project primary benefits was limited to increased net returns on upland crop and home garden areas because the specific data for a complete evaluation of project benefits were not available. Other primary benefits noted, but not evaluated, include increased net returns from irrigated crop production downstream, backyard livestock and fisheries production, increased forest products, reduced damages to roads and villages, reduced downstream floodwater and sediment damages, and increased employment opportunities in the watershed.

The evaluation of cropland benefits recognized that crop yields will significantly increase even without the integrated Watershed Management Project. For present conditions, the net economic return on the 148,700 ha of upland crop and home garden areas amounts to an estimated Rp. 91,936 per ha, and by 1990 estimated net economic returns will have grown to Rp. 104,935 per ha on 155,000 ha for without-project conditions. For with-project conditions, net economic returns to the estimated 155,000 ha of upland crop and home garden area are estimated to be Rp. 136,036 per ha. The evaluation indicates that by the year 1990 the benefits from the proposed five-year project would amount to 4,820.6 million Rupiah per year. The benefit evaluation assumes that Project benefits will increase yearly from zero, in year one, to the 4,820.6 million Rupiah, in year 10, then remain constant for the remainder of a 25-year evaluation period. With these assumptions, total Project benefits for the 25-year evaluation period amount to 96,412.0 million Rupiah (US $154.3 million). There was also an evaluated concurrent increase in labor requirements of 34 percent between present and 1990 conditions, which would materially benefit the agricultural labor force.

To provide an estimate of the potential cropland benefits from a complete watershed project, the crop yields for the year 2005 were projected for both with and without Project conditions, and the net economic returns were calculated. An increase in net returns amounting to 5 percent from the irrigated and rainfed ricelands was also estimated to account for the increased returns available from the longer duration of streamflows and from reduced floodwater and sediment deposition damages in the downstream areas. Potential project benefits for a 25-year evaluation period amount to 196,975.2 million Rupiah (US $315.1 million), or slightly more than twice the benefit from the proposed project. This limited evaluation was developed to indicate the potential for increased crop yields in the Watershed for a complete watershed management project. Please note that these are only benefits to the upland crop, home garden, and rice land areas and that complete project benefits may be twice this value.

Project Justification

The objective of the economic analysis, or project justification, is to demonstrate that expenditures for administration, planning, construction, operation, maintenance, and replacement for all of the conservation measures proposed for the integrated Upper Watershed Management Project are justified by the projected improvements in future conditions that are attributable to the Project. As noted in the description of project benefits, changing the management, or mismanagement, of the Citanduy Watershed should yield very large benefits in relation to the Project cost, but if the proposed project is not fully implemented by the necessary policy statements and by administrative action at all levels of government, the benefits could be much less, or in some cases nonexistent.

Benefit-Cost Ratio. Since the benefits and costs accrue at different times, it is necessary to reduce them to a common time frame by discounting all benefits and costs to the present. At a 12 percent interest discount rate, the benefit-cost ratio is 2.78 to 1.00 for a 25-year period of analysis, and the net benefit (excess of benefits over costs) is 13,717.6 million Rupiah (US $16.3 million). Since only cropland benefits were used this indicates a very favorable ratio of benefits to costs for the proposed project.

Internal Rate of Return. The internal rate of return procedure uses discounted cash flows to find the discount rate at which the net present value of the cash flows is equal to zero, or where the benefit-cost ratio is equal to 1.00. Including only direct Project costs, the internal rate of return to the proposed integrated Upper Watershed Management Project is 29.3 percent. When the farmer and village costs are included in the cost flows, the internal rate of return drops to 22.2 percent. This internal rate of return is about what would be expected from the Citanduy Upper Watershed area, which has a very high potential for increased crop production over present conditions. This rate is also in line with the Solo Project evaluations for the Kali Samin Watershed, which had an indicated internal rate of return for the complete development plan of 22.4 percent from increased crop production in the Watershed. This high rate of return certainly argues that the

Project should be implemented if development funds are available to the Indonesian Government.

Sensitivity Tests. While the economic analyses were based on the best information available, and the results cross-checked where possible, there is still a large potential for error in specific sections of the evaluation. Therefore, a sensitivity analysis was performed to give the decision-maker an estimate of the reliability of the proposed Project's profitability.

If the Project's benefits were reduced by 50 percent, the internal rate of return would still be 16.6 percent, and the benefit-cost ratio would be 1.39 to 1.00 at the 12 percent interest discount rate. To further test project evaluation sensitivity, Project costs were increased by 25 percent, thereby reducing the internal rate of return to 24.6 percent and the benefit-cost ratio to 2.22 to 1.00.

Finally, the Project benefits were reduced by 50 percent and Project costs were increased by 25 percent. This extreme test reduced the internal rate of return to 13.3 percent and the benefit-cost ratio to 1.11 to 1.00. Since the Project is still feasible when based on these extreme assumptions, these tests strongly indicate that the Project is definitely justified and is not especially sensitive to errors in the basic assumptions.

Financial Analysis

Financial Analysis for Project Farmers. Data limitations prevented a complete analysis of the potential increase in the quality of life for the Upper Watershed residents, but estimating the increase in disposable income for the upland farmer was possible. Upland farmers were evaluated to have an increase in disposable income (including the return to labor) from the present 19,884.9 million Rupiah to an estimated 30,583.0 million Rupiah (1979 values) in 1990, or 53.8 percent. Because the area of upland crop and home gardens is expected to increase from 148,700 to 155,000 hectares for both with and without Project conditions, a comparison on per hectare basis is also useful. On a per hectare basis, the upland farmer's disposable income was projected to increase

from the present Rp. 133,725 (US $214) to Rp. 197,315 (US $316), at 1979 values, in 1990 with Project conditions, an increase of 47.6 percent.

From the above analysis it is not possible to guarantee that the proposed Upper Watershed Management Project will sufficiently improve the financial position of the individual upland farmer to enable him to adopt the desired conservation farming methods and to maintain the conservation structures that might be installed on his land. More importantly, it is not possible to objectively predict whether sufficient farmers will adopt conservation farming methods to enable the Project to succeed over the long term. However, it is possible to infer that the expected changes in crop yields and net returns effected by adopting the methods of conservation farming with bench terracing and other practices will allow the average upland farmer to increase his financial position considerably. In general, however, the upland farmer will not have the necessary income to repay any of the Project costs directly.

Project Financial Analysis. The Project financial analysis evaluates the individual financial entities that participate in the Project and covers the cost allocation, scheduled installation of Project measures, foreign and domestic currency requirements, and, where possible, the user charges planned or the repayment capacity of the Project beneficiaries.

As noted in the preceding table, Project costs for the proposed initial phase are estimated to start in 1980-81 (year one) and to be completed in 1984-85 (year five), with total Project costs in 1979 Rupiah estimated at 8.539.9 million (US $13,664,000). The inflation-adjusted price estimate for the Project is 12,955.7 million Rupiah (US $20,729,000), of which 2,569.6 million Rupiah (US $4,111,300), or 19.8 percent, is the estimated foreign exchange component. Foreign exchange costs for the Project are low because the project is deliberately labor intensive and because vehicle or construction equipment costs are kept at a minimum.

The Government of Indonesia does not have a formal policy for repayment of irrigation or watershed management project costs, but it is assumed that, considering the economic position of the upland farmers under present conditions, all Project costs incurred by the Government

will be paid by the Central Government of Indonesia. The farmer and village contribution would then be limited to the labor and other inputs they are expected to supply on the demonstration farms, bench terracing works, other conservation measures, road and trail erosion proofing, and in the reforestation and "greening" activities. These farmer and village contributions are estimated at 29.1 percent of all the costs of improvement in the Upper Watershed area. It is also assumed that the operation, maintenance, and replacement costs for the proposed Upper Watershed Management Project would be obtained from the subdistrict tax base after the Project has been completed.

Conclusions

- The problems of the Citanduy Upper Watershed are "people problems" with technical and physical constraints to their solution.
- The major problem is that the present degree of productivity and the size of farm operations are such that neither the physical nor economic conditions for a conventional conservation program exist.
- The watershed problems of the Citanduy are serious and should receive immediate attention, but, for the most part, the soil losses have not reached the critical stage at which only expensive structural solutions or conversion to permanent cover are required.
- Potential upland Project benefits exceed Project costs by such a margin that the proposed initial phase of the Integrated Upper Watershed Management Project should be initiated immediately if the Central Government of Indonesia can obtain the necessary funds.
- The upland farmer's low productivity, lack of resources, lack of technical knowledge, and limited access to improved seeds, fertilizers, and insecticides prevent him from participating in the "green revolution" or joining the modern economic society. These problems must be at least partly solved before he can become a conservation farmer.

Recommendations

Development of a watershed management program involves three components: first, development of program objectives in accordance with the ultimate ends they are intended to serve; second, the efficient employment of available resources; and third, a program to reach the given objectives.

Program Objectives. The program objectives consist of the changes the Project programs should be striving to effect. These include:

- To instill in farmers and government officials an appreciation of the true nature and condition of the problems they face and to demonstrate methods of solving these problems.
- To develop an integrated multidisciplinary plan for solving the people problems of the watershed.
- To make those concerned aware that livestock and fish production are important complementary activities to the conservation program.
- To capitalize on all previously installed soil conservation works.
- To adopt improved soil and water development methods and to improve agricultural practices through a system of demonstration farms.

Organizational Improvements. Some organizational changes are important in effectively developing a watershed management program within the existing governmental system, primarily because the existing governmental organizations have tended to focus on solving the symptoms of the watershed management problems rather than on solving the people problems of the Watershed. Suggested organizational improvements include:

- A ministerial level council is needed to develop specific soil, water, and renewable natural resource policy for Indonesia.
- The existing central governmental organization should be given the staff and funds necessary to solve the problems at the local level, with the farmer's cooperation, rather than by creating a new organization.

- Direction and coordination of soil and water development programs should be made more effective at all administrative levels to provide continuity of participation in the watershed management program.

Infrastructural Improvements. Local differences in resources, infrastructural development, political organization, and people's attitudes towards development are too diverse to permit a common program aproach to infrastructure and institutional changes throughout the Upper Watershed. The general recommendations include:

- Additional nonagricultural employment opportunities must be developed.
- The transportation network must be improved in order to develop a market economy in the Watershed. Erosion proofing of existing roads and trails as well as all new construction is very important to reduce erosion damages in the Watershed as well as to reduce the maintenance cost of roads.
- The long-term success of the Upper Watershed Program will require a viable farm credit program for upland farmers to enable them to purchase the necessary inputs for adopting new technology.
- Assistance programs for upland farmers should be redefined and expanded to solve what the farmers see as their problems rather than what the government officials see as problems.
- Conservation education programs should be developed to reach all age levels and economic groups.
- The upland farmers' leadership ability and their sense of cooperation and mutual assistance should be strengthened.
- For both planning and construction of conservation measures, the Upper Watershed Management Program should implement activities through upland farmers' organizations (Kelompok Conservation Action Units) that are based upon small hydrologic units.

CHAPTER I
INTRODUCTION

Citanduy Upper Watershed Project

The Citandudy Watershed is located on the south coast of the Island of Java, about 300 kilometers southeast of the capital city, Jakarta. It is bordered on the east by the Segara Anakan, on the north by the Cimanuk Basin, on the north and west by the Citarum River Basin, and on the south and west by the Ciwilar River Basin and the Indian Ocean. The Citanduy Watershed area is approximately 3,500 km^2 and has one of the highest population densities of any major river system in the world. The location of the watershed is presented in Figure I-1.

The integrated upper watershed management and resource development system for the Citanduy Watershed contained in this report was developed with an awareness that watershed problems are really "people problems" that have physical and technical constraints to their solution. Consequently, the well being of people is the central consideration of the watershed management and resource development program for the Citanduy Watershed.

The watershed management approach used for evaluating and evolving the resource development program for the Citanduy Upper Watershed focuses on the total watershed, or hydrologic unit, as the planning and management unit. The program emphasizes the improvement of economic and social conditions, land treatment practices, and the improvement of agricultural and forestry production, rather than emphasizing the capital-intensive structural methods of protecting downstream floodplains.

The natural ecosystem of much of the upper watershed area has been disrupted by deforestation, uncontrolled agricultural development, and many other unwise practices. These environmental changes are the result of population growth and increased demand for agricultural production. This has resulted in extending upland cropping to areas

where soil conditions or steep slopes make the land unsuitable for sustained agricultural production. Except for areas of lowland irrigated rice and some of the uncut forest land, the entire basin is being subjected to heavy erosion and high runoff from mismanaged watershed areas.

Purpose and Scope

The purpose of the Citanduy Watershed Feasibility Study is to identify the problems of the upper watershed areas and to propose a plan for the optimum cooperation and utilization of the land and human resources of the watershed. The watershed management plan provides an integrated agricultural development program designed to provide the maximum long-term production of all watershed lands. While providing for the maximum ultimate development of all resources, an attempt was made to keep the program flexible enough to accommodate changing social and economic environments. The program has been designed from the farmer perspective to allow the farmers and the local village administrative units to coordinate and develop a local program. The proposed watershed and resource development management program is designed to focus attention on private owners' problems and to coordinate those Government programs that encourage the farmers and the community to solve their own problems, thereby increasing economic stability and promoting an awareness of cooperative approaches, to solving problems of soil and water conservation and community development.

Objectives of the Studies. The objectives of the studies, as listed in the provisions of contract Kab. 9.2.14, dated 10 February 1977, were:

1. Identify the problems and needs of the areas;
2. Gather detailed data on the potential land, water, and human resources in the project area;
3. Determine the optimal pattern for the utilization of the available resources;
4. Identify the necessary management system to achieve the projected pattern of utilization;

5. Consider the environmental impacts of the proposed development;
6. Outline the social benefits which the area inhabitants might expect;
7. Based upon economic and financial analyses compatible with technical soundness and social acceptability, recommend the most feasible development plan.

Scope of Work. The studies were conducted within the terms of reference of contract Kab. 9.2.14 dated 10 February 1977; the contract required execution of the services and report preparation described below, for the entire upper watershed portion of the Citanduy River Basin. The specific items included:

1. Review and evaluate existing data and reports pertinent to the watershed areas;
2. Determine the need for additional data and make recommendations for procedures, equipment, scheduling, and personnel necessary for the collection of these data;
3. Assist Government personnel in conducting an inventory consisting of a characterization survey of the watershed including land use, vegetative cover, sediment rates, and erosion areas requiring urgent attention;
4. Assist Government personnel in evaluating the social and economic status, the problems, and the welfare of local people so that the improvement in the local residents productivity, personal income and social well being is considered in watershed planning;
5. Assist Government personnel in reviewing existing laws governing watershed management and protection;
6. Provide on-the-job training to Government personnel in watershed resources management and in soil and water conservation;
7. Prepare a work program for the upper watershed area to counteract the erosion problem: the report shall identify critical target areas, recommend suitable control measures, and specify the consequences for organization, manpower, equipment, and budget in order to carry out a

work program that is technically, economically, politically, and socially feasible. The report shall estimate the rate of deterioration in agricultural resources, production, income, and employment, with and without the recommended program.

The Upper Watershed Feasibility Study was developed to meet the contract terms of reference as well as possible, nonwithstanding the lack of aerial photographic coverage, good base maps and surveys, stream gaging and sediment records, complete records, and some types of equipment. The work was also retarded by the frequent lack of counterpart staff and manpower by the unavailability of statistical records, by time constraints, and, to some extent, by unfavorable climatic conditions for construction activities. The consultants' effort was concentrated on the Panawangan Pilot Watershed; this pilot area was very successful in gaining acceptance of conservation measures and in identifying an integrated approach to upper watershed development. As a result of these constraints, the Upper Watershed Feasibility Study contained herein is somewhat limited and is largely based on the results reported in "The Panawangan Pilot Watershed: Its Implementation and Evaluation", Draft Report June 1979, on data from the Solo Watershed and other reports, and on empirical estimates by the consultant staff.

Statement of the Problem

Although the terms of reference in the contract did not include an integrated program for development of the agricultural sector, it quickly became obvious that, in order to improve watershed conditions, it would be necessary to include an assessment of the general problem of productivity and even to review needed changes in the economic infrastructure of the Citanduy Watershed. Hence, this report has a broader scope than originally proposed.

Conservation practices are bound to agricultural productivity in two important respects: First, they are physically bound because the ground cover and soil management in agriculture or forestry affect both the degree of soil erosion and the maintenance of installed conservation works. Secondly, they are economically bound because the

primary justification for the conservation of agricultural or forestry lands is that those lands, either now or in the future, will be more productive than they would have been without the conservation efforts.

The major problem is that the present degree of productivity and size of farm operations are such that neither the physical nor economic conditions for a conventional conservation program exist. Even if the best possible conservation measures (terraces, drop structures, etc.) were installed, the land, and the works, would continue to erode under currently common agricultural practices. Further, the agricultural productivity of much of the upland is so low that it is questionable whether the net returns to the farmer are sufficient to pay even the maintenance costs of the conservations works -- much less their total cost.

Population pressures create a related problem by causing additional areas of forest land to be cleared for agricultural production, and subsequently abandoned after excessive erosion has occurred. Using each hectare of land within its capability unfortunately requires a detailed inventory of the resources available, and this knowledge has not been developed for the Citanduy Watershed area.

The Watershed Management Approach

The integrated approach to watershed management is designed to develop a comprehensive basin-wide project for solving the watershed problems. This integration is the key to: the coordinated use of limited funds and manpower; the local population's acceptance of the programs; and the maximum productivity of the land while protecting the resources for future generations. In essence this is really the integration of the human element with a system of land management for the protection of the natural resources.

An integrated development program must consider three factors: 1) the existing level of land and water resources development; 2) the existing social structure and infrastructure; and 3) the available resources for accomplishing the improvement program. Obviously the

social factors may be more of a constraint than the technical problems. The evaluation of the technical and human aspects for the management plan should describe: 1) the present status or conditions in the watershed; 2) the present trend (up, down, deteriorating, etc.); and 3) the potential for resource development, productivity, problems, or changes in institutional factors.

A program for an integrated watershed development must first develop a program for improving both the watersheds productivity and the net returns to the farmers. The individual farmers must have the resources to adopt the technical improvements before they will become accepted. This is especially important because many erosion control measures actually reduce the net crop area. Achieving improved agricultural productivity requires a total program: demonstration farms; conservation practice incentives; and increased availability of seeds, fertilizers, and pesticides; and technical assistance in all aspects of crop, livestock, fisheries, and forestry production. Only when the farmer is reasonably able to feed himself and his family can he afford to be interested in conserving the soil and water resources of the watershed for the future.

The watershed management approach to developing and evaluating conservation programs focuses on the watershed or catchment areas as the natural units for soil and water resources development and conservation activities. This approach implies that any conservation treatment should be considered in its relationship to the entire drainage area, both in how the watershed will affect the treatment and how the treatment will affect the watershed. The practical consequence of this concept is that no conservation practices should be planned and installed for any part of the watershed without consideration of what might be needed for the entire catchment. The construction of terraces without considering the nonterraced contributing areas lying above or without considering the problems created downstream by the waterway disposal areas could present serious problems.

Intimately related is the concept that the primary control of soil and water is exerted by vegetation and that all management efforts should aim at increasing vegetative control of erosion and runoff. Therefore, the watershed management approach primarily emphasizes land treatment practices with limited treatment through use of structural measures for erosion control.

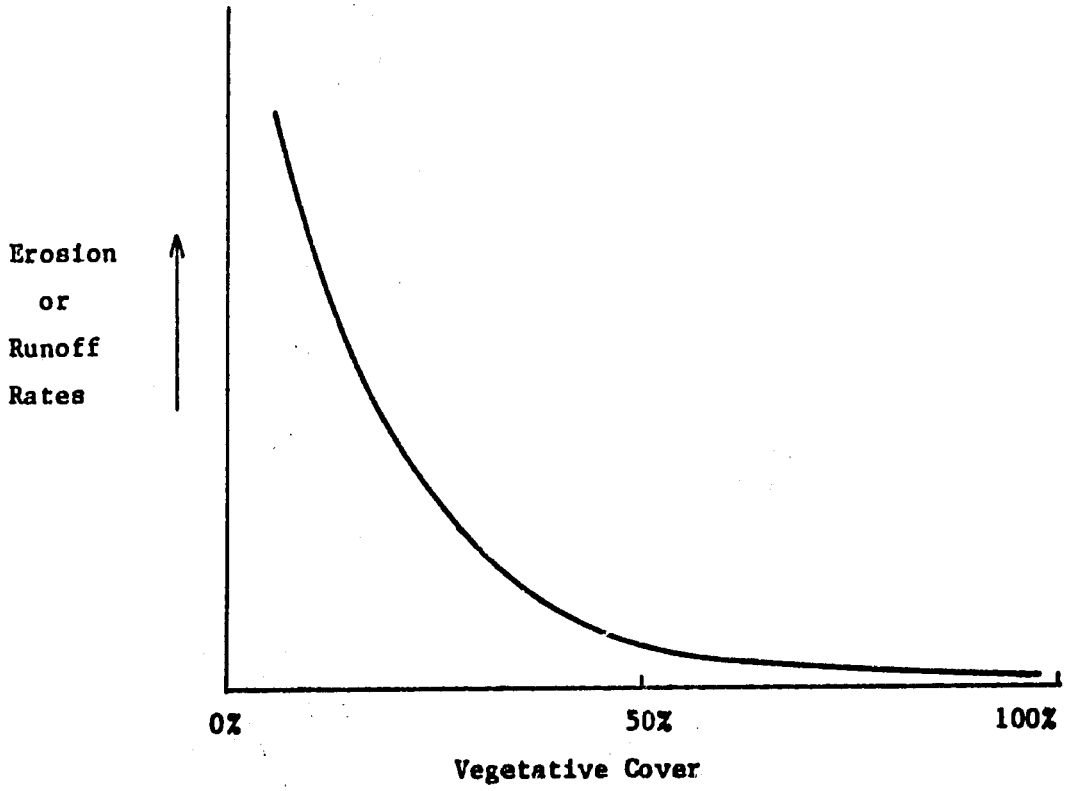
In a developing country, such as Indonesia, the data necessary for watershed analysis is quite limited. Beyond those limitations, other phenomena create problems: the greater the distance a raindrop must travel, the less chance it has of becoming surface runoff from the watershed unit; the same is true of sediment production in that most sediment is deposited at some point in the watershed if water is not available to carry it in a defined gully or stream channel. Thus, the evaluation of runnoff, sediment production, and the benefits of a conservation program are very difficult to measure accurately.

Vegetative Control Concept

The vegetative control concept emanates from the recognition that man-caused increases in soil erosion and runoff result from an imbalance between vegetative cover and soil-landform-climatic conditions. Consequently, the most effective treatment for accelerated erosion and runoff is the restoration of the proper balance between vegetation and site conditions. Vegetative control of runoff and erosion may be achieved either directly, by improving the cover conditions, or indirectly, by effectivly managing crop residues, or mulching, on cultivated areas. Therefore, even where structural measures are utilized, they should be considered as adjuncts to vegetative control methods.

It should be noted that resource depletion through deforestation, upland cropping, and disturbances (such as road and trail construction) may effect little change in erosion or runoff until a critical cover density is reached, after which erosion and runoff increase at accelerating rates. Good watershed management attempts to manage cover so that the critical point is not exceeded. For areas already damaged by erosion, increases in vegetative cover and underground root mass (particularly fibrous roots) tend to increase infiltraion rates rather rapidly.

The following figure illustrates the general relationship that exists between vegetative cover and erosion:



Land Use Capability

Fundamental to the watershed management approach is the concept that every unit of land has a specific capability for use without permanent damage. Land use capability is an expression of the effect of the physical land conditions (including climate) on the suitability for using the land, without damage, for production of crops that require regular tillage, for grazing, for woodland or fruit production, for forestry, or for only wildland and watershed uses.

If the land is used beyond its capability, natural relationships are imbalanced resulting in accelerated erosion and runoff and the consequent loss of soil productivity and soil moisture storage capability. This concept of land capability includes the possibility of adding conservation practices that allow land with known physical limita-

tions to be used for crop production without suffering excessive damages. The role of soil conservation structural measures is limited in changing the capability of the land area. However, soil conservation measures using such structures as detention basins, check dams, gully control, stream bank protection etc. also play an important role in terrain which is highly eroded and can not be rehabilitated by vegetative cover alone.

Soil and Water Resource Development Policies and Objectives

Watershed management is practiced to maintain or improve the quality of the land and water resources for both short-term and long-term uses. Ideally, a program applies those practices that allow the achievement of long-term national goals while maintaining or enhancing the short-term productivity of the resource users land.

The government of Indonesia is becoming aware of the problems created by upstream watershed deterioration and unwise use that results from increasing human habitation and resource development in the upper watershed areas. The Greening Program, the Solo Watershed Project and other programs have attempted to solve the developing problems of the upper wattershed areas with limited success. Therefore, in addition to providing a specific watershed program for the Citanduy Upper Watershed this report has the goal of developing some specific policy and organizational change suggestions that would provide for the development of a true integrated watershed management project that would be accepted by the local people. These recommended policy changes are discussed in the next section of this chapter.

Recommendations

Development of a watershed management program involves three components: first, the development of program objectives in accordance with the ultimate ends they are intended to serve; second, the efficient employment of available resources; and third, a program to reach the given objectives.

For convenience, the recommendations have been divided into three broad categories: First are program objectives; these are the action levels the programs should be striving toward. Second, organizational improvements; changes which are important in effectively managing the watershed management program within the existing governmental system. Third, infrastructural and institutional improvements: these are almost entirely changes designed to provide improved inputs to the organizations responsible for conducting the programs through increased funding and technical assistance.

Program Objectives

1. Individual farmer and government officials should be instilled with an appreciation of the real nature and condition of the problems they face and to demonstrate methods of solving these problems. This process will involve local people in the decision making process and thereby teach them to improve their individual status by making decisions for themselves. This approach emphasizes the maxim "better farming for better living" and attempts to demonstrate to the farmer that soil conservation and improved cultural practices can enable him to make maximum use of his resources and improve his family's standard of living.

2. An integrated multidisciplinary plan for solving the people problems of the watershed areas should be developed. This approach entails the cooperation and coordination of all agencies and political subdivisions in all departments down to the village level. A plan for developing and expanding the cooperative relationships that were so successful in the Panawangan Pilot Watershed Project could be successful for the Citanduy Wathershed though understandably individual areas will require different components and forms of assistance to develop their special requirements and desires.

3. Livestock and fish production should be recognized as being socially and economically important as well as supportive of soil and water development objectives through increasing the family income or improving diets. Livestock production provides provides a use for grass grown on the terrace risers and eroded areas and so should be encouraged and improved.

4. The integrated watershed management program should capitalize on all soil conservation works previously installed. Where practical, existing terraces and waterway systems should be rehabilitated and improved. The program should emphasize innovations aimed at improving existing soil and water conservation systems and the use of simple structures that can be built with local materials and labor.

5. The adoption of improved soil and water conservation development should be stimulated, and agricultural practices should be improved through use of a system of demonstration farms. This program must not be expanded beyond the availability of funds and of trained technicians to assist the farmer and supervise the program at all levels. Building a cadre of professional workers through a program of university training, short technical training sessions, and a major program for on-the-job training is very important. The program should emphasize the potential for promotion of exceptionally capable field workers. Coordination of technical and administrative authorities will also be absolutely essential to enable the program to adapt to local conditions, and to reduce the problems of coordination between planning and implementation of project measures. Advisory groups should become a part of the government structure so that private perspectives may affect management decisions. The shortage of trained, knowledgeable, and capable personnel to coordinate and work intensively with the farmers is a major concern. A central government's Pronouncements on the "right way to do it" never work, but direct participation in the field with the farmer has been proven to work in limited cases, here in Indonesia and in other countries.

Organizational Improvements

Based on the consultant's review and analysis of prior soil conservation efforts in Indonesia, it is believed that future efforts could greatly benefit from a few, but important, organization improvements, primarily because the governmental organizations directly concerned with solving the upstream land and water resource degeneration problems lack coordination and tend not to focus on solving the people problems of the upper watershed. Instead they have worked attempting to solve the symptoms, such as denudation and visible erosion. Further,

these programs are developed from the national level downward and have little or no relevance to the upland farmers' problems. Organizations created to deal with the downstream irrigation and riceland farming problems neither understand the problems facing upland farmers nor currently provide any real assistance to those farmers. More precisely, the past soil conservation efforts have suffered greatly from the lack of continuity and linkages amoung the individual program elements, and the consultants believe that this can only be achieved by an improvement program that is developed from the farmers' level upward. Specific recommendations include:

1. Rather than creating a new organization to accomplish the watershed management objectives, the consultants strongly suggest that the existing central governmental authorities be given the staff and funds necessary to solve the problems at the local level, with the farmers' cooperation. This approach has the advantage of not creating a new bureaucracy with the attendant overhead costs. The Indonesian national government and the Citanduy Upper Watershed Project should provide the management goals: staff training assistance; consultant and other technical guidance; and funds for additional staff, equipment, farmer incentives, and materials. Direct management of the watershed development program should rest with the affected district or subdistrict, with guidance from farmer advisory boards and supervision from the provincial offices.

2. At the national level, a ministerial level council is needed to develop specific soil, water, and renewable natural resource policy for Indonesia. This group would meet infrequently to consider reports or programs, review and make policy decisions, and evaluate progress. This coordinating body would provide the necessary linkages between programs of the separate government agencies that affect the soil conservation problem. The council sould also need a day-to-day coordinator to carry out the wishes of the council and to follow up on decisions.

3. A more effective direction and coordination of soil and water development and management programs in the watershed should be provided for. A much greater and more deliberate effort should be made at all administrative levels to provide <u>continuity of participation</u> in

the soil and water development programs for improving watershed conditions. New programs and staff should be assembled in the light of past experience (including mistakes) to ensure that future programs do not repeat mistakes made in other parts of the country.

4. A major effort should be initiated to improve the soil and water research and basic data collection system, and to expand the upland crop and seed improvement program. Research and basic data collection should be placed high on the priority list because it is the only way to evaluate the effectiveness of projects and programs. This program should include a synthesis of existing information from the various areas-based rural development or watershed programs in Indonesia. Information from neighboring countries should be analyzed for applicability to Indonesian watershed management projects and recommendations made for its use. Similarly, all new plant varieties that have shown promise in comparable situations should be investigated for introduction to Indonesian watersheds.

Infrastructural and Institutional Improvements

Local differences in resources, infrastructural development, political organizations, and people's attitudes towards development are too diverse to permit a common program approach to infrastructure and institutional changes in various areas of the upper watershed. The need for too many different improvements prohibits the use of a single approach for the total upper watershed area. The general recommendations are discussed below, but specific project assessments will need to be developed after project implementation.

1. Development of additional nonagricultural employment opportunities is a critical need in the upper watershed area. Specific infrastructural development programs should concentrate on the promotion of labor-intensive activities, using local resources in their production.

2. Improvement of the transportation network is essential to the development of a market economy in the watershed. Villages with the most pressing economic, social, and land deterioration problems often are the most difficult to reach. The farmers from these villages must face uncertain market prospects in the village or must hand carry their

produce from the upland farms to market centers in the lowlands for sale or trade.

Because the need for road and trail improvement is so severe the immediate program should concentrate on erosion proofing and surfacing of existing roads and trails as a primary means of reducing transportation and vehicle maintenance costs, while reducing future road maintenance costs and downstream floodwater and sediment damages.

3. The long-term success of the upland watershed improvement program necessitates development of a practicable farm credit program so that upland farmers may purchase the technology that will permit them to participate in the green revolution's increased crop production.

4. Assistance programs for upland farmers should be redefined and expanded to assist in solving what the farmers perceive to be their problems. This will require the addition of many agricultural technicians with broad backgrounds in solving local problems and needs; through knowledge of community economic development methods, extension education programs, and conservation farming techniques. Planning and coordination programs between existing government agencies should be improved to reduce the number of infrastructural bottlenecks created by the lack of fertilizers, improved seeds or planting materials, and other technical inputs required by the farmers.

5. Conservation education programs should be developed to reach all age levels and economic groups. The adult programs should also stress economic and social development programs to improve the economic position of the upland watershed residents.

People selected and trained for the local technical staff and as Desa Conservation Technicians should, where possible, come from the local area because they must understand the local culture and the institutional strengths and weaknesses that will permit them to be more effective in motivationg the local people to action. A program should be initiated to locate, recruit, train, and continuously upgrade the training of the needed conservation technicians for optimum project development. This training program should emphasize cooperative planning methods, management skills, upland cropping practices, and yield improve-

ment methods, as well as the necessary conservation farming techniques.

6. The upland farmers' leadership ability and their sense of cooperation and mutual assistance must be strengthened if they are to adopt the watershed management program and to commit themselves to long-term conservation farming methods and maintenance of project measures after the government assistance is gone.

7. Implementation activities of the upper watershed management program should concentrate on upland farmers' organizations (Kelompok Conservation Action Units) that are based on small hydrologic units. These organizations should function as the primary mechanism for farmer conservation education; planning of conservation activities; organization of labor for terrace and waterway construction; and, ultimately, in community development and the provision of watershed management program guidance to the project staff, using representatives of the individual action units.

Acknowledgement

The staff of PRC Engineering Consultants, Inc., would like to thank all of the people who assisted in developing the Citanduy Upper Watershed Management Project. We would especially like to thank all of the people responsible for the success of the Panawangan Pilot Watershed Project because it provides the basis for the development of the entire upper watershed management program.

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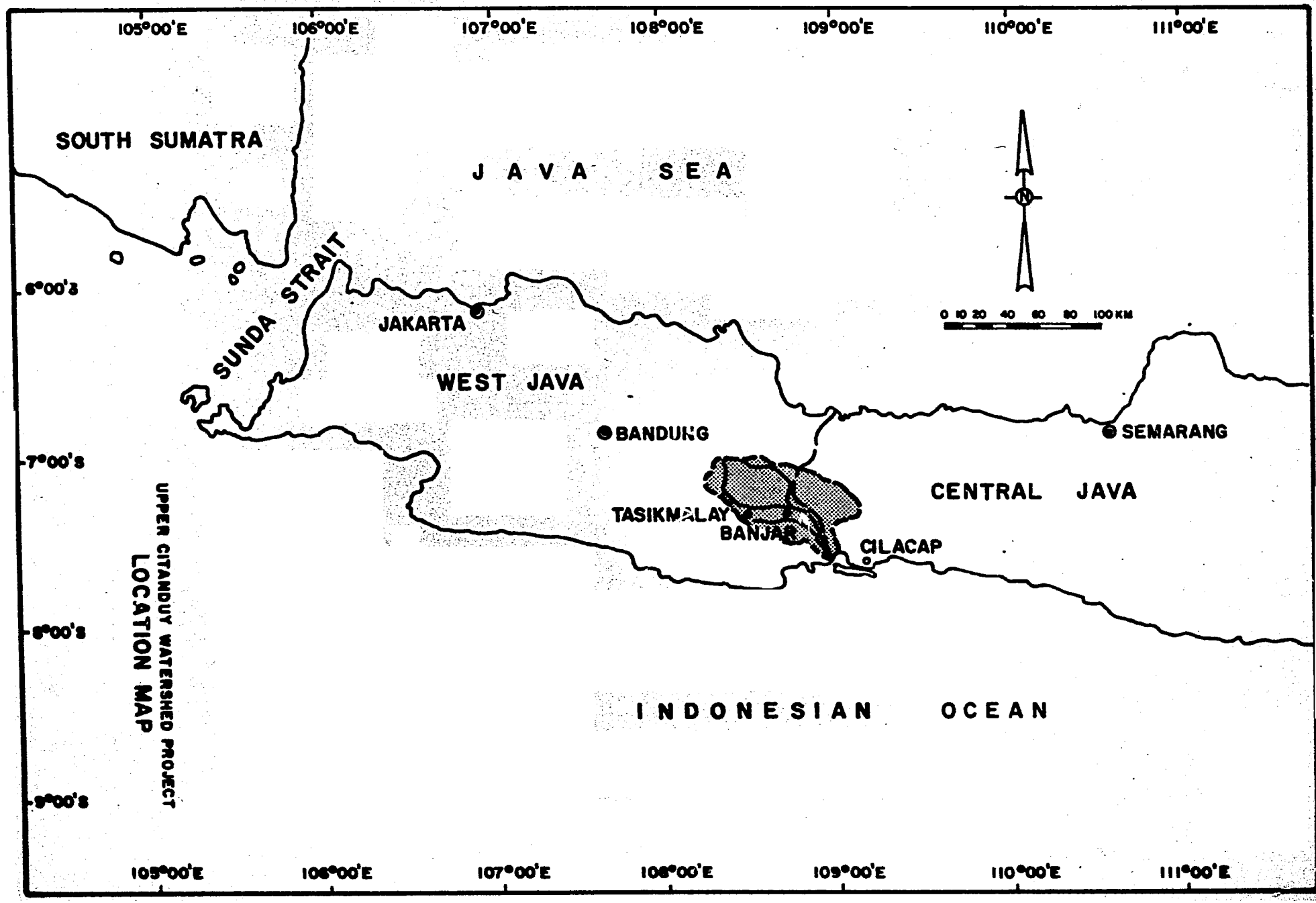


UPPER CITANDUY WATERSHED PROJECT

LOCATION MAP

ENGINEERING CONSULTANTS, INC.

FIGURE 1-1

CHAPTER II
RESOURCE BASE

Citanduy Watershed

Description

The Citanduy Watershed lies between approximately 7°00′ and 7°40′south latitudes and between 108°10′ and 109°15′ east longitudes, about 300 kilometers southeast of the capital city of Jakarta on the south coast of Java. The Citanduy Basin is bordered on the east by the Segara Anakan, on the north by the Cimanuk Basin, on the north and west by the Citarum River Basin, and on the south and west by the Ciwilas River Basin and the Indonesian Ocean. The Citanduy River flows into the Segara Anakan and thence into the Indonesian Ocean. The natural drainage network of the watershed is presented in Figure II-1.

The Citanduy Watershed includes parts of five districts: Tasikmalaya, Ciamis, Kuningan, and Majalengka Districts in the Province of West Java; and the Cilacap District in Central Java Province. Through an error in the base maps, the Majalengka District which is entirely in Subdistrict Cikijing, consisting of about 3,200 ha, was not included in the data collection for the Upper Watershed Feasibility Study. Since this area is known to have severe erosion problems, specific funds are included in the project budget for planning and applying erosion control measures, but it is not included in the resources base or the description of watershed problems. The land area by districts and subbasins for the 350,000 ha Citanduy Watershed are presented in Table II-1 and the subbasin delineations are in Figure II-2.

The Citanduy River originates on Cakrabuana Mountain at about 1,750 m elevation. The river flows in a southerly direction for about 40 km until it passes Sawal Volcano where it turns east for about 70 km, passing by Tasikmalaya, Ciamis and Banjar. The upper drainage basin of the Citanduy River covers the north, west, and south slopes of

Volcano Sawal, which is extinct. The Cimuntur River, a principal tributary of the Citanduy River, collects the runoff from the north and east slopes of Sawal Volcano and joins the Citanduy River about 6 km west of Banjar.

The Cijolang River drains a large portion of the north-central part of the Citanduy Basin. This river originates in the westernmost area of the basin on Gunung Cijolang at about 1,400 m elevation and flows easterly until it is joined by the Cimonte River, flowing from the east. Here the river turns to southeast and finally to the south until its confluence with the Citanduy River about 5 km downstream from Banjar.

The Cikawung River drains the northeastern part of the basin. It originates at about 700 m elevation and flows generally towards the west until it joins the Citanduy River immediately above railroad bridge 1452. The Cikasung River has a number of tributaries flowing into it from the north.

The Ciseel River is the largest tributary of the Citanduy River. It originates on Bongkok Mountain at 1,150 m elevation along the southern border of the basin and flows in an easterly direction for about 30 km, where it is joined by its largest tributary, the Cikembang River. The Ciseel River continues flowing eastward for about 20 km before turning south to flow parallel to the Citanduy River, which it joins just above the village of Kalipucang.

Downstream from its junction with the Ciseel River, the Citanduy River flows southeasterly into the Segara Anakan and thence into the Indonesian Ocean.

The Segara Anakan, evidently once an inland sea protected from the ocean by Nusakambangan, today serves as a reservoir and delta area for the Citanduy River. Eventually, alluviation will fill the Segara Anakan and the entire area will be a low, marshy delta. The other upper watershed tributaries of the Segara Anakan were not included in the Citanduy Upper Watershed investigations by the contract terms of reference. This critical area of about 27,300 ha has many severe erosion problems that directly and adversely affect all proposed irrigation projects. Stabilization of the upland farming systems through improved

production and erosion control systems is crucial to development of the irrigation systems and the flood control project. To some extent this can be accomplished by using the organization and methodology contained in this feasibility study.

Subbasin Delineation

The Citanduy River Basin rather naturally divides into the following five subbasins:

	Drainage Area (h	Percent
Upper Citanduy	74,000	21.2
Cimuntur	61,000	17.4
Cijolang	48,000	13.7
Cikawung	70,000	20.0
Ciseel-Lower Citanduy	97,000	27.7
Total	350,000	100.0

The specific subbasin delineations are in Figure II-2, and the land area by districts is in Table II-1. Specific details of the economic land use areas by subdistrict are available in Appendix A.

Upper Citanduy Subbasin. The Upper Citanduy Subbasin consists of the natural drainage area of the Citanduy River above its junction with the Cimuntur River and totals about 74,000 ha, of which 47,800 ha are in the Tasikmalaya District and 26,200 ha are in the Ciamis District. This delineation does not include the Banjar Plains area, of about 1,100 ha, that is located on the south side of the Citanduy River from the confluence with the Cimuntur downstream to below Banjar. This area might have been included with the Upper Citanduy Subbasin but instead is included with the Ciseel-Lower Citanduy Subbasin.

Cimuntur Subbasin. The Cimuntur Subbasin consists of the natural drainage area of the Cimuntur River and a small area on the north side of the Citanduy River, from the confluence downstream to below Banjar. The entire 60,000 ha of this watershed are in the Ciamis District. The Cimuntur drainage is generally diamond-shaped with very undulating topography. The Cimuntar River has two main tributaries, the Cirende and Cileueur Rivers, both of which join it near the confluence of the Citanduy.

Cijolang Subbasin. The Cijolang Subbasin has a drainage area of about 48,000 ha and is some what T-shaped. The Cijolang river originates in the westernmost part of the subbasin on Cijolang Mountain and flows easterly to the point where it is joined by the Cimonte River, which flows westward. At this point the river turns to southeast and is joined by the Cibeet River. It then flows south to its confluence with the Citanduy River, about 5 km downstream from Banjar. Included within the Cijolang Subbasin is an area on the north side of the Citanduy River from just below Banjar to about 1 1/2 km below the confluence with the Cijolang River. The Cijolang Subbasin has 19,900 ha in the Ciamis District, 11,100 ha in the Kuningan District, and 17,000 ha in the Cilacap District. An additional area of approximately 3,200 ha in the Cikijing Subdistrict of the Majalengka District should have been included in the Cijolang Subbasin of the Citanduy Watershed. This area will require a special study of watershed problems during initial phases of the project.

Cikawung Subbasin. The Cikawung Subbasin, located in the northeastern part of the Citanduy watershed, drains about 70,000 ha, including the Wanareja area which drains directly into the Citanduy River. The Wanareja subarea is drained by the Cibaganjing and Cilaca Rivers. The entire Cikawung Subbasin is within the Cilacap District.

The Cikawung River originates on the northeastern boundary of the Citanduy Watershed on Kendang Mountain at 640 m elevation. It flows south until it intersects the highway between Cimanggu and Ciporos. The river then flows in a westerly direction to its junction with the Citanduy River just above railroad bridge number 1452. Three major tributaries, the Cilopadang, Cileumeuh, and Cijalu rivers have their

headwaters along the northern boundary of the Cikawung Subbasin, and flow southward to the vicinity of Majenang where they more or less disappear in the riceland areas.

Ciseel-Lower Citanduy Subbasin. The Ciseel River is the largest tributary of the Citanduy River, and, when combined with the Lower Citanduy River, it comprises a total drainage area of 98,000 ha. The western 10,100 ha are in the Tasikmalaya District, and the other 87,900 ha are in the Ciamis District.

The Ciseel River has one major tributary, the Cikembang River, which drains an area of about 15,000 ha; that is most of the northern part of the Ciseel-Lower Citanduy Subbasin.

The Lower Citanduy River area includes all of the area south of the river downstream from Banjar, a phenomenon caused mostly by flood dikes preventing water from entering the Citanduy River. In the Lower reaches of the Citanduy River it includes a limited area on both sides of the river.

Topographical and Watershed Features

The Citanduy Watershed has three main topographic zones: the mountainous and higher hill area that occurs above 500 m elevation, the rolling and undulating lower hill area from 500 m down to 35 m; and the alluvial plains and valley paddy areas. The general extent of each is as follows:

	Area (ha)	Percent
Mountainous and Higher Hill Area		
Area above 1,000 m	15,000	4.3
Area between 500 and 1,000 m	80,000	22.8
Sub total	95,000	27.1
Rolling and Undulating Hill Area	161,000	46.0
Alluvial Plains and Paddy Area	94,000	26.9
Total Citanduy Watershed	350,000	100.0

Mountainous and Higher Hill Area. The most prominent physical feature of the Citanduy Watershed is Sawal Mountain (Volcano) which is located in the western portion of the Watershed. From the summit of Sawal Mountain, at 1,760 m, the elevation drops 1,260 m on the west and east sides to an elevation of about 500 m in about 8 km. The southern aspect of Sawal Mountain is incised by long deep canyons that drain into the Upper Citanduy River. In this area streams are very steep with more than 70 percent slopes and a rugged young topography which is dissected by V-shaped valleys.

In the northwest corner of the basin, the headwaters of the Citanduy River originate at an elevation of 1,600 m and drop 900 m to an elevation of 700 m in about 5 km. The upper area has a southern aspect and has a protective forest cover with little erosion potential under present conditions. Similar conditions exist along the western boundary on Beuticanar Mountain, with an elevation of 2,241 m, which has a drop of 1,400 m in 6 km and general slopes of more than 70 percent; the area generally has a protective forest cover and little erosion. Unfortunately, in 1977 an area of 2,000 hectares was cleared for upland farming at an elevation of about 700 m. This critical area should be returned to permanent vegetative cover as soon as possible because the soils of the area derive from highly erodible young volcanic products.

Along the northern boundary of the watershed, in the Cijolang Subbasin, the hill and mountainous area generally has slopes of more than 70 percent. From a crest elevation of 1,347 m, the elevation drops to about 800 m in 3 km. The terrain of the mountainous and upper hill area at about 500 m is rough and rugged, and is incised by many canyons. Some of the streams drop almost vertically down precipitous rock cliffs.

Hurip mountain, with an elevation of about 900 m, and Pojoktiga mountain with an elevation of 1,347 m, form the eastern boundary of Cijolang Subbasin. From 1,347 m the elevation drops 500 m over a distance of 4 1/2 km with very steep relief. The terrain is incised with many sharp ridges and valleys. Continuing eastward, the watershed crest elevation decreases and the upper boundary of the Cikawung Subbasin averages about 70 m elevation, but the side slopes above 500m elevation

are steep and should have a permanent vegetative cover. The upper hills north of Wanareja generally contain limestone and the soils are easily erorded to form a steep relief.

On the southern boundary of the watershed, the Ciseel River originates on Bongkok Mountain at about 1,150 m elevation. Most of the terrain on this mountain has slopes of over 70 percent and is incised by V-shaped gullies. The area has many precipitous rock outcrops and sharp ridges. Except in the teak forest plantations, the runoff is very rapid during high intensity storms. Denuded areas are being farmed, and because of the steep slopes and sparse vegetative cover, erosion is severe and all the streams carry high sediment loads.

Rolling and Undulating Hill Area. The hill area between about 35 and 500 m in elevation accounts for about 46 percent of the land area of the Citanduy Watershed. This hill area generally has very undulating topography. The hill crests gently slope, but the gradient increases to 60 or 70 percent as it approaches the bottomland paddy areas at the base of the hills. The hill area contains most of the upland farms, plantations, and home gardens of the watershed. Because of the rolling and undulating topography it is also the major erosion problem area.

Most of the land has traditional terraces that attempt to modify the natural topography, but they are not effective in controlling erosion. The terraces are not on the contour and the bench slopes outwards to the edge with boundary lines and pathways acting as the water disposal systems. All streams carry high sediment loads during the rainy season due to accelerated surface erosion on upland areas and throughout the year due to mass soil wasting practices used to remove earth deposited from land slides, roads, and building areas.

Alluvial Plains and Paddy Areas. The alluvial plains and valleys consist mostly of sedimentary deposits carried by the Watershed streams over geologic time. This lowland area amounts to about 95,000 ha, or 27.1 percent, of the total Watershed. The alluvial plain extends from the mouth of the Citanduy River upstream to near the confluence with the Cimuntur River; for the Ciseel River, it extends upstream to an area immediately south of Banjar. Within the alluvial plains are local hills

and domes with side slopes, of more than 50 percent, that project through the alluvium. These hill and dome areas are used for upland farming, for home gardens, and, to some extent, for plantations; and whereas the paddy areas experience almost no erosion problems, the hill and dome areas frequently suffer from accelerated erosion.

Land Resources

Land Use and Cover Conditions

The economy of the Citanduy Watershed is dominated by agriculture with over 83 percent of the population directly engaged in its pursuits. The livelihood of a significant portion of the others is indirectly related to agriculture through the transportation, marketing, and processing of agricultural products.

The economic land use pattern in the Citanduy Watershed by District or Subbasin is shown on Table II-2, and is summarized as follows:

Economic Land Use	Area (ha)	Percent
Lowland Rice	86,802	24.8
Upland Crops	120,508	34.4
Home Gardens	28,192	8.1
Plantations	44,548	12.7
Forest	44,049	12.6
Other Uses	21,253	6.1
Subtotal	345,352	98.7
Streams, Lakes, and Other Uses	4,648	1.3
Total	350,000	100.0

Lowland Rice. The lowland rice area includes both the rice paddies of the lowlands and the rice paddies in the valleys and on the flatter slopes of the hill areas. The total area of lowland rice amounts to 86,802 ha. As indicated in table II-3, technical irrigation systems account for 18,732 ha (21.6 percent), and rural irrigation systems consist of 36,767 ha (42.4 percent), for a total of 55,499 ha of irrigated rice land. Of this total, an estimated 33,911 ha is irrigated during the dry season. The balance of the rice land, 31,303 ha (36.0 percent), is rainfed.

During the rainy season, almost all of this land is planted to rice. During the dry season, some upland crops are grown where there are adequate supplies of water and adequate drainage conditions; however, the primary dry season crop for the paddy areas is still rice. A potential exists for an increase in crop production on the lowland areas by diversification of crops, intercropping, and improved systems of water management combined with the use of improved seeds or varieties, fertilizer, weed and pest control, and other types of intensification. The development of improved access roads and trails to provide access to the lowland areas is one of the most important incentives to development of this area.

Between 1972 and 1977 [1] the Citanduy Watershed area increased its lowland rice area 6,010 ha. This includes an increase of over 6,000 ha in the Cilacap District and small decreases within the Tasikmalaya and Ciamis Districts. The reliability of these statistics may, of course, be questioned; however, there does appear to have been an increase in paddy area in the Cilacap District of the Cilacap District of the Cikawung Subbasin.

Upland Crops. The upland crops are generally grown during the rainy season on both the terraced and unterraced cropland. The principal upland crops are rice, cassava, maize, and sweet potatoes. Other field crops of less importance include peanuts, soybeans, mungbeans. The upland crop of the Citanduy Watershed area totals about 120,500 ha (34.9 percent). The upland crop production is just sufficient to meet local needs although corn, peanuts, cassava, and soybeans offer a good potential for cash income.

The need for upland crops to feed the watershed population is evinced by the increase in acreage between 1972 and 1977 within the Tasikmalaya and Ciamis Districts [1], which amount to 8,644 and 29,464 ha, respectively. Unfortunately, a large portion of this increase was on marginal land unsuited for upland crops.

Plantations. In the Citanduy Watershed, the area devoted to plantations totaled 44,548 ha in 1977, a reduction of approximately 23,457 ha since 1972. Much of this land has been converted to upland crops, home gardens, and other uses. The largest reduction in plantations area was in the Tasikmalaya District which had 12,702 ha devoted to plantations in 1972, but only 484 in 1977. The Ciamis and Cilacap districts had reductions of 9,876 ha and 1,397 ha respectively, for this same period. This unfortunate change in land use from plantation to upland crops greatly increases the potential for erosion.

Specific available data for plantation areas do not match the land use information obtained from the district planning offices. The 1978 plantation area data for the for the Ciamis district provides and indication of the diversity of small plantation land crops:

	Area (ha)	Percent
Rubber	2,802	6.1
Coconut	34,863	75.4
Coffee	1,769	3.8
Tea	625	1.3
Pepper	23	0.0
Chocolate	80	0.2
Cloves	1,884	4.1
Cashew	2,818	6.1
Sugar Palm (Aren)	458	1.0
Citronela	907	2.0
Total	46,229	100.0

Only coconut, rubber, and cloves are produced in sufficient quantity to merit exportation from the Citanduy Watershed.

Forest. Forests referred to in this report are all government owned, but there are small areas of private teak and other plantation areas within the Citanduy Watershed. According to District Planning Office figures, forests accounted for 12.9 percent (44,548 ha) of the watershed area in 1977. Because classifications of cutover land and crop or swamp lands administered by the Forest Service vary, other figures are frequently quoted. Figure II-3 identifies locations of the types of forest and critical areas (both forest and private land) as specified by the available Forest Service Maps. Table II-4 specifies the measured areas from these maps.

The natural protection forest amounts to only 32.9 percent of the total forest area and the natural production teak forests amount to an additional 7.6 percent, for a total of 40.5 percent natural forest. The balance of the forest area is in forest plantations; pine plantations total 26,000 ha (47.0 percent), and hardwood plantations of teak, rasamala, and mahogany account for the remaining area. Tree plantations exist mostly where access is not a problem; consequently they occupy the rolling hills and foothill lands close to the road systems. Eventually, much of this plantation forest will be utilized for upland crop production if present trends continue.

Since 1972, the district planning offices have reported a decrease of approximately 5,700 ha of forest area. Most of this area is now used for upland crop production.

The forest contains an estimated 8,686 ha of critical areas. They consist mostly of land denuded by the harvest of timber and not replanted. The restoration of these lands will require special land treatment practices and the replanting to trees or permanent grass cover because of the rough, steep topography and the highly erodible soils.

The boundaries of officially designated forestry land are not clearly defined because accurate cadastral surveys have not been made. Classification of the lands according to best or proper use is a prerequisite to determining proper methods of restoration. Management must also be intensified to prevent illegal encroachment for crop produc-

tion and illegal harvest of timber and firewood; such management will first require better access roads into the forested areas.

Land Status

Table II-5 summarizes the status of lands within the Citanduy Watershed; Appendix A contains further land status information for the upper watershed areas. Privately owned land amounts to 280,343 ha (80.1 percent of the entire watershed). Other areas in private use include 6,892 ha (2.0 percent) in which there is a land use right; 763 ha (0.2 percent) in dispute, and certain areas of the pasture land (3,357 ha) or government owned land that is owned by communities but used privately. Government owned land is mostly forest: 47,124 ha (13.6 percent) including the 44,049 ha of forest and other areas classed as plantation or "other." A portion of the government owned lands is given to village officials for their temporary use as a compensation for their positions, and, in effect, these lands are used as private lands for crop production.

The districts of Kuningan, with 35.6 percent government land, and Cilacap, with 32.4 percent government land, have the highest percentages of government owned land. This rather naturally results in the Cijolang and Cikawung subbasins having exceptionally high percentages of government land, 28.6 and 28.8 percent, respectively. This circumstance, in turn, emphasizes the role of the Forestry Department in the management and rehabilitation of these subbasins.

Geology

Most of the geologic units in the basin are composed of volcanic material, whether the direct products of volcanic activity, eroded and redeposited volcanic sediments, or weathered volcanic products. The reef limestones and the marine sediments in the south and southwestern part of the watershed are generally the only non-volcanic rocks present. Figure II-4 presents a generalized geological map, and Table II-6 provides the subwatershed area affected by the geologic materials. More complete geologic information may be obtained from Appendix C-Geology, of the Citanduy River Basin Master Plan (1974).

The limestone is of Miocene age and is associated with a series of often marly marine sediments and volcanic breccias. Occurences of the reef deposits are irregular, but they do follow particular horizons, and the location of outcrops is generally not difficult to find. The volcanic breccias seem to be more widespread than the carbonate rocks and are frequently found unassociated with the limestones. The marine sandstones and mudstones, however, form the bulk of the Miocene rocks.

Most of the Pliocene rocks appear to be marine siltstones or fine grained sandstones. In places, a basal conglomerate is also present. These rocks are, like the Miocene formations, locally closely folded and somewhat faulted. There are also fairly large accumulations of Pliocene volcanic rocks, mostly breccia or tuff-breccia.

The Quarternary rocks are volcanic breccias with relatively minor amounts of tuff-breccia and tuffaceous sandstone that were derived from the Sawal Volcano. These rocks are found in the northwestern part of the basin; they extend from Sawal toward the southeast, in the direction of Banjar, for about 30 kilometers. There are also Quarternary river deposits, alluvial terraces, and the alluvial plains of the Citanduy River itself.

The geology of the Upper Citanduy and Cimuntur Watersheds consists almost entirely of young volcanic products, accounting for about 134,100 ha of these two subbasins. The parallel drainage pattern of the steep higher elevations is incised in residual soils formed from weathered Quarternary volcanic material and tertiary basalt or andesite. The source of all Quarternary rocks was Sawal Volcano which, is now considered to be extinct.

The geology of the Upper Cijolang Watershed is primarily of Miocene clastic sedimentary rocks (27.9 percent of total) and secondarily of marine sandstones and mudstones. The area surrounding Suband and Pojoktiga mountains are mostly Pliocene sedimentary rocks (17.1 percent) and volcanic rocks with marine siltstones and fine grained sandstones. The drainage patterns of the Cijolang Subbasin are mostly contracted, indicating that geologic faults or joints control the pattern in the Miocene sedimentary rocks. In the vicinity of Suband and Pojoktiga mountains, a parallel drainage pattern has been incised into Plio-

cene sedimentary and volcanic rocks on the very steep slopes forming deep, rough, narrow canyons. Young volcanic products which generally form the upper reaches of the right bank streams entering the Cijolang from the west, account for an estimated 31.9 percent of the Subbasin. The area immediately above the junction of the Cijolang and Citanduy Rivers is alluvium (7.1 percent).

The geology of the Cikawung Subbasin is much more complex. The geology of the upper area, from near the Cileumeuh River along the north and east, consists of Miocene sedimentary rocks which is, in places, closely folded and faulted. The Miocene marine sandstones and mudstones comprise about 18,700 ha (27 percent of the area). From the Cileumeuh River west to Cijolang basin, the geologic formation is Pliocene sedimentary and volcanic rocks which are closely folded and considerably faulted. They occupy about 18,000 ha (about 26 percent). The Pliocene sedimentary formations are found in much of the lower hill area. They are closely folded and considerably faulted and occupy about 15,600 ha (22 percent). They are marine siltstones and fine grained sandstones. The entire Cikawung basin has a contorted drainage pattern. A large area of alluvium in the lower Cikawung reaches from above Majenang to the confluence with the Citanduy River; it accounts for about 21 percent of the 70,000 ha drainage area.

The geology of the Ciseel-Lower Citanduy Subbasin is the most complex of the subbasins within the Upper Citanduy Watershed. Young volcanic products, which comprise about 7,500 ha, are scattered along the west side of the basin. Pliocene sedimentary rocks occupy about 25,500 ha (26 percent of the area) and are marine siltstones and fine grained sandstones. In places they are closely folded and somewhat faulted. Marine sandstone and mudstone compose the majority of the Miocene Rocks. They, likewise, are locally closely folded and considerably faulted in places. They occupy about 30,200 ha (31 percent). About 2,500 ha of Miocene limestone are scattered, mostly along the highway between Padaherang and Kalipucang. About 31,300 ha (32 percent) in the lower plains consist of alluvium. Because of the sporadically folded and faulted geology, the drainage pattern is quite contorted over the upper watershed area.

Soil and Land Classification

Soils. A soils map for West Java was prepared with a scale of 1:250,000. The various soil groups were delineated with a legend identifying each soil group by number and name of soil type. The map can serve as a general guide; however, preparation of conservation plans for villages or small hydrologic units will require a detailed soils and land capability map. A soils map for Central Java is currently being prepared but was not available for this report. The soils map for the West Java portion of the Citanduy Watershed is presented in Figure II-5 and the locations of the major soil groups in Table II-7. A knowledge of the soils of the upper watershed is necessary to better understand runoff and erosion problems and to estimate the soil conservation measures needed to control flooding and sedimentation in the lower reaches of the system.

Altitude may be the main determinant in the color differences between the brown and reddish-brown soil groups. The higher soils remain wet longer with very little drying out, whereas the opposite is true of the more reddish-colored soils of lower elevations. However, duration of weathering may also be a factor, the more reddish soils being formed in older volcanic material than the brown or yellowish soils.

The following sections broadly discuss the major soil groups of the Citanduy major soil groups of the Citanduy Watershed. Additional information may be obtained from the Citanduy River Basin Master Plan, Appendix D - Soils and Land Classification, or from the feasibility reports and appendicies for the Banjar Plains, Central Java Systems, and other irrigation project reports.

Histosols (1,300 ha, 0.4 percent) are organic soils that have an accumulation of plant remains in varying degrees of decomposition. These soils are found only in the vicinity of the Lakbok peat bed.

Alluvial Soils (15,100 ha, 5.4 percent) generally occur in the rice land floodplains of the lower Citanduy and Ciseel Rivers. The soils are generally deep and are derived from parent materials that tend to be of volcanic origin that were deposited as alluvial terraces and alluvial plains (fluvial).

Gleysols (8,900 ha, 3.2 percent) are wet soils found in poorly drained volcanic highland sites. They are rich in organic material, having been developed in colluvial and alluvial materials overlying lagoonal deposits.

Regosols (15,000 ha, 5.3 percent) are young soils found on unconsolidated materials other than alluvial deposits. They show little or no profile development due to the recent age of the sediments on which they have developed; or as the result of erosion, they may have lost the surface horizons. The Regosols of the Upper Citanduy Subbasin are developed on recent volcanic deposits and are sometimes called volcanic ash soils. They are very sensitive to gully erosion but are highly permeable, a fact which helps reduce surface runoff.

Andosols (15,100 ha, 5.4 percent) are developed in subrecent unconsolidated volcanic deposits on the middle and upper slopes of volcanoes. They have a dark, smeary surface soil, rich in organic matter, that overlies a yellowish-brown, medium-textured and porous horizon. They are rich in allophane that is derived from weathered volcanic material. They are sometimes referred to as humid mountain soils and are all highly permeable. Gully erosion is generally moderate.

Grumusols (5,800 ha, 2.1 percent) are now generally classified as vertisols. They have a thick, dark surface horizon but tend to be low in organic matter. They consist of fine textured material with a high shrink-swell potential, and when they they are dry they develop deep cracks which then close during the wet season. The shrinking and swelling is caused by montmorillonitic clays, an alternation of wet and dry seasons, and a warm climate. Grumusols are developed on weathering products of limestone, marl, and volcanic lahar. These

Grumusols, found in the Lower Ciseel Riverl Watershed along the sides of the river, are easily eroded by gully action but are resistant to sheet erosion.

Latosols (158,400 ha, 56.6 percent) younger and less well developed soils, are now generally classified as Oxisols (Ferrosols) but may be classified as Cambisols, Nitosols, or Luvisols. For the Citanduy Watershed they probably would be classified as Cambisols based on their development on subrecent alluvial deposits of volcanic sediments or volcanic deposits. The soils to the east of Sawal Volcano, at the lower elevations, are Red-Brown Latosols, they give the reddish color to the river and stream sediments. Cultivated Latosols are subject to both sheet and gully erosion.

Acrisols (60,200 ha, 21.5 percent) are strongly weathered soils with an argillic B horizon and a low base saturation. In the watershed they are developed by noncalcareous consolidated sediments and volcanic deposits and are found on dissected plateaus and low mountain ranges. Their erosion hazard is moderate, but erosion damage is fairly widespread in the cultivated areas.

Slope Factors. Slope is a very important factor in determining the land capability for upland crop production. The cultivation of any land in the humid areas of the world will result in erosion and degradation of the soils. The steeper the land form, the higher the potential rate of erosion. Fortunately, various forms of protection may be used to reduce erosion rates. Erosion not only results in the deterioration of the productivity of the land, it also results in the aggravation of silting and flood damage on the downstream riceland areas and urban developments.

In the Citanduy Watershed the problem is compounded by the very large human population and the fact that the cultivators are generally poor farmers operating on small tracts, generally less than 0.5 ha. The population pressures of recent years have caused an increasing use of high elevation and steep sloping lands that are unsuitable for upland farming.

The evaluation of specific limitations of maximum acceptable slope is directly related to the population pressures on the land resource. Where large areas of undeveloped land are available, the limitation of land use for cropland to slopes of less than 12 percent might be possible; but in areas such as the Citanduy Watershed, a more practical limitation is probably about 40 percent. At this 40 percent slope a vertical interval of 1.5 meters produces a terrace with a usable bench width of 1.94 meters and an effective crop area of about 5,200 m^2/ha of constructed terrace; that is, after taking out land for terrace risers and waterways (Appendix D). This approachs the upper limits for financial feasibility.

The areas of various slopes for the Citanduy Watershed were measured fom base maps published by the Directorate of Land Use (1970-73). This slope area data is in Table II-8 and is summarized as follows:

Slope Factor	Area ha	Percent of Area	Recommended Land Use
0 - 2%	71,658	20.5	Lowland rice and some unterraced upland crops.
2 - 15%	72,161	20.6	Terraced riceland and upland crops, home gardens, and plantations.
15 - 40%	101,805	29.1	Terraced upland crops, home gardens, and plantation or forest areas with conservation measures.
Over 40%	104,376	29.8	Forestry, recreation, watershed protection, and limited areas of upland crops with intensitve conservation measures.
Total	350,000	100.0	

The probable over-development of the watershed is evident when present land use (Table II-2) is compared with the slope breaks. The lowland rice area is 86,802 ha. upland crops consist of 120,508 ha, and home gardens 28,192 ha. This total amounts to 235,502 hectares, or 96 percent of the 245,624 ha of land with slopes of less than 40 percent.

This is without considering the water areas, urban built up areas and other necessary uses of the more desirable slopes.

Land Capability Classification. Soil and land capability classes are defined by the physical features of the land that determine its suitability for sustained crop production and determine the management level necessary to protect it from erosion and other hazards. These features include soil depth, texture of the topsoil, percent slope, climatic factors, drainage, fertility, stoniness, erosion and other crop production related factors. This information and topographic maps enable a conservation planner to determine the best use of each land area and to locate terraces, water control structures, trees, grasses, and other types of conservation development measures that need to be applied. Vegetative practices and alternatives for the cropping system can also be determined for each farm or hydrologic unit. The land capability map was developed for most of the Citanduy Watershed in 1971 (Figure II-6).

Land capability classes are used to group soils within a complex watershed and thereby partition the watershed into a minimum number of homogeneous units for planning or hydrologic evaluation. In general, the land capability map (Figure II-6) for the Citanduy Watershed was developed for upland (rainfed) crop production potential and limitations. Basically, the higher the land capability class, the more limitations there are on utilizing the land for crop production.

A detailed soil survey and land capability map, based on aerial photo interpretation, must be developed for conservation planning activities in the Citanduy Watershed Project. The present map can only generally project probable problems, and no soil maps are presently available for the Central Java portion of the Watershed.

Table II-9 provides an estimate of the areas for each land capability class and subclass by the individual soil units for each subbasin except the Cikawung. The land capability class is summarized as follows:

Land Capability Class	Area (ha)	Percent
II	0	0.0
III	86,900	31.0
IV	99,600	35.6
V	86,100	30.8
VI	6,700	2.4
VII	700	0.2
	280,000	100.0

This analysis shows that of the 280,00 ha for which land capability estimates are available, only 186,500 ha (66.6 percent) are suitable for crop production, even with good conservation measures. Because under present conditions the equivalent total for lowland rice (66,833 ha), upland crops (99,324 ha), and home gardens (20,685 ha) is 186,842 ha, it is obviously no remaining land is suitable for additional development in these subbasins.

Soil and Land Capability Classification in Conservation Planning. The basis for any conservation planning is a detailed soil survey of the area under consideration at a scale that permits definition of all major soil and topographic factors. Also necessary is a detailed distinction of phases according to slope, erosion rate, structures, and land capability classification. In addition to the soil map, a base map must be made for detailed planning purposes. This map will enable the farm planner to determine the locations and means of implementing terraces, water control structures, trees, agro-forestry, and other types of conservation development measures. Low productivity of soils is mainly due to a shallow profile, physical conditions, leaching, and erosion; these problems need to be defined.

Land capability is the suitability of the land for special uses in the employment of a sound farm conservation plan. Soil conservation planning technicians require land inventory maps that include the type of soil, soil texture, slope, erosion and other soil characteristics that influence crop production.

The land capability inventory map should point out necessary adjustments and treatments required to control soil and water erosion. This map will indicate how the land can be used for the farmer's specified applications on his land, and it will also indicate the adjustments necessary to accommodate his land to hydrologic requirements. Therefore, individual farmers must work closely with their neighbors because; one farmer generally does not farm a large area of land, he and his neighbors must collectively plan and construct the conservation structures and water disposal system.

Most upland farmers do not realize that steeply sloping land cannot be effectively farmed without properly constructed terraces and water disposal structures to prevent erosion. Many of the existing terraces, including those for rainfed rice have cropping rows that are not on the contour and each rain removes part of the soil resource. Because soil losses come gradually, land owners and operators do not recognize the deterioration of their resources until they will not suport the desired crop.

Among the land conservation system's prime goals are increased food production and increased economic returns. This system includes using each hectare of land according to its capability to produce maximum economic yields. The farmer must be aware of the given physical restrictions, such as slope, rainfall, ground cover, and structural measures, for the conservation system to adequatly function. All of this requires close cooperation between, and coordination of, all technical work and the farmers. Above all the farmer must be given more responsibility in planning and operating his farm consistent with the services available to him.

To promote the self-operation concept, the Kelompok Conservation Action Unit (discussed later in this report) will serve as the medium whereby the extension agents and technicians can transfer knowledge and skills about land conservation production, marketing facilities, and other information the farmers may require to elevate their economic status.

Erosion and Sedimentation

Erosion of the upland soils in the Citanduy River Basin is the result of a combination of mass movement and fluvial processes.

Mass movement on the slopes occurs when the force of gravity exceeds the forces holding the soil on the slope. The mass movement can be in the form of soil creep, debris sliding, debris avalanching, slumping, or earth flow. In the tropics, we also see individual aggregates of soil, a few millimeters in diameter, dry out and roll down barren slopes.

Mass movement can be dramatic when triggered by earthquakes, volcanic activities, or large amounts of rainfall. For example, it has been estimated that aproximately 115 mm of surface soil was almost instantaneously removed from the surface of a small watershed in New Guinea as a result of an earthquake [2]. Lahars on volcanos in Java remove massive amounts of sand, gravel, and boulders from the rims of the volcano in a few hours. Newspapers tell of huge landslides occurring during extremely large storms during the last century in Java. In the Philippines, sediment yield of approximately 40,000 t/km^2 from a 2.40 km^2 catchment area has been measured. This yield is the equivalent to a gross soil loss of approximately 35 mm and was the result of numerous small slides initiated by rainfall from a single typhoon (3).

Although spectacular erosion can result from mass movement, it is generally concluded that, over the long-term, fluvial processes cause more erosion in Java and in other heavily populated areas in the tropics.

The impact of raindrops falling on bare soil dislodges soil particles and places them in suspension in water. The water and its load of fine soil particles concentrate in small rills and rush downhill, eroding more soil from the boundary of the rills. The rills combine to form larger channels; some of these may erode into gullies. Larger channels and gullies combine to form streams capable of eroding their soil banks and of carrying away gravel and boulder debris brought down to the streams by mass movement.

When the rivers leave the steep upper watershed, they have a sediment load which may include all particle sizes, from clay to boulders. In Java most of the sediment load consists of suspended clay, silt, and sand. Lesser amounts of gravel and boulders bounce and roll along the bed of the river.

On reaching the lower, flat, alluvial portions of the Citanduy River Basin, the rivers spill over their banks, flooding the adjacent land, and depositing some of the fine silt and clay carried in suspension in the flood water. This new deposit can benefit the land because some plant nutrients are attached to the individual soil particles.

Only a small portion of the sediment load is deposited on the flood plain. Most of the sediment eroded from the Citanduy Watershed is carried out to the Segara Anakan and the Indonesian Ocean. In the past, maybe as much as 25 percent of the sediment load was deposited in the Segara Anakan, but that estuary now is nearly full of sediment.

In some years, the annual rainfall in the Upper Watershed in the Citanduy River Basin can be as great as 4,000 mm. The consumptive use for the natural watersheds in Java is approximately 1,400 millimeters. That leaves as much as 2,600 mm as runoff in wet years. The erosive power of this quantity of water is very great.

In most areas of the upper watershed the residual soils are deep; in some cases, in excess of 50 m.

The combination of high annual rainfall, deep soil, and steep slopes results in a potentially large erosion; that is, if the soil is not protected by vegetation or otherwise managed to prevent excessive erosion.

In its pristine state, the overall sediment yield rate in Java was probably equivalent to an erosion rate of 0.5 mm to 4 mm/y. An average value would be about 2 mm/y. By contrast, the sediment yield in the United States is equivalent to 0.03 mm/y.

Areas underlain with sedimentary rocks have large pristine sediment rates. Soils derived from volcanic debris are more resistant to erosion and have lower erosion rates and sediment yields.

The increase in Java's population has resulted in the natural vegetative cover being removed from the soil and dramatically increased erosion rates. Upland farming practices, now being used, leave the soil dry, bare, and vulnerable to raindrop erosion. The water concentrates quickly on the steep slopes and erodes deep gullies.

In a portion of the Serayu River Basin, the sediment yield has been estimated at greater than 30,000 $t/km^2/y$. This figure is equivalent to more than 30 mm of erosion. The subbasin is formed in soft marine sediments and has been misused in the past.

The Jragung Watershed located on the side of Ungaran Volcano near Semarang, Central Java, is used to a great extent for upland agriculture. Soils in the 100 km^2 watershed are derived in part from volcanic debris and in part from marine sediment. The sediment yield from the basin has been measured as 20,000 $t/km^2/y$, equivalent to approximately 20 mm of erosion. During the intensive sediment measuring program carried out for the Jragung River during the 1977-78 wet season, a suspended sediment concentration of 71,400 mg/l was obtained. Concentrations were probably even greater during some periods when no samples were collected.

An estimate of the sediment yield from the Upper Watershed in the Citanduy River Basin [4] was made from data available data in 1974. The estimates ranged from an equivalent erosion rate of 2.0 m/y for the Cilisun subwatershed, with a drainage area of 190 km^2, to 7.0 mm/y for the 1,300 km^2 watershed upstream from Pataruman. Current preliminary evidence indicates that the sediment yield for the watershed exceeds the original estimates. The sediment yield from the entire upper watershed may now be as large as 10,000 $t/km^2/y$, equivalent to an average erosion rate of 10 mm/y.

Currently, deforested and denuded lands and lands planted to upland crops are a major source of sediment. With no protective covering, the soils of these former forests are easily dislodged and transported through the river system. Landslides and other mass move-

ments of soil and loose rock that reach an active watercourse also provide a source of sediment as the flowing water removes the material from the base of the slides.

An evaluation of landslide prevalence in the basin is difficult because of land preparation carried out by farmers. As soon as a slide, even a small one, moves down, it is terraced and farming begins. Frequently these terraced lands are planted to rice. The slides generally provide more gentle slopes for this purpose than the pre-existing hillside slope. It appears that in some locales, landslides have been encouraged as a means of increasing tillable land.

Built-up areas, roads, and trails produce large amounts of sediment and it appears that this source of sediment expands as agriculture encroachments further into the deforested uplands.

Little sediment is produced in the forests or plantations located in the upper reaches of many subbasins because there is very little direct rainfall impact on the soil. The effectiveness of a forested area as a deterrent to surface runoff and erosion is indicated by results observed in an experimental forestry plot in the erosion experimental basin at Waspada. The experimental basin established in 1963, is located near Garut, south of the Upper Watershed of the Citanduy Basin. An appraisal of the Waspada Project in 1972 [5] reported that "this forestry plot has proven to be 100 percent efficient in stopping runoff as no [surface] water has ever flowed out of the forested area".

The irrigated rice-producing areas are not a significant source of sediment. Due to the current farming practices of terracing and ponding, the rainfall impact energy is harmlessly dissipated in the paddies. During the dry season, the sediment produced usually remains in the immediate vicinity because a transportation system is not available. Sediment moves out of the irrigated rice area during the rainy season when paddies are being drained.

A part of the Upper Citanduy Watershed has been denuded to obtain lumber and firewood and to grow subsistence crops, mainly casava and upland rice. Because of poor management practices for upland agriculture, erosion rates for the agricultural and deforested areas are much greater than the pristine rates.

The large sediment loads have caused an accelerated rate of filling in Segara Anakan; irrigation canals in the lower basin are clogged with sediment; and the domestic water supply is brown in color. Perhaps the floods are greater now than in the past, but the available data cannot prove this.

In other Java watersheds that drain into reservoirs, erosion of the uplands has caused rapid siltation of the reservoir, and downstream irrigation systems do not have enough water.

The single most important consequence of the resources exploitation in the Upper Citanduy Watershed is the loss of topsoil, the critical soil resource. Topsoil contains micro-organisms, organic matter, and nutrients necessary for plant growth. When topsoil is eroded or otherwise lost, production of vegetation greatly decreases. The micro climate becomes hotter and drier. Many native plants cannot be grown in this new environment. Natural rejuvenation of the topsoil takes decades, if at all. Fertilizers are necessary to maintain plant production.

Data from around the world indicate that the total soil wastage is worse than ever, and that little progress has been made in stopping the exploitation of this resource. Two reasons may account for this lack of progress. First, the restrictions necessary to prevent soil exploitation are socially and politically unacceptable to people and to governments when such exploitation is adding to the immediate prosperity of individuals and the nation. Secondly, in a hungry world it is difficult to restrict the growth of needed food crops, even if such growth causes means the reduction of long term productivity. In looking for solutions to erosion problems, we must be concerned with the political as well as the economic and technical feasibility.

How severe is the soil erosion problem in Java? A respected Dutch ecologist, J.P. Theiss, has said publicly that Java could be a desert in thirty years [6]. Other experts do not go as far, but there is little reason for optimism. We could end up with bare mountain and savannah country unless past patterns of watershed use are changed.

There is already alarm that reservoirs constructed to store water will be full of sediment much much sooner than previously expected. If there are no storage reservoirs, where, in the future, will excess rain water in the wet season be stored for use in dry season?

Water Resources

Climate

The climate of Indonesia is primarily influenced by the trade winds, which are in turn affected by the monsoon conditions prevailing over Southeast Asia. Western Java in influenced by the northwest and southeast monsoons, and the May-through-October rainfall, associated with the southeast monsoon, is usually considerably less than the northwest monsoon.

Statistically, the wet season is normally November through April. The trade winds are reinforced by the northeast monsoon which is developed in the polar regions of Asia and caused by differential barometeric pressure. These winds pick up moisture as they pass over the South China Sea. While crossing the equator, the direction of the monsoonal movement changes to northerly and, finally, to northwesterly.

The Asian temperature pattern, during the remaining months of the year, causes a reversal in the differential pressure with a corresonding reversal in the direction of movement of the air mass. The southeast monsoon does not pass over as large a water area prior to reaching Java as does the northwest monsoon. Rainfall during this period is significantly less.

In the Citanduy Watershed, the low-level wind conditions tend to be variable to easterly or southerly for most of the year. To establish the varying conditions within the Citanduy Basin area, climatological data were collected from the stations at Cilacap and Tasikmalaya. Data for Bandung and Jakarta were also collected for comparison. Cilacap and Tasikmalaya stations are located on the eastern and southern edges of the Citanduy watershed, respecitvely.

Temperature. The annual temperature ranges are very narrow, and to distinguish the season by temperature would be extremely difficult. Tropical waters surrounding Java are responsible for this constancy of temperature.

The average annual temperature in the Citanduy Basin is about 25°C at Cilacap. Extreme monthly values have ranged from 32°C at Cilacap to 18°C at Tasikmalaya. At Bandung, the minimum temperature has fallen to 11.7°C, which provides some indication of the higher-elevation lows in the project area. The deviation of the mean monthly from the mean annual temperature is generally less than 1°C. The difference between maxima and minima is about 7°C in the Cilacap area and from 6° to 11°C in Tasikmalaya area. Mean monthly temperatures for the different stations are in Table II-10.

Relative Humidity. Relative humidity is high and relatively constant throughout the year as a result of the tropical island climate. The average annual humidity in the watershed is estimated to be 82 percent. Humidity at Bandung ranges from 51 percent to 86 percent and averages 77 percent; in Tasikmalaya from 70 percent to 84 percent with an average 80 percent; and in Cilacap from 78 percent to 91 percent with an average 84 percent. Mean monthly relative humidity values for these stations are in Table II-11.

Rainfall. The network of rainfall stations with some period of record is quite dense. However, there is no coverage in the higher regions of Sawal Volcano and along the high hills forming the northern boundary of the basin. Some of the rainfall records go back as far as 1879. Twenty stations adjacent to the Watershed and 46 stations within the Watershed have at least five years of consecutive records [7].

Rainfall records were collected from 27 stations located within the basin. The location of these selected rain gaging stations is in Figure II-7. Where possible, records were collected for the period 1915 through 1972. The records at raingage stations were checked for consistency by a double mass analysis; and using procedures recommended by the U.S. Weather Bureau, the data were correlated and extended to cover the period 1915 through 1972. Because only a few stations exhibit erratic tendencies, the records appear to be generally reliable. The

major causes of these erratic deviations from the norm are thought to be the relocation of the gage and errors in measurement. In some instances, it appears that partial records had been inserted as monthly records [7].

Rainfall over the Citanduy Watershed is characterized primarily by high intensity storms of short duration and limited areal extent. These storms are usually convective in origin and are triggered by warm air rising off the land mass in the late afternoon, but topography produces local orographic effects along the northern boundary of the area and on the southeast side of Sawal Volcano.

An isohyetal map was prepared from the available rainfall data. Rainfall trends based on the lower level rainfall were followed in the higher elevation areas. The isohyetal map, based on the 1915-72 average annual rainfall, is presented in Figure II-8. The Theissen Polygon method for areal averaging of precipitation was used to check the annual values obtained from the isohyetal method and to estimate the monthly distribution of the annual values.

Table II-12 provides the mean monhly (1915-72) precipitation by subbasins for the wet (November-April) and dry (May-October) seasons in the Citanduy Watershed. The average annual precipitation for the Watershed is 3,100 mm in the wet season and 946 mm in the dry season. Annual precipitation by subbasins ranges from a high of 3,500 mm for Cijolang to 2,800 mm for the Ciseel-Lower Citanduy.

The minimum and maximum values experienced in each of the subbasins provides additional data for planning (Table II-13). The minimum precipitation received during the wet season in the Watershed ranges from 103 mm in November to 173 mm in January. Minimum precipitation has been zero for the June through September period, 8 mm for October, and 26 mm for May. These minimum values also show the fallacy of using only average precipitation data in watershed planning.

Maximum precipitation for the Watershed amounts to 4,575 mm annually, or almost three times the minimum recorded amount. The average maximum received per month in the wet season amounts to 591 mm, a range of 242 mm in April to 668 mm in December. Somewhat surprisingly, the average of the maximum for the dry season months is 556 mm, or nearly as high as the maximum for the wet season months. The unusually large

amounts of precipitation during the dry season months over a few years raise the average precipitation statistics enough to suggest there would be no significant problem raising upland crops during the dry season; however, actual farmer experience shows that this can be an endeavor that is risky beyond the resources available to most upland farmers. This unpredictability of rainfall is also one of the major reasons so much cassava is planted on the upland area; it has a high resistance to drought.

Water Balance Relationships

Data limitations make it difficult to prepare a detailed description of the hydologic cycle for the Citanduy Watershed; therefore, the approach taken was to quantify the components of a simple water balance model with the recognition that it can only provide indications of the true values. The water balance approach requires that water entering the system must equal the water moving out of the system (runoff, evapotranspiration, or deep percolation) plus that water stored in the soil profile.

The water balance relationship for the Citanduy Watershed can be stated by the equation:

Precipitation = Evapotranspiration + Deep Percolation + Runoff - Changes in Soil Water (initial minus final), or $P = E_t + (D+R) - \Delta S$ (initial minus final).

Evapotranspiration (E_t) is a word coined to describe the combination of evaporation from water surfaces and moist soil and the transpiration from the growing plants. Broadly, it is the amount of water used by the specific ecosystem in the annual hydrologic cycle. While this simplified water balance equation is easily understood, the quantification of specific factors can be difficult. The problem is also

complicated by the lack of the climate data for the steep slopes of moutains such as Sawal Volcano and those on the northern Watershed boundary. Subsequent evaluations indicate that the Watershed precipitation data in Table II-2 may be low.

The water balance bookkeeping involved five items: (1) monthly precipitation; (2) estimated evapotranspiration for the vegetation with water availability not limiting use; (3) soil water storage to the available water holding capacity; (4) actual evapotranspiration; (5) determination of water deficits. It quickly becomes apparent that some simplifying assumptions are necessary. Because the soil moisture storage is relatively constant over long periods of time, this factor can be equal to zero with respect to changes from year to year. By using a large watershed area streamgage as the basis of the water yield, it is also possible to assume that over time all of the deep percolation becomes surface runoff. By treating the average evapotranspiration rate over the watershed as the unknown, it is possible to complete the water equation.

The next sections of this report briefly describe the determination of the specific parameters of the water balance equation.

Precipitation. Total precipitation for a watershed area includes all forms of moisture received on the plants or ground surface. For the Citanduy Watershed this includes large amounts of dew throughout most of the year. Dew formation is not generally measured, but it does account for a considerable portion of the evapotranspiration in the early part of the day.

For evaluation purposes it is not possible to prepare monthly precipitation amounts that exactly correspond with the measured monthly streamgage runoff records. For this evaluation it was decided to use the 1915-72 precipitation amounts for the Citanduy Watershed from table II-12 as the basis for evaluation. To provide a weighted average precipitation for the Citanduy River at Karangsari, the precipitation for the upstream subbasins were weighted as follows: Upper Citanduy, 29 percent; Cimuntur, 24 percent; Cijolang, 19 percent; and Cikawung, 28 percent.

Streamflow. Streamflow records are available for a number of streamgaging sites in the Citanduy Watershed. For this evaluation, the Citanduy River at Pataruman (1,330 km^2) and the Citanduy River at Karangsari (2,540 km^2) were selected (Figure II-9), based mostly on the availability of 1970-77 data for both stations.

The Pataruman streamgage is located on the Citanduy River, approximately 3 km downstream from Banjar at the bridge on the road to the village of Pataruman. The stations commands a drainage area of 1330 km^2. The station was opened in November 1969 and is equipped with an ordinary staff gage. The river reach up and downstream from the gage is straight and appears stable. Overbank flow occurs at a gate height of about 6.5 m. The discharge is then confined by levees located on both sides of the river. The station is located about 200 m above the Patruman Weir, which, to some extent, regulates the stage-discharge relation. At low flow the stage-discharge relation is subject to change due to a diversion to the North Lakbok Irrigation System and operation of a sluice gate in the weir. The weir is submerged at a flow of about 30° m^3/s. The 1970-77 mean annual flow is 98.2 m^3/s, the total is 3078.9 $m^3 \times 10^6$, and the annual water yield is 2,315 mm/unit area.

The Karangsari streamgage station is located at the town of Karangsari, 17 km downstream from Railroad Bridge 1452 and downstream from the Manganti Weir. The station was established in April 1970 and is equipped with an ordinary staff gage located at a slight bend in the river. The streambed is composed of small gravel and sand. The 1970-77 mean annual flow is 168 m^3/s; the total flow is 5,275 $m^3 \times 10^6$, and the annual water yield is 2,078 mm/unit area.

A comparison of the mean flows of the streamgaging sites shows that they are highly related, in spite of the irrigation diversions and other factors. For the 1970-77 time period, the regression analysis indicates that the Pataruman streamgage flows (P_q) can be used to predict the Karangsari flows (K_q) with the equation:

$$K_q = 1.721\ P_q - 1.25, \text{ with an } R^2 = 0.95.$$

The 1970-77 mean monthly water yield for the Pataruman and Karangsari streamgages is as follows:

Month	Water Yield at Streamgage			
	Pataruman 1/		Karangsari 2/	
	mm	%	mm	%
January	224	10.6	2[illegible]3	11.9
February	264	11.4	231	11.1
March	292	12.6	279	13.4
April	257	11.1	201	9.7
May	170	7.3	155	7.5
June	91	3.9	92	4.4
July	77	3.3	49	2.4
August	55	2.4	48	2.3
September	109	4.7	110	5.3
October	219	9.5	172	8.3
November	263	11.4	243	11.7
December	274	11.8	249	12.0
T O T A L	2,315	100.0	2,077	100.0

1/ Based on 1970-77 observed monthly runoff from 1,330 km^2 drainage area.

2/ Based on 1970-77 observed monthly runoff from 2,540 km^2 drainage area.

An examination of these records shows that the water yield in September is higher than the 1915-72 annual precipitation, which indicates that the records period is too short for valid evaluation of the water balance equation. In fact, 1970, 1971, 1973, 1974, and 1975 are all high precipitation and runoff years for most of the available stations.

Additional analysis by the ECI staff showed that the Karangsari streamgage could be synthetically extended, using the gage height record for Banjar for the 1957-69 period. This permitted the development of a 1957-77 combination of synthetic and observed streamflows at Karangsari. This produced an estimated mean annual flow of 153 m^3/s against the 168 m^3/s for the observed flows.

The results of the precipitation and water yield analysis can be summarized in the following table:

Month	Precipitation 1/		Water Yield 2/		Difference		Potential Evapotranspiration 3/
	mm	%	mm	%	mm	%	mm/month
January	420	13.2	252	13.3	168	13.0	136
February	365	11.5	218	11.5	147	11.4	143
March	395	12.4	266	14.1	129	10.0	146
April	304	9.5	182	9.6	122	9.4	129
May	231	7.3	139	7.3	92	7.1	118
June	143	4.5	90	4.8	53	4.1	114
July	118	3.7	93	4.9	25	1.9	115
August	90	2.8	55	2.9	35	2.7	133
September	87	2.7	56	3.0	31	2.4	150
October	255	8.0	120	6.3	135	10.4	146
November	374	11.7	177	9.4	197	15.3	135
December	404	12.7	245	12.9	159	12.3	133
T O T A L	3,186	100.0	1,893.0	100.0	1,293	100.0	1,598

1/ Weighted average precipitation for the drainage area.

2/ Based on the 1957-77 synthetic and observed monthly runoff for the Citanduy River at Karangsari (2,540 km^2)

3/ Penman method from Table II-14

The difference between precipitation and water yield of 1,293 mm in the above table provides a reasonable measure of actual evapotranspiration on an annual basis. The individual monthly values are incorrect, however, because they do not account for changes in soil moisture storage. During the wet season the soils of the watershed become saturated and the portion in the root zone of plants can be used during the dry season.

Evapotranspiration. The potential evapotranspiraton for Citanduy Watershed was calculated using the Modified Penman Method (FAO, 1977). Data on temperature, relative humidity, solar radiation, and wind velocity were obtained from the Cilacap and Tasikmalaya Weather Stations. The calculated Et_p values range from 3.7 mm/day in July to 5.1 mm/day in February, crop coefficients are applied to these Et_p values to develop estimates of evapotranspiration for specific crops (soil water not limiting). The Et_p and crop water demands by month for irrigated rice and upland crops are summarized in Table II-14.

Unfortunately, no equivalent plant water use coefficients are available for natural vegetation in the Watershed, but for the relatively dense cover of undistrubed areas it is approximately 100 percent of Et_p. If it is assumed that the average demand for the watershed vegetation is equal to Et_p and that the average available water holding capability is 125 mm, the following estimate of actual evapotranspiration can be made:

(Millimeters)

Month	Et demand	Precip.	Available Soil Moist. storage	Change in soil moisture	Actual evapo-transpi-ration	Water yield or surplus	Moisture deficit
January	136	420	88	+32	136	252	
February	143	365	120	+ 4	143	218	
March	146	395	24	-17	146	266	
April	129	304	107	- 7	129	182	
May	118	231	100	-26	118	139	
June	114	143	74	-61	114	90	
July	115	118	13	-13	38	93	77
August	133	90	0		35	55	98
September	150	87	0		31	56	119
October	146	255	0		135	120	11
November	135	374	0	+62	135	177	
December	133	404	62	+26	133	245	
Annual	1,598	3,186	88		1,293	1,893	305

This completes the computation of the water balance equation $P = E_t + (D+R) - S$ (initial minus final) or 3,186 = 1,293 + (1,893) - (88-88) on an annual basis. It should be noted that the (D+R) component of both deep percolation and surface runoff becomes water yield over time. Further, to the extent that the dry season stream flow represents base flows or flows from ground water, this water balance underestimates the true actual evapotranspiration for the specific month. The 305 mm moisture deficit is a measure of the additional water the plants growing in the watershed could use for evapotranspiration if the water were available from precipitation or soil moisture in the average year. In dry years this deficit is much larger.

Water Quality

Chemical Quality. Most of the water supplies available are considered excellent for irrigation purposes and good for a domestic water supply. The total dissolved solids are very low, as are the chlorides and sulphates. The percent sodium is a little high for a classification of "excellent" for irrigation, but for water with the indicated range of total dissolved solids, percent sodium is not an especially good parameter. The sodium absorption ratio is low, indicating a low sodium hazard, and because the total dissolved solids are low, the salt hazard is low.

Water quality samples were taken at the active stream gaging stations at Cikawung and Karangsari in September 1972, December 1973, and January 1974. The water quality testing was done by DPMA at the Hydro-Chemical Laboratory in Bandung. Biro Tehnik Video first published the 1973 and 1974 results. The results of the three years of sampling show a classification of irrigation water within the range of permissable limits for all constituents.

Sedimentation. The foremost consideration in a study of sediment load being transported by a stream is the condition of the watershed that produces sediments. In the Upper Watershed sediment results from 1) sheet and rill erosion, 2) mass wasting and hydraulic sluicing, 3) erosion of minor drainage ways, 4) gullly erosion, 5) flood plain scour, and 6) stream bed scour. Because of the extensive levee system that restricts overflow of the Citanduy River in the river course below Banjar, sediment transport is mostly a movement of the sediment discharged from the small watersheds through the system to the Segara Anakan and into the Indonesian Ocean. The exception to this is the scour and fill of the river channel that sometimes occur from one major flood to another.

Actually, the sediment yield in the upper reaches of the Citanduy Watershed varies greatly from one small watershed to another. For example, on the east side of Sawal Volcano, one stream is red with sediment, and bars of silt are deposited along the bank lines; whereas in the neighboring stream, clear water cascades down a riverbed covered with large boulders. In general, the east side of the Volcano yields more

sediments than the west side. Therefore, the Cimuntur River, which drains the eastern slope of Sawal Volcano, has a greater sediment concentration than the Citanduy River, which drains the southern and western slopes of the Volcano.

The volume of sediment transported by the Citanduy is estimated to be large. Over half of the annual load is transported during perhaps 5 percent of the year when large flows occur. The Citanduy River has aggraded considerably for a distance of over 1.5 km upstream of its confluence with Cimuntur. Also, sand and gravel bars are visible at low flows at many bends along a 10 km distance upstream of the confluence.

There are no separate measurements for the bed load transported in the upper reaches of the river. Previous studies have assumed 15 percent of the total load to be the bed load for the Citanduy River.

Suspended sediment discharge measurements were made at a number of streamflow stations in the Citanduy Basin at intervals from 1970 through 1974 [8]. However, the measurements only cover low to medium-high water levels. From the measurements of sediment concentration and discharge at the various sampling stations, sediment rating curves were made in order to estimate sediment transport. From these curves and the average daily streamflow from the gaging station records, average daily transport rates were estimated. The estimate is based on four years' streamflow data and the sediment measurement made during 1970-74. Results of these measurements for the Citanduy stream are more fully discussed in Chapter III and are summarized in Table III-1. Analysis of suspended sediment samples collected in the Citanduy River System show that the suspended sediment is mostly silt. The absence of sand in the samples suggests that the samples were taken near the surface, probably due to insufficient sounding weights for the sampler. The river water in the Citanduy Basin has a very tubid appearance.

Municipal and Rural Water Supplies

Historically, municipal and rural water supplies have come from hand-dug wells and from the Citanduy River or tributary streams. The high rate of annual rainfall and the subsurface geology contribute to widespread occurrence of shallow groundwater and enable use of shallow hand-dug wells for domestic water supplies. Hand pumps are usually used to lift the water, but frequently a bucket and rope are used in uncovered wells. Water from the streams or rivers is hand-carried.

The close proximity of the shallow wells to streams, fishponds, and the river, all of which are highly polluted, causes pollution from human and animal wastes. Ponds, open sewers, and waterways constitute the principal disposal system for sewage. The problem is greater during the dry season when percolation from surface ponds contributes more to the groundwater in the wells. Also, during the dry months of July through October, there is an acute water shortage, and in drought years the only substantial source of water is the major streams.

Thus, both availability and quality constitute problems. Polluted water is a health hazard even if the water is boiled for drinking and cooking. Using the water for washing and bathing can also be a health hazard. Local residents do not customarily boil their water, and boiling is probably not economically possible for most families, given that firewood costs about Rp 1,000 for a large bundle.

The economic prosperity of the region, coupled with the Republic of Indonesia's goal to increase potable water supply in highly populated areas of Java, has brought out a critical need to identify projects for municipal supplies. To attract industries to the region, an assurance of adequate municipal and industrial water supply is needed. "Industrial water supply" is herein defined as the water delivered to large and medium scale industries for process water, landscaping, and incidental domestic use, as well as public service water within an industrial zone.

The city of [illegible] has a water supply system which was installed in 1973 through a loan from World Health Organization. This is a small system with a capacity of 5 l/s. Currently a water supply

system of 64 l/s capacity is under construction for the town of Banjar and surrounding villages. Recently a 115 l/s water supply system was put into operation for the Ciamis town. Tasikmalaya has a water supply system which uses well water which is insufficient. A new municipal water supply system for the town of Tasikmalaya is in planning stages.

Apart from these system, most other municipal needs are obtained from shallow wells, both covered and open, or from the streams and river by hand. Most of the shallow wells are reported to dry up during the dry months. Water in most wells is available at a depth of 5 to 10 m. The capital cost of these wells is about Rp. 1,000,000 each. During the dry season, raw water from the streams is purchased from becaks and porters at an average cost of Rp. 1.25/l in Banjar and other towns and 1.75/l in rural areas. Average daily consumption of this raw river water is 40 liters per capita, and the average annual period of use is 75 days, resulting in an annual per capital expenditure of Rp. 3,750 in Banjar and Rp. 5,250 in rural areas. During the 1977 dry period, drinking water of questionable quality sold for as high as Rp. 6.25/l. Good to fair quality water is obtainable free of charge at a few community wells, small springs, and community mosques.

The system of waste disposal in the towns and villages of the area consists of open sewers, gutters and fishponds. Where sewers exist, they are in clay pipes buried underground at the edge of the streets. The raw sewage is dumped into the nearest natural drainage without treatment. As would be expected, this means of waste disposal is a source of bad odor, insects, and stream water pollution. In the dry season the problems are more acute because the supply of flushing water is reduced. Some of the houses in towns have a septic tank system, but the use of the septic tanks is not widespread. As far as known, there are no plans to provide a modern sewer system or to treat the sewage of any town in the watershed.

Human Resources

The human resources of the Watershed are such that the adoption of many improved conservation practices and control structures is limited; first, because the population density is so high that to install most large structural measures requires the movement of farm families from their land; second, because the average education level of most farm families does not allow the use of printed educational material to teach conservation or improved cropping practices. Therefore, the development of a workable soil and water resources development program must be carefully programmed to meet the needs and desires of the residents as well as the requirement of reducing downstream flooding and sedimentation.

The present population of the Watershed cannot be accurately determined without a special study because the Watershed boundaries and those of the political subdivisions do not match. This is particularly true in the Cilacap District where four of the eight districts are only partially in the Citanduy Watershed and the balance of the area is in the Segara Anakan Watershed. The political subdistrict boundaries for the Citanduy Basin are presented in Figure II-10.

Because the available data indicate a high degree of variability within the available time series, all analyses and projections used in this section are best fit statistical relationships determined by either linear or power function regression analysis. Therefore, the average population increases or percent growth rates quoted in this section cannot be checked by simple calculations.

It should also be noted that the human resources and population data for this section are totals for the Citanduy Watershed, whereas Chapter V, Social Institutional Analysis, attempts to include only the upland watershed areas.

Watershed Population

The historic (1966-1977) and projected (1978-2010) populations, by district, are in Table II-15. The estimated 1979 population of the Citanduy Watershed is 2.24 million people. The 1979 population, by districts, and the population densities are estimated to be as follows:

District	Area km^2	1979 population number	Population per km^2
Tasikmalaya	579.0	664,000	1,147
Ciamis	1,940.0	1,137,100	586
Kuningan	111.0	40,000	360
Cilacap	870.0	395,500	455
T O T A L	3,500.0	2,236,500	648

The population of Tasikmalaya District of the Citanduy Watershed was 518,695 in 1966 and 640,560 in 1977. The regression analysis indicates an average increase of 11,300 people per year and an average growth rate of 1.97 percent per year. This growth rate is unusually uniform and probably indicates an extensive out migration from the Watershed portion of the Tasikmalaya District. Even with this adjustment, the population density increased from 896 per km^2 to 1,106 people per km^2 in the 1966-1977 period. With this population, and the available limited resources, there is some question as to the maximum population that can be supported in the district.

The population of the Ciamis District within the Watershed was 893,659 in 1966 and 1,126,133 in 1978, which is 85.5 percent of the total population for the Ciamis District. During this period (13 years), the Watershed population increased at an average rate of 17,389 people, but the growth was extremely erratic. A 7.9 percent increase in the population between 1966 and 1967 was the result of political activity in Central Java that forced a migration to the Ciamis District. Another large increase in population (5.9 percent) occurred in 1970. This was the result of economic factors causing people to migrate to seek opportunity. There was also a temporary increase in population of 3.1 percent as a result of people returning to vote in the major elections of 1976. A statistical analysis of the population indicates that the 1971-78 period provides a better projection base for the Ciamis District of the Citanduy Watershed. The average increase in population in the 1971-78 period was 9,296 people, or 0.85 percent per year.

In 1966, Kuningan District of the Watershed had a population of 36,113 and a 1977 population of 39,165 for an average growth rate of only 285 people per year or 0.76 percent. This very low growth rate is probably an indication of the very limited resources and infrastructural development in that rather remote area of the Watershed.

The population for the Cilacap District grew from 316,490 people in 1966, with a population density of 364 people/km^2, to a population of 378,043 in 1977, with a density of 435 people/km^2. The regression analysis of 1966-77 data shows an average increase of 5,899 people per year, or an average growth of 1.7 percent per year.

Table II-16 provides an estimate of historic and projected subbasin population. An analysis of the population by watershed subbasins is limited by the lack of accurate maps and in some cases by the lack of village (desa) statistics. Therefore, to some extent the district statistics are prorated on the basis of area, which introduces a potential for error. Citanduy subbasin population for 1979 was estimated to be:

Subbasin	Area km^2	1979 population	%	Population per km^2
Upper Citanduy	740.0	818,600	36.6	1,106
Cimuntur	610.0	377,400	16.9	619
Cijolang	480.0	179,600	8.0	374
Cikawung	700.0	356,900	16.0	510
Ciseel-Lower Citanduy	970.0	504,100	22.5	520
T O T A L	3,500.0	2,236,600	100.0	639

The population densities by subbasins range from 1,106 per km^2 in the Upper Citanduy to 374/km^2 in the Cijolang Subbasin. This variation in population density provides a good measure of the quality of the land resources that permitted the original population to develop. Unfortunately, it is, in some respects, also a measure of the potential people problems of the Watershed as the resources deteriorate.

Population Projections

Population projections were made using linear regression techniques under the assumption that programs for birth control, transmigration and other factors will continue to be effective in reducing population growth rates. Therefore, it was assumed that a constant level of increase (26,887 people per year for the Citanduy Watershed) is more realistic than to assume a specific percentage growth rate for an area that already has a very high population density. This may be questionable in light of Indonesia's 1970-1975 average annual population growth rate of 2.4 percent. The equivalent growth rate for the Citanduy Watershed was 1.3 percent, or approximately one-half that Indonesia as a whole. As shown in Table II-15, the projected linear growth for the Citanduy Watershed would amount to less than one percent (0.94) by 2005. Table II-15 also provides, for comparison, the projected population by percent growth rates. This would amount to an average growth rate of 1.37 percent for the 1977 to 2005 period (28 years), compared to a rate of 1.07 percent for the linear projections.

Perhaps the real value of these mathematical projections is to warn planners and decision makers that portions of this Watershed cannot sustain the population that will occur if population increases are not somehow limited. The resources base is simply not available to maintain an acceptable standard of living. The Tasikmalaya District may be the best example of this problem: its present population density of 1,147 people/km^2 would increase to 1,653 people/km^2 if the 1.97 percent annual growth rate were to continue.

The projected population, by districts, for 1990 and 2005 can be summarized as follows:

	Area	1990 Population		2005 Population	
District	km^2	Number	Density	Number	Density
Tasikmalaya	579.0	788,000	1,361	957,100	1,653
Ciamis	1,940.0	1,239,300	667	1,378,800	711
Kuningan	111.0	43,100	388	47,400	427
Cilacap	870.0	460,400	529	548,800	631
T O T A L	3,500.0	2,530,800	723	2,932,100	838

Please note that the projections for Tasikmalaya, Kuningan, and Cilacap Districts were based on the 1966-1977 data and the Ciamis District projections were based on 1971-1978 data. Therefore, total Watershed population is less than would be obtained by a linear projection of the total Watershed population data.

The projected population by subbasins for 2005 is as follows:

Subbasin	Area km^2	Projected 2005 Population Number	%	per km^2	1979-2005 Population Increase	%
Upper Citanduy	740.0	1,158,100	39.5	1,565	339,500	48.8
Cimuntur	610.0	479,300	16.4	786	101,900	14.6
Cijolang	480.0	220,500	7.5	459	40,900	5.9
Cikawung	700.0	498,700	17.0	712	141,800	20.4
Ciseel-Lower Citanduy	970.0	575,500	19.6	593	71,400	10.3
T O T A L	3,500	2,932,100	100.0	838	695,500	100.0

The limited analysis from Table II-17 illustrates a common problem of projections: areas such as the Upper Citanduy Subbasin which have historically had very rapid population growths, are projected to continue this growth. In this case, the projection probably causes an error because the resources may not be available to provide support for the 339,500 additional people projected for the Upper Citanduy between 1979 and 2005. Conversely, the development of an additional 4,012 hectares of irrigation systems in the Ciseel-Lower Citanduy Subbasin (Appendix A, Table A-14) should permit a larger population increase than the projected 71,400.

These projection problems emphasize the necessity of planners and administrators maintaining a continued awareness of the people problems of the Watershed and the physical and technical constraints on their solutions.

Estimated Labor Force

Unemployment or underemployment, of human resources is a general problem in developing countries with high population densities. Unfortunately, data is not available to identify the extent of this problem in the Citanduy Watershed. The available work force is briefly analyzed in this section and covered more completely in Chapter V. Table II-7 provides an estimate of the 1979 work force by district and subbasin to provide an indication of the present situation. As noted in Table V-5 the number of people in the 15-to-55 years age group constitutes 53 percent of the basin population. This percentage will increase slightly in the future as birth rates decline and the large number of young people reach working age, but at the same time educational opportunities and other factors will tend to keep a larger number of young people out of the labor force.

In 1979, the active working force is estimated to be 46 percent of the total population, based on the 1977 data obtained from the District Planning Offices. As presented in Table II-17, the 1979 work force is estimated at 1,033,200 people; agricultural employment accounts for 858,200 workers (83.1 percent); followed by commerce with 58,100 (5.6 percent); public administration with 50,900 (4.9 percent); and other categories with 66,000 (6.4 percent).

Agriculture Labor Force. Agriculture, in addition to employing 83 percent of the labor force, is the key to the land and water resource development program for the Watershed. But the development dilemma in the Watershed is circular: as population pressures increase, more poor quality land is cleared and output, yields, and incomes decline, thus inducing people to invest less labor, fertilizer and other resources in the production of crops. Traditional farm practices, cultural customs, soil erosion, and low soil fertility contribute to the declining farm income and the increasing need for transmigration or other manpower exports from the Watershed.

Further, one cannot neglect the potentially negative effect on productivity where nutrition is inadequate for some (i.e. the poorest) of the farm labor force. Clearly nutritional deficiencies prevail in many areas and this affects worktime and productivity ad-

versely. Lastly, there is the disincentive that occurs from being landless and having to sharecrop or work as a laborer on the area being farmed. Since this landless group is about 56 percent of the agricultural labor force (Table V-16), it is a powerful force reducing agricultural productivity.

The potential problem in agricultural employment can be illustrated by the following analyses:

Description	Units	1979	1990	2005
Total population	No	2,236,600	2,530,800	2,232,100
Estimated Work Force	No	1,033,200	1,164,000	1,349,000
Agricultural Labor Force	No	858,200	966,000	1,120,000
Agricultural Labor Supply	Mandays	214,600,000	241,500,000	280,000,000

These assumtions were made assuming that the work force would be 46 percent of the population, that the agricultural labor force would remain at 83 percent of the total labor force (39.6 percent of population), and that the average farm laborer would work 250 mandays per year based on a composite estimate for both male and female workers. Thus, if the projections for this report are correct, the proposed land and water resource development program must create additional productive work for a minimum of 261,800 agricultural workers, or 65.4 million mandays of labor by 2005, just to maintain the present relationships within the labor force.

Other Labor Force. Because the economic aspects of the Citanduy Watershed are so highly related to agricultural production, it might be said that if employment is high in agriculture, it will be high in the rest of the economy. Therefore, in this report no attempt has been made to specifically estimate the employment multipliers from the improved agricultural incomes, or from specific employment in the governmental programs.

Existing Agriculture

The agriculture programs of the Citanduy Watershed has concentrated on the production of rice in the irrigated paddy areas. In 1965 two agriculture programs went into effect to boost the irrigated rice production in Indonesia. These programs, BIMAS and INMAS, offer rice farmers high yield variety seeds, fertilizers, insecticides, technical assistance, and credit to purchase these materials (credit only by BIMAS program). However, practically no technical assistance of any kind is given to dryland farmers and home gardens in the Watershed.

Irrigated Riceland

The major effort towards increasing agricultural production is concentrated on the irrigated farmland. From 1968/1969 to 1972/1973 the average rice production of West Java more than doubled for those farmers parcitipating in the BIMAS program. The mean rice production in 1968/1969 for farmers not participating in the BIMAS program was 2,109 kg/ha, but was 4,395 kg/ha (dry stalk rice) for those participating in BIMAS during the 1972/1973 season. Since 1973, however, the yield of irrigated paddy has reached a plateau and is increasing at a much slower rate.

Rice production data within the basin vary tremendously. For example, in the Langansari area under a technical irrigation system the yields of rice are 4 to 4-1/2 t/ha/crop with 2-1/2 crops per year; whereas in the rural irrigations system in the Panawangan Subdistrict, the yields are approximately 2 t/ha/crop with 1-1/2 to 2 crops per year. In the Lower Sidareja Subdistrict above the Segara Anakan, the yields are about 1 to 1-1/2 t/ha/y under rainfed conditions.

In the irrigated areas where water is available throughout the year, only rice is produced with some taro, cassava, and beans planted on the bunds around the irrigated fields. When water is insufficient for rice during the dry season, other upland crops such as soybean, sorghum, tobacco, and soybeans are preferred as an alternative crop by the farmers in the Sidareja area. In the Banjar Plains, irri-

gated beans are frequently grown during the dry season. However, the majority of the irrigated ricelands are idle during the dry season because of water shortage.

Upland Crop Areas

To date, upland farming operations have received only "greening" program assistance with almost no technical assistance or inputs from the government. The farmers' resources are very limited and their production, in most cases, is at subsistence level. The average land holding seldom exceeds 0.5 ha. Farm operations are very diversified, consisting of several upland crops, firewood, lumber, fruit and cash tree crops, grasses, livestock, and in many cases, a fish pond. The following categories of dryland farms are discussed in the following sections:

1. Annual crop production farms;

2. Coconut and annual crop production farms;

3. Part-time farming operations; and

4. Absentee land owner farms.

Annual Crop Production Farms. Tree areas on these farms are usually located in clumps on steep slopes. Most of the cultivated land is fully open to sunlight. Multiple cropping practices prevail. The inter-cropping practices vary within the Watershed. For example, in the Panawangan and Panjalu areas, north of Ciamis, the most common inter-cropping patterns are upland rice, maize, and cassava grown simultaneously during the first part of the rainy season. Sometimes sesame, cucumbers, and sweet potatoes are also interplanted with the previously mentioned main crops. In these areas rice is the primary crop; maize is the secondary crop. In the Magenang-Malabar area in the Cilacap district, the main inter-crop is a combination of cassava and maize with very few farms growing upland rice. After the maize crop is harvested, peanuts are frequently planted among the cassava plants which, by this time, are over one meter tall. Many of the steep upland farms, however,

grow mainly cassava with only small patches of peanuts as a second crop. In the lower dryland farms in the Cilacap district, cassava and maize with peanuts are grown as a second crop, and they appear to have equal importance. Along the periphery of the Citanduy Watershed, cassava is the main crop on the steep mountain slopes. Where cassava is the principal crop, the planting interval is much closer. Under this planting system only one crop of maize can be harvested, early in the rainy season, after which time the cassava has had adequate growth to provide almost a ful canopy, thus creating too much competition for another crop to grow.

During the dry season, most of the land is either idle or planted to cassava, which is usually harvested during the dry season.

Coconut and Annual Crop Production Farms. These farms are located mainly in the lower elevation areas in the central portion of the Watershed. The main crop growing under the coconut trees is cassava, with some taro and fruit trees such as bananas, Bali citrus, and petai. Local grasses and weeds generally cover the ground under the coconuts, effectively preventing erosion but not providing maximum production from the land. In recent years a large number of clove trees have been planted in home gardens, but most of them have not reached production.

Part-time Farming Operations. Part-time farms are common near the larger towns where there is opportunity for nonfarm employment. At their best these part-time farms are efficient because the owner has the funds to buy the needed agricultural inputs, but at their worst, they are semi-abandoned with cassava as the only crop and a high degree of erosion. The land owners frequently do not live on the farm; this causes some lack of community involvement, a necessary factor in most improvement programs.

Absentee Land Owner Farms. The farms of the absentee owners are farmed by share croppers or hired labor or are left idle. When the owners have arranged a partnership with the local farmers, the land is usually under full production to local standards. If the land has been planted with perennial trees, which require little attention, usually laborers are hired only for the harvest and occasionally for maintenance. Before the trees reach maturity and form a close canopy,

only local grasses and weeds grow among the trees. Large areas covered with only clove trees are usually an indication of absentee owners. Frequently, when the owners live far away in the cities, no improvements are made on the land. These farms are usually under shrubs with only a sparse timber stand growing on the land.

Home Gardens

Home gardens consist mainly of fruit trees, with occasional vegetables such a taro, chili pepper, onions, and, rarely, tomatoes grown among the trees. The concept of cleanliness and neatness is associated with bare ground around the housing areas. This ground is swept several times daily and it appears that the larger this area is, the more prosperous the owner. This traditional practice probably results from the old days when snakes and other dangerous animals could easily slip into the housing areas from the nearby jungles. This practice results in considerable erosion and it will be difficult to change. Even short growing grass can hide some undesireable wildlife.

Crop Production

The level of crop production throughout the upland farms in the Watershed is very low. When inter-cropped with maize and cassava, wet season upland rice production averages approximately 500 to 700 kg/ha of wet stalk rice (200 to 280 kg/ha of milled rice). Maize production ranges from 400 to 600 kg/ha of harvested ears (wet weight), which is equivalent to approximately 120 to 180 kg of grain per hectare. Cassava production under the inter-cropped system is about 2.5 t/ha, and under monoculture systems the yields will be somewhat higher but the net income tends to be lower. Peanut production is approximately 400 to 650 kg/ha of wet shell peanuts (about 100 to 160 kg/ha of dry shelled peanuts).

The production trend on upland farms is towards lower yields because of limited technical inputs and excessive soil erosion on most of the farms. About 25 to 30 percent of the dryland farmers use urea, though not enough, on their upland rice, and fertilizer is seldom used on cassava or peanuts. Manure is commonly applied to each maize plant, but the scarcity of livestock in the basin limits the amount of

manure available for crops. Moreover, most of the manure is used to fertilize the few clove trees that almost every farmer owns. The majority of the clove trees in the basin are younger than five years and therefore yield little or no production. The average production of clove is 0.25 kg/tree at 6 years, progressing to about 3 kg/tree at 20 years of age.

Crop Utilization

Families either consume the majority of dryland farm products or sell them to buy food. Farm by-products such as corn stalks, cassava, and peanut leaves are mainly wasted because of lack of silo facilities for storage for animal feed. However, some of the corn stalks are used as fuel for home cooking, and some of the cassava leaves are eaten.

Livestock

Livestock production throughout the Watershed is limited. The prices of breeding stock are high, making it difficult for farmers to purchase additional animals. For example, present prices for breeding sheep are Rp. 15,000 to Rp. 17,000/head, approximatley equivalent to two months of income for the average upland farmer in the basin. Thus, without government low interest loans, it is almost impossible for the farmers to purchase additional livestock.

Forage production under this environment has a large potential, but it is frequently not utilized because of the limited livestock numbers. As far as can be determined, there is a good market for all of the backyard livestock that could be produced using a cut-and-carry forage system, as well as some limited herded grazing.

Livestock owned by the average dryland farmer consists of a few sheep, goats, or chickens. The sheep are kept for special occasions, such as weddings or for emergency cash but seldom are used as a source of meat or marketed for cash. Chickens, however, are more commonly used as a source of meat for the family and are regularly sold for cash. Sheep are not sheared for wool nor are goats milked.

Poultry are popular with farmers, but the production (eggs and meat) with the present native chickens is very low. The level of inputs for raising local chickens is also very low. The average local layer produces about 40 to 50 eggs/year and the production of meat from local broilers is only 1.0 to 1.5 kg for a year-old chicken.

The main animal husbandry program is the BIMAS Ayam (chicken) program. This program supplies farmers with 100 to 1000 baby chicks of improved varieties capable of producing 200 to 300 eggs/year/layer. This program provides loans and technical advice to set up poultry operations. Concentrated feed, vitamins, and vaccines are made available in village markets. The BIMAS Ayam program has been in effect for several years. One of this program's problems in the beginning was that not enough technical assistance was given to the operators in management and sanitation. As a result, many people lost all their layers to disease before any profits were obtained; nonetheless, they were liable for loans from the government. These problems made the BIMAS Ayam Program unpopular; however, the system is currently operating much better, and its popularity is rapidly increasing. The majority of the poultry operations are in or near towns that provide a poultry market. Generally poultry operators are people who have other sources of income and who are investing their savings in the poultry business. Production of eggs from improved layers kept in confinement has increased by five to six fold during the past two years.

Increased egg production has decreased egg prices to approximately Rp. 60/egg for local layers and aproximately Rp. 45/egg for improved varieties of layers, even though the local eggs are considerably smaller than the ones from improved varieties. A kg of eggs from improved layer varieties will contain 16 to 18 eggs whereas local layers contain 20 or more eggs/kg. Interestingly, local eggs are sold at Banjar individually whereas eggs from improved layers are sold by the kg. Local eggs' taste and appearance account for their preference.

Broiler operations are few and are confined to areas near big cities such as Jakarta, Bandung, Jogyakarta. The Citanduy basin has none. The average weight of a local chicken at one year of age is the same as an improved variety broiler at 10 weeks of age. The potential

profit from broiler production is good, especially if the basic feed is produced in the basin and only 25 percent of the end feed supply as a concentrate is purchased from commercial sources.

A sheep program was initiated at Ciamis a few years ago and is reported to be working well. The Ciamis District bought several hundred sheep for the farmers in the district under a revolving system under which a farmer keeps the ewe until the lamb can be weaned, at which time the sheep is passed along to another farmer. Ciamis has also had a cattle improvement program for one year. This program is concentrated mainly in the district's southern part in the Pangandaran area.

Forests and Plantations

Forestry and Greening Program

The forests in the Upper Watershed constitute one of its valuable natural resources. Forest lands account for about 12.8 percent of the Watershed land. If these resources are to serve the best interests of people in the Citanduy Watershed and the national economy, good land and water development practices must be incorporated into new forest plantings and into the adjacent upland farming areas. Careful planning, wise council, and technical help will be required to bring the steep (40-50 percent slope) dry farm land into the "greening" programs. Many lands in the 30 to 40 percent class have some extremely steep slopes and normally should not be terraced but rather should be in a permanent tree or grass cover. In the Citanduy Watershed, because of the heavy population pressure, some of these slopes with deep, stable soils can be justifiably terraced with special water control structures. Shallow, heavily eroded soils should be retired and put in horticulture tree crops, interplanted with legumes and grass. Many of these areas are being abandoned when cassava yields go increasingly lower. A grass-tree-animal combination could be used on these areas as an income source. Currently they are eroding under a sparse vegetative cover of weeds.

In 1969, at the beginning of the Pelita I, the Forest Service reported that the Citanduy River Basin contained 48,377 ha of critical land out of an area of 298,900 ha. They listed 28% of the critical land as being on forest service land, 31% on plantation land and the balance on private lands.

The government set up a program called "Program Penyelamatan Hutan Tanah dan Air," or Program for Safe-guarding Forest, Land, and Water. The program deals with reforestation, afforestation (commonly called greening movement), and soil and water conservation practices such as, contouring, crop rotations, fertilizer use, construction of terraces, waterways, diversion dams, ditches, gully plugs, small irrigation structures, and check dams. Figure II-11 provides an organization chart for the Presidential Inpress Organization of Reforestation and Greening in the Citanduy Watershed. This plan was started in 1969/70 during Pelita I and continued during Pelita II, 1974/79. Its success has varied depending on the technical guidance and help given the land operator and the ability of the land operator to apply the technical knowledge. Many farmers were willing to undertake the program, but because agricultural personnel did not effectively convey their ideas, many conservation terraces and structures have failed to achieve their purpose. The basis of the help is largely a gentlemen's agreement between the farmer and the government. This has created a misunderstanding that the help given by the government was for the farmer's own use, but that the structures were the government's. Long-term rotations of trees were not allowed to mature, and many other land use problems developed.

Table II-18 summarizes the critical land in the forest area of the Citanduy Watershed as evaluated for the Pelita III Master Plan. This table shows that there were an estimated 10,719 ha of critical land in the forest at the start of Pelita II. During Pelita II, 9,202 ha of this critical area reportedly were treated; but during the same period, 6,329 ha of additional critical lands developed on the forest so that there were 7,846 ha of critical land at the beginning of Pelita III. This mismanagement of the forest area is one of the significant problems in the development of a watershed management program for the Citanduy Watershed Area

The critical land out of the forest area (mostly privately owned) amounted to an estimated 24,524 at the start of Pelita Pelita II (Table II-19), but by the end of Pelita II there were an estimated 42,289 ha of critical land in the Watershed. This was accomplished by treating 52,464 ha of land during the period, but with an accompanied increase of 4,394 ha of delayed planting and 65,835 ha of other critical land devel-

opment. There can be little question that this table indicates serious problems in defining critical areas, as well as problems in record keeping. Almost certainly, the same area of land has been showing up several times as being rehabilitated and then again as having reverted to a critical area. This emphasizes the need for good aerial photography and base maps for the preparation of a true critical area survey by a central project group. This information would enable the planning of watershed management programs for the improvement of the upland areas.

The budget of the "greening" program comes from the national government, incorporated within the Pelita Program to ensure its continuation. The Directorate of Forestry is in charge of planning, guidance, and evaluation of the program for the Central Government. Execution of the program is handled by the Provincial, Kabupaten, and Kecamatan levels of administration through INPRES funds. The budget for the PPHTA program is chanelled through the INPRES.

The "greening" projects are not based on the effective precipitation, soil condition, infiltration rate, water storage capacity, ground cover, topography, available labor, or the rural people's socio-economic conditions. The forest areas to be harvested are decided by the existing age and quality of the stand. After the stand is cut, the farmers are supposed to use good conservation practices in replanting the stand. This is not always successful. The farmers have limited capabilities for organization and management of a reforestation project. Species recommended for reforestation are pine, teak, maghogany (Swietenia), albizzia, and artocarpus. Table II-20 summarizes the reforestation activites in the Ciamis and Tasikmalaya Districts by species.

The average farmer with a small, or no, holding will increasingly turn towards the forests for more agricultural lands or for fire wood as land pressures intensify. Encroachment of forest areas with ensuing erosion and other environmental losses is likely to continue in the future if past and present patterns of encroachment continue.

quick review of the production from forest resources indicates that a much better use could be made of the forest resources by better planning and management. The use of forest products has primarily focused on timber and gum or rosin production. Teak timber sales have

averaged 2,099 m^3 annually in the 1974-78 period in the Ciamis District and only about 6 m^3 in the Tasikmalaya District. For the same period other timber sales have averaged 395 m^3 in the Ciamis District and 128 m^3 for the Taskimalaya District.

Paper production is being considered for the future and pine is being included in the present planning. As these areas increase, gum production should increase since present practice is to tap pine trees until they are about 30-35 years of age.

Farmers are moving on to the small scattered blocks of forest land, not within the regular forest boundary, claiming them as their own because of heavy land pressures. This creates extremely difficult problems for forest managers. The farmers move onto the land, cut the trees, and then plant agricultural crops. Generally, these lands should not be cleared or cropped. These farmers use very poor soil and water conservation practices, resulting in serious erosion, sediment, and flood problems. In most of the encroachment areas, soils are poor, slopes are steep, and erosion is removing the fertility and reducing the ability of the soil to produce tree crops. Many seriously eroded lands will require special treatment to restore the land for good water management and forest production.

Even age silvicultural practices are not used as much as they should be to improve various forest functions. Currently the silvicultural practices in the Citanduy Upper Watershed are designed primarily to produce teak, pine, and some minor species. Other species have not been given the attention that will be required under a multiple-use development program. Thinning practices do allow some fuel wood to be harvested during the rotation. However, in producing teak for market, other crops could be developed underneath the stand during its early growth. Grasses and legumes, with good supervision and care, could be grown and harvested. The tongyan system has been used for reforestation and for providing additional food crops. This has produced some additional food crops, but the farmers have lacked careful supervision; the consequently considerable erosion has occurred before the land is protected and therefore the tongyan practice is of questionable value. With proper supervision, some food crops could be grown throughout the rota-

tion on the better lands by using fertilizers and special crops that are shade tolerant.

Tree crops are sensitive to market fluctuation because of their fixed harvesting cycles and the changing weather conditions. Large scale tree crop harvesting could aggravate these marketing problems. Selective harvesting on a 10-year rotation would be a better approach. During each 10-year period the dominant trees are left for the later growth cycles. During early cycles only trees not maturing into high quality lumber are harvested. This system allows flexibility and some high quality lumber is continually being harvested.

Forest roads and trails need constant repair and development. Road construction in the forest and afforested areas is essential for maintenance, administration, and other access. Existing forest roads and trails have a scattered pattern and do not adequately serve the forest areas. These roads and trails are often sources of excessive sediment and runoff because they are not properly drained and graded. A carefully planned road system should be developed with management objectives and drainage receiving priority consideration.

The "greening" areas have some hard surface and many rock surface roads. Most are passable but they require correct drainage and control structures to reduce gullying and head cutting. Large amounts of sediment are removed during each major storm because of the lack of proper drainage disposal structures. Grass will grow naturally, but farmers and road maintenance people seem to feel they have to remove the grass to allow the water to drain off; this practice should be corrected. A general road and trail upgrading program will be needed to correct these conditions. An overall educational program is needed to inform people of the value of grass in erosion control channels. Experience in Panawangan has shown that these kinds of roads can be built and maintained by farmers. This program should be part of the development of their communities and would provide better marketing and transportation opportunities.

Indonesian pulp and paper consumption by far exceeds present production. By the year 2000, paper consumption is expected to range from 1.3 to 5.4-million tons annually [9]. To boost production anywhere near these figures will require a heavy capital investment in a multi-million dollar industry. Extensive areas of pine and other fast-growing species will be needed for raw material to supply these needs. Pine, bamboo, and other forest products should do well on many of the Upper Watershed lands with over 40 or 50 percent slopes. This industry could help to provide employment for those farmers who are forced to take their cropland out of production. This is another alternative to be considered in the overall water and land resource base.

Forest plans are not now coordinated with local plans. People do not understand why it is to their advantage to have well managed watersheds and forest products. Forest regulations are generally well planned but not enforced due to insufficient manpower. Some financial and other incentives are provided to encourage active participation in the greening, afforestation, and other silvicultural and conservation practices. The "greening" program demands only the restoration of the land to tree cover without considering these lands as part of the multiple-use plan recommended for the developent of soil and water resources at the farmer level.

Some natural areas, mostly the higher volcano peaks, have been established. Some other undisturbed areas are high water retaining areas that help to even-out the high storm runoff peaks. These areas are not protected as they should be, and as population pressures increase, these areas will receive greater pressures. People have been at times observed cutting firewood and other timber. Some of these areas contain unique types of plants and animals as well as undisturbed soil profiles, conditions which should be preserved; otherwise their value as bench mark areas will be destroyed. They will become even more valuable as the many pressures on forest land increase.

The forest areas in the Citanduy Watershed are on scattered, isolated tracts. Boundaries are neither clearly defined nor marked "Forest Boundary" so that there can be no mistake about people knowing they are on forest property. This condition has been partly

responsible for the forest tresspass situation. This is a particularly serious problem on lands with over 40 percent slope.

In 1961, Perhutani a semi-government forest resource enterprise, was established in Central Java. Perhutani manages and markets the forests and forest products. Until 1978, the forests in West Java were managed by the Forest Service. Perhutani now also manages the West Java Forest. Perhutani is supposed to maintain the forests in a good condition as well as assume responsibility for the marketing of the forest resources.

Plantations

The Citanduy Basin contains more than 44,500 ha of plantation lands. This is approximately 13 percent of the total land area. The largest areas are in Ciamis district, with over 38,000 ha (Table II-2). Most of the large plantations are in government ownership. They range in size from 20 ha to over 3000 ha.

During the Japanese occupation, many of the large plantations were broken up and the farmers forced to plant coffee and other crops that the Japanese required. When the Japanese left, many of these holdings were taken over by the farmers and are still managed as small plantations.

The plantation crops include those produced by the small holdings. Coconut trees produce the greatest value. Other plantation crops include cloves, tea, coffee, palm sugar, and citronella. Commonly the small holders have only a fraction of a hectare from which they produce these crops. The area hardly justifies the application of the term "plantation", except it is the accepted description of these holdings.

The production of latex for rubber is, by far, the highest value plantation crop. In Indonesia, while the price of latex was low, production dropped off and many plantations failed to replace their old and low producing trees. As a result, they can not increase their latex yields to keep pace with the higher demand on the present world market. Sky rocketing rubber prices have created a good market for latex, thus causing many of the plantations to start replacing their old trees;

however, these trees will not come into producion for several years, latex production can not meet present demand.

Recently, interest in production of tea has increased, and this could be beneficial to the Watershed in that well-managed tea plantations suffer considerably less erosion than most upland cropland. An area in the vicinity of Cakrabuanan mountain in the Pagerageung and Ciawi subdistrits of Tasikmalaya has specifically requested assistance in establishing tea plantations in areas adjoining their other fields. The area elevation is 631-700 meters above sea level and once had 500 ha of good tea that was mostly lost during the Japanese occupation. These two subdistricts have a total of about 6,074 ha of upland cropland and presumably conversion of some of this area to tea production would be possible.

A large area has also been planted to clove trees in recent years, but much of this has not been in long enough to reach production. Clove trees must be about five years old before they reach production, and it is not known whether the relatively high current price of Rp. 5,000/kg can be maintained with increased clove production.

When the Dutch managed the plantations in Java, they were highly skilled and had a skilled labor force. When they left, not enough skilled local plantation managers remained. This, coupled with the political strife of a new developing nation, caused the plantations to be exploited and badly managed. For all practical purposes, they were abandoned.

Since the Pelita I program there has been an effort to bring the plantation management under control. All of the larger plantations were placed under Government control and Government managers were appointed. An effort to rehabilitate the plantations has been partially successful.

With the rise in rubber prices, latex is commanding a good price; so plantation operators are improving rubber operations rather than moving into other crops. As new plantations are planted, efforts are being made to use the best technical help available. Terracing and erosion control practices are greatly improved, but there is still need for better understanding of the problems of soil and water mangement.

Some new crops, such as Calopogonium caleribium and Centarasirum klumari, are being used as ground cover. These are grown both singally and together as a cover crop while the trees are young. They are legumes and look good in trials. They could be used in other erosion control conditions as a cover crop.

With prices and market improving, the managers plan on replacing about 3 percent of the rubber trees a year. Fifty percent of the coconut palms are old or damaged and should be replaced. This condition and the lack of capital for replacement causes low production. Most of the species lack sufficient good improved seedlings but the rubber plantations have their own seedling production in most cases so that they are far better.

Research on all problems is inadequate and many old methods are still being used. This has made it difficult for plantation managers to meet competition from other countries.

REFERENCES

1. Engineering Consultants, Inc., 1976. The Citanduy River Basin Development Project Master Plan.

2. Pain, C.F. and Bowles, J.M., 1973. "Denudation following the November Earthquake at Madang, Papua, New Guinea," Z. Gemorphol. Supple. v. 18, pp. 92-104.

3. Engineering Consultants, Inc., and the National Irrigation Administration, 1978, "Draft Feasibility Report, Pantabangan Watershed Management Project," Chapter VIII, "Erosion and Sedimentation," Republic of the Philippines, Manila, Philippines.

4. Engineering Consultants, Inc., 1974. "The Citanduy River Basin Development Project, Master Plan", Appendix B, "Hydrology," prepared for the Ministry of Public Works and Electric Power, Directorate General of Water Resources Development, Directorate of Rivers and Swamps, Republic of Indonesia.

5. Caughran, G.W., 1972. "Comments and Suggestions Concerning Erosion Experimental Basin at Waspada," United Nations Development Programme.

6. Wall Street Journal, "Third World Theme, The Greening of Java Produces More Rice but Problems Persist", Volume XCVIII, No. 115, June 14, 1978.

7. Engineering Consultants, Inc. 1974. Appendix A, "Meteorology," The Citanduy River Basin Development Project Master Plan.

8. Engineering Constultants, Inc., 1974. Appendix B, "Hydrology," The Citanduy River Basin Development Project Master Plan.

9. Facultas Kehutanan Institute Pertanian Bogor, in cooperation USAID, 1979. "Forestry for industrial and rural develoment in Indonesia."

TABLE II-1

LAND AREA BY DISTRICTS FOR CITANDUY WATERSHED SUB-BASINS

(Hectares)

District	Upper Citanduy	Cimuntur	Ciiolano	Cikawung	Ciseel-Lower Citanduy	Total	Percent
Total Drainage Area:							
Tasikmalaya	47,800				10,100	57,900	16.5
Ciamis	26,200	60.000	19,900		87,900	194.000	55.4
Kuningan			11,100			11,100	3.2
Cilacap			17,000	70,000		87,000	24.9
Total	74,000	60,000	48,000	70,000	98,000	350,000	100.0
Percent	21.1	17.2	13.7	20.0	28.0	100.0	
Economic Land Use Area: 1/							
Tasikmalaya	47,530				10,077	57,607	16.7
Ciamis	25,480	59,206	19,747		85,855	190,288	55.1
Kuningan			11,065			11,065	3.2
Cilacap			16,835	69,557		86,392	25.0
Total	73,010	59,206	47,647	69,557	95,932	345,352	100.0
Percent	21.1	17.2	13.8	20.1	27.8	100.0	

1/ Does not include stream channels or other water areas.

TABLE II-2

ECONOMIC LAND USE PATTERN IN CITANDUY WATERSHED BY DISTRICTS OR SUBBASINS

(Hectares)

Item		Lowland Rice	Upland Crop	Plantation	Forest	Home Garden 1/	Other	Total	Critical Area
By Districts:									
Tasikmalaya		18,168	23,291	484	8,149	5,587	1,928	57,607	2,489
	Percent	31.5	40.4	0.8	14.1	9.7	3.4	100.0	4.3
Ciamis		43,140	71,264	38,612	15,588	13,859	7,825	190,288	42,825
	Percent	22.7	37.4	20.3	8.2	7.3	4.1	100.0	22.9
Kuningan		3,326	878	-	2,685	554	3,622	11,065	3,989
	Percent	30.1	7.9	-	24.3	5.0	32.7	100.0	36.1
Cilacap		22,168	25,075	5,452	17,627	8,192	7,878	86,392	10,211
	Percent	25.7	29.0	6.3	20.4	9.5	9.1	100.0	11.8
Total		86,802	120,508	44,548	44,049	28,192	21,253	345,352	59,514
	Percent	25.1	34.9	12.9	12.8	8.2	6.1	100.0	17.2
By Subbasins:									
Upper Citanduy		22,859	26,152	2,796	10,786	7,020	3,397	73,010	8,094
Cimuntur		11,829	22,593	13,060	4,350	3,848	3,526	59,206	7,529
Cijolang		9,947	13,296	5,517	11,170	2,341	5,376	47,647	8,647
Cikawung		19,969	21,184	2,979	10,898	7,507	7,020	69,557	8,472
Ciseel-Lower Cit.		22,198	37,283	20,196	6,845	7,476	1,934	95,932	26,772
Total		86,802	120,508	44,548	44,049	28,192	21,253	345,352	59,514
	Percent	25.1	34.9	12.9	12.8	8.2	6.1	100.0	17.2

1/ Includes Homes and Yards

Source: District (BAPPEMKA) Offices with the Areas Along Watershed Divides Estimated.

TABLE II-3

RICELAND AREAS BY WATER SOURCE FOR CITANDUY WATERSHED

DISTRICTS OR SUBBASINS

(Hectares)

	Irrigated Land				
	Technical Systems	Rural Systems	Rainfed	Total	Irrigated in Dry Season
By Districts:					
Tasikmalaya	3,238	8,576	6,354	18,168	8,547
Percent	17.8	47.2	35.0	100.0	47.0
Ciamis	12,226	17,600	13,314	43,140	19,601
Percent	28.3	40.8	30.9	100.0	45.4
Kunningan		1,330	1,996	3,326	665
Percent		40.0	60.0	100.0	20.0
Cilacap	3,268	9,261	9,639	22,168	5,098
Percent	14.7	41.8	43.5	100.0	23.0
Total	18,732	36,767	31,303	86,802	33,911
Percent	21.6	42.4	36.0	100.0	39.1
By Subbasin:					
Upper Citanduy	4,759	11,429	6,671	22,859	11,419
Percent	20.8	50.0	29.2	100.0	50.0
Cimuntur	376	8,342	3,111	11,829	6,271
Percent	3.2	70.5	26.3	100.0	53.0
Cijolang	1,400	4,101	4,446	9,947	3,439
Percent	14.1	41.2	44.7	100.0	34.6
Cikawung	3,268	8,381	8,320	19,969	4,658
Percent	16.4	42.0	41.6	100.0	23.3
Ciseel-Lower Citanduy	8,929	4,514	8,755	22,198	8,124
Percent	40.2	20.3	39.5	100.0	36.6
Total	18,732	36,767	31,303	86,802	33,911
Percent	21.6	42.4	36.0	100.0	39.1

Source: District (BAPPEMKA) Offices, ECI Design Reports, ECI Master Plan. and I & D Division Investigations

TABLE II-4

FOREST AND CRITICAL AREAS BY SUBBASINS

(Hectares)

Forest Type	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel-Lower Citanduy	Total Area	%
Protection Forest	8,687	2,563	2,625	-	4,312	18,187	32.9
Pinus (Pinus S.P.P) Plantation	2,625	1,625	6,563	14,437	750	26,000	47.0
Teak Natural Production Forest	-	-	656	3,281	250	4,187	7.6
Teak (Tacona Grandis L.F.) Plantation	-	-	1,750	-	2,812	4,562	8.3
Rasamala (Altingia Excelsa) Plantation	687	1,250	-	-	-	1,937	3.5
Mahogany (Swietenia S.P.P.) Plantation	-	-	-	-	375	375	0.7
Total Forest	11,999	5,438	11,594	17,718	8,499	55,248	100.0
Percent	21.7	9.8	21.0	32.1	15.4	100.0	
Critical area (Forest land)	2,937	937	1,312	1,250	2,250	8,686	
Percent	33.8	10.8	15.1	14.4	25.9	100.0	

Source: Planimeter areas from Forestry Type Map which were assembled from Forest Service Maps, Tasikmalaya, Ciamis and Purwokerto Forestry Data.

TABLE II-5

LAND STATUS IN CITANDUY WATERSHED BY DISTRICT OR SUBBASIN

(Hectares)

Item		Privately Owned Land	Government Owned Land	Forest 2/ Govt. Land	Pasture Land	Land Use Right	Land in Dispute	Total Area
By Districts:								
Tasikmalaya 1/		46,018	398	9,390	-	1,038	763	57,607
	Percent	79.9	0.7	16.3	-	1.8	1.3	100.0
Ciamis		169,258	3,543	8,710	2,923	5,854	-	190,288
	Percent	88.9	1.9	4.6	1.5	3.1	-	100.0
Kuningan		6,696	1,250	2,685	434	-	-	11,065
	Percent	60.5	11.3	24.3	3.9	-	-	100.0
Cilacap		58,371	1,682	26,339	-	-	-	86,392
	Percent	67.6	1.9	30.5	-	-	-	100.0
Total		280,343	6,873	47,124	3,357	6,892	763	345,352
	Percent	81.2	2.0	13.6	1.0	2.0	0.2	100.0
By Subbasin:								
Upper Citanduy		61,367	1,350	8,902	126	625	640	73,010
Cimuntur		52,782	1,863	2,899	530	1,132	-	59,206
Cijolang		33,021	1,996	11,613	713	304	-	47,647
Cikawung		49,527	1,364	18,666	-	-	-	69,557
Ciseel-Lower Citanduy		83,646	300	5,044	1,988	4,831	123	95,932
Total		280,343	6,873	47,124	3,357	6,892	763	345,352
	Percent	81.2	2.0	13.6	1.0	2.0	0.2	100.0

Source: District (BAPPEMKA) Offices

1/Tasikmalaya and Manonjaya Sub-District Status Records not available - estimates prorated on the basis of other subdistrict records.

2/Including land owned by certain communities

TABLE II-6

GEOLOGY FOR CITANDUY WATERSHED SUBBASINS

(Hectares)

GEOLOGY FORMATION	UPPER CITANDUY	CIMUNTUR	CIJOLANG	CIKAWUNG	CISEEL-LOWER CITANDUY	TOTAL
ALLUVIUM			3,400 7.1%	14,500 20.7%	31,300 32.3%	49,200 14.1%
YOUNG VOLCANIC PRODUCTS	73,100 98.8%	61,000 100.0%	51,300 31.9%	900 1.3%	7,500 7.7%	157,800 45.1%
OLD VOLCANIC PRODUCT			400 0.8%	2,300 3.3%		2,700 0.8%
PLIOCENE SEDIMENTARY ROCKS			7,300 15.2%	15,600 22.3%	25,500 26.3%	48,400 13.8%
PLIOCENE SEDIMENTARY AND VOLCANIC ROCKS			8,200 17.1%	18,000 25.7%		26,200 7.5%
MIOCENE CLASTIC SEDIMENTARY ROCKS	900 1.2%		13,400 27.9%	18,700 26.7%	30,200 31.1%	63,200 18.0%
MIOCENE LIMESTONE					2,500 2.6%	2,500 0.7%
T O T A L	74,000 100.0%	61,000 100.0%	48,000 100.0%	70,000 100.0%	97,000 100.0%	350,000 100.0%

TABLE II-7

AREA OF MAJOR SOIL GROUPS BY SUBBASIN

(Hectares)

Soil Map Group	Name of Soil Group	Upper Citanduy		Cimuntur		Cijolang		Ciseel-Lower Citanduy		Subtotal 1/	
		Area	%	Area	%	Area	%	Area	%	Area	%
	Histosols										
1	Eutric Histosols							1,300	1.3	1,300	0.4
	Alluvial										
2	Hydromorphic Alluvial			700	1.2	200	0.4	6,400	6.6	7,300	2.6
5	Associated Grey and Grey Brown Alluvial							7,800	8.0	7,800	2.8
	Gleysols										
6	Associated Humic Gley and Grey Alluvial	8,900	12.0							8,900	3.2
	Regosols										
13	Complex Grey Regosols & Lithosols	8,200	11.1							8,200	2.9
19	Complex Regosols & Lithosols	6.800	9.2							6,800	2.4
	Andosols										
22	Yellow Brown Andosols	7,300	9.9							7,300	2.6
23	Associated Brown Andosols, and Brown Regosols	4,500	6.1	3,300	5.4					7,800	2.8
	Cambisols										
24	Complex Rendzinas Lithosols and Brown							200	0.8	200	0.1
	Grumusols										
25	Grey Grumusols							5,800	6.0	5,800	2.1
	Latosols										
31	Brown Latosols	13,700	18.5	16,300	26.7	14,500	30.2			44,500	15.9
32	Red Brown Latosols	23,500	31.8	40,400	66.2	12,100	25.3	11,100	11.4	87,100	31.1
44	Complex Red-Yellow Latosols, Brown Latosols, Red-Yellow Podzolics and Lithosols							26,800	27.6	26,800	9.6
	Acrisols										
49	Associated Yellow Podzolics and Regosols	800	1.0			11,400	23.8	15,400	15.9	27,600	9.9
50	Complex Red-Yellow Regosols, Yellow Podzlics and Regosols	300	0.4	300	0.5	9,800	20.4	22,200	23.0	32,600	11.6
	T o t a l	73,000	100.0	61,000	100.0	48,000	100.0	97,000	100.0	280,000	100.0

Source: Adapted from Feasibility Study of Reforestation, Soil and Water Conservation Project, IPB 1975.

1/ Data for Cikawung Subbasin of Central Java not available.

TABLE II-8

CITANDUY WATERSHED AREAS BY PERCENT SLOPE BREAKS

(Hectares)

Location	No. of Map	0-2 percent	2-15 percent	15-40 percent	Over 40 percent	Total
Balubur Limbangan	40 BV-2	440	752	3,470	2,858	7,520
Telaga Bodas	40 BV-4	62	2,052	2,270	3,717	8,101
Panumbangan	41 BV-1	1,975	7,435	9,199	4,352	22,961
Panawangan	41 BV-2		6,715	5,420	7,945	20,080
Tasikmalaya	41 BV-3	6,850	9,217	6,337	10,030	32,434
Ciamis	41 BV-4	-	11,470	16,180	6,390	34,040
Lurahgung Landeuh	42 BV-1	-	3,525	2,227	4,485	10,237
Cibingbing	42 BV-2	985	-	-	37	1,022
Rancah 1/	42 BV-3	4,000	7,000	12,600	13,392	36,992
Majenang 1/	42 BV-4	8,000	2,000	7,600	15,100	32,700
Bantarkawung	43 BV-3	95	405	4,937	5,617	11,054
Manonjaya	41 BW-1	3,017	3,332		28	9,585
Cineam	41 BW-2	-	8,480		10,561	29,113
Langkap Lancar	41 BW-4	-	205		447	767
Banjar	42 BW	16,905	4,117		8,155	33,812
Sidareja	42 BW-2	18,705	1,787		450	22,972
Gunung Porang	42 BW-3	877	2,010		1,895	6,564
Kali Pucang	42 BW-4	7,677	1,642		3,820	15,629
Karang Pucung	43 BW-1	2,070	17		5,097	14,419
Total		71,658	72,161		104,376	350,000
Percent		20.5	20.6		29.8	100.0

Source: Maps (1:50000 scale) by Directorate of Land Use, Department of Interior mapped 1970-73, Printed April 1976.

1/ Maps not available-figures are estimates from other base maps.

TABLE II-9

LAND CAPABILITY CLASS AND SUBCLASS BY SUBBASINS
(Hectares)

Land Capability Class	Land Capability Subclass	Soil Name	Number of soil Unit	Upper Citanduy	Cimuntur	Cijolang	Ciseel-Lower Citanduy	Subtotal 1/ Area	%
III	III S1	Humic Gley and Grey Alluvial	6	8,900				8,900	3.2
		Regosols	19	6,800				6,800	2.4
	IIIt2e	Andosols	22	7,300				7,300	2.6
		Brown Latosols	31	9,500	1,300			10,800	3.8
		Red Brown Latosols	32	15,200	17,000	2,000	11,100	45,300	16.2
	IIIS1.W.01	Alluvial	5				7,800	7,800	2.8
	Total Class III			47,700	18,300	2,000	18,900	86,900	31.0
IV									
	IVS1.S2.dl	Regosol/Lithosol	13	3,000				3,000	1.1
	IVS1.t2.e	Latosol	32		10,300	12,100		22,400	8.0
		Podzolic/Regosol	50		300	5,500		5,800	2.1
	IVt2e	Brown Latosols	31	4,200	15,000	12,500		31,700	11.3
		Latosol/Podzolic	44				9,100	9,100	3.2
		Podzolic/Regosol	49	800		11,400	15,400	27,600	9.9
	Total Class IV			8,000	25,600	41,500	24,500	99,600	35.6

TABLE II-9 (Continued)

Land Capability Class	Land Capability Subclass	Soil Name	Number of soil Unit	Upper Citanduy	Cimuntur	Cijolang	Ciseel-Lower Citanduy	Subtotal 1/ Area	%
V	V Sl.W.O	Alluvial	1				1,300	1,300	0.5
	VSl.S2 01	Alluvial	2		700	200	6,400	7,300	2.6
	V Sl. S2tl	Regosol/Lithosol	13	4,500				4,500	1.6
		Grumosol	25				5,800	5,800	2.1
	Vt.2e	Andosol/Regosol	23	1,300				1,300	0.5
		Podzolic/Regosol	50			4,300		4,300	1.5
	V Sl.t2e	Rendzina/Lithosol	24						
		Latosols	32	8,300	13,100			21,400	7.7
		Latasol/Podzolic	44				17,700	17,700	6.3
		Podzolic/Regosol	50	300			22,200	22,500	8.0
	Total Class V			14,400	13,800	4,500	53,400	86,100	30.8
VI	VI 2.e	Andosol/Regosol	23	3,200	3,300			6,500	2.3
	VI Slt2	Rendzina/Lithosol	24				200	200	0.1
	Total Class VI			3,200	3,300		200	6,700	2.4
VII	VIIt2e	Regosol/Lithosol	13	700				700	0.2
	Total Citanduy Watersheds			74,000	61,000	48,000	97,000	280,000	100.0

1/ Data for Cikawung Subbasin of Central Java not available
Source : Adapted from Feasibility Study of Reforestation, Soil and Water Conservation, IBP 1975.

Legend

Limiting factor
- O : No limiting factors
- Sl : Poor physical soil (gravel, rock, stone)
- S2 : Poor soil (cemented material)
- S3 : Poisoning/salt. Saline - toxicity
- tl : Wavy land (rolling to undulating)terrain
- t2 : Hilly to mountainous land

Danger factor
- W : Groundwater level
- 01 : Season flooding
- 02 : Season flooding and tidal influence
- dl : Seasonal drought
- e : Erosion (slight, moderate or heavy)

TABLE II-10

MEAN MONTHLY TEMPERATURE

MONTH	Temperature (Degrees Celsius)				
	Cilacap 1/	Cilacap 2/	Tasikmalaya 3/	Bandung 4/	Jakarta 4/
January	26.7	27.2	25.5	22.8	25.7
February	27.0	27.6	25.8	22.7	25.6
March	26.8	27.4	25.8	23.0	26.0
April	27.1	27.5	25.1	23.4	26.6
May	27.1	27.1	25.1	23.6	26.6
June	26.1	26.3	24.4	23.2	26.3
July	25.2	26.4	23.8	22.7	26.1
August	24.6	25.1	24.6	23.0	26.6
September	25.2	25.8	24.0	23.4	26.6
October	26.5	26.6	25.5	23.5	26.7
November	26.8	27.1	25.0	23.0	26.4
December	27.8	27.1	25.2	22.8	25.9
Average	26.4	26.8	24.9	23.1	26.2

1/ 1961 - 1972 As reported

2/ 1961 - 1972 Average of maximum and minimum readings

3/ 1971 - 1973 Average pf maximum and minimum readings

4/ 1952 - 1971 As reported

TABLE II-11

MEAN MONTHLY RELATIVE HUMIDITY

MONTH	Humidity (Percent)			
	Cilacap 1/	Tasikmalaya 2/	Bandung 3/	Jakarta 4/
January	84.5	79	83	86
February	83.8	80	78	87
March	84.2	80	78	85
April	85.8	80	82	84
May	84.1	82	79	84
June	83.7	80	77	83
July	83.7	81	75	80
August	82.7	78	72	78
September	81.2	78	70	77
October	82.9	77	72	79
November	84.2	81	79	82
December	85.1	80	81	84
Average	84	80	77	83

1/ 1961 - 1972 As reported

2/ 1971 - 1973 Average of readings at 0700 and 1300 hours

3/ 1952 - 1971 Method for estimating mean not known

4/ 1866 - 1935 Method for estimating mean not known

TABLE II-12

MEAN MONTHLY AND ANNUAL PRECIPITATION BY SUBBASINS
FOR THE WET AND DRY SEASONS

(Millimeters)

Month	Upper Citanduy mm	Upper Citanduy %	Cimuntur mm	Cimuntur %	Cijolang mm	Cijolang %	Cikawung mm	Cikawung %	Ciseel-Lower Citanduy mm	Ciseel-Lower Citanduy %	Citanduy Watershed mm	Citanduy Watershed %
Wet season												
November	350	11.2	356	10.8	406	11.6	394	12.7	321	11.5	359	11.5
December	397	12.7	437	13.3	462	13.2	404	13.0	334	11.9	397	12.8
January	397	12.7	449	13.6	455	13.0	394	12.7	325	11.6	393	12.6
February	345	11.1	370	11.2	392	11.2	363	11.7	307	11.0	349	11.2
March	379	12.1	403	12.2	424	12.1	384	12.4	321	11.4	374	12.0
April	291	9.3	307	9.3	322	9.2	304	9.8	259	9.3	292	9.4
Subtotal	2,159	69.1	2,322	70.4	2,461	70.3	2,243	72.3	1,867	66.7	2,164	69.5
Dry season												
May	232	7.4	241	7.3	248	7.1	211	6.8	206	7.4	224	7.2
June	142	4.6	155	4.7	161	4.6	143	4.6	157	5.6	151	4.9
July	133	4.3	119	3.6	130	3.7	93	3.0	129	4.6	121	3.9
August	94	3.0	99	3.0	101	2.9	71	2.3	90	3.2	90	2.9
September	115	3.7	116	3.5	119	3.4	87	2.8	95	3.4	105	3.4
October	246	7.9	248	7.5	280	8.0	254	8.2	256	9.1	255	8.2
Subtotal	962	30.9	978	29.6	1,039	29.7	859	27.7	933	33.3	946	30.5
Total	3,121	100.0	3,300	100.0	3,500	100.0	3,102	100.0	2,800	100.0	3,110	100.0

Source : 1915-72 precipitation with subbasin values calculated by the Theissen Method - Meteorology Appendix, Citanduy River Basin Master Plan, 1975.

TABLE II-13

MINIMUM AND MAXIMUM MONTHLY AND ANNUAL PRECIPITATION BY SUBBASINS

(Millimeters)

Month	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel-Lower Citanduy	Total
Minimum Precipitation						
Wet Season						
November	102	91	146	118	78	103
December	183	142	161	171	148	161
January	201	202	190	165	129	173
February	178	179	181	136	126	156
March	165	167	154	178	116	153
April	136	125	126	101	104	117
Dry Season						
May	28	32	20	38	15	26
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	0	0	0	0	0	0
October	15	7	7	4	5	8
Annual	1,794	1,801	1,567	1,668	1,014	1,523
Maximum Precipitation						
Wet Season						
November	689	662	709	665	543	642
December	733	709	750	695	534	668
January	643	660	625	569	543	601
February	573	534	583	537	479	534
March	653	677	647	530	637	627
April	528	455	477	465	448	474
Dry Season						
May	621	585	500	520	474	537
June	462	514	528	575	466	504
July	605	531	713	513	655	602
August	424	426	476	453	575	479
September	460	660	714	503	526	557
October	507	466	561	668	568	556
Annual	5,220	4,824	4,785	4,436	3,923	4,575

Source : 1915-72 precipitation with Subbasin values calculated by the Theissen Method - Meteorology Appendix, Citanduy River Basin Master Plan, 1974.

TABLE II-14

DAILY POTENTIAL EVAPOTRANSPIRATION (Et_p) RATES AND CROP WATER DEMAND (Et_c) FOR CITANDUY WATERSHED

Month	Potential Evapotranspiration 1/		Crop Water Demand Et_c			
			Irrigated Rice		Upland Crops	
	mm/day	mm/month	mm/day	mm/month	mm/day	mm/month
January	4.4	136	5.1	158	4.2	129
February	5.1	143	5.9	165	3.3	93
March	4.7	146	5.4	167	4.3	134
April	4.3	129	5.0	150	4.3	129
May	3.8	118	4.4	136	3.6	112
June	3.8	114	4.4	132	2.8	84
July	3.7	115	4.3	133	3.7	115
August	4.3	133	5.0	155	3.3	103
September	5.0	150	5.8	174	4.5	135
October	4.7	146	5.4	167	4.8	150
November	4.5	135	5.2	156	5.0	148
December	4.3	133	5.0	155	4.5	140
Annual	4.4	1,598		1,848	4.1	1,482

1/ Computed by modified Penman method using the average of Cilacap and Tasikmalaya weather station data.

TABLE II-15

HISTORIC (1966-1977) AND PROJECTED (1978-2010) POPULATION BY DISTRICTS FOR THE CITANDUY WATERSHED

(Number of People)

	Year	Tasikmalaya	Ciamis	Kuningan	Cilacap	Total	% Change per Year
Historical							
	1966	518,695	893,659	36,113	316,480	1,764,947	4.84
	1967	529,346	964,265	36,023	320,778	1,850,412	1.56
	1968	539,709	975,200	36,732	327,622	1,879,263	1.82
	1969	550,986	991,690	37,306	333,500	1,913,482	3.52
	1970	539,609	1,035,436	38,077	347,801	1,980,923	2.46
	1971	573,779	1,062,099	38,077	355,634	2,029,589	1.37
	1972	585,338	1,073,583	38,359	360,144	2,057,424	1.30
	1973	597,274	1,085,711	38,368	362,731	2,084,084	0.85
	1974	608,240	1,088,323	38,368	366,910	2,101,841	0.61
	1975	621,085	1,087,310	38,730	367,564	2,114,689	2.31
	1976	629,592	1,117,095	39,077	377,875	2,163,639	0.72
	1977	640,560	1,121,488	39,165	378,043	2,179,256	
Average % Change per year		1.97	0.85	0.76	1.71	1.83	
Projected by Linear Regression							
	1978	652,800	1,126,100	39,700	389,600	2,208,200	1.29
	1979	664,000	1,137,100	40,000	395,500	2,236,600	1.19
	1980	675,300	1,146,300	40,300	401,400	2,263,300	1.16
	1985	731,700	1,192,800	41,700	430,900	2,397,100	1.09
	1990	788,000	1,239,300	43,100	460,400	2,530,800	1.04
	1995	844,400	1,285,800	44,600	489,900	2,664,700	0.98
	2000	900,700	1,332,300	46,000	519,300	2,798,300	0.94
	2005	957,100	1,378,800	47,400	548,800	2,932,100	
Projected by Percent Growth Rates							
	1980	682,400	1,147,300	40,400	405,000	2,275,100	
	1985	752,300	1,197,000	41,900	440,900	2,432,100	
	1990	829,300	1,248,900	43,500	479,900	2,601,600	
	1995	914,200	1,303,000	45,200	522,300	2,784,700	
	2000	1,007,700	1,359,500	47,000	568,600	2,982,800	
	2005	1,110,900	1,418,400	48,800	618,900	3,197,000	

Source: Village data supplied by District Planning Offices. Projections for Tasikmalaya, Kuningan and Cilacap Districts based on 1966-1977 data and Ciamis District based on 1971-1978 data.

TABLE II-16

HISTORIC AND PROJECTED POPULATION BY SUBBASINS

(Number of People)

Year	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel-Lower Citanduy	Total
Historic Population						
1970	691,936	339,051	165,419	313,351	471,166	1,980,923
1975	767,620	359,528	172,464	330,758	484,319	2,114,689
Precent						
Projected by Linear Regression						
1979	818,600	377,400	179,600	356,900	504,100	2,236,600
1980	831,700	381,200	181,200	362,300	506,900	2,263,300
1985	896,900	400,800	189,100	389,600	520,700	2,397,100
1990	962,200	420,500	196,900	416,900	534,300	2,530,800
1995	1,027,500	440,100	204,800	444,200	548,100	2,664,700
2000	1,092,800	459,700	212,700	471,400	561,700	2,798,300
2005	1,158,100	479,300	220,500	498,700	575,500	2,932,100

Source : Village data supplied by District Planning Offices. Projections for Tasikmalaya, Kuningan and Cilacap Districts based on 1966-1967 data and Ciamis District based on 1971-1978 data.

TABLE II-17

ESTIMATED 1979 WORK FORCE BY DISTRICT AND SUBBASIN

(Number of People)

	Agriculture	Commerce	Public Adminis-tration	Pension	Other	Total	Total Popula-tion
Employment by District							
Tasikmalaya	159,400	24,800	10,400	900	25,600	221,100	664,000
%	72.1	11.2	4.7	0.4	11.6	100.0	
Ciamis	548,900	22,500	33,400	600	1,800	607,200	1,137,100
%	90.4	3.7	5.5	0.1	0.3	100.0	
Kuningan	19,400	500	700	100	2,700	23,400	40,000
%	82.8	1.9	3.1	0.6	11.6	100.0	
Cilacap	130,500	10,300	6,400	400	33,900	181,500	395,500
%	71.9	5.7	3.5	0.2	18.7	100.0	
Total	858,200	58,100	50,900	2,000	64,000	1,033,200	2,236,600
%	83.1	5.6	4.9	0.2	6.2	100.0	
Employment by Subbasins							
Upper Citanduy	245,100	27,100	15,600	900	24,100	312,800	818,600
%	78.3	8.7	5.0	0.3	7.7	100.0	
Cimuntur	182,200	7,500	11,000	200	600	201,500	377,400
%	90.4	3.7	5.5	0.1	0.3	100.0	
Cijolang	80,800	3,500	4,400	300	6,100	95,100	179,600
%	85.0	3.7	4.6	0.3	6.4	100.0	
Cikawung	117,800	9,300	5,700	300	30,700	163,800	356,900
%	71.9	5.7	3.5	0.2	18.7	100.0	
Ciseel-Lower Citanduy	232,300	10,700	14,200	300	2,500	260,000	504,100
%	89.3	4.1	5.5	0.1	1.0	100.0	
Total	858,200	58,100	50,900	2,000	64,000	1,033,200	2,236,600

Source: Village data supplied by District Planning Offices for 1977 was adjusted to 1979 projected population by consultants staff.

TABLE II-18

CITANDUY WATERSHED CRITICAL UNCULTIVATED LAND
IN THE FOREST FOR THE PELITA III MASTER PLAN
(Hectares)

Unit Forest Administration	Critical Uncultivated Land According to F.S. (Ha)	Decrease during Master Plan II			Additional Critical Land during Master Plan		Critical Land early in Master Plan III
		Real. APBN	Real. APBD	Real. other	Delayed Planting	Other additional	
TASIKMALAYA							
Tasikmalaya	6,578	1,020	-	-	125	-	5,683
Subtotal	6,578	1,020	-		125	-	5,683
CIAMIS							
Ciamis	3,466	2,139	235	472	721	-	1,341
Banjar Utara	548	536	-	-	45	56	113
Banjar Selatan	127	827	-	-	123	1,099	522
Proyek Khusus	-	454	-	-	187	454	187
Subtotal	4,141	3,956	235	427	1,076	1,609	2,163
CILACAP							
Majenang	-	2,292	-	-	-	2,292	-
Wanareja	-	963	-	-	-	963	-
Sidareja	-	264	-	-	-	264	-
Subtotal	-	3,519	-	-	-	3,519	-
Total	10,719	8,495	235	472	1,201	5,128	7,846

Source: Data from Perhutani

TABLE II-19

CITANDUY WATERSHED CRITICAL LAND

OUT OF THE FOREST FOR PELITA III MASTER PLAN[1/]

(Hectares)

Unit Forest Administration	Critical Uncultivated Land According to F.S. (Ha)	Decrease during Master Plan II			Additional Critical Land during Master Plan		Critical Land early in Master Plan III.
		Real. APBN	Real. APBD	Real. other	Delayed Planting	Other additional	
TASIKMALAYA							
Ciawi	2,035	1,680	-	-	50	545	950
Cineam	942	5,225	-	-	100	4,483	300
Cisayong	25	-	-	-	-	-	25
Indihiang	142	100	-	-	-	-	42
Manonjaya	160	2,025	-	-	100	2,522	757
Pagerageung	652	1,700	-	-	135	1,693	780
Subtotal	3,956	10,730	-	-	385	9,243	2,854
CIAMIS							
Panumbangan	225	400	-	-	-	1,764	1,589
Panjalu	1,999	1,612	-	-	-	286	673
Panawangan	1,175	1,165	-	-	-	286	296
Kawali	477	1,188	-	-	-	1,206	495
Cipaku	-	550	-	-	-	750	200
Rajadesa	140	1,904	-	-	-	2,572	808
Rancah	84	2,395	-	-	-	4,035	1,724
Cisaga	-	2,298	-	-	-	2,875	577
Banjar	402	697	-	-	-	1,138	843
Cimaragas	557	2,089	-	-	-	7,914	5,444
Pamarican	3,095	6,672	-	-	-	11,170	7,593
Cihaurbeuti	-	-	-	-	-	712	712
Subtotal	9,801	25,087	-	-	-	40,923	25,637

TABLE II-19 (Continued)

Unit Forest Administration	Critical Uncultivated Land According to F.S. (Ha)	Decrease during Master Plan II			Additional Critical Land during Master Plan		Critical Land early in Master Plan III.
		Real. APBN	Real. APBD	Real. other	Delayed Plnating	Other additional	
K U N I N G A N							
Subang	120	2,107	-	-	498	2,114	625
C I L A C A P							
Dayeuhluhur	2,500	3,400	-	-	-	2,209	1,309
Wanareja	1,088	3,307	-	-	794	3,799	2,374
Majenang	818	1,766	-	-	545	1,877	1,474
Cimanggu	1,368	4,716	-	-	1,608	5,645	3,905
Karangpucung	4,873	1,351	-	-	564	25	4,111
Subtotal	10,647	14,540		-	3,511	13,555	13,173
Total	24,524	52,464			4,394	65,835	42,289

Source: Data from Perhutani

1/ Land out of the forest is mostly privately owned land.

TABLE II-20

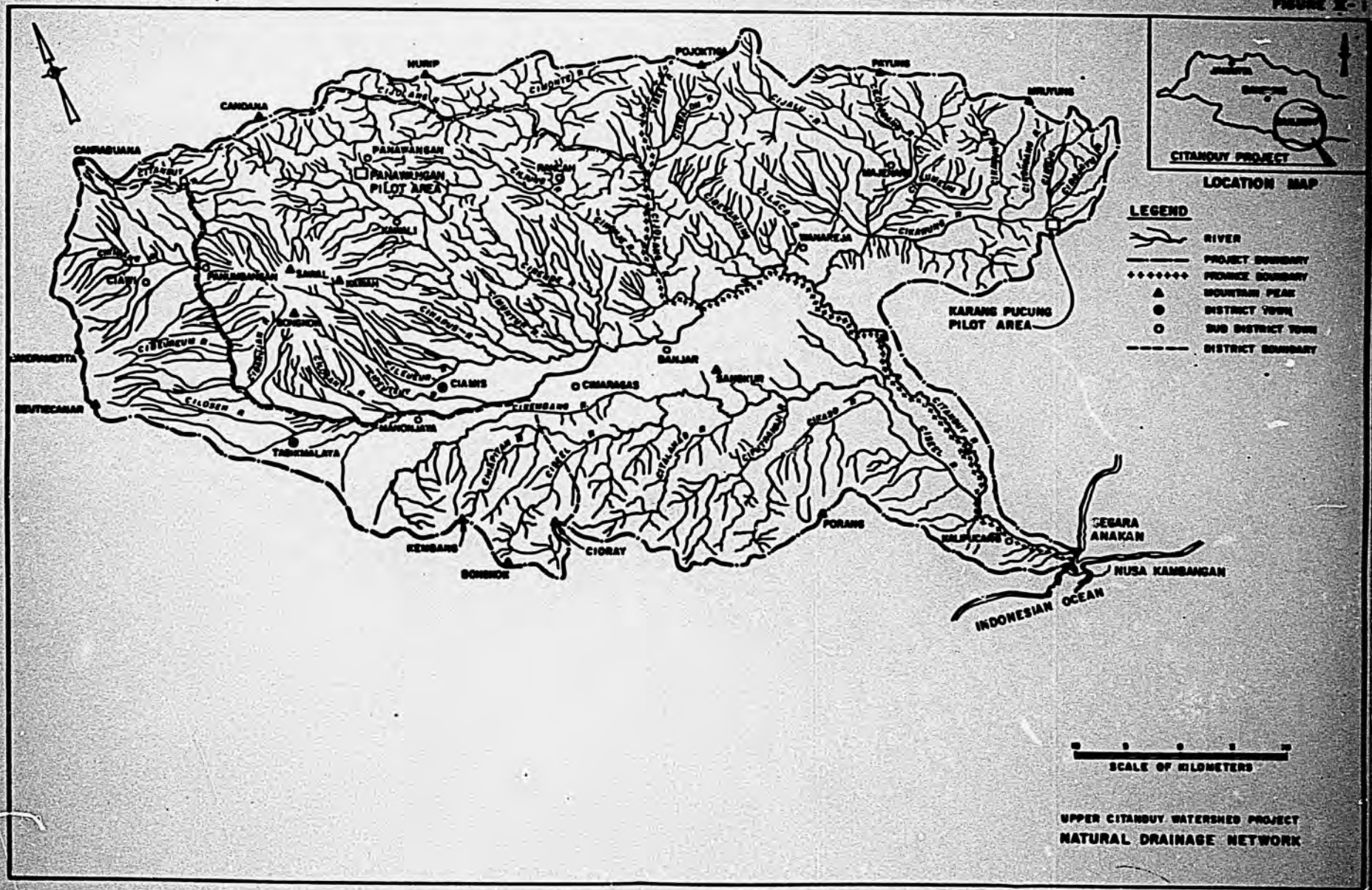
REFORESTATION SPECIES PLANTED IN THE CITANDUY WATERSHED

(Hectares)

	Years					
	1974	1975	1976	1977	1978	Total
Ciamis District						
Teak (Tectona grandis)	545	1,063	640	1,494	604	4,346
Pine (Pinus merkusii)	379	428	415	452	465	2,139
Mahogony (Swietenia macrophylla)	126		495	898	1,425	2,944
Calliandra					90	90
Total	1,050	1,491	1,550	2,844	2,584	9,519
Tasikmalaya District						
Teak (Tectona grandis)	30					30
Pine (Pinus merkusii)	225	230	50	140	10	655
Mahogony (Swietenia macrophylla)	120	25		60	5	210
Total	325	255	50	200	15	895
Total Reported	1,425	1,746	1,600	3,044	2,599	10,414

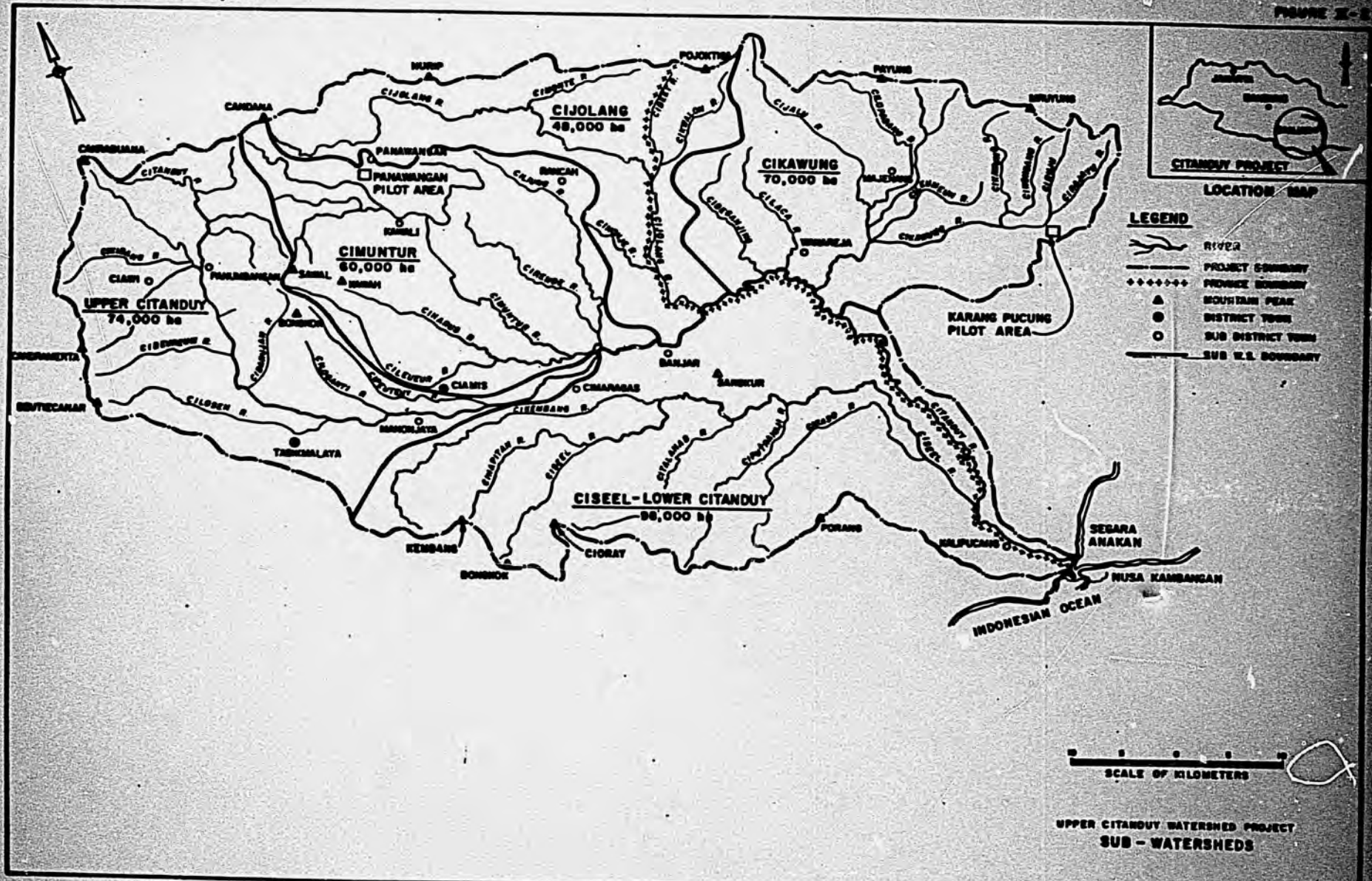
ENGINEERING CONSULTANTS, INC.

FIGURE X-1

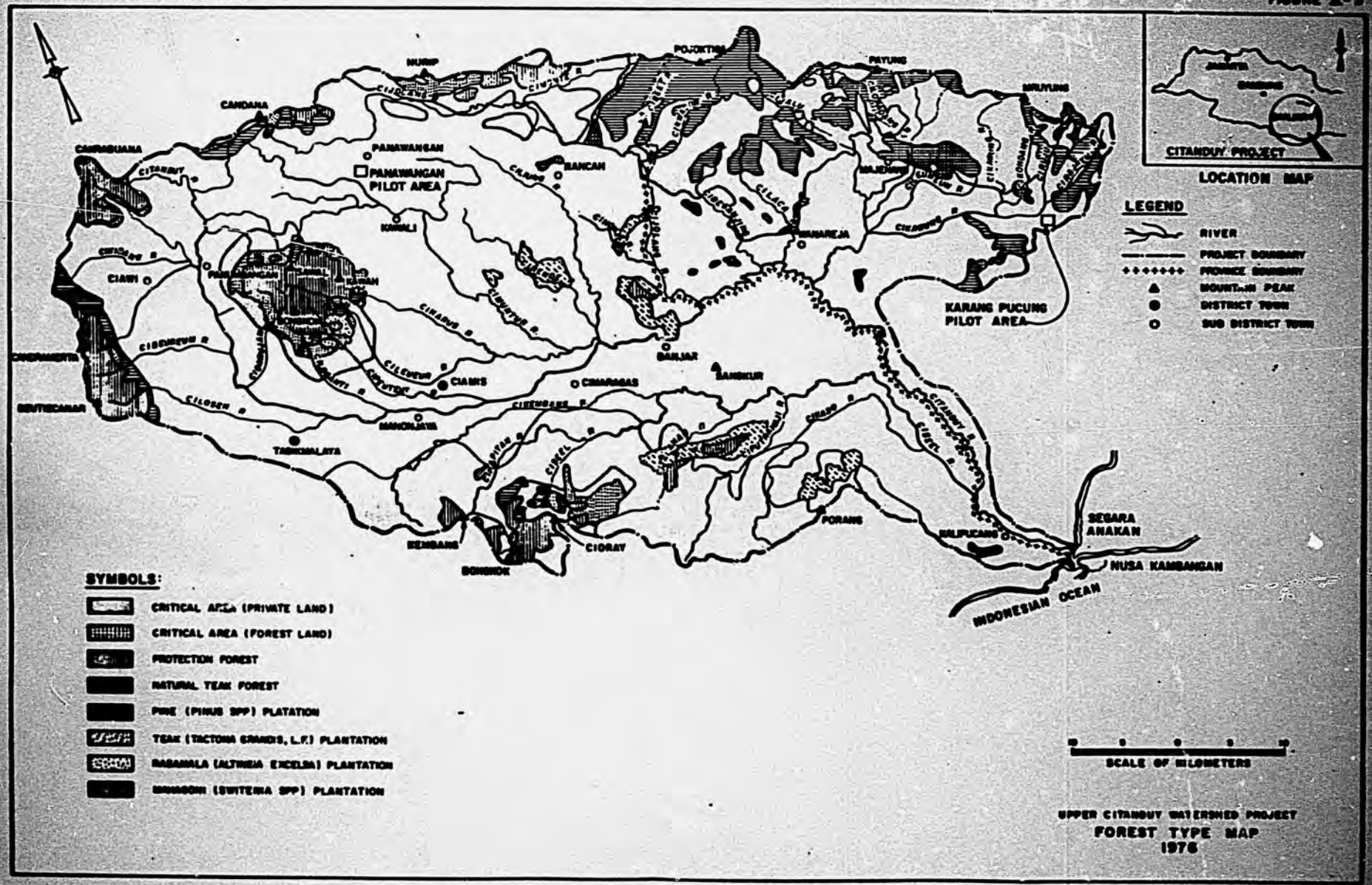


ENGINEERING CONSULTANTS, INC.

FIGURE II-2



UPPER CITANDUY WATERSHED PROJECT
SUB - WATERSHEDS


LOCATION MAP
CITANDUY PROJECT
LEGEND
RIVER
PROJECT BOUNDARY
PROVINCE BOUNDARY
MOUNTAIN PEAK
DISTRICT TOWN
SUB DISTRICT TOWN
SYMBOLS:
CRITICAL AREA (PRIVATE LAND)
CRITICAL AREA (FOREST LAND)
PROTECTION FOREST
NATURAL TEAK FOREST
PINE (PINUS SPP) PLATATION
TEAK (TECTONA GRANDIS, L.F.) PLANTATION
RASAMALA (ALTINGIA EXCELSA) PLANTATION
MAHOGONI (SWITENIA SPP) PLANTATION
SCALE OF KILOMETERS
KARANG PUCUNG PILOT AREA
PANAWANGAN PILOT AREA
SEGARA ANAKAN
NUSA KAMBANGAN
INDONESIAN OCEAN
CANDANA
CAMPAKIANA
CIAWI
CIAMIS
CIMARAGAS
BANJAR
BANDUNG
TASIKMALAYA
MANONJAYA
CIOMAS
CIORAY
PORANG
KALIPUCANG
MAJENANG
CIMANGGU
PAYUNG
MIRUYUNG
POJOKTIGA
RANCAH
KAMALI
HURIP
CIPAMEUNGAN
CIPAMEUNGAN
BENTECANAN
CIMANGGU
CIBENGUM
CIHAPUS
CILOSEN
CIBEUBEUR
CIPEUCEL
CIPAPITAN
CIBEUBEUR
CIPEUCEL
CIBEUBEUR
CIPAMEUNGAN
CIPAMEUNGAN
CIBENGUM
CIHAPUS
CIBENGUM
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CIBENGUM

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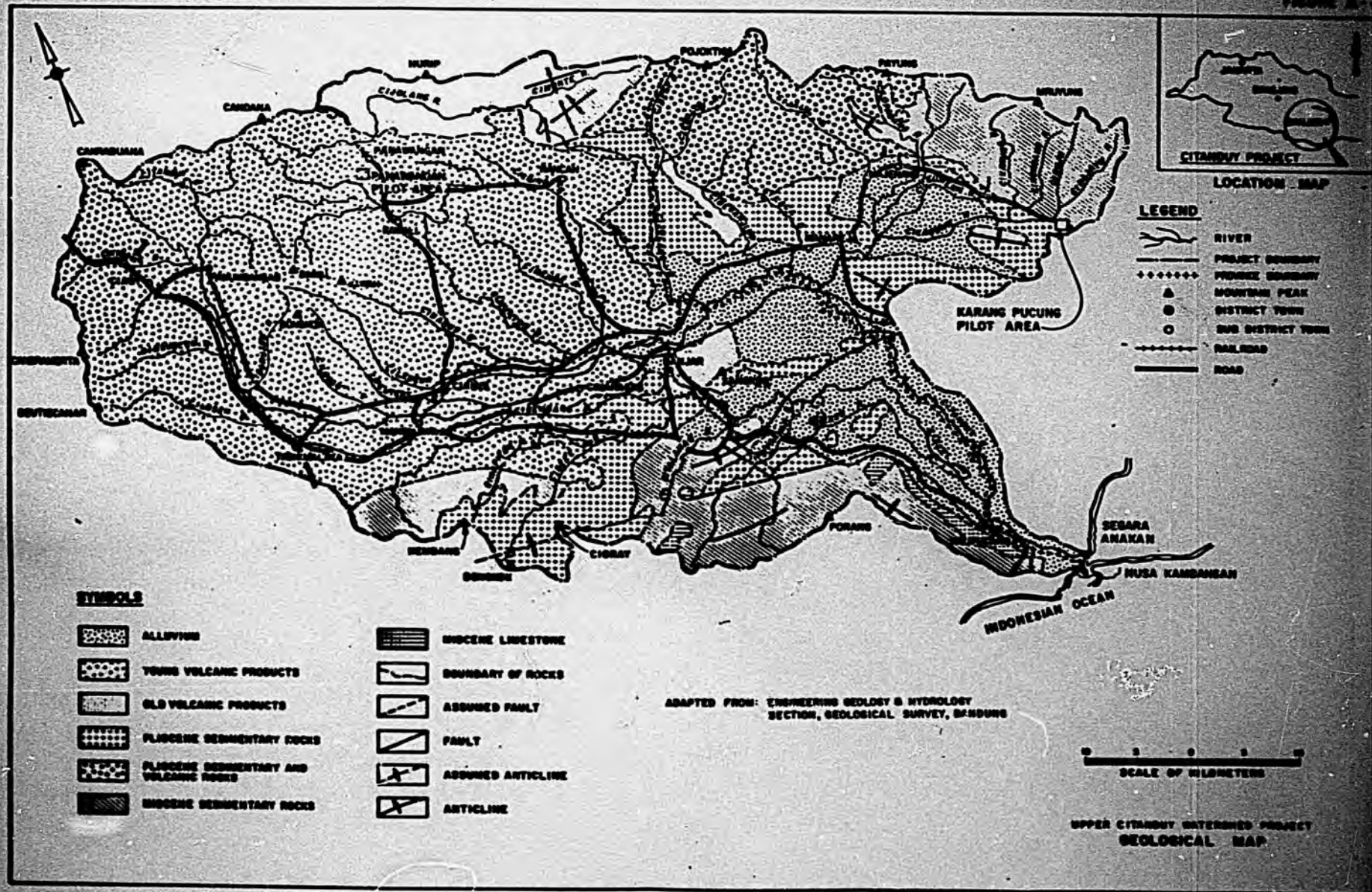
CANDAJA
CAMPANDUANA
CIMANGGIS
CIBUNGUR
HURIP
CIHOLANG R.
CIMUTE R.
POJOKTIGA
PETUNG
MAMUNG
PASIRMUNCANG
PILOT AREA
KARANG PUCUNG
PILOT AREA
CIMANGGIS
CIBUNGUR
CIMUTE
CIHOLANG
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ENGINEERING CONSULTANTS, INC.

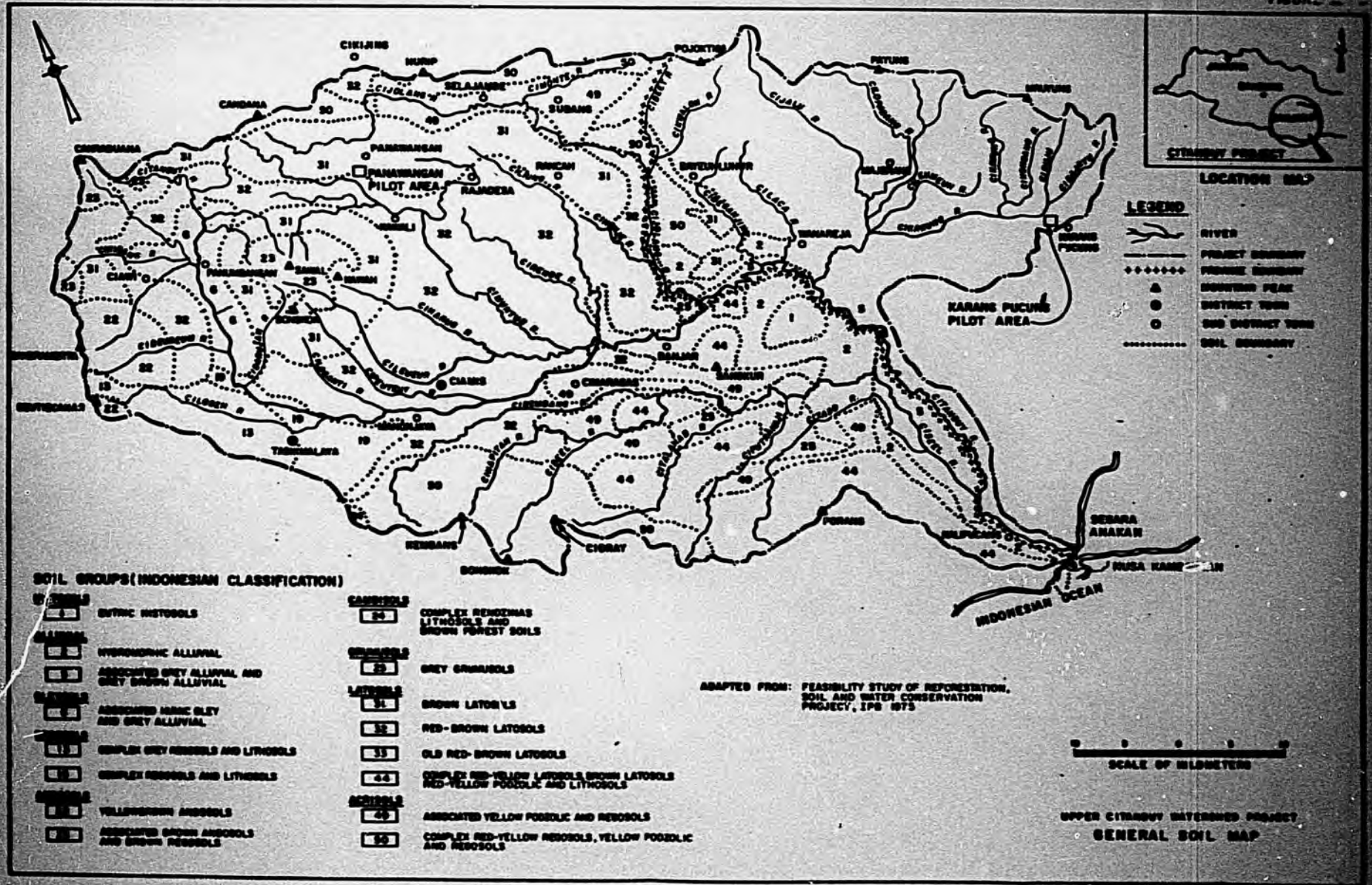

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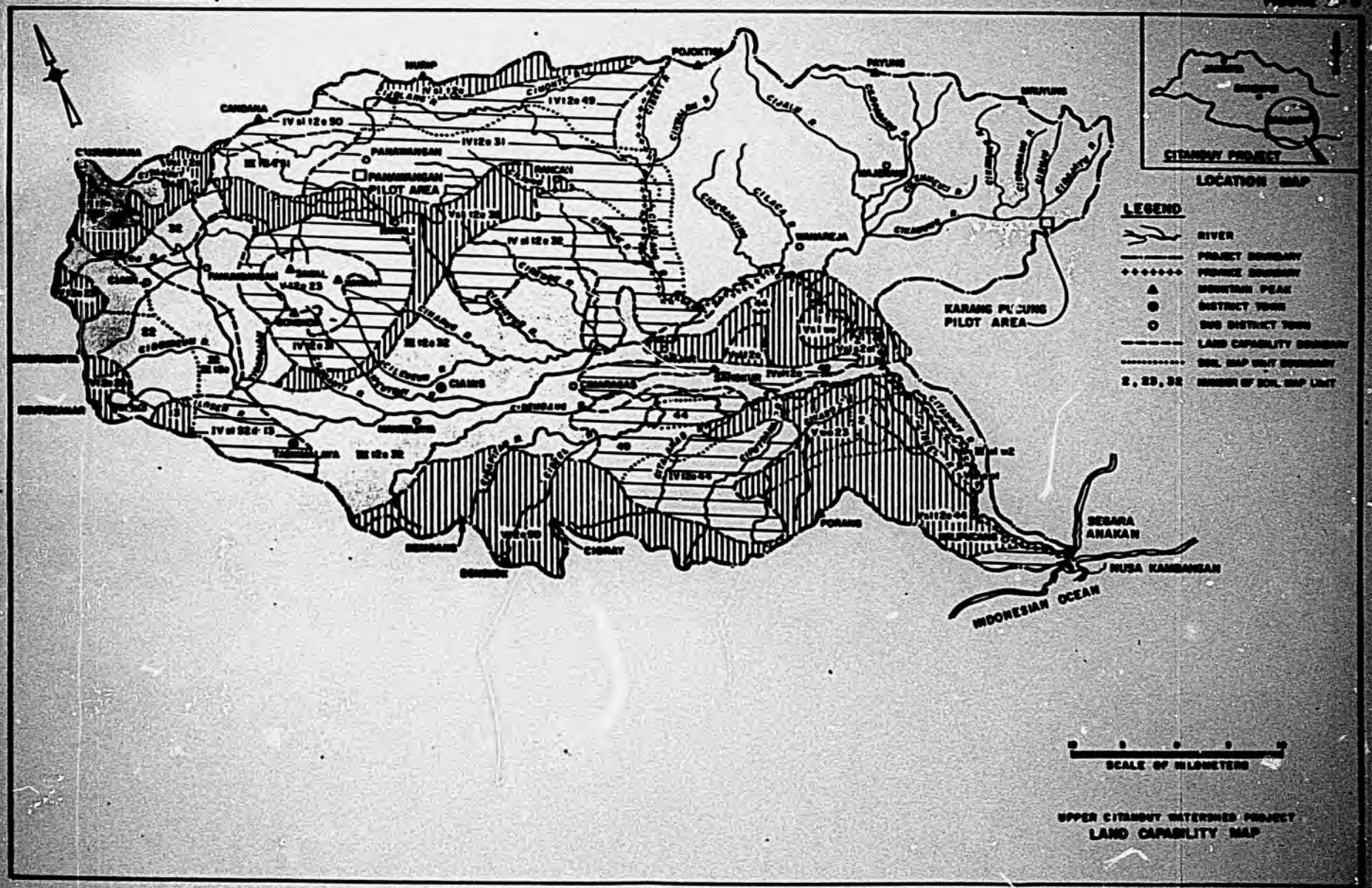
FIGURE 4-6



SPECIAL LEGEND

FOR THE LAND CAPABILITY MAP

LAND CAPABILITY CLASS	LAND CAPABILITY SUB CLASS	SOIL NAME	NUMBER OF UNIT	LIMITING FACTORS ALONE OR IN COMBINATION
III	III S1	Glei humus/alluvial	6	Gravel
		Regosol	19	Gravel
	III t2e	Latosol	31 & 32	Wavy (undulating) land, slight to moderate erosion.
Moderately Suitable	III S1.W.01	Alluvial	5	High water table, poor soil, seasonal flooding and ponding.
IV	IV n	Alluvial	4	Normal (no specific problems)
	IV S1. S2.dl	Regosol/Latosol	13	Poor,rocks,stony soil, season droughty (part of time)
Poor or Marginally Suitable	IV S1. t2.e	Latosol	32	Undulating, hills to mountainous land, gravel,or stony soil,slight to heavy erosion.
		Podzolic/Regosol	50	
	IV. t2.e	Andosol/Regosol	23	Undulating hilly land, slight erosic moderate erosion to heavy erosion.
		Latosol	31	
		Latosol/Podzolic/Litosol	44	
		Podzolic	45	
		Podzolic/Regosol	49	
V	V. S1.W.O.	Alluvial	1	High ground water, poor soil, seasonal flooding.
	V. S1.S2.01	Alluvial	2	Poor soil, gravel, seasonal flooding.
V	V. S1.S2. tl	Grumosol/Regosol Mediteran	13	Wavy (undulating) poor soil, gravel, slight to heavy erosion.

SPECIAL LEGEND

FOR THE LAND CAPABILITY MAP

(CONTINUED)

LAND CAPABILITY CLASS	LAND CAPABILITY SUB CLASS	SOIL NAME	NUMBER OF UNIT	LIMITING FACTORS ALONE OR IN COMBINATION
	V.t 2e	Grumosol/Regosol mediteran Podzolic	23 50	Undulating hilly to mountainous land with slight to heavy erosion
	V.Sl.t2 e	Reusina/Latosol/B.F.3 Latosol Latosol/Regosol Podzolic/Regosol	24 32 44 50	Wavy undulating hilly to mountain land, gravel, high water table, slight to heavy erosion.
VI	VI. t2.e	Andosol/Regosol	23	Hilly to mountainous land, heavy erosion
	VI.Sl. t2.e	Complex Resina/ Lithosol/BF. S Podzolic and Regosol	 24 50	Wavy (undulating) to mountainous land, gravel, moderate to heavy erosion.
VII	VII t.e VII Sl. t.e.	Andosol/Regosol Podzolic/Regosol	23 50	Hilly land, heavy erosion

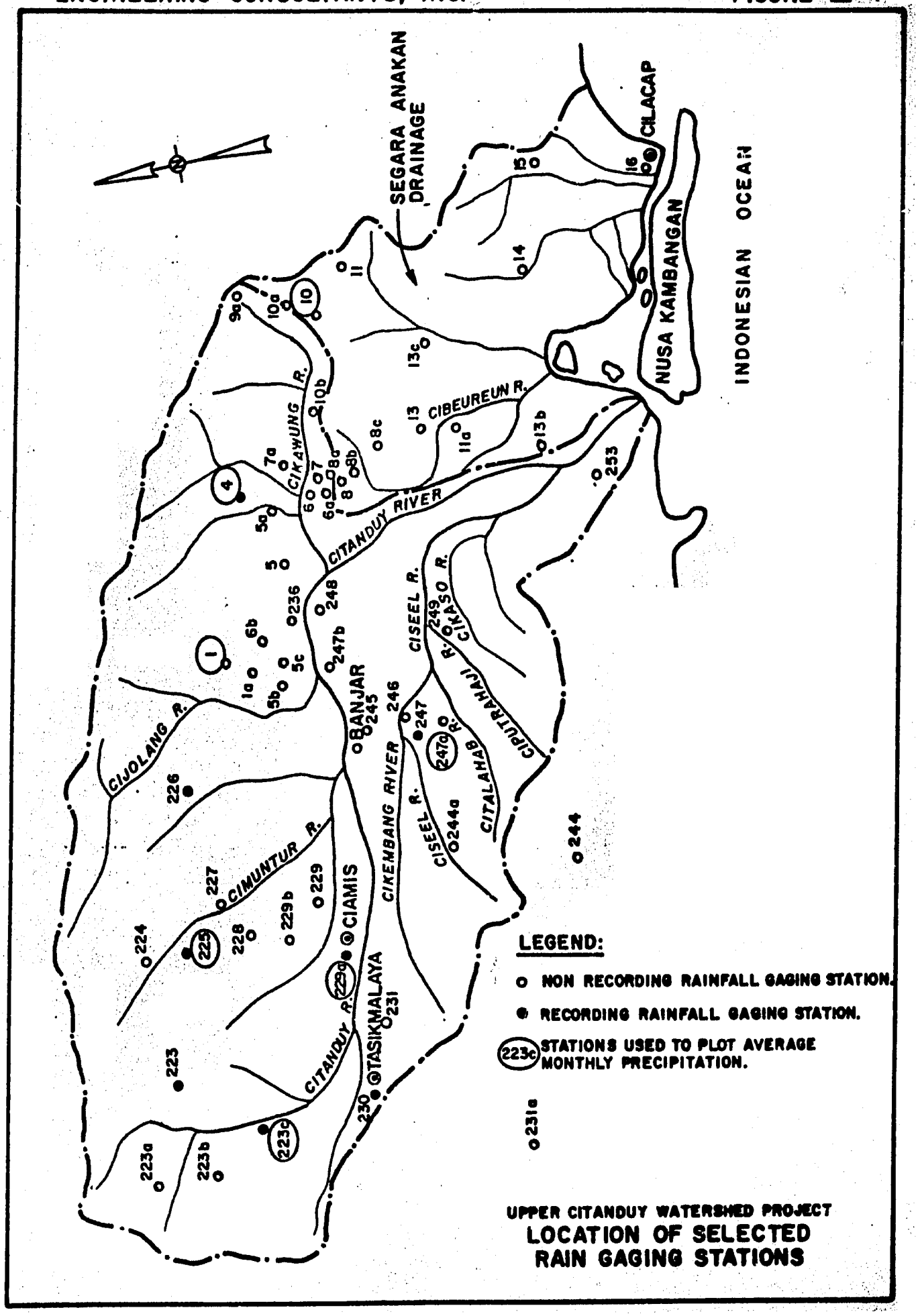
LEGEND

I. Limiting factor

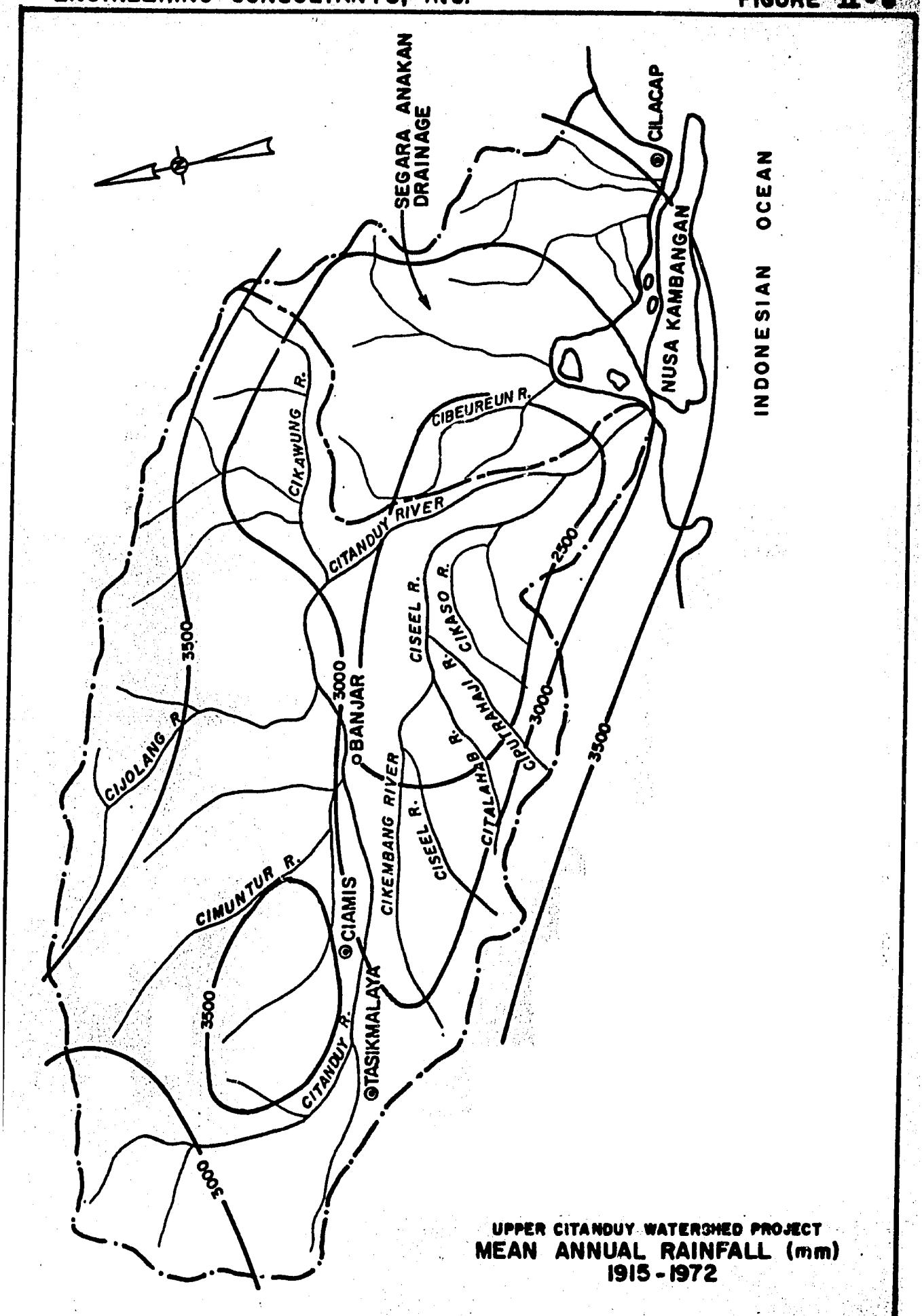
- O : No limiting factors
- Sl : Poor physical soil (gravel, rock, stone)
- S2 : Poor soil (cemented material)
- S3 : Poisoning/salt. Saline - toxicity
- tl : Wavy land (rolling to undulating) terrain
- t2 : Hilly to mountainous land

II. Danger factor

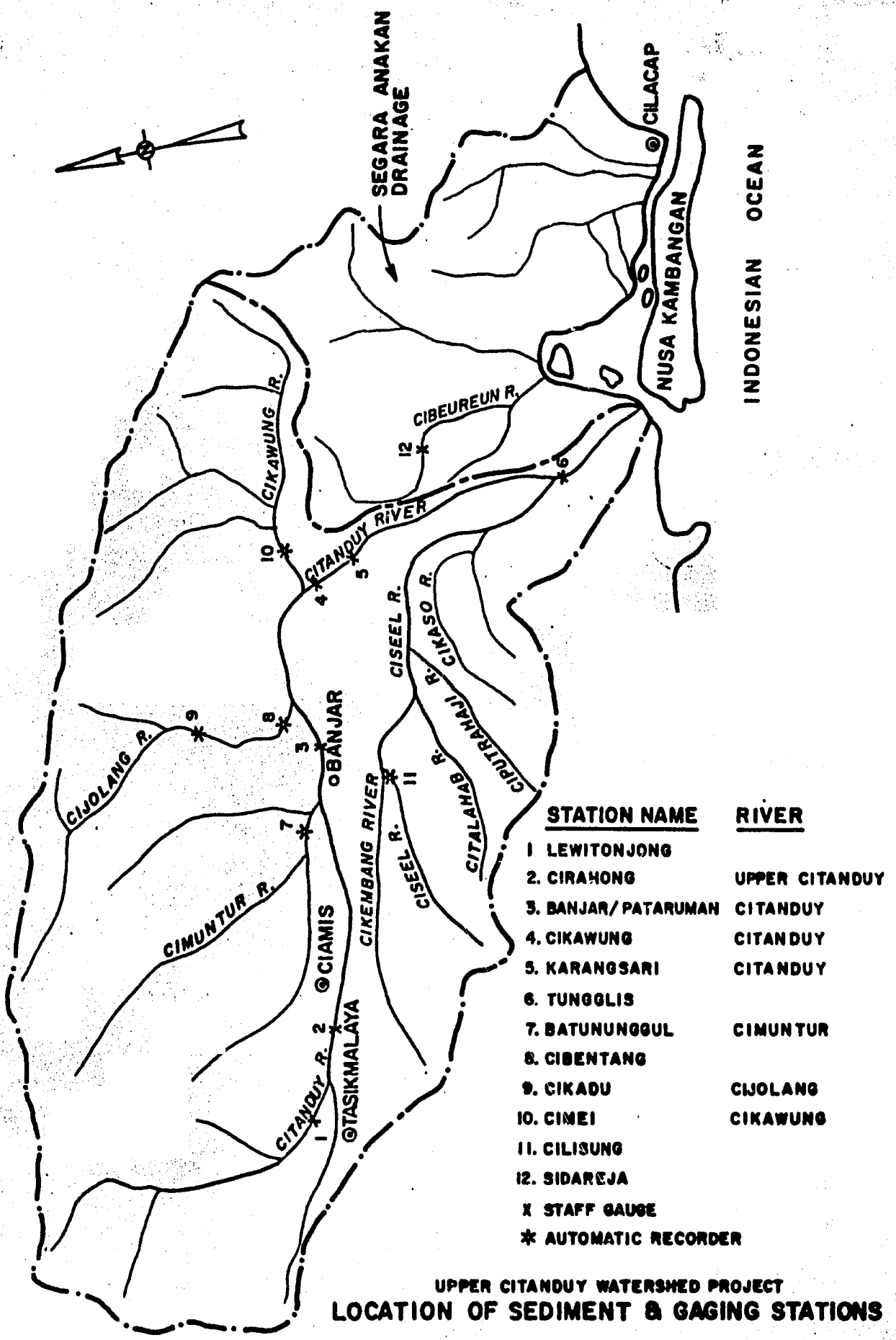
- W : Groundwater level
- 01: Season flooding
- 02: Seasonal flooding and tidal influence
- dl: Seasonal drought
- e : Erosion (slight, moderate or heavy



UPPER CITANDUY WATERSHED PROJECT
LOCATION OF SELECTED RAIN GAGING STATIONS

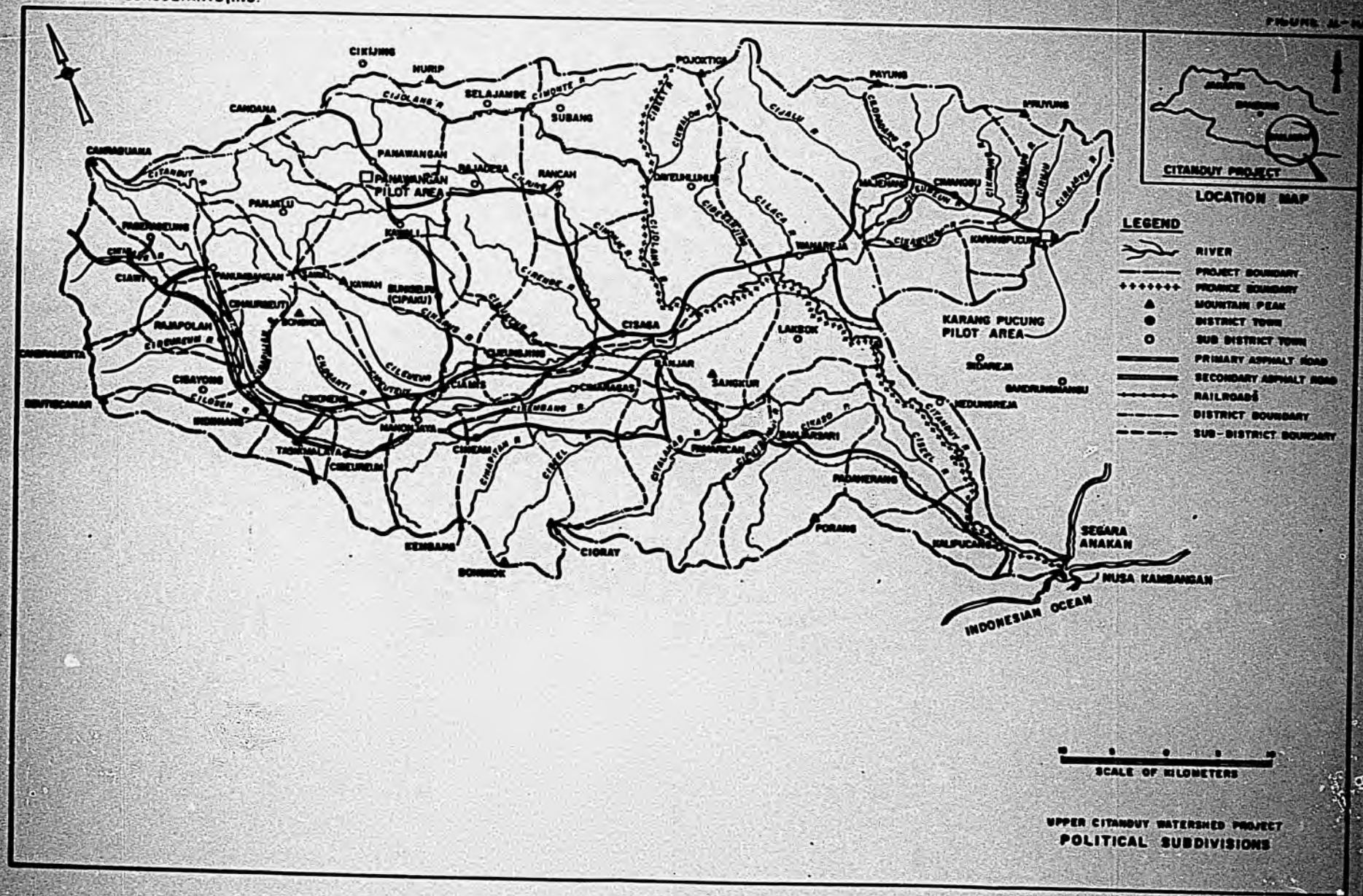


UPPER CITANDUY WATERSHED PROJECT
MEAN ANNUAL RAINFALL (mm)
1915 - 1972



UPPER CITANDUY WATERSHED PROJECT

LOCATION OF SEDIMENT & GAGING STATIONS



UPPER CITANDUY WATERSHED PROJECT
POLITICAL SUBDIVISIONS

CHAPTER III
WATERSHED PROBLEMS

People Problems

Introduction

The soil erosion problems of the Citanduy Upper Watershed are caused by one or more of the following conditions:

1. Removal of the original forest cover,
2. Erosion along roads and trails,
3. Lack of proper bench terraces,
4. Lack of waterways to dispose of excess water,
5. Sluicing to create paddy land,
6. Planting of crops on steep and long slopes without measures to take care of surface runoff, and
7. Lack of vegetative cover to stop sheet erosion caused by raindrop splash and surface runoff.

These problems are well known and have been reported many times. They are also found in many other watersheds of Indonesia and of other developing countries. However, these are not generally recognized as people problems with economic, technical and physical limitations to their solutions. More importantly, planners and government officials seldom realize that the individual farmer, or other watershed resident, is generally completely rational in his behavior, given the specific circumstances of his or her situation. Therefore, to initiate a permanent change it is necessary to change the farmer's economic position, his ability to take risk, or his perception of the problem and of how he might benefit from the solution. Because he often cannot read, his education must be accomplished and by oral and demonstrative communication.

The principal cause of low labor productivity by upland farmers in the Citanduy Watershed today is, in fact, the low productivity of their past labor. Production and economic returns are simply not large enough to start the cumulative process of rising production and

prosperity. This low productivity results primarily from the large population pressures that prevent most farmers from obtaining a unit of land that yields more than subsistence. Although in most cases the farmer does not himself realize their effects, his insecure and financially constrained existence largely determine his behaviour. The truth is that most of the farmers in the Upper Citanduy Watershed are not members of modern economic society and have only limited chances of ever accomplishing this feat.

Simply stated, the upper watershed problem is this: under present conditions, the productivity of upland cropland is so low that neither the physical nor economic conditions exist for a conventional conservation program. The goal of this section is to explain (in part) the real problems of the watershed and to suggest logical solutions to these problems, including some suggestions as to who should pay for certain portions of the conservation activities.

Conservation practices are bound to agricultural productivity in two important respects: First, they are bound physically because ground cover and soil management affect both the degree of soil erosion and the maintenance cost of all installed conservation works. Secondly, they are bound economically because the primary justification for the conservation of agricultural land is the higher productivity of these areas, either now or in the future, than would have been possible without the conservation efforts. Further, to expect the farmer to make expenditures for practices that do not directly benefit him is unreasonable, just as it is poor fiscal policy to spend government funds for conservation measures that provide the farmer with benefits greater than his cost. The farmer should pay these costs since it is to his benefit.

Facilities, such as waterways and drop structures, that are shared by several farms, present a special problem in that the necessity for maintenance may take several years to be realized. It is also possible that the net returns above a minimum living standard may not be sufficient to pay the maintenance cost of conservation measures--much less their total costs.

Improvement of economic conditions on a significant scale is necessary to accomplish the needed improvement in crop yields and the reduction of erosion rates. Proposed physical developments must consider the ethnic background and socioeconomic position of the individual farmers involved. Decisions on alternative structural and land treatment measures or production schemes must be made in accordance with all the human, physical, and economic resources available and with the abilities and special wishes of the people in the small watershed unit or village concerned. These projects can only be developed in direct cooperation with the local people, and although it is relatively impossible for anyone in provincial or district planning offices to really understand the local problems, these offices can coordinate and implement the various projects as they are developed locally. Planning leaders can also ensure that the projects developed are varied enough to broaden the conservation experience of both the local staff and the upland farmers.

Population Pressure

Most people familiar with the agricultural and population conditions of the Citanduy Watershed agree that there is a population problem but few people agree on the solution. Some people see transmigration as the solution; some, birth control; some, industrialization; some irrigation development; and currently some people want to terrace all upland crop areas to provide both jobs and increased food supplies while "solving" the watershed problem. This controversy results from myopia, single-minded dogmatism, and self-interest that causes any people to see only their solution. There is also considerable intragovernmental rivalry of agencies and individuals. The different approaches, governmental agencies and the idndividuals responsible should instead complement each other to achieve a single vitally important end--the current and future well being of the people living in the watershed.

Quality of life

Concurrent with the realization that the watershed problems are really people problems, comes the realization that nothing can be done about the upper watershed condition unless some of the people problems can be solved. Foremost among these problems are the signifi-

cant rural poverty and the isolation of most of the rural poor from any of the government programs. Thus family planning is reasonably effective for the educated and reasonably affluent government worker or merchant in the town but has no effect on the rural poor. Further, the rural poor can not take advantage of most programs because they are too poor to buy the necessary technical equipment, or to travel to the place of distribution.

In considering the problem of the rural poor's quality of life, it hardly matters whether a farmer is upland with a small patch of cassava or on the lowland floodplain where he who gets floods and sediment deposition on his land almost every year. He is so poor that he does not have the resources to attempt the improvement in the quality of his life. Therefore, what is required is a combination of irrigation development, upland watershed management, and general economic development programs so that these people will gain the knowledge and resources necessary to start the human rehabilitation and improve their quality of life. Without this improvement, the ultimate solution of the human problem is to limit the population of the watershed and the country; but the control will be exerted by human misery.

Development Problems

Introduction

The development problems of the watershed are also people problems in that they are related to the lack of resources sufficient to enable the people to adopt the needed conservation measures, or to provide the infrastructure and industrial development that will yield a good standard of living for most of the people.

One problem associated with watershed development is caused by the prevalent impression that farming and forests are not compatible and that there is some simple way of defining where forests should be (for example, all lands with slopes greater than 50 percent). In fact, the land best suited for forestry, or upland agriculture, can only be determined by a complete resource inventory and multiple-use evaluation. An area such as the Citanduy Watershed should also attempt

the maximum development of agroforestry systems of trees and grass, trees, fruit and grass, or trees and upland crops. Admittedly, native trees and wild plants must usually be eliminated to create the open spaces for the sun-rich environment favored by most agricultural crops to reduce competition for nutrients and water, to reduce the insect damage, and to generally facilitate cultivation. However, some specialized crops can be sucessfully grown under trees, and a maximum effort should be initiated to develop systems that produces the maximum food and fiber from each land resource type.

Traditional Agriculture

Cultivated fields on sloping terrain and the concentration of a single crop, such as cassava, that provide little ground cover result in soil erosion, nutrient depletion, disease and pest infestations, and even physical damage to the plants. Most agricultural crops, like their wild relatives, respond with higher total yields in mixed composition and structurally complex communities. The interior of a forest is a benign ecosystem partially shielded from solar radiation, strong winds, and the impact of falling rain. By planting a variety of crops with different growth habits in upland agricultural areas, farmers may profitably imitate some of the structure and species diversity of a tropical forest. To some degree the Indonesian farmer already does this in his garden plot which copies the layered configuration of mixed forests. These small garden areas contain taller plants such as coconut and papaya; a lower layer of banana, coffee, or cacao; and tall or low annuals such as corn, beans, sweet potatoes, taro, and the spreading vines of peanuts. Using this system, food production takes place at many levels and erosion rates are a fraction of the clear cultivated cassava fields on the slopes above.

Denuded forest land that either is left in an unprotected condition, or is farmed with upland crops is a major source of sediment and consequent loss of fertility in the watershed. Land with 50 to 75 percent slopes is being encroached upon by farmers as pressures for food production increase. For example, in 1978 some 2,000 ha of forest land near Cipeundeuy Village in the Tasikmalaya District was plowed and planted to cassava on more than 50 to 60 percent slopes at an elevation of 500-800 meters.

Subbasin Problem Areas. It is almost impossible to discuss all of the problem areas in the watershed so only a few of the worst problems areas are discussed in this section.

In the Ciawi Subdistrict of the Upper Citanduy Subbasin, the village Kadipaten is a good example of a problem area. All private land there, regardless of slope, is being farmed to cassava, rice, and peanuts. Some traditional terraces with downhill sloping benches have been constructed and they are reducing runoff and erosion to some extent. Unfortunately, the runoff ends up in pathways between boundary lines and cascades down the slopes into ditches, road borrow pits and finally into streams and rivers. Land slides are common adjacent to the valley paddy areas. The water in drainage or irrigation ditches saturates the soil by capillary action, building up water tables and severe landslides result. The material from these land slides is then moved by hoe into the ditches and sluiced down the drainage ditches to become a major source of sediment. These landslides result in bare exposures with almost vertical embankments on both sides of some valleys that give the area a somewhat scalloped appearance.

The Cimuntur Subbasin also has large areas where the paddy farmers illegally encroach on the steep banks to gain additional land by undercutting the edge of the banks, a practice which results in frequent landslides. Severe erosion problems can be seen almost any place in this subbasin, and it is one of the reasons the Panawangan Pilot Watershed Project was established in this area. Terraces in the Cirende River area are severely eroded with runoff water and sediment cascading over the terrace lip and down the slope into irrigation and drainage ditches that are located on both sides of the rice paddies. The sloping banks along the sides of many valley paddy fields are continually undermined, resulting in frequent landslides. This material is then hydraulically sluiced through the drain ditches into the streams. The runoff and sediment from the terraces and landslides are not used for irrigation because they would disrupt the irrigation system and the poor quality sediment would reduce the productivity of the paddy. Since the clear water from rain storms provide sufficient water for the rice, almost all of the sediment-laden material is hurried to the stream channel to be deposited downstream.

Much of the Cijolang Subbasin is also severely eroded. Land in the Cibeet River drainage in Central Java has been cleared of forest, and many landslides occur on Pojotoga Mountain at the higher elevations of 900 to 1,345 m. The steep mountain slopes of this area are all planted to cassava. There are only small areas of hillside irrigation in the lower areas. On the west side of the lower Cijolang River almost all of the once fertile top soil has been lost, and attempts by the Greening Program of the Forest Service have resulted in poor tree survivals with rates of about 35 percent. In this program the land was terraced but the quality was poor, and the pine seedlings were planted with cassava. Much of the area appears to be abandoned: very little of the land is terraced and exposed soil is visible from the distance. Teak plantations have been attempted on some of the higher slopes of the government land, but the survival rate has been very poor. Much of this land reverted to government ownership after independence, and farmers were permitted to farm the land thus supposedly establishing a right of ownership; however, the farmer never received a title of ownership. This land policy is causing land abuse and rapid increase in the rate of soil deterioration. The land operator will not terrace the land under the present system because he feels the government should apply the soil conservation practices. As a result, the farmers plant cassava almost exclusively.

The south boundary of the Cikawung Subbasin has a rough topography that is badly dissected with steep short canyons. The maximum elevation of this hill area is about 300 meters. The valley paddy areas are narrow and small, bordered by steep upland with very shallow soils that are badly eroded and probably not suitable for terrace construction. Severely eroded upland areas are also found in the Majenang and Malabar areas where land ownership is ambiguous. The land is steep and seriously eroded.

The Karang Pucung Pilot Demonstration area was set up in the Cikawung Subbasin to attempt to solve some of the problems and to provide a preliminary demonstration of improved practices. This work should proceed with caution, however, because shallow soils and low degree of fertility indicate that it will be a very difficult area to rehabilitate. The people will be watching this program closely; a

failure on the demonstration farms may severely limit future acceptance of watershed management and conservation activities.

The upland watershed problems of the Ciseel-Lower Citanduy Subbasin are mostly found in the Upper Ciseel River and in the higher elevation areas along the southern boundary of the watershed. The Manonjaya area, with shallow soils and hilly terrain at an elevation of about 400 meters, provides a good example. Terracing and upland farming will ultimately be limited to the deeper soils on ridges in this area. The vegetation consists primarily of brush and small trees; even the coconut trees are stunted and yields are very poor. Cassava yields in upland farming areas are only 3.5 to 4 tons per hectare, whereas past yields are reported to have been 8 to 10 tons. Much of the area is suffering severe erosion, and the limited terracing is of very poor quality. The villages of Gunung Tanjung and Cijunjung are typical of this problem. Another severe problem area is the Cijulang village, within the Cineam Subdistrict, where it is reported that 85 percent of the farmers are sharecroppers. Upland rice yields average 1.5t/ha and cassava yields are now 4 to 6 t/ha. The area has requested a dam for irrigation of the village area.

As previously stated, these problem areas in the subbasins are only examples of areas examined by the consultants staff and are in no way exhaustive.

Soil Erosion Problems. Erosion on cropland degrades the productivity of the soil resource base which is necessary for crop and food production. When new cropland is brought into production to meet demands for an increased food supply, its erosion problems are often more serious than those of lands already being farmed. Soil erosion reduces the potential soil productivity because plant nutrients and fine particles are selectively removed, causing poor soil tilth and increasing runoff because of poor infiltration. Usually crop yields can be increased by the addition of fertilizer, pesticides, herbicide, hybrid seed varieties, and management, but eventually the progressive degradation of the soil resource through erosion becomes evident.

Most upland areas exhibit a combination of sheet, rill, gully, subsurface flows and channel flows. A decrease in the amount of runoff or of runoff rates from upland farms affects the detachment and transport capacity in the stream channels. Sediment yield rates of the streams in the Citanduy Watershed relate directly to sediment production on upland crop areas, but controlling upland erosion does not always immediately reduce sediment yields. Instead, eliminating incoming upland sediment makes channel flow more erosive. If sediment is available from previous deposition or from erodible channel boundaries, sediment yields may continue for several years at the same high rate before the system readjusts and responds, if it ever does, to control of upland erosion from agricultural and nonagricultural lands. For this reason, the control of upland erosion will have greatly delayed benefits to the downstream watershed areas even if the treatment program on upland areas is very effective. Quite simply, a great deal of sediment remains in the stream system through it will eventually be delivered to the Segara Anakan or the Indonesian Ocean.

During runoff and transport of eroded sediment, plant nutrients are lost from the soils either as soluble constituents (primarily No_3 or N) or attached to the sediment particles (particularly phosphorus, the exchangeable cations, trace metals, and organic nitrogen). The loss of organic matter by erosion from the surface will be detrimental to crop production not only because of the plant nutrients it supplies, but also because of the beneficial role of organic matter in maintaining soil structure, water holding capacity, and increasing infiltration rates.

In the Phillipines, research on a 40 percent slope at Diadi, Nueva Vizcaya, stressed the importance of soil cover for upland agricultural land. The control (protected plot) had a sediment yield of less than 0.1 t/ha/y, whereas rice and corn had sediment yields of about 73.5 and 69.8 t/ha/y[1]. The paucity of erosion data makes it difficult to objectively state the importance of soil cover and conservation measures for continued or sustained upland crop production. Visual observations can easily be made by an outsider, but it is the farmer who daily confronts the problem, and he usually fails to see it because it develops so slowly. He usually does not realize the problem exists, or

he only vaguely remembers that his father used to get much higher yields of cassava than he does. The higher prices for his smaller crop may yield the same income as his father's so the problem is further masked.

In general, accelerated erosion, low soil fertility and productivity, poor or nonexistent terraces, the near absence of developed waterways, a lack of credit facilities, limited infrastructural facilities, inaccessibility to markets, low-level application of known technology, and some land tenure conflicts constitute the main problems associated with upland farming in the Citanduy Watershed.

Road Construction and Maintenance

Road construction, and the poor maintenance of roads, in the watershed are among the major sources of sediment to downstream areas. Road construction disturbs the natural channels for water and at the same time loosens and exposes the soil. Erosion problems are especially acute during the early life of a road when the slopes are still devoid of vegetation and a large amount of finer soil size materials are still susceptible to erosion because ground cover has not developed.

Roads are continuously being developed to provide access to additional areas of the watershed, to exploit the timber resources and to provide access for construction. In 1978 the watershed had 4,473 km of roads, including 175 km of provincial roads, 457 km of district roads, and 3,841 km of village roads. The road network still leaves many villages without proper access and almost all of the roads need erosion proofing. As previously mentioned, the current practice of clean cultivating of the road shoulders and waterways must cease. These areas, and the large amount of steep cutbank cause considerable soil loss even on the paved provincial road systems. The district road system has considerably more erosion, and the village road system is often impassible to vehicles because of road surface erosion.

The Ciamis District reportedly also has some 29 km of forest access roads; the total watershed has an estimated 80 km of forest roads. Almost all of these roads are of low quality and suffer severe erosion problems. The erosion proofing of these forest roads should have a high priority in the management budget. Efficient management of the

forest areas (44,049 ha) would also require the development of an estimated 300 km of additional access roads for management and tresspass control.

Development Trends and Problems

Severe change in local ecosystems, and consequently in the total environment, began taking place in the Citanduy Watershed about the turn of the century. The first change was the almost total removal of the tropical forest, nature's climax vegetative cover. Concurrently, rapid population growth, partly through an influx of people from other areas and islands resulted in increased demands for food production. This required the cultivation of lands less suited for cropping. Traditional agricultural practices used in upland cultivation and farming of steeper and less suitable land resulted in serious soil erosion. Severe alterations in the soil and micro-climate often brought on serious problems of vegetation and soil management. Unwise use of the agriculture resources has taken its toll by severely altering the landscape and has resulted in depletion of the soil fertility and a gradual degradation of agricultural production in the Citanduy Watershed.

In West Java the natural fertility and deep soil has somewhat hidden the gravity of the conditions and has delayed the impact of the dwindling agricultural productivity. The Cimuntur River sediment load resulting from upstream erosion is a clearly visible, and constantly shocking reminder to all observers of the insidious effects of current damages in one of the most fertile agricultural areas in the entire watershed.

Shallow and less fertile soils in the Cikawung Subbasin of Central Java severely restrict the natural agricultural potential when compared to that of West Java. Field observation shows obvious soil erosion and depletion, and an advanced degradation of agricultural resources. Growing crops, or even vegetative cover, to protect the soil is very difficult. Soil erosion and depletion of land resources are thus aggravated, resulting in more rapid land deterioration and more rapid fertility depletion. In many areas the farmers are now farming soils with a depth of 30 centimeters or less which are largely subsoil. This

is a poor and unproductive soil for food crops. The local farmers state that in the past 10 years cassava yields dropped from 8 t/ha to 1.5 to 2 t/ha. The remaining soils will require extensive conservation measures and fertilizers to improve productivity. Land use adjustments and flexible farming enterprises, including grass, livestock, and fruit trees, will be needed. The watershed area provides only a subsistance level of living for much of the population. If present trends of population growth and traditional soil and water management practices continue, the general productivity of the land will decrease even more rapidly.

As a result of repeated plowing, erosion, and leaching, some of the forest and grassland area in the watershed has deteriorated to the point where even growing grasses and trees may be difficult. In some places in Central Java, even large amounts of fertilizer may not permit food crop production. Such areas must be used for livestock forage production, forestry and limited farming operations.

Overcoming the relatively high erosion rates presents great challenges in both immediate and longer term development periods. Minimizing the gravity of the problem would serve no purpose. The farmers' poverty and lack of technical knowledge are linked to the unavailability of capital and lack of land conservation and improvement programs. All resources must be mobilized to reduce the effects of the past unwise use of the land. Appropriate fiscal and monetary policies will be necessary for establishing and implementing a continuing land and water conservation program. This program must include an attempt to develop the farmers' willingness to cooperate and to provide the information and knowledge that will enable local groups to correct past soil and water misuse.

Improving those social, economic, and physical resources will also improve production and will improve the general health of the people in the farm communities. The investment programs must give an increasingly higher priority to education and health. The investment in upgrading human resources will certainly improve the farmers' productivity and general quality of life.

A complete soil and water development program requires a reorientation of the whole structure of education and assistance to the land user. The land owner must be made a part of the decision process because he will be the person to put the plan into full and successful operation. This is paramount to the success and management of the watershed.

The Government should encourage the farmer to understand his soil and water resources and their proper management. He will then be able to use more of the scientific and technological developments available. The farmer can overcome many of his problems with a soil and water conservation program that incorporates well defined, immediate and long-term goals. The smooth integration and implementation of all social, educational, economic and technological activities designed to better meet the needs of the farmer and his family, will also improve the structure and stability of the communities and and will increase the appreciation of the success of cooperative approaches to their problems.

Observation strongly indicates that agency funds are often used disproportionately to maintain the administrative personnel structure with too little to maintain field operations. To understand and to begin to overcome this problem, management efficiency and agency objectives must be analyzed. Additionally, too many projects undertaken simultaneously dilute the strength and efficiency of each.

At present, too many agencies report data independently and no official organ checks for and reconciles discrepancies and redundancies. Data collection must become better organized, and a central publication agency (or at least a coordinated system applied by all agencies) should be established so that source material would be published on a consistent and continuing basis. Few statistics can now be used to record accomplishments of development programs.

Floods

Historical records do not indicate that floods have caused much damage in the upper watershed areas. The runoff from the steeper upland areas concentrates rapidly in the steep mountain streams, but the well developed and incised stream channels prevent much overbank discharge. There is, however, considerable local flooding of flatter rice land areas where adequate drains are not available or where the rivers overflow their banks and flood dikes.

At Banjar the Citanduy River has dropped about 1,700 meters in 85 kilometers distance; from there to the sea it travels 83 kilometers to lose the other 15 meters. Most of the flood damages occur in the downstream areas of the Citanduy/Ciseel River systems. In these areas some flooding occurs each year and reports all indicate that the damages increase each year as a result of deforestation and increased upland cropping.

Specific determination of the historical flood damage in the watershed exceeds the scope of this report. The available flood data are in the Citanduy River Basin Development Project Reports [2]: Master Plan (1975), Feasibility Report for a Comprehensive Water Management Scheme for the Lower Citanduy/Ciseel River System (1976), Appendix B-Hydrology (1974), and Citanduy Flood Control Design Report (1976).

The accurate determination of historical flood damages and trends towards increasing damages is an essential feature of a complete Upper Watershed Project evaluation. If there is a positive correlation between deforestation and annual flood damages, it will provide both an estimate of damages and a means of estimating benefits if the watershed condition trend can be reversed. This determination should definitely be a component of the future program in the Citanduy Watershed. However, it should be recognized that no watershed management program can ever be effective in reducing floods from the infrequent large precipitation events.

Erosion and Sedimentation

Introduction

Erosion occurs in our watersheds with or without the aid of man. As discussed in Chapter II, the natural or geologic erosion rate for the Upper Citanduy Watershed might have been approximately 2mm/year.

In its pristine state, approximately 3 million cubic meters of sediment was transported from the Upper Citanduy Watershed each year. Along with the sediment, nutrients were washed from the forest floor and leached from the soil and rocks. Much of the sediment and nutrients were left on the flood plain of the Citanduy River as it meandered through its lower valley. The rest was carried to the ocean, or to the Segara Anakan, there to build new alluvial land at the estuary.

The products of erosion were not destroyed, but merely moved to a new area where they were of benefit in building land and providing food for vegetation. At the same time, natural processes at work in the watershed produced 2 new millimeters of soil to replace the eroded soil.

In the initial studies for the Citanduy River Basin (1974), the sediment yield for the entire watershed was estimated at approximately 4600 $t/km^2/y$. This is approximately 6.6 mm/y, three times our estimate of what the gross geological erosion might have been.

Where does the sediment come from?

Definition of Terms

Not all soil eroded from the landscape is carried off to the rivers and subsequently to the sea. Most of the eroded soil particles travel only a short distance before being deposited, in a micro-depression or in a clump of grass, for example. A precise vocabulary is necessary for accurate communication; therefore, the latest definitions published by the American Society of Civil Engineers are included with specific applictions to Java[3]:

Erosion is the loosening or dissolving and removal of soil or rock materials from any part of the earth's surface. Erosion is often differentiated according to the eroding agent (wind, water, rain-splash) and the type of source (sheet, gully, rill, etc.).

Sediment is the particulate matter of mineral composition derived from the soil or rock by erosion.

Sheet erosion is the wearing away of a thin layer of land surface. This includes rill erosion unless otherwise specified. Sheet erosion is the principal mode of erosion in the Panawangan erosion control pilot watershed and is severe on the upland farmed areas.

Rill erosion is the removal of soil by small concentrations of flowing water, with the formation of channels that are small enough to be smoothed completely by normal mechanical cultivation methods. Rill erosion is very common on road-cut slopes in Java.

Soil loss is the quantity of soil actually removed by erosion from small test areas. In large areas most of the soil which is eroded is not removed from the area. The Panawangan Pilot Watershed research areas were selected to be very small so that the soil loss could be estimated.

Gully erosion is the removal of soil by concentrations of flowing water sufficient to cause the formation of channels that cannot be smoothed completely by normal mechanical cultivation methods.

Sediment delivery ratio is the measure of the diminution of eroded sediments, by deposition, as they move from the point of erosion to any designated downstream location. This is also expressed as a percentage of the eroded material that reaches a given measuring point. In very small watersheds, the sediment delivery rates are almost 100%.

Sediment yield is the total sediment outflow from a watershed or drainage basin, measurable at a cross section of reference in a specified period of time.

Rate of erosion is the rate at which soil is eroded from a given area. This is usually expressed in volume or weight units per unit of area and time. When the areas involved are small, the rate of erosion, soil loss, and sediment yield are equivalent.

Suspended sediment particles are held in suspension in flowing water by the turbulence in the flow. The turbulence is generated at the boundaries of the channel; that is, on the soil surface and on the bed and banks of rills, gullies, and other channels. Turbulence is also generated by twigs, grass, branches and other obstructions in the flow.

Individual silt and clay particles are transported almost entirely in suspension. The individual particles have a large surface area in comparison to their weight. The hydrodynamic forces that act on the surface area are sufficient to keep almost all particles in suspension. Most sediment in the Citanduy River system is suspended sediment.

Sand is transported as suspended load, but the turbulence level must be greater to keep sand particles in suspension. The particles are spherical in shape and have a larger weight-to-surface area ratio than silt and clay particles.

Bed load consists of unsuspended sediment. Some gravel may move in suspension but most is rolled and bounced along the bed of the stream. Cobbles and boulders rarely move as suspended sediment. They are also bed load.

Sediment transport is the total amount of sediment carried along by the flowing water and consists of the suspended load and the bed load. Common units employed are kilograms per second (kg/s) or metric tons per year (t/y).

It is convenient to look at the sediment transport in two components: the wash load and the bed-material load.

Wash load - Once the silt and clay gets out of the rills and into the gullies and larger channels, the turbulence in the flow can, in most cases, carry away all sizes of sediment being supplied. That is, the amount of silt and clay carried by the larger streams is dependent only on the amount supplied and not on the properties of the channel or the flow. This fine part of the sediment load is called the wash load. Most of the sediment in the Citanduy River system is wash load.

Bed-material load is the sediment transported in the stream is dependent on the properties of the channel and the flow. Bed-material load is almost always made up of the coarsest particles: sand, gravel, cobbles, and boulders. If the flow velocity in the channel is large, bed-material transport is very large; if the velocity is small, very little bed material is transported. When the capacity of a stream to carry bed-material load decreases, material is deposited on the bed of the stream, thus the origin or the term. Bed-material is sediment found in appreciable quantities on the bed of the river.

In the Upper Citanduy Watershed, gravel, cobbles and boulders are derived predominately from mass wasting and gully erosion in the catchment. A portion is derived from the lateral movement of the larger rivers. In some areas, the supply of sediment is so large, the streams downstream from the gullies cannot transport all the silt and clay, let alone the larger sizes. Then the silt and clay are deposited along with the normal bed load and the streambed aggrades or rises.

Geologic or Natural Erosion

Natural erosion is a watershed's rate of erosion that is not affected by man's influences. It is also known as "geologic erosion" and is one of the major factors in landform evaluation. In truth, it is more a concept than a precise phenomenon. Perhaps it would be better to define it as erosion unaffected by modern man's activities since it is

relatively recent that man acquired the ability to really transform the landscape to his purposes.

Natural erosion rates vary greatly because of the great difference in weathering rates of parent rocks; the differences in rainfall amounts, intensity, frequency, and type; and the effects of various vegetation types on total ground cover.

Mass Wasting. Mudflows are the most fluid form of mass wasting; that is earth movement in response to gravity. The drier processes are earthflows, slumps, debris avalanches, soil creep, and land slides.

Mass wasting occurs where slopes are steep and is usually triggered by earthquakes or heavy rainfall. Mass wasting in the form of slumps and slides is common in the Upper Citanduy and Cijolang Watershed.

Channel Erosion. Channel erosion is the removal of material from the banks and beds of waterways in the catchment. In this case flowing water may be the agent causing the erosion or it may be merely the conveyor of the eroded material.

In the entire Citanduy Watershed, gully erosion in the upland areas is the dominant form of channel erosion and is almost entirely of the accelerated type. The main river system of the watershed is well developed, and only limited streambank erosion occurs under the present regimen, but this would be subject to change if these same streams were carrying clear water.

Gully erosion is characterized by the severe downcutting of the channel bed, followed by the widening of the channel as the banks cave in and the material is eroded. Gully erosion advances in the upstream direction, and generally all tributaries to the gully become eroded in the same manner.

The process whereby gully erosion is initiated is complex and not well understood. In an effort to help predict the initiation of gully advance, Schumm (1977) put forth the concept of threshold geomorphology [4]. In its simplest context, gully erosion begins as a result of exceeding an "erosional threshold", which is the set of conditions or stage at which the effect is produced. This can be the result of in-

creased flows upstream or disturbance of the natural cover in the stream channel or any number of other factors. The resulting change from stream channel to gully is quick and dramatic. In the Citanduy Watershed development of gullies is almost entirely related to man's activities.

When left to nature, gullies sometimes do fill themselves in, then recycle into the erosional state many times. However, the time span for recycling is too slow to be of any value for watershed management; that is, we cannot expect gullies to heal themselves in the time span of an erosion control project.

Geological Erosion Rates. Geological erosion estimates are usually made to determine of the amount of sediment carried by rivers to the sea. Throughout much of the world, this rate in relatively undisturbed watersheds ranges from 0.03 mm/y to 1.0 mm/y.

Studies of erosion in Indonesia, early in this century, indicated that the geologic erosion rate in volcanic areas of Java were about 2.0 mm/y, which was the rate estimated for the Citanduy Watershed with a very low population density.

Accelerated Erosion.

Accelerated erosion is the degree of man-caused erosion beyond the normal or geologic erosion. In the Citanduy Watershed, the major activities by man that have caused accelerated erosion are: removal of the original vegetative cover, upland farming, road construction, timber harvesting methods, and other unwise uses of the watershed resources.

Accelerated erosion occurs when the stabilizing vegetation is destroyed by man and is no longer able to hold the soil against the eroding forces of nature. Such erosion is generally the aftermath of vegetation removal or diminution of the vegetative cover. Since this is caused by man, man's wise use of the resources may reduce or correct accelerated erosion, although this may require that that particular resource not be used for anything but watershed lands. Corrective measures can consist of altering the land-management systems so that nature can rebuild the damaged ecosystem. However, if erosion is far advanced, waiting the necessary decades for nature to rebuild the eco-

system may be impractical. In these cases, speeding up natural healing processes by mechanical structures and by reestablishment of vegetation may be necessary.

Since reduction in vegetative cover is the primary cause of accelerated erosion, vegetation is also the chief weapon in controlling erosion. The land manager or planner must determine the highest and best use of the land from a scientific, social, and economic viewpoint.

Two major factors control the erosion of soil. The first is the particular soil's resistance to erosive forces, and the second is the protection provided by the natural vegetation or by the crop being grown on the land.

Studies at different locations in Java indicate that soils derived from sedimentary rocks are approximately 5 times as erodible as residual soils derived from volcanic rocks [5]. Even though the volcanic rocks are weathered in place to depths of 50 m and the dry unit weight of the soils is less than 1,000 kg/m^3, the ionic forces developed between the soil particles, when the soil is wet, resist erosion very well.

The erodibility of some of the broad classification of soils found in the Citanduy Watershed was discussed in Chapter II, but no real definition of the erodibility of the watershed soils has been attempted to date. This information, very important to the development of a watershed management program, must be the object of investigation in the development of a program in any planning area. Unfortunately, the lack of good base maps, aerial photography and trained soil scientists to do the field mapping. Mapping of upland soils is much more difficult than mapping of riceland soils in irrigated or potentially irrigated areas because of the more limited accessibility of upland areas and the much larger variability in factors to be mapped.

Citanduy Sediment Measurements

Introduction

Suspended sediment discharge measurements were made at intervals at a number of streamflow stations in the Citanduy Basin from 1970 through 1974. However, the measurements only cover flow up to medium high water. From the measurements of sediment concentration and discharge at the various sampling stations, rating curves were made with which to estimate sediment transport. With these curves and the average daily streamflow from the gaging station records, average daily transport rates were estimated. The estimate is based on four years' streamflow data and the sediment measurements made during 1970-74.

A detailed description of the methods used, including the sediment rating curves, is available in the Appendix B - Hydrology report prepared by ECI in November 1974 [2]. Inspection of the sediment transport calculations indicates that over half of the annual load occurs when the very large flows are in evidence, perhaps 5 percent of the year.

Due to lack of proper sampling equipment during the sediment sampling program, not only was collection of samples impractical during high flows but determination of bed load was not included in the surveys.

Analyses of suspended samples collected in the Citanduy River system show that the suspended sediment is mostly silt. The river waters in the Citanduy basin have a very turbid appearance. The Citanduy proper and its tributary, the Cimuntur River, are reddish in color except at very low flows. In the Cojolang River and the Cikawung River, suspended sediments give the water a more grayish appearance.

A tabulation of the grain size of a typical sample of suspended and bed load sediment taken from Citanduy River at Cikawung is shown below:

	Percent of Sample by Weight	
	Suspended Load	Bed Load
Clay	35	--
Silt	55	--
Fine Sand	10	50
Coarse Sand	--	48
Gravel	--	2

The size classification used in erosion and sedimentation engineering is given below:

Size Classification

Class Name	Size Range (mm)
Clay	0.00024 - 0.004
Silt	0.004 - 0.062
Sand	0.062 - 2.000
Gravel	2.00 - 64
Cobbles	64 - 256
Boulders	256 - 4096

Sediment Yield

Using the results of suspended transport, calculated from reports of various sediment sampling stations during preparation of the above mentioned Appendix B, estimates of total sediment load have been made for selected stations. In these computations, the bed load is assumed to equal 15 percent of the total load except for the Cijolang River where the bed load is assumed to equal 25 percent of the total load. This increase was based on a visual inspection of the bed load materials at the Matenggeng damsite. The estimated sediment yields are shown in Table III-1, and locations of the gaging stations are shown in Figure II-9.

The values of sediment yield for the Batununggul station, given in Table III-1, have been revised from those given in the original report. The revised value agrees better with the other values in this general area.

The erosion rates given in Table III-1 are based on field iata collected only during periods of medium to low flows. More recent studies made on other streams in Java indicate that these erosion rates may be too low. In addition, erosion rates have increased since the data had been collected. The present-day sediment yields may in fact, be twice those given in Table III-1.

The design of river development systems requires refinement in the calculations and estimates of sediment yield and the requisite sediment measurements at higher river flows. However, these sediment yield rates for the Citanduy Watershed may be used in a comparison of erosion studies made by empirical formulas based on land use, proper terracing, and vegetative cover.

Comparison of Subbasins

The information in Table III-1 and the geologic, forestry, land use, and topographic maps yield certain conclusions concerning erosion in the Citanduy Watershed.

The Upper Citanduy River drains the west side of Volcano Sawal. The area is young volcanic material and has deep soils. The topography is steep and there are 12,000 ha of protected forest and plantations. The equivalent erosion rate given in Table III-1 is 5.7 mm/year, approximately three times the pristine rate.

The Cimuntur Subbasin is also on young volcanic materials. The topography is steep. Approximately 75 percent of the area is forested and a sizable area of private land is critically eroded. The Panawangan Pilot Watershed is within this area. The equivalent erosion rate, given in Table III-1, is 7.4 mm/year.

Some observations of mass movement and unusual land management practices in the Cimuntur Subbasin are presented below:

Road cuts in this mountainous area are steep and long. Erosion of the slopes occurs with and without the aid of mass movement or water. The drying out of the soil in the banks of cuts causes cracking and the soil particles travel down the slope to the drains. Excess runoff, primarily from the road surface, collects in the ditches and transports the sediment down the slope and into the river system. Roadways appear to be a major source of sediment, on a per unit area basis, in the entire Citanduy catchment.

In other areas, farmers have terraced the stream beds down the small valleys and a tiny waterway is left along one edge of the terraces. The walls of the valley have been used to provide the soil for the terraces. The walls are left very steep, and when slope failure occurs, the material slides into the waterways. Some of this slide material is used to widen the cropped area of the small valley; the rest is sluiced downstream in the waterway.

This system of terraces with small waterways works very well for small storms. Much of the water is stored in the paddies, and the small waterway transports the rest. When larger storms occur the terraces are washed away, providing a large amount of sediment to the downstream river system. After the storm, the farmers re-build the terraces with soil from the valley walls.

The sediment yield in the Cimuntur Area varies greatly from one small watershed to another. For example, on the east side of Sawal Volcano, one stream is red with sediment and bars of silt deposited along the banklines. In a neighboring stream, clear water cascades down a riverbed covered with large boulders. In general, more sediment is obtained from the east side of the volcano than from the west side, which may be partly a function of precipitation amounts.

The residual soils on Sawal Volcano and the hill areas are being eroded by rainfall impact and by stream channel cutting. These areas are currently being cropped. Within the river channel system active bankline erosion is taking place.

The Cijolang Subbasin is mostly on young sedimentary rock. Thirty percent of the area is young volcanic products. The topography is steep. One-half the area is protected by forest and plantations, but the other half is private land and future erosion rates in this watershed are expected to be much larger than the equivalent erosion rate of 3.4 mm/year given in Table III-1.

The Cikawung Subbasin is mostly in sedimentary rock. However, nearly 2 percent of the area is alluvial along the main river. The topography is not as steep as in the areas previously described. The equivalent erosion rate is 5.7 mm/year. However, at present the landscape appears more devastated than the sediment yield indicates. Probably the erosion rate is very large in the upper reaches of this catchment, but most of the sediment is being stored in the alluvial part of the watershed along the river.

Reconnaissance of the area between the Cijolang and Cikawung subbasins has indicated erosion on private land is severe. In addition to poor upland farming practices, land slides, resulting from a weakening of the soil by percolation from irrigation ditches, aggravate erosion.

Nearly one-third of the Ciseel-Lower Citanduy Subbasin is flat alluvium. Almost all of the remainder is on sedimentary rock. The measured sediment data from the Ciseel River System are too sparse to estimate the sediment yield.

In the lower Citanduy River basin, the land is almost entirely alluvium. The topography is flat. This is the rice producing area, and a depositional area for sediment carried down during floods. However, along the river banks, some erosion occurs in the form of slip-circle failures of the riverbank. The failures, a few meters in length, produce a scalloped appearance of the bankline in reaches where many failures occur. Nevertheless, there is no net river channel migration because the slip-circle areas fill in with sediments deposited by the river, as much as 15 cm of new deposits have been measured immediately after a single flood.

A study of aerial photographs and of old hydrographic and topographic maps of the Segara Anakan and the Indonesia Ocean at the mouth of the Citanduy River shows an alarming increase in the sedimentation rate in the Segara Anakan during the last decade. At the same time, the rate of growth of beaches in the coves at the mouth has been greatly increasing. Both the increase in filling of the estuary and the beach building are very good indicators of increased erosion upstream.

All the information available indicates erosion in the uplands of the Citanduy River Basin is severe and increasing. The continued loss of the soil resources of Java in untenable. This trend must be stopped and reversed.

From a technical point of view, the answer is simple: "good farming and forestry practices". By using the universal soil loss equation we can predict how much soil can be saved through various management practices.

Prediction of Soil Losses with the Universal Soil Loss Equation

The universal soil loss equation was developed by the U.S. Department of Agriculture with experimental data collected from cultivated plots [6,7]. The purpose of the research was to develop a method of predicting soil loss from agricultural land under various cropping patterns and conservation management programs. In general, the equation can be used to predict erosion from small fields but not from larger watershed.

The universal soil loss equation is presented in the form

$$A = RKLSCP$$

in which

A = Average soil loss, t/ha

R = rainfall erosivity factor, tm/ha

K = soil erodibility factor, t/ha/unit of R

L = slope length factor

S = slope gradient factor

C = crop management factor

P = erosion control practice factor

The rainfall erosivity factor, R, is a number indicating the impact power of the rain and the erosive power of moving water. The expression for this factor is

$$R = \frac{EI_{30}}{100}$$

in which

E = kinetic energy of the storm rainfall, tm/ha

I_{30} = maximum 30-minute intensity during the storm, cm/h.

The component of E occurring during a fraction of the storm (Δt) is

$$e = p\ (210 + 89 \log i)$$

in which

p = amount of storm rainfall in time, Δt, cm

i = intensity of rainfall in time, Δt, cm/h

Then for the storm

$E = \Sigma e$

and

$P = \Sigma p$

the summation being for all increments of time Δt comprising one storm. Here P is the total storm rainfall in cm.

Researchers in Indonesia [8] have shown that, when averaged for many storms

$$E = 247\ P$$

and

$$I_{30} = \frac{P}{0.073P + 0.73}$$

These two equations were developed from rainfall records for the tropical storms experienced in Indonesia. Then

$$EI_{30} = \frac{247\ P^2}{0.073P + 0.73} \quad \text{or} \quad R = \frac{2.5\ P^2}{0.073P + 0.73}$$

Annual values of the erosivity factor, R, in Indonesia range from approximately 1900 tm/ha to 8000 tm/ha.

When only monthy rainfall records are available, the rainfall erosivity factor R can be estimated using the expression

$$R = 6.12\,(P_m)^{1.21}\,(N)^{-0.47}\,(P_{max})^{0.53}$$

in which

R = average monthly erosivity factor, tm/ha

P_m = average monthly rainfall, cm

N = average number of days with rain per month

P_{max} = average maximum precipitation in 24 hours for every month.

Values of average monthly rainfall, number of days with rain, and maximum precipitation for rainfall station Panjalu, adjacent to Panwangan, are presented below. The data are from the period 1952-1968.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pm	35.4	31.4	35.1	28.7	21.1	12.3	9.4	7.1	8.3	19.1	31.2	36.7	275.8
N	15.2	14.7	14.9	12.4	8.4	8.2	10.2	6.9	6.4	8.9	14.2	15.9	136.3
P_{max}	6.8	6.3	6.4	6.5	5.8	4.5	3.3	2.8	4.1	4.8	6.5	6.1	----
R	352	297	341	294	229	105	58	46	70	179	305	340	2,616

Under field conditions, the distribution of erosive rainstorms within the year in relation to seasonal vegetative cover and crop residue effects is very important. High intensity rain when there is little foliage produces much more erosion than when the crops have maximum foliage.

The soil erodibility factor, K, is a measure of the rate at which a soil erodes under standard conditions of slope and cultivation. The factor is the rate of soil loss from a hectare of land 22.1 m long with a 9 percent slope under conditions of continuous fallow when the rainfall erosivity factor is unity.

Values of K are determined from plot studies on various soils. In the Pacific, K values have been obtained in Hawaii [9] and Indonesia [6]. In Java, soils derived from volcanic rock have K values approximately one tenth of those derived from marine sediments. Typical

values are 0.03 and 0.3 t/ha/unit of R. Values of K obtained in Hawaii range from 0.2 to 1.1 t/ha/unit of R. In the mainland United States, K varies from 0.04 to 1.6 t/ha/unit of R.

The slope length factor, L, is the ratio of soil loss from a specific length of slope to that with a length of 22.1 m. The slope length is the distance from the point where overland flow begins to the point where the slope decreases enough that deposition begins or to the point where runoff enters a well-defined channel that is part of the drainage network.

The L factor is given by the expression

$$L = \left(\frac{a^m}{22.1} \right)$$

in which

a = length of slope, m

m = 0.5 if the slope is greater than 5 percent

m = 0.4 if the slope is 4 percent

m = 0.3 if the slope is 3 percent or less

The slope gradient factor, S, is the ratio of soil loss from a specific percent slope to that on a 9 percent gradient. The expression for this factor is

$$S = \frac{430 \sin 2\theta + 0.43}{6.57}$$

in which

θ = slope angle, degrees

The crop management factor, C, is the ratio of soil loss from land cropped under specific conditions to the corresponding loss from tilled continuous fallow. In physical, terms the crop management factor describes the effect of vegetation in protecting the soil from erosion. Continuous fallow is land that has been tilled and kept free of vegetation for a period of at least three years or until prior crop residues have decomposed.

Because there are many combinations of crops and soil management, the crop management factor is widely variable. Crop residue can be removed, left on the surface, or plowed under. Seedbeds can be left rough with much available surface capacity to absorb rainfall, or they can be left smooth. Different combinations of these variables have different effects on soil loss.

The effectiveness of crop residue depends on the amount of residue kept on the surface. The canopy protection of crops depends on the type of vegetation and varies greatly in different months or seasons. Therefore, the overall erosion reduction effectiveness of a crop depends largely on how much of the erosive rainfall occurs during the periods when the crop and crop residues provide the most protection.

Some typical crop management factors are:

Crop	C Value
Bare, continuously fallow, up and downhill cultivation	1.00
Upland rice at 0.2 x 0.3 m followed by goundnuts	0.45
Upland rice followed by fallow	0.71
Sorghum at 0.2 x 0.5 m	0.30
Sorghum at 0.3 x 0.6 m	0.61
Cassava	0.51
Peanuts	0.4 to 0.8
Palm trees, coffee, coco with cover crop	0.1 to 0.3
Savannah, prairie in good condition	0.01
Forests, dense shrubs, high mulch crops	0.001

The erosion control practice factor, P, is the ratio of soil loss from a plot with specified conservation practice to the soil loss occurring from up and downhill tillage operations when other conditions remain constant.

Terraces are effective mechanical practices used to reduce soil loss. Typical P values for terraces in Indonesia range from 0.03 to 0.05 for the benched type and from 0.10 to 0.50 for the broad base conservation terraces. Terraces in shallow soils sometimes have P values greater than 1.0.

The universal soil loss equation's primary value is its use in comparing different crop and conservation practices. We can use the equation to predict how much soil can be saved. The two multiple factors are the crop management factor and the erosion control practice factor.

The factor C is by far the most important manipulative factor. In fact, as long as the vegetal cover is uninterrupted, whether it is forest, bush, savannah, pasture land, or a simple mulch, erosion and runoff are small despite the erosivity of the rainfall, slope steepness, and soil instability. Studies show that when the soil is totally denuded in the tropics, erosion becomes catastrophic; soil losses are multiplied by 100 to 1,000 and the flow by 20 to 50. Under cultivation, the erosion is intermediate and varies to a large degree according to the type of crop, the rapidity with which it covers the soil, and the cultural techniques put into use to encourage its growth. Density and earliness of planting, cultivation of the soil, appropriate fertilizers, and return of plant residues play predominant roles.

Control of erosion by crop management is just <u>good farming</u>. The costs are low and the benefits are high. Soil loss from agricultural land should be reduced to no more than 5000 $t/km^2/y$ in the hilly tropics.

Many erosion control practices cost very little. Intercropping cultivation and contour cultivation are two inexpensive methods. Mechanical measures, such as bench terraces, are very effective but more expensive.

The amount of soil saved in upland areas by good management practices is illustrated in the comparisons summarized in Table III-2. Here it is assumed that R = 2616 tm/ha/y, and that K for the soil is 0.25 t/ha/unit of R. Then

$$R \times K = 654 \text{ t/ha/y}$$

For comparitive purposes, we have chosen a slope length of 100 m and a slope gradient of 20 percent. Then

L = 2.13

S = 3.48

so

LxS = 7.4

and

KRLS = 4850 t/ha/y

If the objective is to decrease the sediment yield from the cropland in the upper watershed to 5000 $t/km^2/y$, Table III-2 indicates that cassava is not a suitable crop even when planted on terraces. Cocoa on benched terraces has a low soil loss and meets our requirement. The high mulch crops have very low soil loss, with or without terraces.

Other supporting practices that minimize erosion from croplands are contour tillage and contour strip cropping.

For the upper watersheds in the Citanduy River Basin, terracing is proposed as the basic control practice. If terraces are properly constructed, a value for P of 0.10 or less appears to be realistic, in view of findings of project ATA 105 [5].

REFERENCES

1. B.B. Jasmin, "Grassland Uses: Effects on Surface Runoff and Sediment Yield," Silvatrop, Philippine Forest Research Journal, Vol. 1, No. 2, April - June 1979.

2. Engineering Consultants, Inc., "The Citanduy River Basin Development Project, Master Plan" Series of reports. prepared for the Ministry of Public Works and Electric Power, Directorate General of Water Resources Development, Directorate of Rivers and Swamps, Republic of Indonesia.

3. ASCE, "Sedimentation Engineering," Manual and Reports on Engineering Practice No. 54, 1975, ed. Vita A. Vanoni.

4. S. A. Schumm. The Fluvial System. (New York: John Wiley & Sons 1977).

5. Belgian Technical Assistance Program, "Report on activities of project ATA 105," Soils Physics, April 1976 - March 1977. (Bogor, Indonesia: Soil Research Institute 1977).

6. W.H. Wischmeier, D.D. Smith, and R.E. Uhland, "Evaluation of Factors in the Soil-Loss Equation," Agricultural Engineering, 39, 8 (1958), pp. 458-462.

7. Agricultural Research Service, 1975, "Universal Soil-Loss Equation," Agricultural Handbook 282. U.S. Department of Agriculture.

8. P.S. Bols, "The Iso-Erodent Map of Java and Madura, Belgian Technical Assistance Project ATA 105," (Bogor, Indonesia Soil Research Institute, 1978).

9. S.A. El-Swaify and E.W. Dangler 1976. "Erodibilities of Selected Tropical Soils in Relation to Structural and Hydrologic Parameters," Erosion Control Prediction and Control, (Soil Conservation Society of America 1976).

TABLE III-1

ESTIMATED TOTAL SEDIMENT YIELD

River	Gaging Station	Station No.	Drainage Area km^2	Average Daily Discharge m^3/s	Sediment yield $t/km^2/year$	Equivalent Erosion Rate mm/year 1/
Upper Citanduy	Cirahong	2	627	46	4,000	5.7
Cimuntur	Batununggul	7	578	42	5,200	7.4
Citanduy	Banjar/ Pataruman	3	1,314	86	4,800	6.9
Cijolang	Cikadu	9	382	25	2,400	3.4
Cikawung	Cimei	10	550	37	4,000	5.7
Citanduy	Cikawung	4	2,515	182	5,300	7.6
Citanduy	Karangsari	5	2,540	187	4,300	6.1

1/ It is assumed that the dry unit weight of the residual soil is 0.7 ton/m^3.

TABLE III-2

COMPARISON OF FARMING AND MANAGEMENT PRACTICES,
UNIVERSAL SOIL LOSS EQUATION

Practice	C	P	A t/ha/y
Cassava with no erosion control	0.51	1.00	2,470
Cassava with benched terrace animal control grassed riser	0.51	0.03	74
Cocoa with a cover crop	0.01	1.00	485
Cocoa with a cover crop, benched terrace	0.10	0.03	15
High mulch crops, no management	0.001	1.00	4.8
High mulch crops, benched terrace	0.001	0.03	0.2

CHAPTER IV

PREVIOUS PROGRAM AND STUDIES

Panawangan Pilot Watershed

The Panawangan Pilot Watershed Demonstration Project was created to exemplify important soil and water management practices and to establish conservation practices and programs applicable to all of Java. The main purpose was to determine which soil and water conservation practices and community development techniques that would maintain a stable and productive upland agriculture in the Citanduy Watershed. The general consensus is that this program has been successful. A more complete discussion of this project is contained in a report entitled "The Panawangan Pilot Watershed: Its Implementation and Evaluation," Draft Report June 1979, by Engineering Consultants, Inc.

Watershed Description

The Panawangan Pilot Demonstration Project is located in the Cimuntur Subbasin (Figure II-2). The watershed area is on the west side of the Ciamis-Cirebon highway in the northern part of the Ciamis District (Figure IV-1). The village of Cibogor is on the east boundary, the village of Cibariwal is on the west boundary and the village of Ciracak is near the center in subwatershed No. II. The subdistrict village of Panawangan is immediately north of the watershed area. The pilot watershed is divided into 12 subwatersheds, with a total area of 365.9 ha, and a control watershed to the west, consisting of the upper Ciyansang River drainage of 78.0 ha. Conservation practice recommendations were not made in this comparison watershed. To date subwatersheds II through VI, with a 213.5 ha drainage area of the Cicarenang River, constitute the watersheds primarily treated.

The history of the watershed area indicates that it consisted of native vegetation until a short time before the turn of the century, when tea plantations were established. Over time, economic losses caused by tea diseases caused the plantations to convert to coffee. The coffee plantations were neglected during the Japanese occupation in World War II and they never recovered. Upon Indonesian independence, the plantation areas were divided into the small-area ownership pattern found today. Much of the area raised citronella grass, but recent low prices for citronella oil have resulted in the decline of this cash crop. Most of the area is now devoted to raising food crops.

Where citronella grass is found on the slopes and deteriorated terraces, serious erosion is taking place. This erosion is evident from the stcols of citronella high above the soil surface, indicating that the surrounding soil has been washed away. In an effort to discourage citronella sowing, the Ciamis Bupati issued an edict in the early 1950's stating that citronella was not a good plant for soil conservation. Citronella also produces chemicals that tend to inhibit growth of other plants for several years thus impeding rehabilitation of citronella grass areas.

Most of the Panawangan Pilot Watershed had poor quality terraces before the project's initiation. These terraces were constructed with improper gradient along the contour, sloped toward the terrace's outer edge, and lacked a disposal system for excess water. These traditional terraces do not significantly increas crop production or reduce soil erosion, surface runoff, or downstream sedimentation.

These well-known watershed problems are found over large areas where population growth has forced the cultivation of ever steeper upland areas without proper conservation measures. The farmers generally recognize that their main problem is the lack of land and capital resources, but they do not recognize that the lack of training and knowledge of improved crop varieties, proper use of fertilizers and pesticides, and proper use of conservation farming techniques may be considerably more important. In short, the inadequacy of human resources may be one of the major problems of the area.

Table IV-1 provides the area measurements from the land capability map for the 12 treated subwatersheds (365.9 ha) of the Panawangan Pilot Watershed. This analysis shows that 39.5 ha (10.8 percent) is suitable for growing paddy rice, 106.7 ha (29.2 percent) with slopes of from 0 to 50 percent is suitable for upland crop production, and 219.7 ha with average slopes greater than 50 percent should always have a permanent vegative cover of trees and/or grass. Table IV-2 delineates the May 1979 land use in the Panawangan Pilot Watershed. These two tables permit the following comparison between land capability and land use:

Land Use	Percent Slope	Land Capability Classification (ha)	May 1979 Land Use (ha)
Paddy Rice	0 - 8	39.5	32.9
Upland Crop	0 - 50	106.7	81.3
Forest and Grass	50+	219.7	251.7
Total		365.9	365.9

This analysis ignores other land uses such as roads, trails, streams, and villages, but it does indicate that the Panawangan Pilot Watershed area is basically being used within its capability. This statement, of course, assumes that of the 81.3 ha of upland cropland, the remaining 26.5 ha of traditionally terraced land will be bench terraced in the near future. It should be realized, however, that the 39.5 ha of Land Capability Class IV (Table IV-1) with slopes of from 25 to 50 percent is not suitable for crop production without very intensive conservation measures. These measures must be very well maintained; otherwise, a large storm may cause their failure and considerable erosion will occur. Installation of conservation measures does not change land capability, but it does permit use of land unsuitable without their installation.

Project Implementation

The Final Design Report of the Panawangan Pilot Watershed Conservation and Development Project, was submitted in 1976, and specific funding was available for project works in November 1977. The program was implemented on the 6.1 ha Pilot Demonstration Farm, which originally

was 5.0 ha but subsequently added some land from the Panawangan Watershed because of overlapping ownership patterns (Figure IV-1). During fiscal year 1977-78, the budget for implementation which came through the Directorate of Rivers, did not become available until November of 1977. This caused considerable difficulties in that the farmers resented building terraces in the month of November when crops normally would have been well established. This budget was never fully spent because of many purchasing restrictions and delays in money availability.

During fiscal 1978-79 the budget was allocated as a Sectoral Project, but no allocation was made for the Pilot Demonstration Farm. The lack of consultant counterparts from Forestry and Food Crops also created problems. Work on the Pilot Demonstration Farm was conducted with limited special funds from Project Citanduy and USAID. Supervision, data collection, and field assistance work was done voluntarily by some of the Ciamis Technical Staff, P_3RP DAS, and the farmers from Ciracak, Panawangan.

The 1979-80 budget was allocated as a Sectoral Project with an allocation of 38.4 million Rupiah to the Directorate General of Water Resources Development and 60.5 million Rupiah to the Ministry of Agriculture with specific departmental allocations to the Directorate General of Food Crops, Directorate General of Forestry, Directorate General of Fishery and Directorate General of Animal Husbandry. Work on the Panawangan Pilot Watershed includes the design and installation of two measuring weirs at the junction of the Cicarenang and Cinyangsang Rivers to measure runoff and silt load from the control and treated watersheds. It also includes funds to continue the terrace construction, other conservation construction, and the greening or reforestation works. This budget also includes funds for work on the Karang Pucung Pilot Watershed area in the Cikawung Subbasin.

Soil and Water Conservation Program

Topographic, soil survey, and land capability maps were available for the entire watershed prior to the implementation stage, and after funding became available, planning immediately began for conservation measures on the Pilot Demonstration Farm in subwatershed No. II. On

the demonstration farm, each farmer, individually working on his own land, constructed terraces. This approach was impractical because it was difficult to supervise and maintain uniform terrace quality. Variable width terraces were constructed because it is very difficult to fit a uniform two-meter wide bench into the existing terrace system. The farmers also seemed to be more comfortable with the relatively narrow and variable width terraces they were accustomed to using. For the balance of terrace construction throughout the watershed, the Forest Department used a crew of 18 to 20 farmers working together as a gang to construct terraces. Supervision and quality control were much easier and resulted in more uniform terrace quality. Initially, some difficulty was also experienced in waterway location to fit the terrain and hydrologic considerations. Experience has shown that terraces and waterways must be constructed without considering property boundaries in order to attain terrace uniformity throughout the contour and to use the waterways efficiently to obtain drainage of the terraces.

The original plans called for the construction of a wide variety of diversion terraces, bench terraces, check dams, gully stabilization by drops and forest trees, stone drop structures, small irrigation canals for production of home gardens, and fish ponds. Perhaps unfortunately, the structural program focused on construction of bench terraces and waterways with bamboo drop structures. Conservation (contour) terraces were used only for forest and grassland areas, which resulted in some loss in the demonstration function of the Pilot Demonstration Farm, but did promote successful bench terracing program for the balance of the Panawangan Watershed. This approach can be partially justified in that other types of terraces and erosion control structures for gullies are being studied at Waspada (near Garut) and at the Solo Project Area, but future work in the Panawangan and Karang Pucang Pilot Demonstration Watershed should be expanded to include construction and evaluation of additional types of conservation structures and erosion control measures.

Another significant change made in the implementation phase was the use of Subwatershed I as a small control watershed. In the original plan, this subwatershed was one of the treated watersheds. This usage was changed when the decision was made to install sediment traps and flumes at the outlets of subwatersheds I and II to measure the

effects of untreated versus treated watershed areas. The results of this measurement program are discussed under sediment and runoff measurement in a later section of this chapter.

Records of specific accomplishments in conservation measures were not kept for many practices, and many practices applied have not been specifically measured. Therefore, only a partial record is available for conservation measures applied to the Panawangan Pilot Watershed between November 1977 through May 1979, but Table IV-2 summarizes most of the specific measures applied in this period.

This conservation work may be summarized as follows:

Item	Units	Accomplishment
Bench Terrace	ha	54.8
Waterways	m	19,346.0
Drop Structures	no.	4,345.0
Sodding of Structures	m^2	275,363.0
Tree Planting	ha	183.8
Grass Planting	ha	55.4
Conservation Terraces	ha	55.0

In addition to the above measures, construction was completed on about 0.6 km of stone surfaced road with proper erosion proofing. An access road was also built from Ciracak Village to subwatersheds III and IV. Other roads and trails in the area have been improved, but neither the improvements nor the cost of the work have been recorded.

As shown in Table IV-2, a total of 54.8 ha of bench terracing had been completed in the Panawangan Pilot Watershed as of May 1979. An additional 26.5 ha of traditional terrace will presumably be bench terraced if the program continues in the present fashion. Nearly the entire area of bench terraces in the Panawangan Watershed Project had some type of existing traditional terraces. Table IV-4 summarizes the available cost data for terracing and other conservation works in the Panawangan subwatersheds II, III, IV, V, and VI to April 1979. The total area terraces in these Subwatersheds is 46.4 ha, and no cost information

is available for the other 8.4 ha of terracing that is reported to be complete as of June 1979.

The Pilot Demonstration Farm totaled 4.0 ha of terracing, which was completed by the local farmers with an incentive payment of Rp. 50,000 to 70,000/ha of land that they owned. As previously mentioned, the balance of the terracing was completed under the supervision of the P_3RP - DA3 Citanduy staff with a payment based on Rp. 300 per man-day(md). The labor charges for terracing and waterway construction on 46.4 ha amount to Rp. 8,077,913, or Rp. 174,100/ha terraced. Note that this figure accounts for the government cost of labor for terrace construction; and the farmers' contribution is not included in the labor costs. The farmers' labor contribution probably approaches the government cost, both from the level of pay for terracing relative to other regional wage scales and the labor performed for which no payment was made.

Also note that Table IV-4 does not include any costs for administrative supervision or transportation furnished by Project Citanduy or the Ciamis District. The costs for two full-time consultant staff for watershed management activities, plus their expenses, are also missing but would be included in a strict accounting system.

As far as can be determined, only on subwatershed II have the work of sodding the risers and other conservation practices been completed and the grass established. The other subwatersheds (III, IV, V, and VI) still have some work to be completed. Even if we assume that all work has been completed on subwatersheds II, III, IV, V, and VI (213.5 ha), the total itemized cost of Rp. 28,765,083 would average Rp. 134,731/ha of watershed. If this cost were all charged to the primary work of bench terracing of 46.4 ha it would cost about Rp. 620,000/ha.

On the Panawangan Demonstration Farm, the soil conservation practices were inspected after two very heavy rains of 120mm and 142mm, each in about 2-1/2 hours, soon after the terraces were established in 1978. The risers and lips were only spot sprigged to elephant, setaria, and other grasses. Most of the risers and lips were bare, and eroded soil filled the drain at the base of risers. As a result, runoff

and silt cascaded over terrace edges in spots and down the hill to the paddy fields where the runoff was intercepted by paddy irrigation or drain ditches and led to the streams. Rapid vegetative protection of risers and lips is crucial if the terrace system is to be stable and operative. This phase of the terracing program must not be neglected for want of grass required to give proper protection. Sodding and terrace repairs in Subwatershed II have cost a total of Rp. 564,700 to date, an investment which emphasizes the need for rapid revegetation of the lip and risers following terrace construction.

Even more importantly, waterways and drop structures must be completed prior to terrace construction in order to safely dispose of surplus water from the terraces without creating erosion.

The main conservation activity in the Panawangan Pilot Watershed has been related to the bench terracing program. As shown on Table IV-3, the bench terracing of 54.8 ha of land required 19,346 meters of waterway, 4,345 drop structures and 275,363 m^2 of grass sodding. Thus, bench terracing one hectare in the Panawangan Watershed has required 353 meters of waterway, 79 drop structures, and the sodding of over 5,000 m^2 of terrace risers, waterways, and miscellaneous disturbed areas. More important, when areas such as the Panawangan are bench terraced, the useable cropland on the bench varies from about 0.5 to 0.7 ha per hectare of bench terraced land depending on the slope being terraced (Appendix D). The balance of the area is terrace risers and lip, drainage ditch, and waterways with drop structures. Therefore, the farmer has to raise twice as much on the available area in order to make bench terracing profitable. For this reason, simple bench terracing programs that provide only the structural components always fail. It is absolutely necessary to provide the farmer with high yielding varieties and technical inputs that enable him to maximize his return from the terraced area. The normal terracing process causes further problems by burying the most fertile material and leaving only low fertility materials on the surface. Stockpiling topsoil is recommended but seldom practiced because of the extra work involved. Alternatively, the problem can be corrected only through the application of commercial fertilizers, cover cropping, and crop residue management.

Unfortunately, the agricultural development program was applied only to the 6.1 ha Pilot Demonstration Farm of the Panawangan Watershed; however, the other farmers have benefited from observing the practices and attending the training meetings held in the area. Of course this was the purpose of the demonstration farm, but the farmers need additional help in applying the conservation practices and assistance with seeds and fertilizer inputs to make the bench terracing profitable. Even with the best advice, crop failures will result when the farmers grow unfamiliar crops or high-yielding varieties that require proper fertilizer and biocide inputs and timing.

Agricultural Development Program

Landholdings of the upland farmers in the Panawangan Watershed area average about 0.5 ha, and the farming operations are typically diversified.

Crop Yield Trials. The agronomic trials were all conducted on the 6.1 ha Pilot Demonstration Farm over a 16-month period with all crop production work performed by the individual farmers. The first year crops were not planted until November 23-25, 1977, about three months after the recommended date for some crops. Information on the agronomic trials are only summarized in this report and details, if desired, should be obtained from the previously mentioned Panawangan report or from the background files in the Consultant's office.

Rice variety trials had the following results with 400 ha of urea and 200 kg of TSP per hectare:

Rice Variety	Kg/ha production	
	wet stalk rice	rough rice
C-22 upland rice from CRIA in Bogor	2,828	1,810
IR-2061-522-69 SL-1213	1,331	852
IR-36	1,090	698
IR-30	1,675	1,072
SAGI, a local upland rice	1,675	1,072
Average, all tests	1,720	1,100

Specific rice fertilizer trial were conducted with the local SAGI variety, but there was only one replication because one replication was planted in an old citronella area and nothing grew, and another area was harvested by farmers without being measured by the consultant. The fertilizer application with the highest yield was 1,675 kg/ha wet stalk rice (688 kg milled rice) for the 400 kg/ha of urea and 200 kg/ha of TSP, which was also the highest application rate. This strongly indicates that the rate of fertilizer application was less than optimal for maximum yields on newly terraced lands that have lost much of their fertility. This would be particularly true for the improved high yielding varieties (HYV).

Corn and cassava yield tests were not recorded by the farmers, so no yield estimates are available for these crops.

Soybean test trials in the dry season of 1978 germinated well and grew to about 20 cm height but died of root rot disease. Low soil pH of 5.3 may also have been detrimental.

Sorghum did not grow uniformly in the test trials and greatly varied in maturity and height. Yields were not recorded.

Sweet potato cuttings of varieties LP3 Maura 3-6 and No. 395 from CRIA were planted in bed furrows at 20 x 20 cm spacing and fertilized with 200 kg/ha urea and 100 kg TSP/ha. The sweet potatoes were heavily damaged by insects despite periodic spraying by farmers. No yields were reported.

Peanuts of the variety Gajah from CRIA were planted in a monocrop system to compare yields to those of intercropped areas and other season plantings. They were planted in November 1977 and harvested in March 1978. Fertilization rates were 200 kg/ha urea and 100 kg TSP/ha hectare. Average yield was 935 kg/ha wet weight with shells for all fertilizer applications. Duplication of results among the replications was poor, as would be expected in a newly terraced area. The different fertilizer applications did not produce statistically different yields. The highest average yield of 1,272 kg/ha was produced with 100 kg urea, 200 kg TSP and 300 kg k_2SO_4 per hectare. Plant density trials with peanuts indicated that the 15 x 15 cm spacing produced yields of nearly 1-1/2 times that of the 20 x 20 cm spacing. The increase in plant

population produced significantly higher yields for the year of the tests but this would not necessarily be true in a dry year.

Peanuts were also used to test the effects of raised bed versus flat ground planting; in these tests wet weight yields averaged 875 and 1,051 kg/ha, respectively. This trial indicates that the latosols and oxisols of the watershed generally do not require additional drainage and aeration for good crop production on hillside bench terraces.

Several intercropping trials of CRIA varieties were also conducted as a part of the agricultural development program. The results were somewhat inconclusive due to some farmers' harvesting without weighing and due to other problems, but the crop yields can be generally summarized as follows:

	Rice, Cassava and Maize		Maize, Cassava and Soybeans	
Crop	Variety	Yield (kg/ha)	Variety	Yield (kg/ha)
Rice (wet stalk rice)	C-22	2,378		
Maize (wet weight, peeled ears)	BC-2	600	H-6	720
Cassava	W-236	2,000	W-78	3,520
Soybeans			(died)	
Peanuts (wet weight, with shells)-alternative crop			Gajah	500

Rice and maize were also intercropped in a test with sixty field plots planted in October 1978; but the farmer was sick during the growing season, so the plots were full of weeds and the data very erratic. However, some of the plots yielded over 1,000 kg/ha of wet stalk rice.

Several generalized conclusions can be drawn from the field trials in the Panawangan Demonstration Farm. First, a demonstration farm is not the proper place to conduct research on varietal yields, fertilizer response, or cropping systems because inputs cannot be precisely controlled or accurately measured. The certain purpose of demonstration farms is to put the knowledge gained from research to use in demonstrating how to produce maximum economic returns from the land. Secondly, average yields obtained by village farmers are considerably less than research yields because of the many less-than-optimum condi-

tions under which the upland farmer produces. Thirdly, the person in charge of all activities absolutely must maintain close contact with the demonstration farm at all times to enable him to take immediate action on insect or disease control problems and to ensure that production inputs are performed at the proper time, even if the project must hire additional labor. A demonstration farm always has trouble selling success, but a large failure becomes well known over the area very rapidly.

Grass Revegetation. The main purpose of vegetation in a conservation program is to provide soil cover to protect the structure of the topsoil from being broken down by raindrop impact. Breaking the structure of the topsoil (usually clay or clay loam texture) decreases the infiltration rate, thus increasing water runoff which carries away the dislodged soil particles. Vegetative ground cover should be established as rapidly as possible on all disturbed areas using a combination of grass and legumes. All revegetated areas should be considered as a potential income source for the farmer. In most cases a cut-and-carry system of harvesting these forages is recommended. The main areas to be revegetated are waterways, terrace risers, and the areas around new tree plantings. The areas under tree canopies offer a good opportunity for raising additional livestock forage and some food crops. Table IV-4 summarizes the number of pulls of grasses produced and used from the Panawangan nursery.

The average farmer in the watershed owns only about 0.5 ha, and good land use planning is necessary to provide the farmer with a maximum return from his resources, especially where a portion of the farmer's land is too steep for crop production. Planting proper grasses and legumes not only offers same protection against erosion, but it can also significantly improve the farmers' income and family nutrition.

Grass varieties are available with many different characteristics and properties, each suited to a specific site. In the Panawangan Pilot Demonstration Area the following grass varieties were evaluated:

The local short sod grass is good for waterways, but it does not spread rapidly on steep road banks and other disturbed areas. It is also of limited value for livestock forage.

Kikuyu grass(Pennisetum clandestinum) grows well and spreads quite rapidly on terrace risers, even in areas with low fertility. It is a good soil conservation species that is easy to propagate vegatatively because it spreads by stolons and rhizomes.

Setaria grass (Setaria sphacelata) is a bunch grass with low value for soil conservation, but in combination with legumes may be a good species to grow under the tree canopy. It has a low tolerance to poor soil fertility.

Brachiaria brizantha and Bracheria documbens were the most productive species at Panawangan and grew well under poor soil conditions. Propagation is by stolons, both are easy to establish vegetatively. When sprigged 70 cm apart in a triangular pattern, they form a sod within six to seven months.

Under Panawangan conditions Guinea grass (Oabucyn maximum or Panicum Muticum), elephant grass (Pennisetum purpureum), Pangola grass (Digitaria documbens), and Pakistan grass did not grow on the terrace risers. From research in other areas, they should be considered for more fertile areas or well-managed pasture under a semi-cover of trees, such as in plantation areas.

Certainly, a great deal more research is needed on grass varieties for vegetation and forage production throughout the year. Many legumes are also well adapted to the Citanduy environment that should be included in future research trials and on demonstration farms.

Trees for Lumber, Fuel, and Agroforestry. All slopes of over 40-50 percent in the Citanduy Watershed should have some type of permanent cover. For government-owned or forest lands, the choice is simple and for the most part, reforestation requires only the funds necessary for planting the desired species. However, the change in land use must be made economically attractive to the farmer. Generally this requires some system of agroforestry of trees and grass. High cash return trees such as clove (Eugenia aromatica), petai (Parkia spaciosa),

avocado (Persia americana) and various citrus species are suggested. Fast growing fuel wood trees such as Albizia falcata, puspa (Schima walichii), africa (Maesopis sp.), and Caliandra are accepted by the farmers. For some sites cemara (Casuarina equisetifolia) bamboo (Gigantochloa species), and Leucaena leucocephala should be utilized because they are fast growing species that provide good ground cover rapidly. Clove trees grow well throughout the watershed, and the current price of dry clove is Rp. 5,000 per kg; but this price may not be maintained if production were greatly increased, and it clove trees take five years to start producing. Petai trees are nitrogen fixers, but they have the disadvantage that the trees are very large when mature and do not produce full until about 10 years of age. These trees produce up to 100 pods per tree with 10 to 13 large beans per pod, which sell in the market for about Rp. 50 per pod. Table IV-4 summarizes the trees produced at the Panawangan nursery.

Fertilizer recommendations. Based on the soil analysis data and field trial results, the fertilizers recommended for Panawangan are:

Crop	kg/ha		
	Urea	TSP	KCl
Rice	150 to 200	100	50 to 100
Maize	150 to 200	100	50 to 100
Peanuts	50	50 to 100	50 to 100

Urea for the rice and maize should be applied in three equal portions about one month apart.

The TSP should be hand broadcast prior to seeding operation and hoed in the top 15 cm of soil. Phosphate in the soil is usually immobilized by the iron and aluminum compounds in the latosol. Thus, it is essential that the phosphate be placed in the root zone to give the plants access to it.

The KCl and urea are water soluble and therefore can be hand broadcast on the soil surface or incomrporated with the soil at the same time as the TSP. The KCl may also be added in two or three applications together with the urea to avoid excess loss of fertilizer by leaching.

For tree fertilization, a mixed fertilizer such as 15-15-15 (15 percent N, 15 percent P_2O_5, and 15 percent K_2O) should be used at the rate of 40 to 60 grams per tree. The fertilizer should be applied about 15 to 20 cm away from the tree in two or three holes approximately 15 centimeters deep.

Local grasses transplanted on steep eroded banks for soil stabilization should also be fertilized with urea at the rate 100 kg/ha. This will guarantee a quick establishment and fast propagation of the grasses to protect the site from soil erosion.

Livestock Development Program. Potential production of meat from sheep and goats is good in the Panawangan area. Local farmers traditionally keep about equal numbers of sheep and goats most of which are kept penned; a cut-and-carry forage system is used. For the Panawangan Pilot Demonstration Farm, 30 sheep (27 ewes and 3 rams) were given to the 27 farmers owning or working land in this farm. The sheep were given to them on a "revolving system" by which the farmer will keep the animal until lambs can be weaned, at which time the original sheep is passed on to another farmer within the watershed. From the original 27 ewes given to the farmers, only 15 lambs were born (56% lambing percentage), and death loss was 53.3 percent. This resulted in production of only 0.3 lambs per ewe the first year. The Panawangan livestock improvement program, for the 4th quarter of 1978/79 began with 117 sheep; 5 rams were purchased; 30 were born; 6 died; and the program ended the quarter with 146 head, worth Rp. 2,470,000 (Table IV-6). The experienced high death losses and low lambing percentages indicate that the farmers need more training and advice from the Dinal Peternakan (Animal Husbandry Office).

Three beehives were also brought to the Panawangan Pilot Demonstration farm by the Forestry Department, and classes were provided in beekeeping. Beekeeping requires little labor and costs for the hives are limited. Honeybees can provide an extra source of income or food, and they are important in pollinating fruit trees and other plants.

Community Development Program

From its beginning, the Panawangan Pilot Watershed was conceived as a complete conservation and development project. The project commenced in early 1976 with a survey of socio-economic conditions in the project area, soil surveys, and the development of information on climate, vegetation, agricultural practices, and a plan for project implementation. This phase was completed in 1976, and almost immediately planning for the community development work was initiated. The program was carried out by the Ciamis District technical staff, coordinated by Mr. Rachlan, the Chairman of the Bappemka (planning Board), by the Greening Program Staff (P_3RP-DAS), by Project Citanduy (Directorate of Rivers), and by Engineering Consultants Inc. Public meetings were held in the Panawangan area to inform the people of the proposed conservation program and to encourage their participation in the planning and implementation of project features. Discussions centered on obtaining the communities' understanding, approval, and support. The effort to involve the local community in the project was carried out during the entire project period to give the local people a sense of belonging and to gain support and participation. The terracing, road construction, agronomic trials, grass transplants, and tree planting on the 6.1 ha demonstration farm were all performed by the land owners and/or the community.

Cropping Systems and Rotations. Conservation activities planned for the project area were discussed with the farmers in a series of meetings held in the village of Ciracak (Subwatershed II) prior to their implementation. The reasons for installing modern bench terraces, waterways, and conservation plantings, as well as instruction in the proper methods of construction, were throughly explained. The purpose of the field trials for variety testing, the proper use of fertilizers, and simple economic analyses for cost and yield output for increased economic

returns were also discussed. After each field trial was harvested, the positive and negative results of the trials were discussed on the spot with the farmers and members of the community.

Higher plant density of peanuts increased the yields by nearly 30 percent; this and other yield successes deeply impressed the farmers regarding the potential improvement of their own yields. The farmers' understanding of the agronomic trials was proven best soon after the maize harvest was completed in January 1979: The farmers admitted that they had been doing their own testing, using the improved variety of maize (H-6 from CMIA) and the traditional variety. The yield for the improved variety with approved management practices was five times that for the traditional system. Some farmers have now tried grafting Mukibar cassava that produces up to 120 kg per plant, and the practice is spreading.

Farmer Leader Training. A "Skill Development Training Course" was offered for farmer leaders, PPL's, and PLP's (Appendix E has additional information). The classroom training was held in the Subdistrict office in Panawangan during the week of March 26-31, 1979. Attendance of key farmers included 8 from the Ciamis District, 6 from Cilacap, 4 from Tasikmalaya, 2 from Kuningan, and three PPL/PLP's in attendance. Topics covered during the training included land use capability, soil and water conservation, agronomic practices for dryland farming, grass management practices, animal husbandry, fishpond management, natural resources and the environment, principles of nutrition and balanced diets, leadership, management of cooperatives, and finances. Field trips were taken to the Fishery Development Center at Singaparna, Tasikmalaya and to the Panawangan Pilot Demonstration Watershed. The training course was organized by Project Citanduy of the Ministry of Public Works and ECI, Inc., in cooperation with the Bappenka Office of Ciamis and with Ir. Nurdin (P_3RP DAS Citanduy) as chairman of the committee.

Panawangan Watershed Concept Dissemination. Many villages and subdistrict offices throughout the Citanduy Watershed were visited during the project period (1977-79) to discuss and promote watershed concepts. These meetings were taught by a team generally consisting of

Mr. Rachlan (Chairman of the Ciamis Bappenka Office), Ir. Nurdin (Chief of P_3RP DAS Citanduy), the counterpart staff from the Project Citanduy, and the consultants. Each technical specialist presented a prepared section and answered specific questions. Most of these meetings were attended by the local technical staffs, chiefs of the villages and subdistricts, and local farm leaders. Judging by the participation, interest in the discussion, and attendance, the meetings were highly successful. In the last meeting, two of the best Panawangan farmers were added to the team, and their discussion with other farmers proved effective in disseminating the Panawangan concept.

In 1978, the Ciamis District started a program by which the village leaders, PPL's, and key farmers of the district were brought to the Panawangan Pilot Demonstration Watershed. These groups were lectured by the previously described group and were given field demonstrations by the staff. Numerous tours by student groups, press, television, government officials up to ministry levels, and USAID officials have also been conducted. The success of these tours, and more specifically the 6.1 ha Pilot Demonstration Farm, can in part be rated by the decision to implement a series of small demonstration areas throughout the Watershed. The success of a single demonstration farm carries a significant problem, however, in that the future demonstration farms will not have the concentration of highly trained technical people to supervise their activities or to explain and sell their results to local villagers.

Community Communication Development Training. Five officials from the Ciamis, Cilacap, Kuningan, and Tasikmalaya Districts attended a course in community development conducted by the Yayasan Indonesia Sejahtera in Solo from January 22 to March 10, 1979. This course provided training to government officials as coordinators and instructors for community development programs. The course attempted to upgrade the officials' knowledge of how to influence people through efficient and effective communications with the community. Appendix E provides a more complete description of the specific program and all other training activities discussed in this section.

From March 26 through 31, 1979, a continuation of the Solo Community Development Course was held in Ciamis. This course was attended by 41 active participants; in addition 53 district-level representatives of government agencies attended on a non-regular basis. Lectures were conducted by four members of the Yayasan Indonesia Sejahtera, Project Citanduy Counterparts, P_3RP DAS Citanduy staff, representatives of Bappemka, and members of the Ciamis technical staff.

Audio-Visual Aids. Watershed development illustration with the aid of slides, pictures, and taped voice are presently under development for the dissemination of watershed management concepts to interested villagers. The different activities taking place at Panawangan are also being filmed with an eight millimeter sound movie camera, and plans call for using this film in future farmer training programs for the Citanduy and other wathersheds.

The use of audiovisual aids, pamphlets and simple manuals with adequate pictorial illustration and designs for easy understanding help tremendously in selling improved soil and water conservation and agricultural development to the individual farmer. Only the farmer can actually accomplish the reduction of erosion on upland cropland; therefore, it is very important to convince him of the need for the conservation management system.

Sediment and Runoff Measurement.

Measurement of watershed treatment effects through the use of comparison watersheds, was one of the objectives of the Pilot Project. To assess the effect of treated, versus nontreated, small watershed areas, two water measuring devices and sediment traps were constructed to measure differences in runoff and sediment yield.

The first, at the outlet of subwatershed I, was constructed to measure runoff and sedimentation from 13.0 ha, of which 1.0 ha was devoted to rice paddy, 3.5 ha to traditional terraces, and 8.4 ha to trees, grasses, and home gardens. Measuring structures installed at the outflow of Subwatershed I included a cutthroat flume with a flow capacity of 0.3 m^3/s and a sediment trap section that was 38.9 m long, 0.45 m wide at bottom, 1.4 m wide at top, and is 0.4 m high. Unfortun-

ately, the primary sediment trap section is only 15 cm in depth and has a capacity of 2.63 m^3, and the total sediment trap has a capacity of about 5.3 m^3, which is a very small part of the 130 m^3 required for a one-millimeter sediment capacity from the 13.0 ha watershed. The upper portion of the sediment trap section also has a restricted section in which the maximum velocities will exceed 1.0 m/s, and large amounts of sediment from the watershed will bypass the sediment trap area. No provision for taking regular sediment samples from the flume outfall has been made.

The second measuring device receives the runoff from 53.2 ha of Subwatershed II, with a land use of 14.7 ha of bench terrace, 9.0 ha of rice paddy, and 29.5 ha of forest, grassland, home gardens, or village. The cutthroat flume in this case has a design capacity of 1.9 m^3/s, and the sediment trap section is 28.3 m long, 1.15 m wide, and 1.4 m high. The primary sediment trap section is again only 15 cm in depth, so the capacity is 4.88 m^3, and the total sediment capacity is about 15.3 m^3.

The two sediment traps and flumes were completed in October 1978, and water measurement recorders were installed in March 1979, but problems with the flume construction have prevented any data collection. The original construction cost of the two sediment traps and flumes was Rp. 4,031,700. The flumes are presently being modified and collection of runoff data should be possible for the 1979-80 rainy season.

The sediment traps and cutthroat flume sections have had a number of specific problems. In June and October of 1978, overtopping of the embankments upstream from the sediment basin and at the basin itself occured from rainfall amounts recorded at about 120 and 142 millimeters that fell in approximately 2-1/2 and 4 hours, respectively. This rainfall is expected to have a return interval of between 5 and 10 years. Overtopping may also occur with rainfall of lesser amounts because the the October 1978 flood overtopped by about 0.3 meter. In addition to the probability of floods bypassing the flumes, much of the sediment from these watersheds is deposited upstream in rice paddy areas in large flows. This leads to the general conclusion that these measurement

stations are suitable only for providing generalized information and are not reliable for scientifically useable data for project purposes without considerable modifications.

Some measurements have been made in the sediment traps since January 17, 1979. The initial cleaning of the traps on that date verified the maximum sediment capacity of the trap areas. The Subwatershed I sediment trap has a calculated maximum capacity of 5.3 m^3 and contained 5.067 m^3; Subwatershed II has a calculated capacity of 15.3 m^3 and contained 15.738 m^3. These measurements verify the calculated maximum capacities of the sediment traps, but before each reaches its capacity, most sediment is bypassing the traps.

Sediment trap measurements from January 17 to April 10, 1979 (83 days), totaled 18.705 m^3 for Subwatershed I, which is 0.144 mm/unit area of sediment from the 13.0 ha area; and 64.419 m^3 for Subwatershed II, which is 0.121 mm/unit area of sediment from the 53.2 ha area. These measurements indicate approximately the expected relationship, considering the watershed sizes and vegatative cover, but runoff measurements and water quality samples would have to be included to ensure an estimate of sediment bypass to provide meaningful measurements. These subwatershed areas will probably not differ significantly over time, but several years of data would give good measurement of the relationships expected from similar watersheds.

At present, installation of two additional stream measuring devices is being planned at the outlet of the 78.0 ha control watershed of the Cicerenang River and at the outlet of treated watersheds I through IV, having a combined drainage area of 157.3 ha, on the Cinyangsang River. These measuring flumes were included in the original design report for the Panawangan Pilot Watershed. Streamflow will be measured by flumes with a preliminary design capacity of 16 m^3/s for the Cocarenang River and 32 m^3/s for the Cinyangsang River at an estimated cost of 7 million Rupiah.

Preliminary water quality sampling has been conducted at the sites for the measuring flumes and downstream since May 10, 1978. During this period, 12 useable samples have been taken and analyzed for each of the three sites. These samples have a mean value of 63 mg/l for

both the control watershed and subwatersheds I through IV, and the downstream samples have a mean value of 59 mg/l. No information is available as to the relative streamflow at each sampling period, but the water quality indicates that they were taken only during periods of low flow because the highest sediment reading was only 197 mg/l. This is consistent with the expected values, because the inaccessibility of the site causes the sampling to be done only in relatively good weather in the absence of a specific time schedule. The sampling results indicate that there is no discernible difference in sediment rates between the control and the treated watershed, even though some of the samples were taken during the construction period of the treated watersheds. Please note that the samples for July 26, 1978 should not be used for evaluation purposes because of an obvious error in recording the results of one sample.

Farmer Acceptance of Project

The farmer acceptance of any government project can be determined only after the project has been completed for a considerable time. Available indicators, however, suggest that the Panawangan Watershed Project approach is generally successful, and the complete assistance approach taken with the 6.1 ha Pilot Demonstration Farm has been very effective. Only long-term observation of the area can determine whether or not the farmers truly recognize the value of their farm topsoil and the necessity for soil conservation practices together with careful maintenance of the bench terraces and waterways.

Obviously, the farmers of Panawangan have a difficult time identifying themselves with big Government projects or programs. They also tend to blame the lack of success of their farm enterprises on their lack of resources, but this lack is more frequently the lack of proper technology. This demonstrates the need to provide the farmers with appropriate technology and with information showing that proposed changes will benefit their operation.

Applicability of the Approach to Other Watersheds

Whether or not the Panawangan Pilot Watershed approach can be successfully applied to other watersheds can be determined only by trying to apply it. Certainly the basic approach of demonstration farms and assistance has been successful in other developing countries. From a practical point of view, the main problems are the inadequate number of trained technicians and the unavailability of funds to apply the same degree of intensity to other demonstration farms as that applied to the Panawangan Pilot Demonstration Farm.

A careful review of the problems associated with conservation and economic development projects or programs in other countries indicates that officials tend to attribute success to any current project. Certainly, the Panawangan Pilot Watershed Project has been visited by enough USAID, Indonesian Government Officials, and publicity agents to leave some questions as to the scientific validity of its success story.

Karang Pucung Pilot Watershed

The Karang Pucung Pilot Watershed has an area of 42.7 ha and is located near the far eastern boundry of the Cikawung Subbasin (Figure IV-2). It is adjacent to the Majenang-Karang Pucung Highway, about two kilometers northwest of Karang Pucung. The Pilot Watershed consists of a 29.0 ha subwatershed that will have complete conservation practices applied, a 10.1 ha control subwatershed, and a 3.6 ha demonstration farm adjacent to the road. These watersheds are all located on steep sloping terrain southwest of the highway. Many of the soils in this watershed are severly eroded, and the shallow soil depths limit rooting depth, water retention, and, consequently, crop production.

This Pilot Watershed area is situated in an area of Pliocene sedimentary rock which formed from a fine marine silt and very fine sand. The siltstone and sandstone is soft and unconsolidated and breaks down easily. The soil developed from this material is a yellow mountain soil closely associated with the mountain yellow podzolic soils. Soil texture is usually lighter on the surface than in the subsoil. The clay is mostly kaolin with a low cation exchange capacity, so the soil is

highly acid. Most of the soils are severely eroded, and the present soil depth on existing benches (traditional terraces) is generally only 15-20 cm above the C horizon; this means that the A horizon is missing. This past erosion severely limits the potential for building quality bench terraces in this pilot demonstration area. A complete detailed soil survey should be completed before any terracing is attempted.

Topographic surveys at a scale of 1:1000 have been completed, but the much needed soil surveys, land capability mapping and land use determinations have not been initiated. Preliminary evaluations for the 29.0 ha treated subwatershed from the topographic surveys shows that 1.74 ha of land have more than 50 percent slope and preliminary waterway designs show total length of 2,239 m with a total drop of 581 m. The 3.6 ha demonstration farm area has 0.64 ha of land with more than 50% slope and is estimated to require 791 m of waterways with a total drop of 167 m.

The P_3RP-DAS Citanduy staff are actively working on the establishment of conservation works on the Karang Pucung Pilot Watershed. Plans for the current year also include the installation of measuring flumes and a weather station by the Citanduy Project staff.

Solo Watershed Project

The work done on the Upper Solo Watershed Management and Upland Development Project (INS/72/006) of the Food Agricultural Organization of the United Nations provides a major source of information on upland development. These reports were reviewed as a part of preparing the Watershed Plan, and some of the more important conclusions are summarized and discussed in the following sections.

If land is supplied with water diverted from a stream or spring, farmers will construct quality terraces for flooded rice production, terraces that for the most part stop erosion. Internal rates of return of over 26 percent may be attained from irrigation development, but almost all this land has been developed in the Citanduy Watershed. The FAO report also concluded that slopes of over 40 percent are not useable for irrigation development.

Terraces for upland crops were found to be inappropriate if the soils were shallow, or the slope greater than 40-50%. Bench terraces have been implemented on seven selected Solo Watersheds. The soil conservation activities have also included demonstrations of gully control and investigations of erosion and runoff from the bench terraces compared with the traditional terraces in the area. Erosion and runoff investigations in the Dumpul, Tapan, and Wader subwatersheds establish the following relationships[1]:

	Traditional Terrace		Improved Bench Terrace	
Location	Erosion (cm)	Percent Water & sediment runoff	Erosion (cm)	Percent Water & sediment runoff
K. Dumpul	2.9	80	0.2	40
K. Tapan	2.0	75	0.1	30
K. Wader	1.4	75	0.2	30

A study of the production increases from bench terraces in the Solo Watershed, where both bench terraces and traditional terraces received the same fertilizer and cultivation techniques, proved that production increases of 200-300 percent were possible with bench terraces. The internal rate of return for terracing has been estimated to be 18 percent for dryland terracing.

Studies of plant varieties used to strengthen terraces and waterways have been limited to grass varieties, but the best grass variety for soil cover in the Solo Watershed studies has been *Brachiria brizantha*.

The rehabilitation and reforestation of privately owned land in the Solo Watershed has been implemented with tree species such as like *Pinus*, *Albezia falcata*, *Eucalyptus alba*, and a number of grasses planted in the understory. Elephant grass has been the most successful for soil cover and cattle feed. This program has been used successfully to rehabilitate steep slopes and was calculated to have an internal rate of return of 17 percent. Research on erosion and runoff relationships on treated and untreated forest land in the Tapan and Pidodso Subwatersheds produced the following results:

Location	Traditional Practice Erosion (cm)	Traditional Practice Percent Water & sediment Runoff	Treated Private Forest Land Erosion (cm)	Treated Private Forest Land Percent Water & Sediment Runoff
K. Tapan	2.9	80	0.06	20
K. Pidesko	1.4	75	0.04	30

These results indicate that it is technically feasible to rehabilitate even rather steep lands by afforestation and elephant grass. While this afforestation program has a good internal rate of return, it is not popular with the farmers because they prefer to grow food for their families directly and because it is difficult to obtain the credit necessary to purchase fertilizer and cattle.

A specific comment from the Kali Samin economic study deserves to be quoted: "The internal rate of return of the complete development plan for the Kali Samin is 22.4%, a rate which sustains the comparison with net profit margins of most industries. This is one of the most striking findings of the project; although conceived originally as a costly rescue operation, watershed management and development is in fact leading to positive, economically sound proposals." [2. Emphasis as in original.]

In summary, the conclusions from the Solo Watershed Demonstration and from field observation indicate that there is very little erosion from areas with good forest cover, home gardens, plantations, and riceland, except for occasional landslips on steep slopes and some gully erosion from scouring in drainage channels. Virtually all erosion is occuring on the upland areas that are farmed without adequate soil conservation measures. This erosion tends to be more rapid on steep slopes, but high intensity rainfall is the most important single factor in the net erosion rates, and this is one reason for the higher erosion rates experienced on the higher mountains, which have much higher precipitation rates. The observations also concluded that bench terraces that are properly designed, constructed and maintained will reduce erosion to an rate acceptably compatible with the rate of soil regeneration [3].

Government Programs

As previously stated, many Government programs have some activities related to the improvement of the upper watershed areas of the Citanduy River. Because these are so complicated and are poorly documented, it was decided to work only on the necessary additions to the central governmental activities for upper watershed development of the soil and water resources, and to assume that all current activities would be continued to some degree. It was further assumed that the new national committee for planning and government policy creation would adjust the programs, as needed, so that they would be coordinated under the supervision of the District Bupati in which the activity is to be performed.

Two major activities for upland development receive the major portion of the upper watershed management improvement funds: the tree planting activities of the Perhutani Enterprise and the Greening Program. These are also discussed in other chapters of this report.

Perhutani State Enterprise

The tree planting activities of the Perhutani State Enterprise are most commonly applied to government land allocated to Perhutani. Reforestation is generally accomplished by allocation of about 0.25 ha to each farmer, who then clears the land, plants his crops, plants and maintains the trees, replants where the seedlings have died, and supposedly leaves the land after two years. By this time the trees are supposed to be tall enough to compete with the brush, grass, and weeds. This is the "tumpangsari" system.

During past reforestation attempts, many gullies were started under the mass intensification of the "tumpangsari" system. Some still exist and are providing large amounts of sediment to the streams. An intensive gully control program will be needed in some areas where poor soil conditions or continued cropping by farmers has created a critical situation. This is especially true on the steeper slopes. Fortunately, the general conditions for reforestation are so favorable in

the Citanduy Watershed that once an area is replanted and protected from further use by upland farmers, a good vegetative cover is established within approximately one year.

If the "tumpangsari system" of reforestation is to be continued, a system should be developed to provide additional inputs to farmers on poor soils. Any fertilizers not used by the crops will generally be incorporated into the nutrient cycle of the forest system and will pay off in more rapid growth of the new forest area. The system should also discourage the practice of a monoculture of cassava by the farmer because this crop leaves the ground without cover and permits severe erosion.

Greening Program

The greening program, conducted on the farmer's land, generally involves terracing and tree planting on the upland crop areas. The terracing is useful, particularly where the soil has sufficient depth to permit this operation, but a review of the terraces in the field shows that the farmers often misunderstand the purpose of the terraces. On steeper slopes the contour terraces generally constructed consist of a simple ditch that is seldom on the desired grade. Grassed waterways and drop structures to safely dispose of the excess water are almost never constructed under this program. The tree plantings are generally less successful because the farmer often does not understand how the trees can enable him to make a better living, and therefore they are often allowed to die. In some cases the trees are harvested for firewood before they have a chance to produce much growth.

Having established high quality bench terraces with good waterways and drop structures in the Panawangan Pilot Watershed, the P_3RP-DAS Citanduy staff are better able to improve the greening program in the Citanduy Watershed. The Greening Program's success could also be improved by adding staff to provide technical advice and to teach the farmer the purpose of terraces and the economic opportunities from the agroforestry system. The program would also benefit if assistance and supervision could be extended over a longer period of time. In many cases the farmer could eventually build good bench terraces by moving

some soil with each cultural practice, but to accomplish this task he must be instructed in the proper way to complete a bench terrace.

General Comments

Much research and crop variety development needs to be conducted before the problems of upland crop production can be solved. Only a few new crop varieties for uplands have been tested at Solo and elsewhere, and there is little evidence that matters will rapidly improve. Indonesia is relatively slow to take advantage of research conducted in other countries, partly the result of the Plant Quarantine Service's practices. The cost of new plant varieties that are more suited to existing upland farming conditions is small compared with the potential benefits. There is also an extreme need to obtain upland food crop varieties that provide better ground cover than those currently planted on upland. The need for research in the optimum fertilization rates is so obvious it is hardly necessary to be mentioned in this report.

Innovative research and thinking are needed to develop techniques hitherto unused in Indonesia such as the use of fodder grasses in solid stands on very steep land as has been observed in the Guyas Basin of Ecudor, or in contour strips as used in Kenya, Ethiopia and other parts of Africa. The role of forestry in upland development needs careful examination. Perennial ground cover is very desirable on lands that cannot be terraced, and the forests of Java, where they exist, protect the land very well, but tree plantations may not be appropriate in high density population areas. Some type of agroforestry that produces a combination of wood and food crops may be very importatn in the future. Timber production produces much less employment, and there is a question as to whether timber plantation may be appropriate to existing socio-economic conditions, particularly if the land is suitable for crop production. Multiple use planning should be the guide to land use planning to ensure it is used optimally over the long term. This should include transfer of land suitable for crop production to private use and the growing of shade-tolerant crops under forests.

Some additional land should be returned to forest, and certainly the valuable and productive forest plantings that now exist should be left to nature, but a large forest planting program should not be initiated on the unproven assumption that it is the only way to protect the watershed catchment. Certainly the reforestation plan should not be based on the often-cited notion that 30 percent of the area should be in forest. This concept itself may be responsible for some of the mistakes and inefficiencies in the Greening and Perhutani programs. Tree planting on cropland appears to be a waste of time and scarce resources. The farmer simply cannot allow the trees to shade his food crop. Much worse is the cheap and politically convenient "tumpangsari" method of reforestation that permits farming of a cutover forest area. This has resulted in a great deal of erosion and, very frequently, in poor forest stands. From a watershed management standpoint, this method should be used only where the land is suitable for upland crops.

Both the Solo and Panawangan Projects are connected with the Directorate General of Forestry, a situation which has been specifically described as follows:

> "Attempts made during the past two and a half years to inveigle the corresponding Government agencies into participating in the multi-disciplinary, comprehensive watershed management approach sought by the Project team failed . . . . . Instead INS/72/006 was attached to the narrowly specialized Directorate of Forestry, which limited further the sphere of influence and field activity of the Project."[2]

There should be grave doubts as to the advisability of placing the program of upland development or watershed management under the control of the Directorate General of Forestry. The need for an integrated approach to watershed management is stressed in this report and elsewhere. For the Citanduy Watershed, that the upland watershed problems derive from upland cropping areas makes it obvious that more input is needed from agriculture than forestry. Furthermore, it would cause an wasteful redundancy of effort for the Forestry Department to acquire the needed expertise in upland agricultural and infrastructure development.

REFERENCES

1. Directorate of Reforestation and Rehabilitation, 1978. Proceedings of Discussion Meeting on Watershed Management in Cibulan, January 30 - February 1, 1978, Jakarta.

2. M.J. Gauchon, et. al., 1976. "Some aspects of water management economics," Field Termination Document. Upper Solo Watershed Management and Upland Development Project, UNDP/FAO INS/72/006 Solo, Java, page 70.

3. B.C. John, and W. van de Goot, 1976. "Soil Conservation Measures in the Upper Solo Basin." Termination Field Document Soil Conservatoin. Upper Solo Watershed Management and Upland Development Project, Indonesia. UNDP/FAO INS/72/006, Solo, Java.

TABLE IV-1

LAND CAPABILITY BASED ON SLOPE FOR SUBWATERSHEDS IN THE PANAWANGAN PILOT WATERSHED

(hectares)

Subwatershed No.	Paddy Rice	Upland Crop					Permanent Cover	Total Area
		I	II	III	IV	Subtotal	V	
	0-8%	0-3%	8-15%	15-25%	25-50%	0-50%	+50%	
I	1.1	-	1.5	0.6	1.4	3.5	8.4	13.0
II	6.7	-	6.6	3.5	4.6	14.7	31.8	53.2
III	3.6	0.2	3.7	2.0	2.2	8.1	32.3	44.0
IV	6.3	-	1.3	7.5	1.5	10.3	30.5	47.1
V	0.6	-	0.2	3.7	9.3	13.2	19.0	32.8
VI	1.0	0.2	-	9.6	4.2	14.0	21.4	36.4
VII	2.2	0.2	1.7	3.6	1.8	7.3	8.7	18.2
VIII	0.7	-	1.4	2.4	1.5	5.3	9.3	15.3
IX	2.7	-	1.9	1.8	1.1	4.8	12.3	19.0
X	8.8	-	2.0	3.3	7.1	12.4	19.1	40.3
XI	1.3	-	1.1	0.9	0.1	2.1	11.6	15.0
XII	4.5	-	4.2	2.1	4.7	11.0	15.3	30.8
Total Area	39.5	0.6	25.6	41.0	39.5	106.7	219.7	365.9
Percent	10.8	0.2	7.0	11.2	10.8	29.2	60.0	100.0

TABLE IV-2

LAND USE IN THE PANAWANGAN - MAY 1979

(Hectares)

Sub Water-shed	Rice Paddy	Bench Terraced	Traditional Terraced	Forest and Grass 1/	Total	%
I	1.1		3.5	8.4	13.0	3.6
II	9.0	14.7		29.5	53.2	14.5
III	3.6	8.1		32.3	44.0	12.0
IV		10.3		36.8	47.1	12.9
V	0.6	5.0		27.2 3/	32.8	9.0
VI	1.0	8.3	0.6	26.5	36.4	9.9
VII	1.1	1.9		15.2	18.2	5.0
VIII	0.7		5.3	9.3	15.3	4.2
IX	2.7		4.7	12.4	19.8	5.4
X	8.8		12.4	19.1	40.3	11.0
XI	0.3	3.9		10.8	15.0	4.1
XII	4.0	2.6		24.2	30.8	8.4
Total	32.9	54.8	26.5	251.7	365.9	100.0
Percent	9.0	15.0	7.2	68.8	100.0	

1/ Includes village and home garden areas

2/ Includes 4.0 ha on the Pilot Demonstration Farm and 10.7 ha on the balance of Subwatershed II.

3/ Includes 9.0 ha of clove plantation

TABLE IV-3

PANAWANGAN PILOT WATERSHED ACCOMPLISHMENTS THROUGH MAY 1979

Subwatershed Number	Bench Terrace (hectare)	Water-ways (meters)	Drop structures (number)	Sodding of structures 1/ (square meter)	Tree Planting (hectare)	Grass Planting (hectare)	Contour Terrace (hectare)
Pilot Demonstration Farm	4.0	980	240	16,200	1.7	1.1	
Balance of Area	10.7	3,336	642	43,335	27.4	5.2	
Total II	14.7	4,316	882	59,535	24.9	4.4	
III	8.1	2,650	486	30,740	25.0	7.6	10.9
IV	10.3	2,108	721	41,715	24.6	5.1	15.5
V	5.0	1,721	304	18,975	15.5	6.0	9.9
VI	8.3	2,731	581	39,217	23.2	5.4	8.3
VII	1.9	483	99	7,210	12.1	7.3	10.4
VIII							
IX							
X							
XI	3.9	572	234	10,530	8.3	4.4	10.0
XII	2.6	449	156	7,907	21.1	8.9	2.5
Total	54.8	19,346	4,345	275,363	183.8	55.4	55.0

1/ Sodding of terrace risers, waterways, diversions, etc.

Source : Pilot Demonstration Farm from Project Citanduy and balance from P_3RP - DAS Citanduy

TABLE IV-4

COST OF TERRACING AND OTHER CONSERVATION WORK
IN THE PANAWANGAN WATERSHED

Item	Pilot Demonstration Farm	Sub-watershed II 1/	Sub-watershed III, IV, V, and VI	Total to April 1979
Labor				
Administrative Supervision				
Chief Executive	NA	180,000	480,000	660,000
Consultants	NA	220,000		220,000
Field Work Assistants	NA		1,260,000	1,260,000
Secretarial Staff	NA	210,000	420,000	630,000
Other Staff 2/	NA	210,000	815,000	1,025,000
Subtotal	NA	820,000	2,975,000	3,795,000
Subdistrict Staff Support	NA	30,000	150,000	180,000
Wages for Field Work				
Planning, operational surveys, staking and final surveys	139,080	551,600	200,000	890,680
Terracing and waterway construction	480,500	2,319,300	5,278,113	8,077,913
Ridge treatment		95,700		95,700
Road Bank Construction	52,500			52,500
Diversions			171,000	171,000
Sodding, repairs and terrace maintenance	179,000	385,700		564,700
Subtotal	851,080	3,352,300	5,649,113	9,852,493
Forestry Integration	25,000		288,000	313,000
Nursery Field Work				
Nurseryman			692,550	692,550
Wages for spreader			84,350	84,350
Land preparation			587,350	587,350
Subtotal			1,364,250	1,364,250
Overtime fees		111,300		111,300
Total labor cost	876,080	4,313,600	10,426,363	15,616,043

TABLE IV-4 (Continued)

Item	Pilot Demonstration Farm	Sub-watershed II 1/	Sub-watershed III, IV, V, and VI	Total to April 1979
Materials				
Bamboo	116,200	420,000	983,425	1,519,625
Stone	54,000	216,650	307,250	577,900
Fertilizer	101,000			101,000
Seeds and grasses	355,385	105,000	633,175	1,093,560
Tools	44,000	357,800		401,800
Other	38,200			38,200
Total Materials	708,785	1,099,450	1,923,850	3,732,085
Transportation				
Vehicle cost	NA	390,960	460,980	851,940
Official travel	NA	901,650	1,151,000	2,052,650
Total Transportation	NA	1,292,610	1,611,980	2,904,590
Miscellaneous Expenses				
Meeting costs		160,325	336,260	496,585
Meals for visitors	56,820			56,820
Construction of field house	250,000			250,000
House or field office rental	35,000	525.000	1,500,000	2,060,000
Land rent	10,000			10,000
Land tax			200,000	200,000
Writing tools		119,990	294,070	414,060
Trees, and grass for forestry		1,258,900		1,258,900
Rock for road surfacing		1,766,000		1,766,000
Total miscellaneous Costs	351,820	3,830,215	2,330,330	6,512,365
Total Cost of Project	1,936,685	10,535,875	16,292,523	28,765,083
Bench Terraced Area	4.0	10.7	31.7	46.4

1/ Balance Sub Watershed II - 38 hectares with 10.7 hectares terrace construction.
2/ Includes administrative supervisors, evaluation and data processing costs.

TABLE IV-5

PLANTS PRODUCED AND USED FROM THE PANAWANGAN NURSERY

Item	Plants takens	Plants in Nursery	Total Produced
Grasses (No of pulls)			
Signal Grass (Brachiaria brizantha)	59,450	250,100	390,550
B.D. (Brachiaria decumbens)	11,700	95,230	106,930
R.G. Rumput Garut (Local)	38,925	301,025	339,950
R.B. Rumput Baung (Local)	3,400	25,000	28,400
Setaria Grass (Setaria sphacelata)	3,500	35,580	39,080
Guinea Grass (Panicum maximum)	4,800	150,673	155,473
Total pulls	121,775	57,608	979,383
Perennials (Number of plants)			
Albazia sp.	32,386	50,024	82,410
Kaliandra	28,200	35,425	63,625
Mahogany (swietenia macrophylla)	2,523	11,223	13,746
Coffee		9,976	9,976
Eugeniz	2,598	11,950	14,548
Mesopsis sp.		11,230	11,230
Jengkol	1,287	3,000	4,287
Petai	1,736	13,859	15,595
Nangka		6,805	6,805
Total	68,730	153,492	222,222

Source: Table from P_3RP - DAS Citanduy

TABLE IV- 6

PANAWANGAN LIVESTOCK IMPROVEMENT PROGRAM FOR SHEEP

(IV Quarter 1978/1979)

Description	Rams (Male)	Ewes (Female)	Total
Beginning Inventory			
Breeding herd	3	77	80
Lambs	11	26	37
Total	14	103	117
Value of Sheep Herd (Thousand Rupiah)	230	1,800	2,030
Increase in Quarter			
Purchase	5		5
Born	12	18	30
Subtotal	17	18	35
Decrease in Quarter			
Slaughtered			
Died	2	4	6
Subtotal	2	4	6
Ending Inventory			
Breeding herd	8	77	85
Lambs	21	40	61
Total	29	117	146
Value of Sheep Herd (Thousand Rupiah)	530	1,940	2,470
Less Purchases (Thousand Rupiah)	200		200
Value of Increase (Thousand Rupiah)	100	140	240

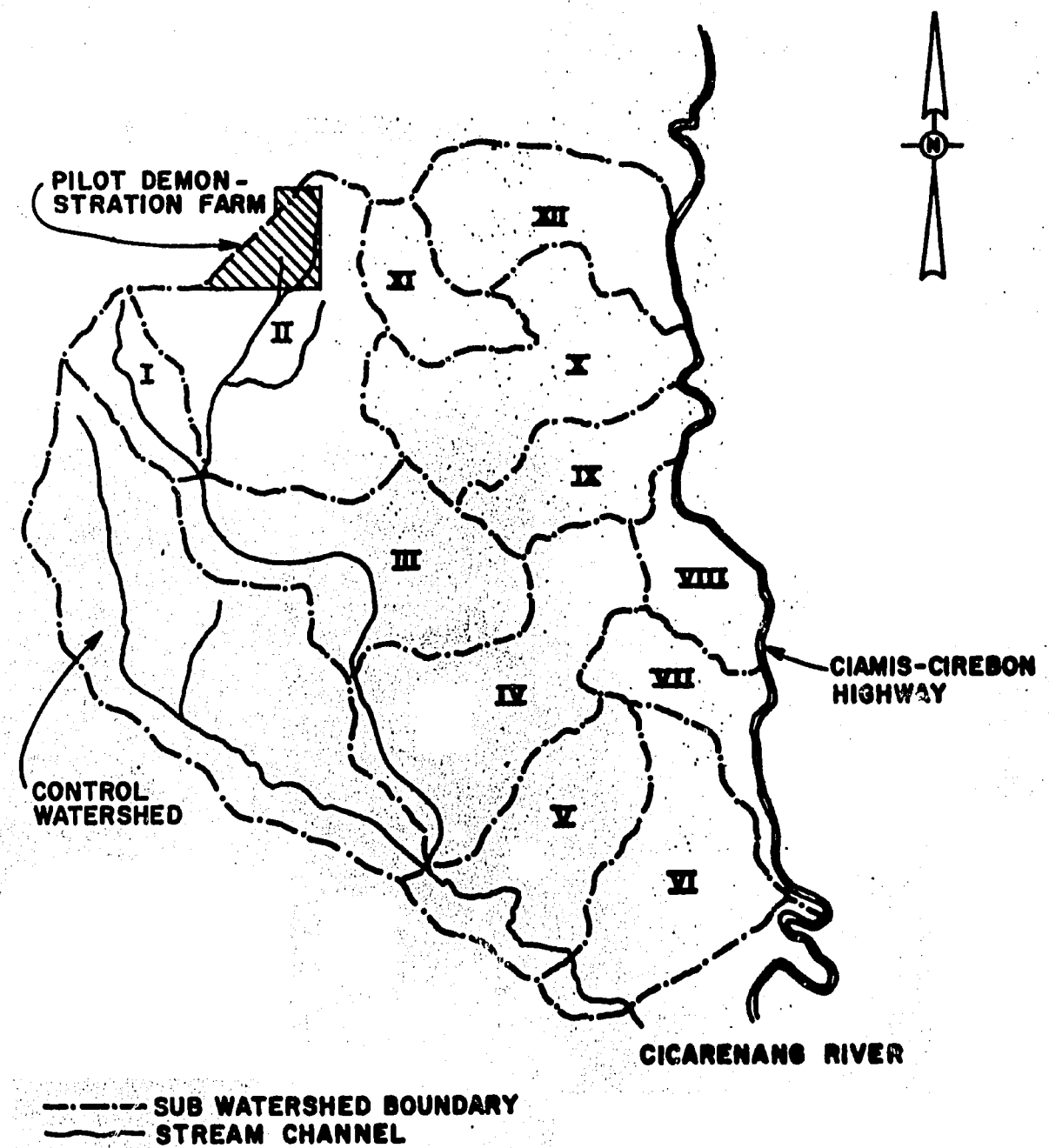
Valuation:

Rams Rp. 40,000

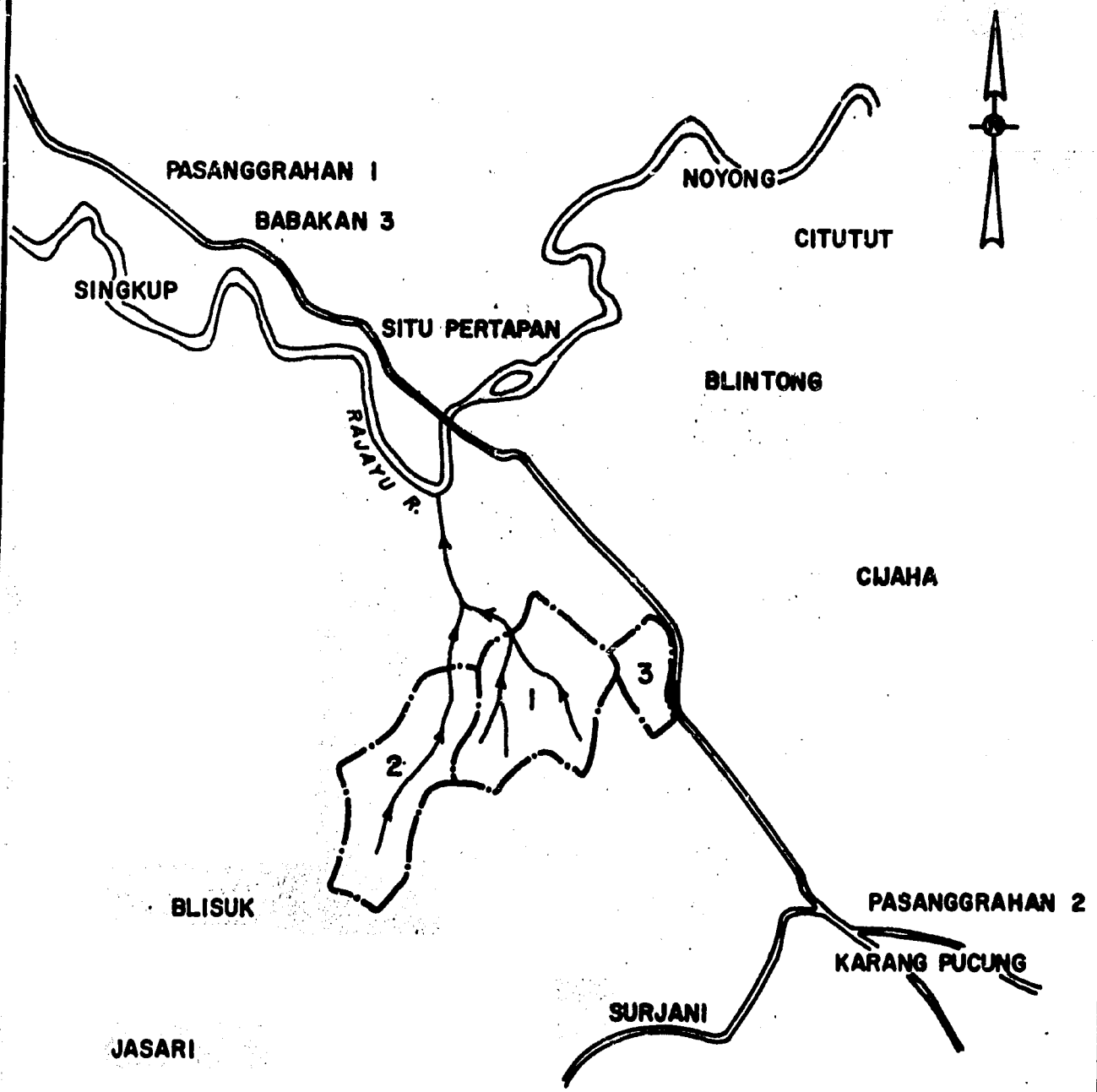
Ewes Rp. 20,000

Lambs Rp. 10,000

Source: Animal Husbandry Department Ciamis District.



UPPER CITANDUY WATERSHED PROJECT
SUBWATERSHEDS
PANAWANGAN PILOT WATERSHED



NOTE:

PLOT NO. 1 29.0 HA PLOT WITH SOIL AND WATER CONSERVATION PRACTICES.
PLOT NO. 2 10.1 HA CONTROL PLOT.
PLOT NO. 3 3.6 HA ROAD DEMONSTRATION FARM.

UPPER CITANDUY WATERSHED PROJECT
KARANG PUCUNG PILOT WATERSHED
CIKAWUNG SUBBASIN

CHAPTER V

SOCIAL INSTITUTIONAL ANALYSIS

Introduction

This chapter reports the results of the study conducted to determine the social soundness of the Upper Watershed Conservation Program and its potential impact on the target population. Thus the focus is on the people in the project area and their activities, institutions, and resources, as well as on the program itself. For the program to be socially sound, it must be acceptable to the people who are supposed to benefit from it; it must benefit a significant segment of the target population -- the rural poor; it must be organizationally adequate for the assigned task; and it must produce the kinds of benefits specifically desired without causing unintended negative effects.

This chapter is based on materials obtained from a number of sources. The data and analysis are believed to be adequate for feasibility determination, but additional data should be sought for updating the work plan during project implementation. A statement of further data reqirements follows the analysis and recommendations.

The analysis leads unequivocally to the conclusion that the Upper Watershed Conservation Program is socially sound and socioculturally feasible. It will diffuse a feasible technology for badly needed erosion control in the Upper Watershed and it will provide support mechanisms to help to help upland farmers increase their productivity and incomes. Concurrently this will induce these farmers, individually and collectively, to maintain and improve their terraces and waterways. The majority of farmers in the Upper Watershed will benefit directly from the program and many other people will benefit indirectly. Moreover, its qualitative impact will be greatest on the poorest farmers whose continuing attempts to survive on marginally productive land are leading to increasingly precarious incomes and ecological ruin.

Chapter Format

The greatest problem that program planners and administrators must face is the project area's tremendous diversity: in terrain, cropping patterns, cropping intensity, population density, accessibility, prosperity, organizational structures, infrastructure, and so on. Thus, the greatest task they will face is to create a program sufficiently decentralized to enable it to respond concretely and adequately to specific local needs, yet also sufficiently centralized to make efficient use of scarce fiscal and human resources. If the program is defined as an integrated upland rural development program, rather than as merely an erosion control effort; and if strong emphasis is placed on building the capacity of local governments to handle the many aspects of the program, rather than merely building a temporary technical support structure, then the program can succeed. If it is limited to erosion control, oblivious to farmers' other needs, the program may succeed in building terraces and waterways, but may not create the circumstances under which farmers will feel compelled to maintain those structures.

The remainder of this chapter attempts to convey an understanding of the diversity in the area and thus to set a basis for planning an integrated watershed program. It cannot pretend to cover completely the variety of social phenomena in the watershed area, but it does indicate general axes of variation and identifies certain problems to be found. It indicates the circumstances administrators will find, but not their distribution or magnitude. More data are needed about target areas in order to tailor the program specifically for them.

The final part of the Introduction discusses data and data sources. Three major sections follow: The first section discusses various characteristics of the Upper Watershed area and how they relate to the program; it looks first at population and work force questions, then community structues, and, finally, infrastructural elements.

The second section analyzes the Upper Watershed Conservation Program; socio-cultural feasibility is discussed first, followed by an analysis of motivators, participants, and beneficiaries; then some anticipated consequences of the program are outlined, followed by a look at spread effects.

The third section reviews the assets and problems of the program and outlines recommendations and further areas of inquiry.

Data and Data Sources

Data presented in this chapter were gathered from five sources: published materials, brief site visits to other watershed project areas, discussions with district and sub-district officials, village statistics supplied by district planning offices and field visits to a number of villages within the Citanduy River Upper Watershed area. Published materials were rarely useful, but other sources were helpful in different ways. Village statistics and field data from sample villages merit special explanation.

First, although a multitude of statistics are generated on the local level in Indonesia, collection and reporting procedures vary from one place to another, and discrepancies are magnified at each step up the governmental hierarchy. Thus, the village statistics are indicative at best, not precise tabulations. But another factor further complicates the problem of interpretation: the widely varying conditions of villages actually represented. We originaly intended to narrow the focus by obtaining data only from villages which seem to have moderate or severe erosion problems; but the maps available at the time of our request did not permit identification of all relevant villages in each of the four districts which lie partially within the Citanduy River Basin. The planning offices of Cilacap, Tasikmalaya, and Kuningan Districts responded by providing data for each village in the sub-districts located within the basin, whereas Ciamis District provided data only for the specific villages we requested. Consequently, data from 37 lowland villages in Ciamis District are missing, including urbanized areas of Ciamis and Banjar. In order to make the data more comparable, the administrative center of Tasikmalaya, including 13 villages, has been excluded. Nonetheless, the reconciliation of the two data sources has not been entirely satisfactory. Finally, because of the exclusions mentioned above, the totals used in the tables in this chapter will not be consistent with figures presented in other chapters of the report. The second data source which needs explanation is the village sample

chosen for field visits. The Citanduy River Upper Watershed contains a wide variety of types of terrain, administrative jurisdictions and farming practices; and the relative standard of living, population pressure, and accessibility vary considerably throughout the area. The Watershed Conservation Program must respond to such diversity; thus, field investigations attempted to understand the range of variation along certain dimesions which were thought to be relevant to program formulation.

With the help of planning officials, at least two villages were chosen in each district to compose the sample. Each village was visited from one to three days, during which time an attempt was made to talk with various village and sub-village officials and farmers. The consultant/counterpart team was free to move about unescorted in some districts, but in others it was accompanied by as many as five district and sub-district officials. Additional villages were visited more briefly by a team of three consultants, with a considerably larger entourage of officials. The field visits thus yielded data of varying utility, but resulted in an understanding of the situation which is adequate for feasibility analysis. In aggregate, the village sample is believed to represent an indicative, but not exhaustive, sample of variations to be found in the area.

The Upper Watershed Area

This section presents background data concerning the people in the upper watershed; what they do, how they are organized, and what they have to work with. At times, the data emphasis shifts from overall description to identification of major internal variations or their program implications.

The Citanduy River Basin includes parts of two provinces (West Java and Central Java), four districts (Ciamis, Tasikmalaya and Kuningan in West Java, and Cilacap in Central Java) (Table V-1), 37 sub-districts (Table V-2), one administrative center, and over 350 villages. For the purpose of this analysis, most of the data are aggregated at the

district level, although some sub-district data are used. Although the great diversity found within the basin becomes obscured even in sub-district statistics, using smaller data units would not contribute enough significant information to warrant introducing the additional detail. Data from sample villages are used in some instances, however. In the Upper Watershed we are concerned with approximately 300 villages covering 3,335 square kilometers with a total population of slightly less than 2 million people. Thirty-nine predominantly lowland villages in Ciamis District are excluded from calculations, as well as 13 villages in Tasikmalaya and all sub-districts within the four districts lying outside the Citanduy Basin.

The upper watershed areas of the Citanduy River Basin are extremely diversified in topography, and that diversity is reflected in many social characteristics. Variations are notable between districts, as well as within them, and between sub-districts, villages and sub-villages. There are sparsely populated zones where people enjoy a higher standard of living based on mixed crop production integrated with fish-ponds and some animals (Ciamis), handicrafts (Rajapolah), fruits fruits (Cineam), and other sources of livelihood. In general, landowners fare better than the landless, and farmers who own paddyland or both paddyland and upland parcels have higher standards of living than farmers who own just upland tract. In some areas, the population is concentrated in valley villages; in others, homesteads dot the terrain. Some villages are growing rapidly; others are losing population through seasonal or permanent out-migration. In some villages, nearly every family owns some land, if only for a house; in others, land ownership is less common, and sharecropping, renting or squatting on Forestry land are prevalent in greater or lesser degrees. Some sub-districts and villages are linked to major roads, and farmers have easy access to markets and agricultural inputs through official and private commercial channels; in others, the farmers are virtually isolated. The prevalent patterns in each village must be identified in before the program is enacted, as they will dictate the appropriate strategy.

Population

Population Growth. Between 1966 and 1976, the population in the upper watershed villages grew 19 percent: from 1,621,147 to 1,926,844 (Table V-3). Tasikmalaya and Cilacap had the greatest increases (24 percent and 20 percent respectively) and Kuningan had the smallest increase (8 percent). Fifteen-year data are available only for Ciamis and Cilacap, and they show an increase from 1961 to 1976 of 29 percent and 23 percent, respectively. In each of the four districts, the population increased more during the 1966-1971 five-year period than it did between 1971 and 1976.

The sub-districts with the highest percentages of population increase between 1966 and 1976 (Table V-2) are Banjar (86 percent), Karangpucung (32 percent), Sidareja (34 percent), Pagarageung (28 percent), Cineam (28 percent), Cineam (28 percent), Indihiang (26 percent) and Cisayong (26 percent). Banjar's population growth patterns have been significantly distorted by the creation of Proyek Citanduy. The other rapidly-growing sub-districts contain major market centers, which primarily function to aggregate local production for transport to urban markets. The sub-districts with the lowest population increases during the same period are Ciamis (3 percent), Rajadesa (4 percent), Padaherang (5 percent), Selajambe (8 percent), Kedungreja (8 percent), Subang (9 percent) and Rancha (9 percent). Most of these sub-districts are essentially isolated from the major transport networks, or, in the case of Ciamis, are represented in our calculations by the upland villages of the sub-district which are remote and difficult to reach. Not surprisingly, four of the sub-districts -- Subang, Selajambe, Rajadesa and Rancah -- are located in the rugged uplands of the Cijolang River.

In general, population growth reflects the congruence of local resources and communications neworks. The more isolated villages generally have the least favorable conditions and the lowest rates of population growth. Field inquiries substantiated the inference made from population statistics and isolated two factors which contribute to low growth rates in some disadvantaged areas -- traditional birth control methods and out-migration.

Population Density. Population density in the four districts averages 627 persons per square kilometer (Table V-1), varying from 432 in Kuningan to 886 in Tasikmalaya.

Sub-district population densities range from 273 persons per square kilometer in Dayeuhluhur to 1,644 in Rajapolah (Table V-2). Individual village density figures show an even broader range, indicating dense population settlements along main transport routes and in areas with the most favorable physical conditions for agriculture. However, there are large, virtually uninhabited tracts of forestry and plantation land in Tasikmalaya, Kuningan, and Cilacap that distort population density figures somewhat. In general, there is a correlation between the location, prevalence and size of dense population settlements and the terrain, land use, and communication patterns.

Based on data from other parts of Java, White distinguishes between population "density", a simple measure which relates population to land area, and population "pressure", a more complex measure which relates population to the quality of local resources. He observes that although population densities are increasing unevenly, population pressure seems to increase more uniformly. This seems to be the case in the Citanduy River Basin, although the phenomenon is impossible to document with precision. That is, population density is increasing all over the basin, but the increase is more rapid where exploitable resources are more abundant. Population density increased markedly between 1966 and 1977 (Table V-4), but much less in Kuingan than in the other three districts.

Age and Sex Distribution. The population in the watershed villages is relatively young. In 1977, 38 percent of the people were under 15 years of age (Table V-5), with variations ranging from 33 percent in Ciamis to 42 percent in Tasikmalaya. The sex ratio (the number of males per 100 females) in the villages was 91, with variations ranging from 87 in Tasikmalaya to 95 in Ciamis and Kuningan. The sex ratio in each district is rather consistent between age groupings, with the exception of Kuningan where the ratio is inordinately low (84) in the 25-54 year old group. This ratio undoubtedly reflects the impact of the out-migration of working age males. A more detailed age group breakdown

might also reflect demographic effects in Kuningan of the civil disturbances around 1958 and 1965, but data at hand do not permit such manipulation or interpretation.

Family Size. With the data at hand, we can only estimate roughly the average family size for three of the four districts (Table V-6). The estimates are calculated from wetland landowner/cultivator statistics, which exclude purely upland farmers; consequently, they can only be seen as indicative. Calculations show an average family size of 4.95 persons in the three districts, with larger families in Ciamis (5.17 persons) and smaller ones in Cilacap (4.78 persons). Average landowning family size is larger than cultivating family size in Ciamis and Cilacap, but not in Tasikmalaya, perhaps because that average landholdings are smaller in Tasikmalaya than in the other districts. Field observations lead one to believe that these estimates understate family size in general and conceal an inconsistency between upland and lowland family size. That is, in the absence of other documentation, data from field observations and discussions, indicate that upland families in more remote, agriculturally unfavorable areas tend to be smaller than lowland families. It is unclear whether the government-sponsored family planning program has influenced this trend, but it is doubtful that it has.

Religion and Ethnicity. Because the watershed population is overwhelmingly Muslim and the small numbers of Buddhists and Christians are located primarily in the urban centers, most of the countryside is homogeneous. There were 4,921 mosques and 28 churches reported in the upper watershed villages, equaling one mosque for every 395 persons, and one church for every 68,000 persons (excluding Kuningan).

The area is not ethnically homogeneous, however. The people in Central Java (Cilacap District) are predominantly Javanese, but those in West Java (Ciamis, Kuningan and Tasikmalaya Districts) are predominantly Sudanese. The groups are distinguishable by their language and traditions. There is some movement between the two provinces, and within a strip 10 kilometers wide along the Citanduy River a cultural hybrid group has formed of people who speak an amalgam of Sudanese and Javanese. The uplands and the swamp areas are most affected by ethnic movement. Sudanese have fled east to the tidal forest area on the lower

Citanduy and Javanese have moved west into the hills along the lower reaches of the river basin. In addition, there is considerable labor movement back and forth across the provincial border during land preparation and harvesting seasons.

Ethnic relations are congenial; thus, they should not be a factor in the success of the watershed program. Religious ties can be a positive factor, however, particularly if religious leaders are persuaded to discuss the program at Friday prayer meetings in the mosques. Religious leaders should be involved in the educational campaign from early stages, and members of the program field staff should systematically attend prayer meetings throughout target areas to discuss the program and answer questions. This procedure will reduce of the time required to make contact with the whole farmer population, and it will lend moral authority to the program, which will be important for stimulating farmer participation in implementation and subsequent maintenance.

Education. Educational levels in the upper watershed population are generally low, but vary considerably between districts (Table V-7). Cilacap has the lowest educational levels and Ciamis and Tasikmalaya have the highest levels. Thirty percent of the population over 10 years old in Cilacap District have not attended school and another 29 percent did not complete elementary school. In contrast, only 8 percent of the population over 10 in Ciamis District and 9 percent in Tasikmalaya have not attended school and another 27 percent in Ciamis and 26 percent in Tasikmalaya did not complete elementary school. The comparable figures in Kuningan are 18 percent and 23 percent, respectively. Fifty-two percent of the people over 10 completed elementary school, ranging from 37 percent in Cilacap to 60 percent in Ciamis; 4 percent of the total completed middle school and 2 percent completed secondary school.

A more simplified breakdown of 3 educational levels (less than elementary, elementary, more than elementary) (Table V-8) further illustrates the discrepancy between districts. Clearly the proportion of educated people in Cilacap is significantly lower than the proportion in the other three districts. And the incidence of post-secondary education in the total population shows a similar pattern. In Cilacap, 3.4 persons

per 10,000 have studied beyond high school, compared to 14.8 persons per 10,000 in Tasikmalaya.

Educational levels can be expected to rise markedly in the near future, however. The first two national five-year plans strongly emphasized elementary school construction and now local elementary schools are scattered throughout the area. By 1977, there were 1960 schools in the watershed area (Table V-9), 90 percent of which were elementary schools. Middle schools comprise 8 percent of the total and secondary schools 2 percent. Seventy-two percent of the schools are government schools and 21 percent are Islamic. Eighty-eight percent of the students enrolled in 1977 were in elementary school, and 8 and 3 percent were in middle and secondary schools, respectively.

Data on school attendance or the percentage of people now in school who can be expected to complete elementary school or higher were not available. However, we can obtain a rough approximation of school attendance by relating the number of students to the number of people between the ages of 5 and 15 (Table V-10). The ratio thus obtained is 62.2 students per 100 people aged 5 to 15 in Tasikmalaya, 66.5 in Kuningan, 66.9 in Cilacap and 74.9 in Ciamis. It would thus appear that Ciamis has a greater percentage of young people in school than Tasikmalaya, even though students in Tasikmalaya have tended on the average to reach slightly higher educational levels.

Now that the elementary school system is developed throughout the watershed villages, the middle and secondary school networks must be expanded.

<u>Housing</u>. Housing data are presented in Table V-11. Unfortunately, this table is not altogether useful because the Cilacap figures are incorrect and because the dichotomous classification used obscures more than it illuminates. Nevertheless, it is clear that semi-permanent (part stucco) and temporary (bamboo) uses are much more prevalent than permanent (stucco) houses. But field observations lead one to predict a rapid increase in the proportion of permanent and semi-permanent homes over traditional bamboo homes in the next few years. Two percent of the homes in Ciamis and Cilacap Districts have electricity as do 3 percent in Tasikmalaya (excluding the cities of Ciamis, Banjar and

Tasikmalaya, respectively) and 5 percent in Kuningan.

In general, each nuclear family owns its own home but does not necessarily own the land upon which the home is constructed. Throughout the area, there has been a longstanding tradition of sharing living areas (kampung) without transferring ownership or requiring an exchange of goods or services. In the rural area, house construction continues to be a community activity; people contribute both materials and labor to help relatives and neighbors build homes. If the watershed program succeeds in increasing the productive value of upland areas, and thus increasing farmer incomes, this community tradition may change. That is, the incidence of more expensive, permanent homes may increase, especially those which require skilled labor in construction, and landowners may become reluctant to allow newcomers to settle on their lands. A fairly fluid, adaptable situation thus might be replaced by a more rigid one, based on economic rather than communitarian principles.

Public Health. Disease and health problem statistics were not obtained for this report. However, discussions with public health officials in Kuningan and Cilacap revealed that some health problems, especially malaria and some water-borne diseases and parasites typical for the general area are less prevalent in the uplands than the lowlands. The most common problems treated by public health personnel are simple upper respiratory ailments, rheumatism, diarrhea and anemia. Symptoms of Vitamin A deficiency are reported in public health clinics occasionally and beriberi less frequently. In general, the level of health seems better than might be anticipated by income levels.

The official public health system reaches a relatively small proportion of the population. For most ailments, people use home remedies or go to traditional curers. Most babies are delivered by traditional midwives who receive no formal training, except in Ciamis District where there is a program of midwife training and certification. The official system has been expanding, however. Under the second five-year plan, public health clinics were instructed to provide medicines for a low fixed fee, rather than at cost, which seems to have increased use of the system. Nonetheless, the health care system still has an urban bias.

Statistics for the Upper Watershed villages reveal a total of 192 clinics of various types in the villages and a total of 324 doctors, physicians' assistants, nurses and trained (non-traditional) midwives (Table V-12). For some reason Ciamis has a high number of mother/child clinics and Tasikmalaya has a particularly high number of family planning clinics. When the public health system components are divided by the population in each district (Table V-13), the same relationship prevails. That is, there is one mother/child clinic for every 21,600 persons in Ciamis, but only one for every 49,500 persons in Tasikmalaya; however there is one family planning clinic for every 9,000 persons in Tasikmalaya, and only one for every 36,300 persons in Ciamis. Overall, there is a public health clinic for every 62,700 persons, one doctor for every 74,800 persons, and one physicians' assistant for every 29,500 persons in the Upper Watershed. These aggregate figures obviously combine many unlike entities, however, because they do not account for accessibility, population concentration, or other factors which greatly influence a person's ability to utilize the system. In this sense, the data from Kuningan in Table V-13 not only are deceptive, but they also contaminate the total figures.

It is strongly recommended that Upper Watershed field staff be alerted to symptoms of dietary deficiencies which might be found and that they make systematic inquiries to detect less obvious deficiencies. Having found evidence of deficiencies, the staff should recommend homegarden cropping patterns which can overcome the deficiencies. This effort would occupy minimal time but could add immeasurably to the value of the program.

Work

Work Force. Probably no characteristic of the population is more important to understand than the one which relates to making a living. The greatest problems to be solved in the Upper Watershed area, and indeed throughout Java, affect people's livelihoods by reducing productivity. Thus, programs that enable people to increase the magnitude and dependability of their incomes by protecting their resource base and by making work time more efficient and productive must be imple-

mented. Ultimately, this means improving agricultural yields and, thus, remuneration and providing alternative jobs inside and outside the agricultural sector. In order to design these programs and to evaluate their effects, reliable data relating to the work force is essential at the outset.

Unfortunately, however, occupational and and work force statistics are incomplete and deceptive. In rural areas, practically everyone has to work in some way to contribute to family incomes, often doing different things at different times, yet people are not busy all of the time. Most people work or are somehow involved in the agricultural sector, whether farming, processing or marketing. Moreover, except when they are engaged in seasonal tasks related to crop production or harvesting, people spend a great deal of their time doing work which pays very low or uncertain hourly or daily wage equivalents -- petty commerce, minor home industries, paid or voluntary manual labor, or paid or unpaid community service. Official statistics clearly do not tap everyone who participates in the work force, and those who are included are listed in a single occupational category. Thus the statistics underestimate the actual size of the productive population, in most cases, and they oversimplify the reality of work force participation for virtually everyone. In addition, the magnitudes of unemployment and underemployment are simply beyond reasonable assessment with the data available.

Despite the limitations of official data, available statistics and field data do convey some understanding of the work situation in the Upper Watershed area and particularly those aspects which may be affected by the Upper Watershed Conservation Program.

The work force officially includes everyone between the ages of 15 and 55 who is gainfully employed. The age group includes 1,026,000 people in the Upper Watershed area, or 53 percent of the area's total population. According to occupation distribution statistics (Table V-14), the active work force comprises 87 percent of the eligible people ranging from a questionably low 67 percent in Tasikmalaya to an erroneous 165 percent in Kuningan. Seventy-one percent of the eligible people in the four districts are in the agricultural work force ranging from 48 percent in Tasikmalaya to 136 percent in Kuningan. From these figures,

one can infer a very high rate of work force participation by women, particularly in agriculture and particularly in the least urbanized areas. Women constitute a vital segment of the work force. They perform tasks especially relegated to them as well as others which are done by people of either sex. Women are especially active in commerce; they participate in household economic decision-making; they own land; and they may contribute the bulk of their family's earned agricultural income from their work in the rice fields. The extent of women's participation in the labor force and in decision-making have not been investigated for this report. However, they should be documented before the Upper Watershed Program is adaptd to each location because such information will help define the strategy apprproiate to the location. For example, in specific localities, household cropping or marketing decisions may be made jointly by farming couples or individually by individual landowners, male or female. If joint decisions are the norm, then men and women should jointly participate in community discussions regarding such things as terracing benefits and cropping recommendations; alternatively, separate sex peer meetings should be held if that arrangement is deemed to be more comfortable for participants. Whatever the arrangement, because all participants in household decisions should be involved in the program at appropriate times, the decision-making patterns must be investigated and not merely assumed.

Occupational distribution of the active work force is shown in Table V-15. Agriculture is overwhelmingly the largest occupational group (81 percent, varying from 72 percent in Tasikmalaya and Cilacap to 90 percent in Ciamis), followed by commerce (6 percent) and public administration (5 percent). A number of other jobs (ranging from plantation workers to professionals, industrial workers, and entrepreneurs) are obscured in a residual category which includes 8 percent of the total. Clearly nothing rivals agriculture as the principal source of livelihood in the Watershed area.

However, the agricultural population comprises a heterogeneus mixture of people with different relationships to the land they till, from, landowners to renters, sharecroppers, laborers and squatters. The distribution of farmer types is an important consideration because it has implications for the implementation and ultimate impact of the Upper

Watershed Program. For example, renters or sharecroppers are unlikely to be willing to invest their own time and energy to construct terraces if they have reason to fear that their contracts will be terminated once the work is completed. Likewise, if a terracing subsidy goes to landowners rather than to tenants, the tenants may refuse to participate in a terracing program. The data presentd below show that the distribution of farmer types varies considerably from one village, sub-district, and district to another. But it also varies within each village, and the incidence of sharecropping and renting may vary considerably between dryland and paddy areas in the upland and between upland and lowland areas within a village. The available data do not permit analysis below the village level, thus more specific data will have to be gathered in each village in early planning stages to permit the adoption of strategies appropriate to each.

Table V-16 shows the proportion of owner-operators, renters, sharecroppers, and others in the agricultural work force; landowning entrepreneurs, such as merchants who own land, presumably are listed under owner-operators. Owners are most prevalent, but they make up less than half of the total (44 percent). Cilacap has the highest proportion of owners (48 percent), and Kuningan has the lowest (38 percent). The proportion of owners is followed by laborers (34 percent), sharecroppers (17 percent), other (3 percent), and renters (2 percent). Tasikmalaya has the highest percentage of laborers (39 percent), and Ciamis has the lowest (29 percent). Kuningan, Tasikmalaya, and Cilicap have nearly equal proportions of laborers and owners (assuming that the "other" in Cilicap consists largely of plantation workers), but there are considerably more owners than laborers in Ciamis. Ciamis has the largest percentage of sharecrppers (28 percent), followed by Kuningan (17 percent) and Tasikmalaya (13 percent). There are renters in Kuningan (6 percent) and Cilicap (4 percent) but only a small proportion in the other two districts.

The distribution of farmer types within sub-districts (Table V-17) indicates a wide range of variation. Banjar sub-district has the highest proportion of owners (84 percent); Indihiang, the lowest (22 percent). Indihiang has the highest proportion of laborers (67 percent); Lakbok has the highest proportion of sharecroppers (55 per-

cent); and Gandrungmangu has the highest percentage of renters (9 percent).

Although the available statistics do not allow documentation, field inquiries suggest that renting and sharecropping are more prevalent on paddylands than on uplands. However, the situation must be ascertained in each location.

Land Use and Ownership. Land throughout the Upper Watershed is used primarily for cropping and living space, with some forests, plantations and fishponds. Very little land use is not related to agricultural production or housing. Land use distribution for the Watershed villages is shown in Table V-18. Forty percent of the land is used for dryland cropping, 26 percent for wetland rice, 22 percent for forests and plantations, 11 percent for homegardens, and 1 pecent for fishponds. Ciamis has the highest proportion of dryland cropping (59 percent); Tasikmalaya has the highest proportion of wetland rice (33 percent) and forest/plantations (53 percent), including a great deal of mixed horticulture; and Cilicap has the highest concentration of homegardens (15 percent).

The actual agricultural land use varies greatly from one part of the Upper Watershed to another. Paddy rice is grown wherever adequate water is available and paddy terraces are neatly constructed and maintained up to the maximum altitude attainable in any location; housing areas are surrounded by palms, bananas, and bamboo and cassava is grown all over in varying amounts. There are few other common agricultural patterns, however. Above Ciamis and Tasikmalaya, on the slopes of Mt. Sawal, fishponds are interspersed with habitations, homegardens, cassava plants, and some cloves. In the uplands of Cilicap, fishponds are rare; cassava is most prevalent there, sometimes intercropped with maize, peanuts, upland rice, or other crops. Many hillsides in the southern part of the Watershed are covered by dense mixed orchards, generally including cassava. Government forests are visible on the highest slopes in the area and some plantations are scattered around. Kuningan and Cilicap have the highest concentration of forests although the forest tracts in Ciamis and Tasikmalaya appear more prominent. Squatters have cleared and settled some forest land, with subsequent deterioration due

to erosion. However exact figures have not been obtained.

In general, land used for paddy is highly prized, skillfully terraced, and well maintained, but other land does not generally receive such meticulous attention. Where terraces are used in dry uplands, they rarely match the soil and water control of paddy terraces; upland cropping areas have rudimentary, frequently ineffective terraces, if they have them at all. Many denuded slopes are planted only in cassava, thereby stimulating erosion both during the growing season and at harvest time. Not surprisingly, cassava yields have tended to decrease under such conditions, but that has led farmers to clear additional land, to turn to exclusive cassava production and out-migrate part of the year, or to do both. Where horticulture or mixed horticulture/cropping prevails, individual farm units differ greatly in the effectiveness of the vegetative cover to protect the soil from erosion.

Most of the land (82 percent) is owned by private individuals (Table V-19), with the remainder owned by the Government (15 percent), by villages (2 percent), or in some sort of uncertain status (1 percent). In general, the Government lands are forests and plantations. Kuningan and Cilicap have the lowest rates of private ownership and highest rates of government ownershp. Village officials are given usufruct rights to vilage lands as compensation in most villages, so these lands are treated much like private land.

Landowners are almost entirely local residents. Only Cilacap District made available data regarding the amount of land owned by non-residents; village officials in the other districts keep absentee ownership records, but they are not necessarily aggregated on the district level. In Cilacap, 4 percent of the land belongs to people who reside outside of the village in which it is located. Discussions in the sample villages in other districts uncovered absentee ownership rates of similar or lower magnitude. Sometimes further inquiry revealed that most absentee owners live in nearby towns; in other cases, they are former residents of the village who have moved away, generally to larger cities. Throughout the discussions, village officials maintained that absentee ownership is not a problem. They say that peple who ive far away invariably assign responsibility for the land to a resident family member.

Nonetheless, the experience at the Panawangan Watershed Pilot Demonstration Area indicates that any program which requires the direct participation of landowners can be weakened if the landowners are unavailable at critical periods. Thus, contingency plans have to be made to anticipate resolving this problem when it develops during project implementation.

Private landholds are very small throughout the watershed. Tables V-20 and V-21 indicate the distribution of landholdings by unit size and the concentration of private land in different sized units, respectively, but the data are complete only for Cilacap and Tasikmalaya Districts. The tables indicate total ownership units, including cropland, homegardens and orchards. Although ownership unit size and actual farming unit size do not strictly correspond, from Table V-15 we can surmise that they are not widely discrepant.

Table V-20 clearly indicates that the large majority of landholding units in the upper watershed are small. Seventy percent of the 377,508 units in Ciamis, Cilacap and Tasikmalaya are under 0.5 ha and 90 percent are smaller than 1 ha. In Tasikmalaya, 96 percent of all units are under 1 ha. The average sized landholding unit is 0.47 ha in Tasikmalaya, 0.63 ha in Cilicap and 0.84 ha in Ciamis.

Landholding concentration is somewhat different. Of the 130,917 ha of private land in Cilacap, Tasikmalaya and Kuningan, 44 percent are in units smaller than 0.5 ha and 71 percent are in units of less than 1 ha. However, 9 percent of the land is in units of from 3 to 5 ha. Kuningan and Tasikmalaya each had a higher-than-average proportion of land in units under 1 ha (84 percent and 86 percent, respectively). In sum, landholdings consist of a great number of tiny units concentrated in many hands, rather than in few. However, the available data do not allow us to classify ownership patterns according to paddyland/dryland/homegardens, or even by upland/lowland. Thus, it is impossible to say to what degree the earning potential of landholding units is as evenly distributed as the number of units or to what degree upland ownership and lowland ownership are coincidental.

Farming Patterns and the Upper Watershed Conservation Program. Cropping patterns vary markedly within the Watershed with concomitant variations in standards of living, mobility patterns, and the like. Rather than repeat detailed descriptions of the farming patterns identified in previous chapters, this chapter's aim is to describe some farming patterns within their broader village contexts and to highlight their implications for the Watershed program. The discussion will cover the following topics: agricultural products, land ownership patterns, the farm labor situation, and farmers' apparent responsiveness to innovation. The five villages in the discussion (Table V-22) were chosen to represent certain farming types in each sub-watershed, not to exhaust the varieties that exist. This preliminary study should be followed by more detailed systematic surveys in each of the target villages that are identified in the work plan, both to facilitate adjusting the program to local conditions, and to provide benchmarks for subsequent evaluation of program impact.

Some crops are grown in all of the villages and throughout the Watershed, but there is, nonetheless, a particular prduction emphasis in each village. The common crops are paddy rice, cassava, bananas, coconuts (and other palms), bamboo and cloves. Except for cloves, which were introduced commercially into the area during the last decade, all of the common crops are traditional. Taken together, they can very nearly meet all of one's subsistence needs for food, shelter and tools. The production emphasis of each of the five villages can be seen in Table V-23. Payungagun, a village of fairly high altitude, is becoming a major clove seedling center. Karanglayung, also nestled in the hills, has long been a horticultural village where farmers raise multi-canopied lots of trees, fruits and cassava. Lately, the trend there has been toward introducing improved fruit varieties and cloves and reducing the prevalence of cassava. Bantarpanjang, highly dependent on cassava, has the most traditional cropping mixture. Other crops are mixed but limited. Dayeuhluhur and Cantilan also have traditional, intercropped mixtures of trees, vegetables and tubers. Cantilan is at a lower altitude than Dayeuhluhur and farmers raise a greater variety of marektable crops there, including some, like pandan, that are used in local home industries.

Land ownership in the villages varies somewhat as indicated in Table V-22. All of the villages have high rates of agricultural land ownership; that is, few families in the villages do not own productive land. The high rate of sharecropping in Payungagung and Dayeuhiuhur shows that many of the ownership units in those villages are too small to support families, thus family members sharecrop additional land.

Although land ownership is common in the villages, the mixture of upland (dry crop land, forests and orchards) and lowland (paddyland in plains or valleys) varies considerably. This is important for two reasons. First, both holding size and land type are critical determinants of potential farm family income. For example, given three landholdings of equal size, one which contains both lowland and upland portions may yield a higher income than holdings consisting of only lowland or only upland tracts, unless the lowland is irrigated all year. The combination offers food, as well as security, in ways that single types of holdings do not. In any case, however, an upland tract will invariably render the lowest income of the three possibilities. Second, the upland/lowland mixed holdings constrains time allocations, which may or may not constrain the ability of farmers to devote time to a terracing program.

The proportion of families in the five villages who own only upland tracts varies from an estimated 15 percent in Bantarpanjang to 55 percent in Karanglayung; the proportion of families with upland/lowland mixtures varies from 85 percent in Bantarpanjang to 30 percent in Karanglayung. This means two things: First, all other things being equal, farm income levels are likely to be more evenly distributed in Bantarpanjang than they are in Karanglayung, where there may be a smaller proportion of people with relatively high incomes and a larger proportion of families with low incomes. The distribution in the other villages would vary accordingly. Second, the upland, upland/lowland ownership distribution means that, other things being equal, a relatively high proportion of farmers in Karanglayung would have time to devote to a terracing and waterway project compared to the proportion of farmers in Bantarpanjang who would be free to devote time to terracing. Of course, other things are never equal; thus these factors must be combined with other considerations in planning a program. Nonetheless, data from

these villages give an idea of the difference between villages to which the program will have to adapt.

The village farm labor situation also varies considerably throughout the Upper Watershed and thus must be assessed specifically in each target village. This is a significant factor for two main reasons: First, terracing will require a great amount of labor, and the availability of local labor will determine both the ease with which the terracing work can be done and the population which will benefit from that part of the program. If outside laborers must be recruited for the work, the beneficial impact on the immediate community will be reduced somewhat. Second, if there is a local labor shortage, the concomitant agricultural intensification efforts may be limited, at least in the short run. From Table V-22, we can see that one of the five villages has a local labor shortage; one has a clear surplus; one fluctuates seasonally; and two are relatively balanced, thanks to active home industries. Labor migration patterns between these villages correspond in direction but not degree. That is, workers from villages having labor surpluses migrate to villages having labor shortages. However, the migration does not fully balance the surplus or shortages. In summary, it is not safe to assume that because the Upper Watershed area is densely populated there are surplus laborers available everywhere or that they will be available throughout the calendar year. Rather, each village's situation must be determined and considered in program implementation.

Finally specific information needs to be developed regarding farmer responsiveness to innovation. This characteristic is difficult to define and more difficult to measure systematically. At best, the concept is loaded. The very use of the words "responsiveness to innovation" assumes that positive responses are the only reasonable ones and that innovations are automatically good. However, the assumptions are rarely made explicit and they too frequently are found to be without justification. Frequently, also the question is of responsiveness is never clarified at all. Rather, the notion is applied after a program fails to achieve its goals in order to shift the onus of failure from program design or program staff to supposedly recalcitrant or stubborn and unresponsive farmers. In spite of such conceptual and pragmatic problems, however, it is important to determine whether or not farmers

are attuned to changes in agriculture before a particular program is introduced that is supposed to induce change. The after-the-fact victim-blaming is unfortunate when it occurs and is avoidable if the question is raised from the outset.

Many factors prohibited a direct assessment of the responsiveness to innovation of Citanduy Upper Watershed farmers, however, thus an indirect assessment was attempted through discussions of existing programs. Two indicators were used: the adoption of high yielding rice varieties (HYVs) and local responses to the Greening Program. Quantifications were attempted but only incidentally because they can be deceptive. A quantified HYV adoption rate may sound precise, but unless it specifies the conditions under which the adoption occurred, it may be meaningless or misleading. For example, in Cantilan an estimated 60 percent of the paddies are planted in HYV's. This seems to indicate a mediocre response. However, on closer inspection, the situation is rather different. Although the overall adoption rate may be 60 percent, the rate is close to 100 percent in the paddies with technical irrigation, about 50 percent under semi-technical irrigation, and practically nil in rainfed paddies. Indeed, many farmers in the well-irrigated area have started using early maturing varieties which permit them to obtain three crops per year, while their fellow villagers with rainfed yields use traditional varieties because they are the only ones which yield reliably under the uncertain water regime Although the aggregate rate may indicate relative unresponsiveness, such does not seem to be the case.

Similarly, in the adjacent village of Selajambe, the HYV use rate fluctuates greatly from year to year. Although this may seem to suggest that the farmers are fickle, in fact they are not. HYVs have been in widespread use, but some varieties are developing susceptibilities to various pests and other varieties require such precise management that local farmers find themselves unable to obtain anticipated yields. In both villages, farmers seem eager to try new varieties if they have suitable conditions, but they are understandably reluctant to repeat failures. The most frequent problem is the quality of the innovation, not the farmers' responsiveness.

Similar patterns appeared in the other four villages. In Payungagung, HYVs were tried but found to yield poorly above 500 meters, thus few farmers continued to use them. In Dayeuhluhur, farmers who had grown HYVs were returning to local varieties because the HYVs proved too susceptible to pests. In Karanglayung, a considerable proportion of the rice is grown for home consumption. People prefer to eat the local varieties rather than the HYVs; thus they grow enough of the local varieties to meet their own needs and plant HYVs on the remaining land.

Local responses to the Greening Program seemed to indicate similar patterns of variation which often indicated problems in the program itself rather than local resistence to it. In Dayeuhluhur, the Greening Program involved some rather neglected holdings. However, farmers outside of the designated areas did their own terracing, which was of higher technical quality than the subsidized terraces. The Greening Program was brought to Bantarpanjang for the first time in 1978, but farmers were already prepared to participate. Some of them owned land in the adjoining village of Bantarkawung, which had been involved in the program the previous year; others simply saw terracing in nearby areas or heard about terraces. However, because the implementation schedule in 1978 conflicted with harvesting and land preparation in the lowlands, compliance in Bantarpanjang seemed unenthusiastic. Moreover, because of the long delay between the scheduled terrace construction and scheduled tree and grass deliveries, the newly terraced areas seemed destined in December 1978 to face the months of greatest potential rainfall without a vegatative cover. Late terracing was prudent.

Officials in Payungagung and Karanglayung maintain that Greening Program targets were reached in those villages by 1977 and that farmers have proceeded to up-grade the quality of their terraces since then. In the case of Payungagung, the contention seems reasonable, but the suggestion of upgrading in Karanglayung seems dubious. The sequential improvement of terraces in Payungagung was attributed, in part, to the influence of the Panawangan Watershed Pilot Demonstration Area, which some villagers had visited.

Several points emerge from the above discussion which has relevance to planning and implementing the Upper Watershed Conservation Program: First, farmers in the Watershed have experience with a great number of crops, but they tend to emphasize different crops in different areas, even though the favored crop throughout is paddy rice. In order for the Watershed Program to be effective, it must lead to measurable increases in farmers' incomes. Thus it will have to take the form of an upland agricultural development program which enables farmers to increase yields of familiar crops while introducing new types of production destined for external markets or local processing industries. Such a program will require field staff who are knowledgeable about a great number of crop, animal and fish varieties and mixed crop/animal/fish production systems; who are flexible and imaginative in adopting general recommendations to local conditions; who are personally capable of identifying local agricultural needs and devising strategies to meet them, and are permitted by their institutional sponsors to devote the time and resources needed to respond to local problems; who are able to identify infrastructural deficiencies and overcome them in such areas as transport, marketing, inputs and credit.

Second, the size, location and incidence of land ownership units varies throughout the Watershed. Because each factor influences the likelihood that farmers will be interested in the program and will be willing to participate in it, the local mix must be determined program strategy adjusted accordingly. If the preponderance of landowners have both upland and lowland tracts, the demands of the Watershed Program may compete with demands of paddy production. Timing thus will be important, as will the need to prove to farmers that investments of time and energy on the uplands will pay off. On the other hand, if most of the farmers in an area only own upland tracts, they are likely to be able to devote great amounts of time to the Watershed Program once they are convinced of its value.

Third, the local labor situation will dictate the timing and intensity of program implementation in a village. Where there is a local labor surplus, the program might be enacted during any part of the year; but where seasonal labor shortages occur, implementation will have to be scheduled for periods of low labor demand and high availability.

Similarly, the program may be implemented in full force where there is a labor surplus, but it may have to be enacted in phases if there are shortages. One special problem which is likely to appear is a dire shortage of labor, due to out-migration, in those areas which have the greatest need of massive intervention. In such cases, the terracing subsidy may have to be greater than it is elsewhere in order to induce people to stay home, or in order to draw laborers from the outside. The situation must be determined empirically in each village so that appropriate strategies can be devised.

Fourth, farmers cannot be expected to respond favorably to an innovation whose benefits are not easy to understand. Furthermore, they cannot be expected to embrace wholeheartedly a technological innovation that is deficient, too demanding of time or expertise, or too expensive. For example, a farmer who barely subsist by growing mostly cassava on an eroding upland slope will have little reason to participate in a simple bench terracing program that may ultimately enable him to grow slightly more cassava per land unit on a slightly smaller amount of surface area. He would be correct in assuming that such a program would add to his burdens and solve none of his problems. On the other hand, the same farmer may participate enthusiastically in a program that enables him to mix his cassava production with other crops that he can eat and sell, as well as with grasses to feed his newly-acquired animals, without initially causing a great reduction in the amount of cassava he harvests.

Three elements of the above configuration are important. First, the program's benefits must be demonstrable. In Cantilan, farmers learned proper fertilization application techniques after a one-season demonstration trial; all over the Watershed, farmers are planting clove seedlings without needing an officially sponsored program. The proliferation of HYVs clearly demonstrates that innovations are adopted or abandoned, depending on demonstrated benefits. Nothing will sell the Upper Watershed Conservation Program as well as credible examples of its success. Second, cropping and other recommendations that supplement terracing and waterway recommendations must be reliable and practical. It is better to delay the program in order to develop recommendations that will work in each specific locale rather than proceed with incomplete or

general recommendations. If the original program recommendations fail, farmers will not be inclined to listen favorably to modified recommendations because ultimately they pay the price of failure. Finally, this means that the pilot demonstration watersheds scattered throughout the Citanduy River Watershed must be experimental facilities, as well as demonstration plots. Each plot must demonstrate practices appropriate to the immediate area and include enough fertilizer and variety trials to enable program staff to formulate a good package of recommendations for each village. In addition, the demonstration areas should be implemented long enough before the program to enable the staff to verify the recommendations. A poor scheme will defea itself. This is especially important in light of the virtual absence of other experimental facilities which concern themselves with cropping systems, as such. Having recourse to no other sources of information, the program will have to develop its own.

The proliferation of terracing efforts throughout the Citanduy River Basin clearly demonstrates that the fundamental idea is familiar to farmers. Nonetheless, the technology recommended in this program is a significant improvement over existing dryland terraces, thus it constitutes a noteworthy innovation. Ultimately, however, the terraces recommended are potentially more fragile than current ones; maintenence is absolutely indispensible. It may be easier to carry out the program of terrace and waterway construction than it will be to maintain them. But if they are not maintained, the result may be more harmful ecologically than not having a program at all. Thus it is vitally important that the program be a comprehensive upland development program based on location-specific recommendations and implemented by staff. people who have the time and knowledge to tailor the program for the needs of each village. Conditions vary, and so must the program. In each village, at least a few farmers will embrace the program, regardless of its adequacy or its appropriateness. But that is not enough. In order to tailor the program, planning and field staff will require a certain amount of information about each locale. Some of the information needs have been outlined above, and some implications were presented in order to suggest some important dimensions to consider. Additional recommendations are presented at the end of this chapter

Village Organization

This section focuses on village organization in the Upper Watershed area in order to identify formal and informal social structures that influence people's interaction and especially those structures that influence the implementation of the Upper Watershed Conservation Program. Although the basic operational unit of the program will undoubtedly be a watershed sub-division, a physical hydrological entity, the basic organizational unit of the program must be the village (desa), the smallest official political and administrative unit. Larger political units such as sub-districts (kecamatan) and distructs (kabupaten) will provide resources, expertise, directives, and encouragement to the villages; but the program ultimately will be implemented within each village under the stewardship of the village head (kepala desa). Thus, it is important to outline common characteristics of village organization and to suggest strategies that will most effectively take advantage of that organization to ensure the program's success: to curtail environmental degradation, consistent with local traditions and in the best interests of local farmers. After describing the sample villages in their wider context, we look at formal organization, informal structures, and implications for the Program.

Village Structures. Four of the five villages in Tables V-22 and V-23 are used here to exemplify organizational patterns found in each of the four districts, but additional villages will be drawn upon for elaboration in the discussion. The villages each have an internal structure consistent with the official model of its district, although they are not necessarily representative of their district in the effectiveness of the structure. District and sub-district offices promulgate regulations and organizational models, but the village head is the final arbiter and he may or may not transform directives into local realities. As Table V-24 indicates, the major units in the administrative hierarchy, both within and above the village, are subdivided.

The village is the elemental political unit in the Indonesian government, and the village head is the one popularly elected official; virtually all other administrative officials are appointed. The village head is nominally responsible to the village assembly. The

assembly delegates most of its authority to a skeletal village council with whom the village head interacts continually. The village head oversees an administrative staff, as well as a coterie of sub-village officials. The composition of the village staff varies slightly between districts (Table V-25), but it usually contains police, an agricultural officer, a religious official and one or more secretaries. In Cilacap District, each village also has a treasurer. Villages are divided into sub-villages, of which each has a head. In Cilacap District, the religious officer and a kind of public works official are subordinate to the sub-village head. Sub-villages in each village are divided into neighborhood and family units, which serve largely traditional functions although they are also called upon to mobilize labor and resources for community improvement campaigns. The everyday importance of neighborhood and family units to the village administrative apparatus derives from their positions in the local communications web. The village and the broader society are minutely hierarchical: organizational charts abound in every public entity, regardless of their relationship to reality, and the hierarchical relationships they represent are structured into the everyday interactions among administrators themselves, and between administrators and the general public. Information is assumed to spread up and down each stage of each hierarchy. In the village hierarchy, the village head is at the top and family heads are at the bottom. The effectiveness of the information's spread is another matter.

Outside the village unit is a plethora of administrative hierarchies which parallel, overlap, leap-frog, complement or impinge upon each other, depending on circumstances. Governmental ministries are represented at levels down through the province and region, and sometimes at levels as low as the district or sub-district. Sometimes the successive ministerial levels correspond to administrative units of the province, district, or the like; but sometimes the boundaries do not correspond at all. For example, the Citanduy River Basin jurisdiction in the Forestry Department incorporates parts of four districts located in two provinces. Whatever their external jurisdictions, however, governmental entities operate within villages only with the consent of the village head. He is the gatekeeper, filter, and buffer whose role is to translate external policies into local programs, or to protect his people

from the central government and its representatives. The village chief's personality thus virtually shapes the nature of a local administration.

In practice, a village head normally works closely with his sub-district head (camat), and occasionally the area head (wedana), but bonds to the district head (bupati) and others above him are more tenuous. The rapport between village heads and their sub-district heads tends to bring a modicum of administrative similarity to village regimes within a sub-district, particularly if the sub-district head has passed the special training program which is required of present appointees. However, the similarity is fostered by persuasion, not by fiat; a sub-district head can make suggestions but cannot issue orders to a village chief. Nor can representatives of other governmental entities execute programs without the blessing of the village head. Extension, family planning, and public health personnel, for example, work within a village under the jurisdiction of the village head. National programs that require the creation of local units, such as the village cooperative (KUD) program and the village social committee (LSD) program, are enacted or become influential only if the village head actively supports them. The only exception to the rule seems to be the Public Works Department which seems to be able to build and improve roads, irrigation, and other infrastructural elements without the collaboration of village heads, and sometimes even without their knowledge.

Besides the institution of village headship, the elements of formal village structure which will be most relevant to the Watershed Program are the agricultural officer, the social committee, and the system for mobilizing people for village public works projects. The first two elements are rather standard, but the third is not. The agricultural officer (PTD, or Raksabumi, depending on the district) acts as a liaison between farmers, the village administration, and the extension service. He assists the extension officer (PPL) in making contacts and identifying problems but does not systematically perform extension functions. PTDs generally are not farmer leaders (kontak tani or tani madju) and are not necessarily distinguished for their farming skills, resourcefulness, or energy levels. They are also among the lowest paid village officials; only the religious official is paid less (Table V-26).

Virtually every village has a social committee (LSD) although the committees' composition and functions vary considerably. The LSD was promulgated a few years ago, theoretically to consolidate the activities of a number of village committees into a single entity that could coordinate their activities, set priorities, mobilize and allocate resources, and identify problems which need attention. In some villages, the LSD has become a local planning and executing unit similar to the national and district planning agencies; in others, it is an inconsequential "rubber stamp" committee. In some villages, the LSD handles questions involving village public works, education, family planning, farmer education, and other areas; in other villages, the areas of responsibility are much more restricted. Increasingly, LSDs are called upon to identify public works needs and to mobilize resources and manpower to respond to them. The LSD membership generally consists of the best-educated, most influential people in the village: particularly school principals and teachers, some of the largest land-owners, and token farmer representatives. Women also play a greater role in the LSD than they do in other village groups. The LSD can play a valuable part, both symbolic and practical, in the implementation of the Upper Watershed Conservation Program.

Finally, in each village there is a mechanism for assigning responsibility for participation in community service activities, such as public works projects. Once the LSD or other responsible entity decides that something needs to be done (such as building a school, a drainage ditch, or a meeting hall, improving a road, or distributing food or water during a shortage), and decides how much labor, money, or materials will be needed, this system mobilizes the resources and people. In Cilacap District, the job is managed by the kebayan, a part-time sub-village official. In the other districts, the neighborhood heads have the responsibility to solicit assistance, although the organizer is often the sub-village head. Normally, each family is assessed a contribution, either in labor units, money, or materials. Assessments vary according to family means and size; the burden is distributed equitably throughout the village. This means that wealthier people are expected to make greater contributions than poorer people; likewise, poorer people are more likely to contribute labor, and the more wealthy contribute money.

The allocation mechanism must be determined in each village prior to implementation of the Upper Watershed Conservation Program. In some villages, the mechanism may help to mobilize labor for the program, but it may not be helpful in others. Local officials will be able to indicate the degree of help it is likely to give and how to solicit that help effectively.

The public service program is one formal manifestation of the gotong-royong tradition. Gotong-royong is a complex institution of labor exchange and mutual assistance which enables people with very limited resources to pool assets for important events. The institutionalized form indicated above is an extended version of private gotong-royong, described below. It seems to work well for activities that truly benefit the whole community, but it has not worked for projects like new irrigation construction, where the benefits are unequally shared. Public gotong-royong is the clearest example of the incorporation of informal traditions into a formal governmental institution. It links traditional authority and deference to the formal body politic.

Gotong-royong, a form of indirect taxation in a limited money economy, can consume considerable time. In Cantilan, one farmer estimated that he spent about two months per year on gotong-royong. Three weeks were devoted to renovating the traditional system, and the remainder went to various other village projects. The amount of time required varies from village to village, and from season to season, but the considerable amount of time gotong-royong occupies undoubtedly is classified officially as idle time. Intensifying farming on the uplands, as a result of the program, may lead to modifications of gotong-royong.

Another formal institution that attempts to utilize traditional patterns of deference is the structure of key farmers (kontak tani) and progressive farmers (tani madju), which links PPLs to groups of regular farmers. The network concerns itself exclusively with rice production; thus it will have little relevance to the Watershed Program unless the extension program is significantly overhauled.

Informal Structure. Informal structure within villages consists primarily of private gotong-royong -- a remarkable, indigenous institution -- and any number of other small functional groups. In its original, private form, gotong-royong is used for home-building, weddings, funerals, circumcisions, and other occasions which an individual family cannot afford to sponsor without tremendous sacrifice. People in the neighborhood thus contribute to the event and the assisted family reciprocates when others need assistance. This private gotong-royong is egalitarian and spontaneous -- a genuine manifestation of community solidarity. It is the strongest informal institution in most Javanese villages, but its basic unit is the neighborhood, not the whole village.

Most other elements of informal structure, indigenous and acquired, also have a neighborhood (kampung) focus. Active family ties, beyond the nuclear family, are usually restricted to relatives who live nearby, and neighborhood bonds have the force of extended family bonds in other societies. The bonds are strengthened through gotong-royong, as well as through less structured exchanges and through more formal employment relationships during land preparation, harvesting, and at other times in the agricultural calendar. In addition, there may be any number of other groups in a kampung that generally serve functional or instructional purposes. For example, in Banjarangsana (Ciamis District), thirteen types of groups were identified (Table V-27). Many of the groups pertain to agriculture, most relating to a specific government agency not otherwise represented in the village structure. Unfortunately, most of the groups depend on an outside stimulus for their energy and, when the stimulus subsides, they often become little more than statistics in the agency's list of accomplishments. Few groups survive the initial organizational impetus to become autonomous, viable entities. Radio listener groups are among the few exceptions.

Religious groups are also exceptions, although their strength and pervasiveness vary markedly throughout the Watershed. In some areas, local religious movements are strong and pursue diverse interests. In such cases, religious leaders have been able to spearhead community improvement campaigns to establish cooperatives and promulgate soil conservation techniques, for example. But this is a highly localized phenomenon. Nevertheless, even where local religious groups are not

strong, Islamic institutions can considerably affect the Watershed Program for two reasons: First, weekly mosque attendance is normally high. People who are not otherwise accessible at public functions come to the mosque. In fact, key farmers frequently pass on information from PPLs at prayer time. The same information dissemination techniques should be employed for the Upper Watershed Conservation Program. Second, certain passages in the Koran advocate soil and water conservation; thus, discussing the program in the mosque can help establish a moral imperative for popular participation in the program. The potential impact is inestimable although it will vary from one area to another.

Implications. This discussion of community structures has a number of important implications for the Upper Watershed Conservation Program. They revolve around three main concerns: leadership, organizational aims, and informational strategies. Each will be treated in turn.

Leadership is an important concern in any proposed program, but it is doubly important when two very different leadership groups are critical to the program's success. On one hand, the leadership of some program personnel depends on technical and perhaps organizational expertise. On the other hand, are village leaders who must approve the program before it can even be enacted and who bear the main responsibility for building local enthusiasm and mobilizing manpower. The two groups represent different administrative hierarchies and, to some degree, they manifest different leadership principles.

The technical leaders will be drawn from sections of the Department of Agriculture, primarily, and their leadership is based on expertise, whereas local leaders possess paternalistic authority and depend upon traditional deference to their authority. Each is part of a complex hierarchy, but the village boundary constitutes a qualitative break in the normal arrangement of top-down authority because of the village head's veto power. This arrangement is not necessarily problematical if certain conditions prevail. It should not be a problem if, for example, village leaders genuinely understand local problems; if they participate in defining the the program locally; if they decide to make the program their own; if they receive adequate and timely support; and if they can maintain local autonomy. The arrangement will be proble-

matical, however, if village leaders are not convinced of its value; if it is imposed upon them with predetermined inflexibility; if adequate support is not available; if the technology is anappropriate or inadequate; or if they feel threatened. If village leaders do not promote the program, local farmers will not participate. The importance of this critical link across hierarchies cannot be underestimated in program design and implementation.

Second, the organizational aim of the program is to mobilize farmers to adopt soil and water conservation measures throughout the upper watershed of the Citanduy River Basin and, individually and collectively, to maintain those measures. Its short-term goal is to generate sufficient enthusiasm and mobilize the necessary manpower to carry out the terracing, waterway, and planting program; the long-term goal is to organize farmers into local groups that will maintain the terraces and collectively improve their individual incomes by improving agricultural practices and developing alternate income sources, such as marketing and processing. Informal village structures, coupled with paternalistic leadership, can provide vehicles for achieving these goals. Gotong-royong is the most visible sign of local social control. Neighbors share a commitment to honor their mutual obligations and so are motivated by that commitment as well as by a fear of criticism should they not fulfill it. Local leadership can help to portray the Watershed Program as a community good, emphasizing the need for all farmers in a hydrological unit to participate. When so portrayed, the degree of community solidarity will determine its relative success.

However, as in irrigation construction, not gotong-royong but rather its underlying spirit should be employed for the Upper Watershed Conservation Program. Because the immediate beneficiaries of the program will be landowners, not everyone in the village, it would be improper to expect everyone to contribute. Nonetheless, it is proper to mobilize community sentiment to encourage all landowners to participate. This is perhaps a fine distinction, but the it must be made in order to utilize the tradition without violating it.

Experience in the Panawangan Watershed Pilot Demonstration farm area has demonstrated that local solidarity and mutual assistance are more powerful than impersonal rules. Two events illustrate that power: First, when the original terraces were completed and tree seedlings were to be distributed among the participating farmers, instructions were given to plant seedlings only on the land of cooperating farmers. However, those very farmers violated the instructions, at their own sacrifice, by planting seedlings on the plot of an absentee landowner, as well as their own. Second, in a competition devised to promote terrace maintenance, participants were issued limited supplies of seeds and fertilizer on the condition that they follow a similar planting schedule. Although they knew that the supply was limited, participants nonetheless requested that their non-participating neighbors also share the supply. Both incidents demonstrate the strength of local mutual support traditions and they also illustrate the folly of trying to violate the traditions. Competition is potentially a useful technique for generating enthusiasm and enforcing disipline, but it should be fostered between identifiable, geographically distinct groups, not between members of the same group. In any case, however, field personnel should be familiar with local traditions before they become active in the community, so that they can devise strategies to draw upon local strengths, rather than to defy them.

The long-term organizational goal of forming effective local groups will not be as easy to achieve as the short-term goal, but it is possible to reach the goal if local structures are utilized rather than bypassed. As the list in Table V-27 indicates, local groups generally are formed around narrowly defined interests, and the focus and structure are usually imposed by an external agency. Thus the group may serve real goal needs, but it does so in terms that reflect local needs less than they reflect bureaucratic exigencies of the sponsoring agencies -- the division of labor, ministerial mandate, and so on. Plant protection groups are separate from water users' associations, fishery groups, animal husbandry groups, and so on. If a lowland farmers' association exists, it is undoubtedly also separate from the others. The groups generally do not pretend to include everyone who shares their interest, with the exception of water users' associations, which require minimal

involvement. However, if they did expect to involve everyone, the result could be disastrous: a farmer who grows rice, who has a few animals, some fish ponds, and upland crops, who listens to the farm radio broadcasts and stores some of his crops, could potentially spend all of his time going to meetings, none of which would help him to manage an integrated, multi-faceted farming operation. Very little positive village farmer group experience exists to be drawn upon in providing guidelines for the creation of upland farmers' associations; and many negative experiences definitely should not be repeated. However they are formed, the groups should draw upon local conditions and should be organized so that they incorporate most farmers' needs into single comprehensive units. Terrace maintenance will not work or survive, but upland farmers' associations may if they focus on terraces as well as on improving existing cropping patterns, introducing new crops, improving marketing, and perhaps stimulating local processing. Farmers in the uplands do many things and they have strong traditions of mutual assistance which help them to do those things. Other associations will emerge, succeed and survive only if they respond to that reality and honor those traditions.

The third concern, informational strategies, can be dealt with more briefly. Quite simply, several networks transmit information in the villages, and they should all be used to inform people about the program and to generate support. The village head, sub-village heads, PTD, and other officials can legitimate the program through official pronouncements and informal contacts. The LSD members can do the same and can stimulate interest by introducing soil and water conservation information into the school curriculum. They should also focus the attention of boy scouts and girl scouts to the problem. Finally, the mosques should be used at women's meetings, as well as at men's.

In sum, the Upper Watershed Conservation Program presents great challenges to the villages, but it presents even greater opportunities. The problems will be minimized and the opportunities will be enhanced if individual village organizations, village idiosyncracies, and village potentials are understood and if appropriate strategies are adopted before the program is implemented locally. The program must build on the existing situation, making use of local strengths and compensating for weaknesses. A uniform strategy cannot do this, and it is not likely to be effective.

Infrastructure

Local organizational differences are too great within the Watershed to allow a common program approach to all parts of the Upper Watershed. Similarly, great variations in local infrastructure also make it unrealistic to prepare a common package of inputs for the whole Upper Watershed area. Simply too many different things need to be done in different areas to expect a uniform program to have significant impact. This brief overview of the infrastructure highlights the range of differences to be found, as illustrated by the sample villages: A more thorough survey must be made in each target area at an appropriate planning stage in order to tailor the local program accordingly; the survey should gather village-level data, but the analysis should be conducted on a subdustrict basis to put the villages in proper perspective. In this section, transport, communications, electricity, commerce, industry, and farmer support are discussed, and some recommendations are made regarding proposed village surveys.

Transport. An efficient transport network is absolutely essential for a market economy. Farmers have very little incentive to produce more than they need for subsistence unless they have access to markets to sell their products. Unless the markets are easily accessible, the cost of marketing goods can be greater than the value of the goods. Although some parts of the Citanduy Upper Watershed are touched by good roads, most are not. In many areas, the road network and transport system are so poor that they would severly limit the effect of an upper watershed development program.

The major roads follow lowland paths except where it was impossible to avoid the highlands. The southern trans-Java highway (Bandung - Yogyakarta) bisects the Citanduy River Basin, roughly following an east-west course. It descends to Tasikmalaya from the west, paralleling the Citanduy to Ciamis, Banjar, and Wanareja and eventually leads through the hills beyond Karangpucung at the eastern end of the Citanduy Basin. The other provincial road leads north from Ciamis toward Cirebon, passing through the hills east of the center of Mt. Sawal. Bunieruri, Kawali, and Panawangan are along this road. Most district roads parallel rivers; thus, roads that wind through the uplands are

primarily village roads. They vary from stable asphalt and stone roads to dirt roads and footpaths. Over 4,400 kilometers of roads in the watershed area are under consideration (Table V-28), 86 percent of which are village roads. In general, village roads in valleys, and those near to provincial and district roads, are more likely to be passable year-round by motorized vehicles than the roads that reach higher elevations. Under prevailing rainfall conditions, maintenance is obviously a major problem for all roads.

District and sample village calculations (Table V-28 and V-29) reveal average road densities of one kilometer of road per 1.33 and 1.32 square kilometers of area, respectively. However, the figures conceal very great differences in road quality and actual accessibility. Ciamis district has the most extensive road network in the Upper Watershed with the greatest provincial and district penetration, and Kuningan and Cilacap have the least penetration. The sample villages illustrate the situation. Dayehluhur is intersected by the Ciamis-Cirebon provincial road as well as by the Kawali-Rancah-Cisaga district road. Most of the village lies within easy reach of one of those roads, and village roads lead from the hills down to them. In contrast, there are no provincial or district roads in Karanglayung. Village roads lead from the village center up to sub-village centers in the hills and from the village center over a high hill to Cijolang and out to Cineam. The road to Cineam is unstable, rough, and sometimes impassible, and movement is complicated by tollgates near Cineam. The farmers in Karanglayung depend largely on the sale of horticultural products for their cash incomes. Their share of the market price is undoubtedly decreased as the result of the tollgates, as well as by the difficulty of travel.

Some people in Cantilan are accessible, but others are not. The single main road passes through the village center on its way from the Ciamis-Cirebon road to the sub-district centers of Selajambe and Subang. The narrow road follows along a ridge and then alternately dips and rises as it follows first the Cojolang River and then one of its tributaries. Travel is slow, and some sections are very rough, but the road is always passable. The village head of Selajambe, adjacent to Cantilan, maintains, ironically, that the best sections of the road get occasional maintenance, but the rough parts are never touched. Clearly

the road compounds local disadvantages. For example, it takes so long to go from Cantilan to Kuningan that what should be a simple task of taking hand sprayers to Kunigan for repair becomes a major ordeal, which is put off for a long time, possibly putting crops in jeopardy. However, the people living in sub-villages of Cantilan are even more isolated than those in the village center. The sub-villages are nestled in valleys high above the village center and are reachable only by footpaths that ascend the mountains to a high ridge and then descend to the small hamlets. People who live in the hamlets walk to market, carrying everything on their shoulders. When loaded down with bananas, pandan, or hairy coconut, it takes two hours to walk to the village center from the hamlet. Any program to encourage farmers in the hamlet to intensify their production, and thus increase their labor requirements, must also solve the transport problem in order to be successful. Under existing conditions, intensification would lead to a conflict between production and marketing; there would not be enough time to do both.

Upland farmers in Bantarpanjang experience similar limitations. Upland tracts are accessible only by footpaths, and the hamlets off the main road are connected by a lowland road that fords the Cikawung River at several points. According to the sub-district head in Cimanggu, Bantarpanjang is easy to reach compared to other villages in his sub-district. Some of the others are isolated for as long as two weeks at a time during the rainy season and accessible only by foot or motorcycle during other times.

The poor status of the road network constitutes a double impediment to an upper watershed development program. On the one hand, many poor small villages have the most pressing need of the program, from ecological as well as economic viewpoints, yet they are the most difficult to reach. Farmers in those villages face uncertain market prospects, in general, but the prices they receive for their products in local markets are also clearly depressed because of transport difficulties. On the other hand, farmers have to carry produce by hand from their upland holdings down to the village centers, an arduous task. Likewise, some of the most remote tracts are those that need the most conservation attention. Farmers working such tracts may not respond positively to opportunities to increase production unless they are

assured that the transport marketing bottleneck will be removed. Otherwise, they face the likelihood that increased production will mean only more backbreaking drudgery, and perhaps even lower prices.

Despite the poor quality of most roads, the area has a surprising volume of traffic, and most village centers now are accessible by some form of public transportation. The situation has improved markedly in the last few years, even more than vehicle ownerships indicate (Table V-30). Two factors account for the change: First, the quality of road transportation between major population centers has been up-graded, with repercussions all along the line; that is, the old buses replaced by newer ones along major routes have been shunted into service along minor routes, replacing still older ones, which were shunted into smaller feeder routes, and so on. Up-grading the complex bus hierarchy at the top has meant extending the bus network into increasingly remote centers. The second important change in transportation has been the proliferation of microbusses throughout the road system. Called Colt because of the first manufacturer, these small vehicles carry up to 14 passengers, plus a small amount of cargo. They increasingly carry the bulk of short-haul passengers. Colts can maneuver narrower roads and make profits with smaller loads than buses; and they require a far smaller initial investment. They are also more flexible; they can be shunted easily from one route to another, to accommodate immediate demands. Although they seem to wreack havoc on major thoroughfares, Colts have significantly broken the isolation of many areas.

Colt, bus, and truck ownership increased in the Upper Watershed area by 42 percent, 19 percent, and 47 percent, respectively, between 1975 and 1977. Many of the trucks and Colts that travel the rural areas are owned by urban entrepreneurs (excluded from our calculations); thus ownership (Table V-30) does not reflect the actual magnitude of local traffic. However, Table V-30 does suggest that participation in the transport sector is increasingly spreading to rural areas. Table V-21 shows that there is some, although not much,transport vehicle ownership in the sample villages.

There are few automobiles in the Upper Watershed area (193 in 1977), but motorcycles and scooters are becoming rather common. In 1977, there was one motorcycle for every 396 persons, and one automobile for every 10,079 persons (Table V-32). Tasikmalaya had the highest incidence of each, and Kuningan the lowest. Colt ownership is rather more evenly distributed, averaging one Colt per 2,465 people, with a high of one per 2,052 in Ciamis and low of one per 3,852 in Cilacap.

It can be expected that local vehicle ownership will increase as the road network improves. It is also very likely that a successful upper watershed development program, which would increase the supply of marketable products, will draw outside transporters and middlemen to all parts of the Watershed, even if the roads are not improved. However, as long as roads remain bad, a disproportionate amount of product value will accrue to everyone but the producing farmers, thereby decreasing the potential net benefit of the program to the target group.

Communications. Most communications in the Upper Watershed are passed orally. Official government pronouncements pass down the hierarchy: village officials transmit them to sub-village heads, who pass them on to neighborhood heads, and so on. Public announcements often are transmitted during prayer time on Friday. Other types of information follow the appropriate hierarchy, just as agriculutral extension information passes through the key farmer network.

Unofficial information spreads through a multitude of personal exchanges in neighborhoods, markets, along the street, and so on. News travels quickly if it is of local interest.

Exposure to mass media is rather restricted. Village records indicate an average of one radio per 39 people and one television per 1,139 people in Ciamis, Cilacap, and Tasikmalaya (Table V-33). The incidence of ownership was highest in Tasikmalaya and lowest in Cilacap. The incidence of radio and television ownership is estimated to be even lower in Kuningan. Television ownership, even more than radio ownership, is limited by the absence of electricity in many areas, as well as by the high cost of television sets. Nonetheless, the ownership of radios in the Upper Watershed increased 80 percent between 1965 and 1977, and television ownership increased 1,479 percent during the same period.

Table V-34 shows radio and television ownership in the sample villages. Although the table would suggest very limited media exposure, the impression is perhaps exaggerated. Radio listening groups, which draw people together for weekly farm broadcasts, exist in most villages. Current programming is directed primarily toward problems of wetland rice production, with a district focus. The farmer program should be used by Upper Watershed Program personnel to direct attention to upland cropping and conservation issues. However, it should not be seen as a possible substitute for more intense direct farmer contact.

Electricity. Electrical power is available in some parts of the Citanduy River Basin, but rarely in the Upper Watershed. Some upland villages are served by small hydroelectric generators. Generally, they are small units that operate rice mills during the daytime and are switched to power a few domestic lights during the evening hours. Some private diesel-powered generators are also switched in the evening from the rice mills to a few houses nearby. For the most part, however, electricity is unavailable beyond the urban grid.

The lack of electricity should not limit implementation of the basic physical elements of the Upper Watershed Conservation Program, but it may limit secondary elements, such as stimulating the creation of rural industries. This question should be examined more comprehensively as part of the preparation of the integrated upland development program.

Commerce. The commercial structure in the Upper Watershed is very complex, involving several different levels of exchange from simple stalls in houses to regular stores, and from exchanges between farmers to farmers' cash sales to middlemen who may have clients as far away as Jakarta. The array of exchanges found locally varies from one area to another, as does the predominant form. Stores and markets are located in the villages, of course, but one finds small stalls all over, even in isolated sections. The limiting factor in the proliferation and expansion of commerce is the low level of disposable incomes, and thus severely limited markets, not a lack of entrepreneurism. Indeed, it seems that the commercial sector is perhaps super-saturated, rather than underdeveloped, given average income levels.

Data pertaining to stores (food and non-food) and markets (daily and weekly) in the Upper Watershed area are shown in Table V-35. Unfortunately, the data do not include stalls, housefront stores, or peddlers, and there is some doubt about the uniformity of classification in the four districts. Nonetheless, the table can be used as a rough indicator. A total of 5,567 stores were reported, 3,204 food (58 percent) and 2,363 non-food (42 percent). Almost 60 percent of the total number of stores were located in Ciamis District, which has 41 percent of the population. There were 105 markets reported, 91 weekly (87 percent) and 14 daily (13 percent). Almost 50 percent of the markets were in Cilacap District, which has 31 percent of the population.

In total, there is an average of one store for every 350 people, and one market for every 18,500 people. Ciamis has the highest incidence of stores, and Kuningan the lowest; Kuningan has the highest incidence of markets, and Tasikmalaya the lowest. The totals average out to 19 stores per village (11 food and 8 non-food) and 1 market for every 3 villages (one weekly market for every 3 villages and 1 daily market for every 21 villages) (Table V-36). In aggregate, Kuningan seems to have the greatest dependence upon bazzar commerce in the marketplace, and Ciamis is the most store-centered. This is consistent with expectations based on urbanization and standard of living observations.

Most agricultural products are sold by farmers to middlemen, many of whom live in the more urbanized centers and comb the interior areas for things to buy, collect, and sell. The more remote areas are the most disadvantaged by this arrangement, both absolutely and relatively. They have the most difficulty finding buyers; they are paid low prices by middlemen; and most of the middlemen they encounter are outsiders. The most remote villages retain the least amount of added value.

In some areas, the lack of a market discourages farmers from growing a dryland crop on their paddyland during the dry season. For example, this is the case in Subang Sub-District, and the poor road is blamed for such market deficiencies. Presumably this is not an isolated example. Government-sponsored village (or sub-district) cooperatives (KUD/BUUD) purchase rice, but the only other cooperative encoun-

tered in the field is a nascent clove grower cooperative in Payungagung (Ciamis District). The Upper Watershed Program will provide a good opportunity to build community cooperatives, and efforts should be directed to incorporate transport, as well as marketing into the structure, in order to maximize the local economic benefits from production increases.

Industry. There are numerous tiny cottage industries in the Upper Watershed, some of which are seasonal. They involve such things as palm sugar, coconut oil, copra, soy sauce, fermented soybean cake, cassava flour, crackers, floor mats, baskets, hats, brooms, wall mats, and many other things. The work or processing is done at home and the products are sold directly to consumers in the market or to middlemen. Only Cineam and Rajapolah have recognized artisan traditions, as such. Cineam is known for brightly colored mats loomed of string and a reed-like grass. Rajapolah is famous for a multitude of articles woven of pandan (screw pine fronds). Such things as letter holders, purses, jewelry cases, briefcases, hats, and shopping bags, are produced for urban markets and export. The distinctive black and white checkerboard motif is familiar to tourists. Cottage industries normally yeild miserably poor wages when calculated on an hourly or daily basis.

Three traditional industries involve small factory production -- bricks, citronella, and cassava (flour and tapioca). Citronella grass production and processing have declined in the past few years, particularly in Ciamis District where production has been discouraged due to the deleterious effects of the grass on the soil. Brick production continues, undoubtedly stimulated by the prevalent trend in stucco home construction. Cassava remains a standard upland crop, even in places where continual production visibly creates serious erosion conditions. Although district and village officials in some areas contend that cassava production is minimal or declining, the contention is supported by available statistics (Table V-37) and field observations only in Ciamis District. Whatever the case, however, cassava processing is alive and well in the Upper Watershed, in at least 110 tapioca and flour plants, which employ almost 3,500 people (Table V-38).

Probably the most prevalent rural industry, and most lucrative, is the rice mill. Since about 1972, mechanical hullers and polishers have replaced hand milling (pounding) throughout the Citanduy Basin. People still pound rice for celebrations, but very few families continue to do so for daily consumption. Most huller units are electric, powered by diesel generators. They are small and are scattered throughout the Basin. Available data show a total of 989 rice mills in the Upper Watershed area, which employ almost 2,900 people (Table V-38).

Data relating to other industries are fragmentary and unclear (Table V-38). What is clear is that the success of the Upper Watershed Program depends on its ability to convince farmers to replace cassava with other crops that are more lucrative and less ecologically destructive. Ultimately, the amount of land devoted to cassava should decline markedly, although the volume of production may decline less rapidly if farming methods are improved. The net result will undoubtedly be the demise of the bulk of existing cassava processing units. However, it is expected that this loss of employment will be more than compensated for by the creation of new rural industries or by the expansion of existing ones during later phases of the upland development program.

Farmer Support. This generic category incorporates a number of goods and services that farmers generally need in order to increase their production levels, and without which they rarely exceed traditional levels: improved varieties, fertilizer, pesticides, credit, and extension assistance. Although these elements might be treated separately in another context, they essentially are part of a complete package in Indonesia, and often the package is either available in its entirety, or not available at all. The situation is less fixed now that fertilizer and pesticides are sold on the open market. However, the concept of a package of inputs still remains, as does the reality, albeit somewhat modified. In general, the Agricultural Extension Service has the responsibility to promulgate the BIMAS package of recommendations, which ties inputs to credit; INMAS includes the package of inputs without credit. Extension officers (PPLs) help certify farmers for credit and spread information through the old Key Farmer network or the newer, geographically defined, WILUD and WILKEL system. In either case, the PPLs theoretically are able to provide assistance on a wide variety of

crops. In practice, they focus almost exclusively on rice. Moreover, their greatest concern is irrigated rice, for which the BIMAS package was designed.

BIMAS results are not directly relevant to the Watershed Program, but they are useful as an indirect indicator of the effectiveness of the Extension Service in its main function. Table V-39 indicates target and actual BIMAS-INMAS area as a percentage of total paddyland in the four districts during two wet seasons (1975-76 and 1976-77) and two dry seasons (1976 and 1977). BIMAS-INMAS targets were generally much higher in Tasikmalaya and Ciamis than in the other two districts. The targets were met or exceeded rather consistently in Ciamis and Kuningan Districts, not at all in Tasikmalaya, and only during the wet season in Cilacap. In general, the system is unable to meet current demands and would fare worse if responsibility for other crops were taken seriously.

BIMAS package components are distributed through the BUUD system. Fertilizer and pesticides are also increasingly available in small private stores at slightly higher prices. Coverage in the Upper Watershed area is uneven, however. In some areas, the BUUD outlets are the only ones available; in some others, both are present; other areas are not served well by either. The input system will have to be expanded quantitatively as well a qualitatively beofre it can be expected to meet the needs of intensified cropping on the uplands.

Through the BIMAS program, government-sponsored, subsidized credit is available to qualified landowners. It enables them to purchase paddy rice inputs and provides a minimal living allowance. Although BIMAS type credit is supposed to be made available for other crops, there is none. Thus no support is available at all for upland crop improvements. Unless inputs are provided free to farmers who participate in the Upper Watershed Program, provisions will have to be made to secure credit.

As indicated previously, the PPLs have a broader mandate than they actually carry out. They should be concerned with dryland and upland crops, in addition to rice, but they rarely are able to devote time to anything but rice. Farmers participating in the Greening Program have a forestry extension person (PLP) available to oversee the terracing

and planting phases of the program and to offer cropping advice. However, the PLP mandate and training are both too narrow to expect them to provide broad assistance to upland farmers. The sub-district agriculture office includes an animal husbandry advisor who is supposed to work with village representatives of animal farmers, and the district fishery department has a sort of fishery extension staff which is supposed to keep in contact with people who have fishponds. In addition, the plant protection specialists in the district office may have sub-district counterparts. These people do not constitute an adequate core of support people for upland farmers, even if all positions are filled. Their areas of expertise are limited and do not overlap.

Farmers generally need assistance across a wide spectrum which may include crops, trees, animals, and fish. Most importantly, however, farmers need advice on improving integrated farming units, the very sort of assistance that the different experts are unable to give. By training and experience, the experts can talk about plants, trees, animals, or fish, for example, but they cannot give advice on how to combine them all into a progressive small farm unit. In addition, soil and water conservation are only residual concerns of the food crops hierarchy, rarely represented below the regional (Wilayah) level. Consequently, as it is currently structured, the agruculture administration is incapable of providing the kind of personnel or expertise which will be needed to complete the Watershed Program. More of the same will not suffice; a re-structuring is absolutely essential.

Besides re-structuring the government agriculture establishment to re-define areas of expertise into more useful configurations, a re-definition of role is required. It is commonly assumed that the role of people in the government agriculture hierarchies is to provide information to farmers to help them become better farmers -- to give "guidance." The "guiding" role will not be appropriate in an upper watershed agricultural development program because there can be no set program to which, or through which, farmers should be guided. A local program will have to be created in each area in collaboration with local farmers, based on their local needs, resources, potentials, infrastructure, experience, constraints, skill, and opportunity costs. Rather than talking to farmers, or at them, agricultural personnel will need to learn

how to listen to farmers and how to collaborate with them. They will have to learn how to create programs, rather than just promulgate or impose them. Rather than guiding the farmers, the government agricultural establishment will have to learn to serve them. In essence, the existing farmer support system is woefully inadequate to meet the needs of upland farmers. It is deficient in many areas. Moreover, it is based on a principle that will prove counter-productive if applied in the heterogeneous agricultural environment of the uplands.

The Conservation Plan

The following section analyzes the social soundness of the Upper Watershed Conservation Program. Each of the four sections asks and attempts to answer a basic question regarding the program. First, is it appropriate institutionally? Second, who is involved in it, and who will be affected by it? Third, what will be its consequences? Fourth, to what extent, and how, will it have additional secondary benefits which spread elsewhere?

Sociocultural Feasibility

The Upper Watershed Conservation Program is socioculturally feasible. It aims to diffuse a soil and water conservation technology that is significantly superior to most existing dryland practices. It aims to involve prospective beneficiaries in the implementation of the program and to prepare them to assume maintenance responsibilities. The technology is compatible and comprehensible; the organizational approach is acceptable; and the concept is operatable. However, it will be easier to organize and execute terrace and waterway construction than it will be to ensure continued maintenance. Unless the terracing is part of a larger program of upland agricultural development which is tailored to the needs of each specific location, maintenance is going to be a constant problem. This section examines the question of institutional sociocultural feasibility by reviewing previous erosion control experiences, delineating salient features of the program, analyzing their congruence with existing institutions, and outlining needed institutional linkages and adjustments.

Previous Programs. The Upper Watershed Program has four precedents to observe -- three watershed projects and the Greening Program. Individually and collectively, they offer a number of lessons on how not to conduct a program, but they also offer some lessons which will help in planning such a program. Focus here is on the social prespective. These precedential programs are discussed in the following order: the Solo River Basin Project, the watershed project at Majalenka, the Greening Program, and the Panawangan Watershed Pilot Demonstration Area.

The Solo Project in east Central Java has concentrated on developing erosion control technology and applying it in several sub-watershed pilot areas. The technical aspects of the project have yielded invaluable results; indeed, they constitute the technological basis for recommendations in this report. However, the diffusion aspects have been far from successful; even where the recommendations were implemented satisfactorily, maintenance has been a chronic problem. Technical experts in the project selected the sites, designed the pilot demonstration layouts, and supervised construction by the farmers who worked the land. Participating farmers were given incentives in the form of food payments. In most of the seven pilot areas, the Extension Section of the project established contact with farmers in advance of the technical people, in order to explain the program and prepare them to participate in it. In at least one area, the Extension preparation was bypassed, only to be reinstated later when strong farmer resistance was encountered. Some farmers on land nearby or adjacent to the demonstration watersheds followed the example of the project and terraced their own lands, but participating farmers have had a generally poor maintenance record. The situation has worsened over time.

The maintenanace problem in the Solo Project is sometimes attributed to the high proportion of land rentals in the demonstration watersheds. The argument emphasizes the disincentive effect of uncertain land tenure. This has merit, of course. But another likely explanation is the general strategy of imposing the project directly on the farmers, virtually ignoring local governments. Even when the Extension Section was involved, its aim was to get people to accept an inflexible, predetermined program, not to adapt it to local needs or local curcumstances.

Project people assumed they knew what should be done for the farmers, by the farmers. However, the farmers correctly viewed themselves as passive recipients of someone else's program, not participants in it. They worked on the terraces, but to them, the structures belonged to the Project; it was not their program. Thus the farmers have not assumed responsibility for maintenance and the impact of terracing has been less than anticipated. In contrast, people outside the demonstration areas who built terraces and waterways seem to do a better job of caring for them.

Several lessons can be learned from the Solo experience. First, a good technical idea is no more valuable than the program which implements it. Second, programs that violate established patterns of communication and responsibility-sharing have little chance of success. Third, people assume imposed responsibilities, like maintenance, only if the execution of those responsibilities yields direct benefits; that is, the Solo Project technology is good, but it was imposed on people as an an end in itself, rather than presented as a means to meeting local needs.

The watershed project at Majalenka is more modest than Solo but similar in many regards. The Majalenka Watershed plot is in a sub-watershed of the Cimanuk River Basin, located northwest of the Citanduy River Basin. It is essentially an erosion control pilot demonstration plot, administered by the Forestry Department, on a tract of land administered by the village. Although officially grazing land, it was actually rented to farmers for cultivation, with dire ecological consequences. From a social point of view, there is little more to the project than the application to the eroded slopes of technology derived from the Solo Project. Farmers already had little say over the land, and they had even less to say about the project. Nor were local officials involved in planning or executing the project. The terracing was executed by farmers, but they are not assuming maintenance responsibilities. Nor are farmers who live in the area copying the techniques used on the demonstration plot. This project remains where it started. This also reinforces the lessons from Solo.

The Greening Program is the third relevant precedent. It is described more fully in other parts of this report; thus we focus here on aspects which relate to the Citanduy Upper Watershed Program as a social program. The Greening Program was created by Presidential Instruction as part of the Second Five Year Plan (Repelita II) and is administered within the Forestry Department. Its aim is to reduce erosion by subsidizing the reforestration and terracing of private lands. Unlike the projects described above, the Greening Program is executed through local governments with the support of a staff of Greening extension people (PLPs). The program is directed by river basin authorities, but personnel are allocated by districts to sub-district offices, as are PPLs.

Greening Program staff identify specific target areas that need attention and the campaign proceeds through sub-district and village offices. In designated areas, landowners are given a set amount of money per hectare as an incentive after they build the terraces or dig holes for trees; the Greening Program then supplies seedlings and grass seeds. PLPs then monitor progress for two years, using tree survival rates as indicators of success. Unlike other parts of the country, the Citanduy River Basin's Greening Program uses bench terraces, rather than ridge terraces.

Although the Greening Program is on the right track in many important ways, especially within the Citanduy River Basin, it nonetheless has problems which are instructive to outline for our purposes. Coordination has been a problem, manifested most frequently in two ways: First, by the time all parties get involved in the program, from the village to the district, program execution frequently conflicts with other labor demands or cropping schedules, and farmers thus have trouble meeting program deadlines. Second, the seedlings and grass seeds distributed in the first few years of the program frequently were dead by the time they reached the farmers, and replacements were not forthcoming. Nursery production has been somewhat decentralized to reduce this problem.

However, the Greening Program has other limitations that affect its impact. First, the program is far too limited in scope, both in the amount of area involved and the range of services offered. Terracing and replanting simply are not enough to solve the problems that cause erosion. Second, the approach is too standardized. The combination of inputs may be helpful in some areas, but its impact will be minimal in areas which require different inputs. Further, the terracing subsidy is the same regardless of the fact that some areas are harder to terrace than others. Third, implementation of the program is too mechanical; farmers must complete their work by a fixed date, after which time the seedlings and seeds are delivered. Farmers who complete the work early can be left in a vulnerable position, inviting erosion, while they wait for the delivery.

Despite its weaknesses, the Greening Program can contribute significantly to the ultimate success of the Upper Watershed Program in three principal ways: First, it helped to diffuse bench terraces all over the watershed. Most people undoubtedly know what bench terraces are, and they have an example nearby, however imperfect. Dryland terracing is not a new phenomenon, but the dryland bench terrace is an innovation in many areas. Thus when the Upland Watershed Conservation Program is implemented, the target population will have already received a modicum of advance preparation. Second, the Greening Program has shown that subsidy levels need not be high to induce farmers to participate in erosion control activities. Finally, the Greening Program has created a cadre of young PLPs who have obtained valuable field experience in their work. They constitute an important manpower resource which should be tapped in planning, training, and implementing the Upper Watershed Program.

The PLPs can be utilized in at least three ways. First, they can offer warnings of problems or offer advice for a variety of considerations in a comprehensive program, based on their involvement in a more limited one. No other group of people has had such a wealth of relevant experience. Second, their learned insights into village organizations ought to be shared with new field trainees. Third, the PLPs

could be organized to train village cadres in construction techniques, supplementing the work of program field staff. However, the potential contribution of PLPs to field aspects of the program will be maximized if they undergo further training in upland cropping techniques and problems, farm planning, community resource assessment, and program monitoring. Likewise, PPLs involved in the program will need similar training, as well as training in conservation methods similar to that which PLPs have already received.

The Panawangan Watershed Pilot Demonstration Project is a valuable resource which stimulates many questions about social aspects of program design and implementation and answers others. The Panawangan Pilot Area was planned at the outset to be more comprehensive and more responsive to local characteristics than the other programs mentioned. The aim was to obtain the cooperation of farmers in the designated area to build terraces and waterways according to recommended specifications and then participate in agronomic trials to test recommendations about inputs and intensification. Farmers were subsidized for their terracing work, provided with fertilizer and seeds, and guaranteed minimal compensation in case of crop failures. The trials focused on crops familiar to the farmers, as well as on grass varieties intended to support increased livestock production. From initial stages, the project received the enthusiastic support of the Ciamis District Planning Chief, which was then translated into support from village leaders and key farmers. That support has been a fundamental element in the success of the project to date.

The Panawangan Pilot effort has benefitted from a number of characteristics which should be incorporated into the Upper Watershed Program. First, it has had a local focus, one which was taken very seriously. It started from given conditions and attempted to proceed without being disruptive. Second, local leadership was integrated into the program, not merely offered lipservice. Third, interaction with leaders and farmers was continual and informal, with emphasis on the quality of rapport as well as on the substance of the work. Fourth, the agricultural input first treated familiar crops and then moved to complementary and supplementary activities -- new crops, livestock, and fishery improvement. Even the smallest farm units are complex integrated opera-

tions, and the project attempted to respond accordingly. Fifth, the farmers involved in the initial small pilot area became team leaders in the expansion of the project to the rest of the sub-watershed, under Forestry Department management. The technical and organizational success of the expansion is attributable as much to the effectiveness of the local team leaders, benefitting from their own experience, as to the expertise and commitment of the Forestry Department. All of these strengths of the Panawangan Pilot effort are concrete manifestations of the great value of pilot programs. They argue very convincingly for the creation of pilot areas in other parts of the watershed where physical characteristics, cropping patterns, and other conditions are different, before the program is implemented in those areas.

The Panawangan Pilot effort also suffers from typical weaknesses of pilot projects, which limit its usefulness as a program prototype: First, a critical strength -- the response to local conditions -- is a critical weakness as well, because many of the techniques and recommendations will not be applicable to areas with different conditions. Thus, the effort is useful, but it is not an adequate base upon which to design a broad program, nor does it offer a sufficient guide in the formulation of a mechanism to make a broad program as responsive locally. Second, one element of success consisted in consultants, Citanduy Project personnel, and other interested parties spending a great deal of time in the field, talking to farmers, overseeing, and evaluating. This intense concentration of manpower, expertise and attention will surely not be duplicated elsewhere when the program is implemented on a broader scale. Thus the problem arises as to how to obtain similar results without this important factor. Frequently, the concentration of effort on a pilot project produces the phenomenon called "demonstration effect," in which project subjects think of themselves as special, and consequently respond to project personnel in ways they might not otherwise respond, in order to ensure the success of the project. This is an intrinsic danger in pilot projects and must be reckoned with by careful analysis and appropriate planning. Third, the Panawangan Pilot effort required inputs from a number of different agencies, and therefore created a number of budgetary and coordination problems. Some coordination problems were resolved by transferring responsibility from

the Citanduy Project to the Forestry Department, but others were never resolved satisfactorily, nor were many budgetary problems resolved. Planning for the broadened Upper Watershed Program must include a careful analysis of the allocative and administrative problems at Panawangan in order to reduce the likelihood that they will appear in this program and cripple it. Fourth, in any program, it takes time for participants to become fully convinced of the value of the program and to accept routinely the burdens it imposes upon them. Under any conditions, the conviction and acceptance of burdens do not really occur until after the participants have obtained dependable, concrete benefits from the program. In agricultural programs, the results are often not apparent for a season or two. In Panawangan, it may still be premature to determine whether the participating farmers will translate their satisfaction with the program into spontaneous, systematic maintenance and improvement of the terraces and waterways. Many factors suggest, but cannot yet certify, that they will. Nonetheless, the need for erosion control is too important and immediate to delay planning the program until the question is answered. Instead, periodical evaluations should be built into the program to assess its results and allow for changes in strategy if things do not work.

In sum, the Panawangan Pilot Project avoided some of the weaknesses of the Greening Program and the Solo and Majalenka Projects, and thus offers some lessons regarding general strategy and basic components of an upper watershed program. First, local officials must be integrated into the program from the outset, and contracts must be maintained continually through field staff stationed in the project area. Second, the program must be tailored to the specific needs of farmers in the target area. It will become a community program only if it is indeed a <u>local</u> program in each community. Furthermore, the terracing and waterway elements will be adopted only if they complement other aspects of a broader program. Terrace construction takes time and energy and reduces the cultivable land area; farmers cannot be expected to spend the time and energy or to accept the land loss without assurance of a commensurate increase in productivity and income. Third, defining an appropriate package of program elements for a specific area will require the coordination of different agricultural and other agencies. This will not

be easy and may be impossible without judicious planning.

In the end, the success of a watershed management program will hinge on its ability to do two things: to kindle the spirit of farmers to protect and improve their natural resources while improving their productivity and standard of living; and to provide them with adequate and appropriate assistance in order to foster the spirit and produce obvious results. The Solo Project has produced technical results that will be valuable components of the technical assistance program, but it offers little insight into the kindling problem. Majalenka offers very little insight for solving either problem. The Greening Program has helped set the stage for acceptance of the Watershed Program by spreading a sense of the technology through a small cadre of trained field technicians. Finally, the Panawangan Watershed Pilot Demonstration Area has combined many elements into an embryonic upper watershed development program.

Extrapolation and projection suggest that a reasonable program should contain the following elements: first, small teams of Dasa Conservation Technicians, stationed in target villages, whose tasks are to generate interest in erosion control, canvass local needs, train local supervisors, organize construction of terraces and waterways and mobilize additional resources to meet other needs; second, a number of demonstration watershed areas which provide examples and generate upland cropping recommendations for specific locations; third, a back-up team of agricultural specialists, including soil and water conservation, cropping systems cooperatives, marketing, rural industries, and community development specialists, to support the field staff and work with demonstration personnel; fourth, parallel administrative and farmers' organizations, tied to the planning hierarchy, to strengthen and expand the impact of the program.

Social and Institutional Congruence. As outlined above, the program should contain elements which are congruent with existing institutions and traditions. Congruence does not guarantee efficacy, however; thus additional considerations in this regard are important: the technology itself, the organization of the program, and the support structures.

The basic erosion control technology to be promulgated has one familiar element -- the bench terrace, and one less familiar element -- the waterway. The notion of terracing is hardly new, but the use of bench terraces for dryland cropping is a recent innovation. The protected waterway being recommended is a new idea, but it should be accepted easily; people will readily understand its function, as they have in Panawangan. However, there may be some difficulty convincing many farmers that the innovations will be worth the time and energy they need to spend on construction. Furthermore, if waterways are placed according to hydrologic criteria, rather than along property lines, landowners may refuse to relinquish the needed land. Responses will vary, of course, and will be affected by such factors as the time of the year, farmers' upland/lowland ownership patterns, alternate income sources, and owner/operator relationships. Such things as the information available, persuasion, peer pressure, and the subsidy will also affect farmers' responses. Field staff should foresee such problems and try to avoid them whenever possible by using natural waterways where feasible and by making sure that all farmers are contacted. No general staff directive will substitute for a local resolution of problems, however.

Once farmers are prepared to be involved, scheduling will be critical. The work should be organized for slack periods when farmers have few compelling tasks, few opportunities to work for others, and few demands for gotong-royong participation. The local work schedule must be locally planned. Field staff must therefore be given administrative and budgetary flexibility and not be tied to a rigid timetable.

The Upper Watershed Program should be organized and administered entirely through existing political systems, with appropriate modifications in personnel, training, and authority. Although different agriculture agencies will play major roles, the departments of Planning, Public Works, Cooperatives, and Industry will also be involved. But the primary agents of the program will be local officials: district, sub-district, village, and sub-village. They will bear the greatest responsibilities for legitimizing, mobilizing, and organizing the field work; and their conviction, enthusiasm and vision will determine whether the program merely retards ecological deterioration or really promotes sustained rural development. Program field staff will do much of the

legwork, but they will be ineffective without the active support of local leaders.

District authorities will have general planning and coordinating responsibilities, but the program cannot operate effectively from that level. Authority, as well as fiscal and human resources, must be decentralized. The sub-district is the most reasonable level for major operating authority to reside. Some personnel will need to be added at the district level, notably people with scarce program-related expertise. However, the greater personnel increases will occur at the sub-district level. With the assistance of district authorities, local programs will be formulated and executed through villages from sub-district offices. Sub-district personnel will need to receive additional training, and their ranks will be expanded with the addition of project specialists, generalists, and field staff. Unless the sub-distirct has the authority to make decisions, to coordinate, execute, and insist on support from higher authorities, the program runs the risk of being too standardized or of becoming paralyzed by bureaucratic intrigue or inertia.

Organizationally, the program should result in the creation of two types of permanent sub-district positions: one soil and water conservation officer and approximately four "spot workers" for extension activities. One conservation person per sub-district will be adequate, but the number of upland extension people per sub-district will depend on the amount of upland farming area. The number of hectares for which one upland extension marker should be responsible will have to be determined by monitoring the work of field staff during program implementation.

In addition to sub-district staff, the program will result in the formation of (Kelompok Conservation Action Units) based on hydrological units. If the task of creating the associations is taken seriously from the outset of the program, they can serve initially as a mechanism for organizing labor for terrace and waterway construction; ultimately, they should serve as the organizational ties for the formation of multi-purpose cooperatives. It is important to start the associational process early, and treat it as an integral part of the program. To facilitate this, the village field staff should include a community

development worker (Desa Conservation Technician), with assistance from a specialist on the sub-district or district support staff.

The Upper Watershed Program will fail if it succeeds in building terraces and waterways wherever needed but fails to integrate their maintenance and exploitation into the everyday routines of farmers. The erosion control technology can yield great benefits, but they will not materialize automatically. Farmers will have to increase production levels, and intensify or diversify production, in order to realize the benefits. They will need various new sorts of assistance in order to do so. The program can provide adequate assistance and guarantee its continuity only if it operates through regular administrative channels, as indicated here. To create a temporary parallel structure would be short-sighted and self-defeating. However, it will not be easy to mobilize entrenched administrations, nor are existing administrations adequate as they are; existing personnel will have to be trained and additional personnel added, some permanently and others just for the duration of the program; and authority will have to be decentralized to the sub-district level. Thus the aim of the program should be to develop the long-term capacity of existing institutions to respond to immediate erosion problems and to prevent future ones from developing by eliminating their causes.

The technology and organization of the program do not present cultural incongruitites, but, to some degree, the support network of pilot demonstration areas does. Paddy farmers are familiar with variety trial plots, and they may have been exposed to demonstration plots managed by PPLs. However, the pilot watersheds will be qualitatively different from PPL plots because their purpose will be to conduct original trials and tests, not merely to duplicate those which the Agricultural Extension Service recommends. The pilot watersheds constitute an indispensible element of the Upper Watershed Program whose short-term and long-term values are inestimable. To generate support for the program, field staff will need to show officials and farmers what the program would mean under conditions similar to their own. Subsequently, in order to meet the need for adequate assistance, the field staff must be provided with solid, dependable recommendations for improvements or crop introductions, which can only be generated under appropriate conditions.

Upland farming research experiences have been very limited in Indonesia and elsewhere, and there have been even fewer research efforts that focus on mixed upland cropping systems rather than on single crops. Consequently, there simply is no data base to which program staff will have recourse for recommendations. Data will have to be generated in the area as part of the program. Research on the pilot watersheds will have to be coordinated closely with program staff from the village to the district level. It will have to be forward-moving, foreseeing problems and demands and responding to them. The pilot watersheds cannot become mere showcases for the technology; to permit them to ossify would render them useless.

This research and demonstration component of the program will present socio-cultural problems at the institutional level, not in the villages. The idea is not entirely foreign to people in agricultural administration, but such components are normally relatively isolated from the regular administrative apparatus. What is proposed here is the establishment of a close, day-to-day working relationship between research and operational components. To do so will require that field staff ask questions, look for problems, and then communicate their findings to the pilot watershed personnel. This will make field work more difficult than it would be if the assignment were to execute a fixed program like BIMAS; however, it will also make the work more rewarding. Similarly, administrators and advisors will undoubtedly wish they could move without seeking consultation or waiting for results, but the quality of their decisions will be improved by having access to data relevent to specific local conditions. This potential institutional difficulty will not adversely affect the program unless program administrators allow bureaucratic concerns to overshadow the goal of this program.

<u>Linkages and Adjustments</u>. Currently, villages and sub-districts have executive responsibilities for programs over which they have no planning or fiscal control. They recieve directives, but rarely are called upon to help set priorities or to decide budgetary allocations. In practice, their limited resources constrain them to exercise discretionary powers in many ways, but always from positions of weakness. This proposal calls for considerable strengthening of the sub-district government, coupled with close collaboration with the villages. The real

focus of administrative and allocative power in the program will be in sub-districts. This will require strengthening external linkages between sub-districts and administrative levels, and between sub-district officals who represent other administrations and agencies. The sub-district staff must be able to identify local problems and constraints and to mobilize resources to overcome them without having to submit to successively higher authorities for executive and fiscal support.

A few critical institutional linkages will require modification. For example, the planning function must be up-graded in two ways: First, planning must include responsibility over all factors which affect the program, including agriculture, public works (infrastructure), cooperatives, industry, marketing, and so on. Second, planning authority must be delegated to the sub-district and planning capacity developed there. The authority need not be absolute, but it must be sufficient to permit sub-districts to articulate needs and respond to them in more than a residual manner. District planning activities will thus be restricted somewhat, but that will enable district personnel to focus on broader issues than they do now.

Similarly, infrastructural bottlenecks will appear quickly; thus the sub-district will need authority over public works, markets, and input provisions which it does not now have, as well as have access to seed funds to support local initiatives, such as cooperatives. The problems will differ from one area to another, and the response will also vary. For example, some sub-districts obviously need major road improvements; others do not. Where they are needed, Public Works personnel should be assigned to the sub-district, rather than attempt to provide major inputs from afar. Similar decentralization may be needed in other departments that normally do not have personnel at the sub-district level. The district planning offices can work with sub-district officials to determine what is needed in each sub-district, and who can best provide it. In any case, the role of the district administration should be to facilitate and support sub-district implementation of the program, not to direct it.

Motivators, Participants, Beneficiaries

From questions of institutional feasibility, the focus shifts here to questions regarding the advocates of the program, participants, and beneficiaries. In brief, the advocates represent a number of government entities, participation will be widespread, and there will be many beneficiaries, direct and indirect, in both the uplands and the lowlands of the Citanduy River Basin.

Motivators. Four principal groups have been advocating the Upper Watershed Conservation Program -- Proyek Citanduy and its consultant (ECI), USAID, the Forestry Department, and the district planning boards (BAPPEMKA and BAPPEDA). Other sections of the Agriculture Department have also been advocates, but less directly than the other four groups. Each of the groups will be discussed in turn.

The impetus for this report dates back to the Citanduy River Basin Development Project Master Plan of 1975, in which an upper watershed conservation program was deemed essential to halt further environmental degradation of the lowlands as well as the uplands and to protect anticipated investments in irrigation and flood control projects in the lowlands. The strategy adopted for the watershed consisted of starting with pilot projects and then moving to a basin-wide program, based on consultant recommendations. The Panawangan Watershed Pilot Demonstration Area was created under the aegis of the Citanduy Project as the first of a projected series of such areas located in different parts of the Citanduy Upper Watershed. Later, budgetary and operational management of the Panawangan Pilot Area was transferred to the Forestry Department, which also supervised its expansion. Throughout the first period, the Project's consultants participated significantly in planning, mobilizing, executing, and coordinating activities in the original pilot area, but Forestry has assumed the major role in the expanded area. Additional pilot areas are under consideration and are being designed at present, through Forestry - Consultant - Project Citanduy collaboration.

USAID has taken an active interest in the watershed problem as part of the overall Citanduy Basin development program, which is envisioned as a prototype of its kind. Operationally, USAID has been instrumental in establishing a basis for coordination and cooperation

among public entities involved in the Panawangan Pilot Area.

The Forestry Department's Citanduy Basin (DAS) Office is the government agency most actively engaged in upper watershed problems in the Citanduy Basin, through the Greening Program as well as the Citanduy Project. Forestry has established a very close working relationship with the consultants in the Panawangan Pilot Area, engaging its trained field staff and technical personnel in major field activities, as well as with the Ciamis Planning Office.

Finally, the district planning offices have played important roles in various ways. Consistent with USAID, the planning officers advocate the Upper Watershed Conservation Program as the first step in a broad integrated upland development program. To that end, they have familiarized consultants with common and unique problems of their districts by providing data and accompanying them on site visits. Meanwhile, the planning officers have met to develop an organizational framework for coordinating different aspects of the program.

The Planning Chief of Ciamis District has had enormous impact on the success of the Panawangan Pilot Area from the very beginning. He suggested the site, established contacts, oversaw coordination, arranged for site visits by farmer leaders and village officials, and made numerous other contributions. The other planning officials will undoubtedly make similar contributions to the pilot watersheds set up in their own districts. However, the Citanduy River Basin comprises a much smaller proportion of each of the other districts than it does Ciamis; thus officers in the other districts will not be able to devote as much of their time to the project as the Ciamis Chief has. Nonetheless, they have all played critical roles which will increase significantly as the program is planned and implemented.

<u>Participants</u>. The cast of participants in the upper watershed program will change over time, shifting from officials to farmers. Farmers will do the actual work in the project. Unless they build the terraces and waterways themselves and experiment with recommended practices the program would be outrageously expensive and self-defeating. The cost of field execution by any government agency would be prohibitive, and the process of imposing the program on farmers would

alienate them. Thus the question is not who will do the work, but under what circumstances; that is, how will farmers be organized, and who will arrange for technical assistance and logistical and infrastructural support? We look first at external participation and then turn to participation at the local level.

Under any circumstances, the program will require participation by a number of governmental units. The problem of designating a principal unit to coordinate and execute the program is very important because the designation will have both short term and long term consequences for program strategy and success. Four units are possible candidates: The Citanduy Project, the Forestry Department, the Agriculture Department, and the district and sub-district administrations.

The Citanduy Project has a definite interest in upper watershed problems, but they have not been central to its concern. Currently, it has neither the staff nor the experience to manage the program. Although a couple of Project staff have received some appropriate technical training, that will not be adequate. The major problems that will be encountered are organizational in nature, not purely technical, and are largely outside the Project's control. To expand Project's competency to deal with the problems may be unwarranted for two reasons: first, once the program is enacted, the manpower and experience would remain outside of day-to-day administration; second, and more importantly, Project has no authority to direct other relevant agencies to participate, nor does it have much positive experience in other areas of persuading people to collaborate in its activities. On the other hand, Project could be called upon to play a very important role in overall fund management, engineering design, and infrastructure construction.

The Forestry Department has a clearly defined interest in watershed management and a wealth of institutional experience on its own lands. Through the Greening Program, it has also acquired staff experience in problems associated with enacting a soil conservation program on private lands. The Greening Program experience has been valuable and should be considered in the upper watershed program. The Forestry

Department has the capacity to organize and execute programs, as their involvement in the Panawangan Pilot Area testifies; however, the other projects in Majakenka and Solo also testify that their record for obtaining grass-roots participation is still very limited.

Despite short-term practicality, there are two principal reasons why it would be inappropriate for the Forestry Department to administer the upper watershed program: First, the Greening Program staff have been trained to execute a very limited program. Their experience was excellent preparation for something like the demonstration farm terracing program, but it is inadequate in other respects. The PLPs would not be qualified to serve as field staff without additional training in upland cropping and community development, at least. Thus, as long as staff training investment would be required, it is more beneficial in the long run to train people who will become permanent upland PPLs, rather than train PLPs who would have no local functions after the terracing and waterway construction is completed. Second, like the Citanduy Project, the Forestry Department has no authority over the other government entities that must be involved in the program, and it is doubtful whether it could even coordinate other divisions of the Agriculture establishment. The only way to grant such authority to Forestry, or to Project, would be in effect to create a new entity which parallels regular governmental structures, but bypasses them. Although the prospect may appear superficially advantageous, over the long term it would be both wasteful and counterproductive. Once the project is completed, the regular administrative structures would end up with greater responsibilities than they had before, but they would be no better prepared to handle them than they had been.

Nevertheless, the Forestry Department can contribute significantly to the upper watershed program in many ways. For example, it should help in training in forestry practices and terracing. Forestry personnel are undoubtedly the most qualified to conduct many of the training programs that will be required for officials, field staff, farmer cadres, and others. In matters of erosion control, they have the best technical training and most experience. In questions of community organizing, they can use the Greening Program experience. For areas, such as cropping systems, in which they have no preparation, they can

draw upon the assistance of others. In addition, they may transfer staff. At the conclusions of the Greening Program, much of the PLP and other field staff could obtain additional training and then be brought into the permanent upland PPL staff. Third, Forestry should be involved in designing and constructing the demonstration watershed areas. Another Agriculture section may assume operating responsibility after construction, but Forestry should maintain an advisory relationship, at least. Finally, they should establish nurseries to grow the seedlings that will be required for the program. Depending on local circumstances, it might be advisable to utilize Forestry Department land for the nurseries, rather than monopolize private land. In sum, the Forestry Department will be an integral part of the upper watershed program, but it should not be the principal administrative unit.

The Agriculture Department will be a major participant in the program, but it would be inappropriate for the Department to assume the central role. Many sections of the Department will be involved: Animal Husbandry will supply grasses and promote animal husbandry; Fisheries will support fishpond improvements; Food Crops will assist with new varieties and recommendations; Plantations may be able to offer assistance on perennial crops; Forestry's role has already been outlined; the Research branch should help establish the demonstration areas and perhaps should staff them; and Agricultural Extension will provide assistance and, if the program is successful, will acquire a new division devoted to the needs of upland farmers.

This list gives an idea of the division of labor in the Agriculture Department, and that division's consequences: the Department is a complex, diffuse body which is so fragmented that as a whole institution, it is virtually incapable of meeting the needs of great numbers of Indonesian farmers, or of even recognizing the legitimacy of their needs. Farmers typically intercrop a bit of everything in a complicated, complementary, highly individualistic system. In contrast, the Agriculture agency is full of specialists of various degrees, each of whom views the farmers in terms of his own specialty, seemingly oblivious to other elements of the farming system. Thus, besides suffering from basic internal coordination problems which do not seem to get resolved, the Department, as an institution, lacks experience in defining and resolving

problems congruent with the program's perspective; that is, Agriculture is only beginning to focus on such things as the problems of integrated upland farming systems, yet that is the kind of focus needed for the program. In addition, Agriculture, like Project and Forestry, has no authority outside of its realm. Consequently, although the Department's contributions to the program will be numerous and absolutely essential for its success, there is no reason why it should administer the program.

Instead, the program should start out, and end up, as part of the normal administrative apparatus on the district, sub-district and village levels. The bulk of the actual work will be done within the villages and sub-villages; most detailed planning, coordinating, advising, and allocating will be done at the sub-district level; and broader policy-making will be done at the district level. Districts will also offer specialized support to the sub-districts and oversee the pilot watershed areas. The greatest qualitative changes will occur in the sub-districts, which have neither the personnel, authority or experience to define and execute programs of such magnitude and scope. The districts already have basic preparation, but the program will change their role somewhat. It will require them to offer new services, and to assume a more collaborative stance vis-a-vis sub-districts; it will limit the districts' discretionay powers while adding to their responsibility to assure inter-governmental coordination and cooperation on various levels. Villages, on the other hand, will have more burdens, but also more opportunities than before, to obtain and mobilize resources for communal and individual benefit. The added responsibilities will lead to greater autonomy for villages and sub-districts.

These structural changes will not be easy to implement. There will be opposition from agencies that want to perserve their own autonomy; there will be lags while personnel are trained for positions; there will be instances of people attempting to simplify and accommodate the program to their habits so that their new jobs resemble their old ones; and there will be conflicts between new and old employees, and between temporary program and regular staff people. There will also be problems in trying to keep well-trained project staff people in the field rather than at their desks. Nonetheless, after adjustments are made, staff people are trained, and the basic program is completed, what will

result is a stronger governmental system that is capable of identifying additional problems and taking steps to solve them.

Project participation at the village level will start with a demonstration watershed and, it is hoped, end up involving all upland farmers. The number of people active at different stages will depend on local characteristics as well as on the general strategy adopted. Before the program becomes operational, a decision must be made as to which villages and subdistricts are ready for establishment of demonstration watersheds, and which of the critical areas offer the most potential for improvement with the limited resources available. A gradual approach is recommended for a more compelling reason: the farmers who obtain experience in the first villages can serve as field leaders in neighboring villages, thereby decreasing the size of project staff and increasing the potential effectiveness of field operations. This approach was effective in the Panawangan expansion and should be followed throughout the program, in planning, waterway and terrace construction, as well as in cooperative formation and other relevant areas.

The program should evolve through four phases in each village: information dissemination and support generation; organization and training; execution; and consolidation. During the first phase, village leaders would be informed about the program and canvassed as to specific local needs; they would then relay the information to the people in various ways. Project field staff would establish themselves in the community during this phase. They would conduct mini-training courses for officials and farm leaders and arrange for them to visit pilot watershed areas. The leadership group would include the village head, sub-village heads, "elders," religious leaders, LSD leaders, the PTD, farmer leaders, and the kebayan or whoever manages public gotong-royong. They would be responsible for stimulating broad interest in the program by holding discussions, speaking in mosque and neighborhood groups, introducing conservation topics into school curricula, and whatever other means are appropriate.

The mini-training advocated for village officials will serve two purposes: to give them enough information to discuss the program in detail with villagers; and more importantly, to convince the leaders themselves of the seriousness of erosion problems, and impress upon them the feasibility of the program. It is vitally important to obtain the unequivocal commitment of village leaders, particularly the village head, to the program; such commitment is a necessary, but not the exclusive, condition for success. The point is emphasized here because discussions with various village heads indicate that village heads seriously underestimate the magnitude of the erosion problem, exaggerate the impact of traditional terraces and the amount of land terraced, or combine the two. Unless village heads become committed to the program and insist upon results in their villages, and upon support services from those responsible for their provision, the program could end up to be ecologically damaging or merely a futile exercise. Such commitment must be developed carefully; it cannot be assumed to exist.

The second phase would prepare for implementation by identifying tasks, organizing people, and training those who will assume leadership roles. Sub-district staff will assist villagers and the field staff in designing terrace and waterway layouts. The layouts, in turn, will determine work groups (based on ownership or proxy), the membership of upland farmers' associations, and potential field leaders. The field leaders will be trained in appropriate technical and managerial techniques by project field staff and the PTD. The nascent upland farmers' associations should be given the responsibility to organize farmers for the work. Meanwhile, village leaders will consult with farmers' associations to identify relevant non-terracing elements of the program, and then work with sub-district program staff to map out a timetable to get them.

During the execution phase, terracing and waterway construction will be carried out, and major infrastructural dificiencies should be overcome. As field work is completed, field leaders may start working in other villages. External support will be critical at this time to guarantee the prompt arrival of inputs -- seeds, fertilizer, seedlings, animals, fingerlings, and so forth.

The final consolidation phase should result in the transfer of local initiative from project field staff to the upland farmers' associations, which thereafter will articulate local needs; call upon agencies for specialized assistance in such things as organizing cooperatives, building storage facilities, obtaining therfore unavailable inputs, or developing processing or marketing facilities; and otherwise establish and maintain conditions adequate to induce their members to maintain and improve the erosion-control technology. If the task of organizing the farmer associations (Kelompok Conservation Action Units) is taken seriously from the very start; if they are conceived of as vigorous, self-sustaining entities, not mere letterhead groups; and if they are given appropriate encouragement, support, and autonomy; then they can become productive, worthwhile groups. If so, the upland farmers' associations should be able to manage by themselves the task of replacing bamboo waterway structures when they deteriorate.

Beneficiaries. The principal beneficiaries of the program will be the upland farmers and their families in the Citanduy River Upper Watershed. Many others will be affected indirectly by the expansion of the local economy and the reduction of sedimentation downstream. The adverse impact will be indirect and minimal.

Two groups will benefit directly from the conservation aspects of the program: upland farmers and public officials. Many others will benefit from the expanded upland development program.

It is impossible to determine precisely how many farmers will benefit. The impact on individual farmers will vary greatly, depending on the quality of their land, the amount of eroded land, the size of their holdings, the upland/lowland ratio of their holdings, their cropping patterns, and their alternative income sources. The farmers who currently grow primarily cassava on un-terraced, eroded slopes and have no paddyland, will benefit the most in the near term, and their children will benefit even more over the long run. Farmers whose holdings are primarily in the lowlands will benefit proportionately less. Farmers with erosion problems will benefit most immediately, but all upland farmers will gain from the improved agricultural support structure and

other community improvements.

Landless laborers will benefit in two ways. First, they will find employment in terrace and waterway construction. Second, they will find more upland work opportunities available to them. Currently, hired laborers do proportionately more upland farm work than paddy rice work. The intensification of upland production should increase the proportion of hired labor and so increase the demand then for labor, benefitting both landless and other laboring farmers.

The economic benefit to upland farmers will derive from a number of sources: higher yields; new crops, potentially with higher than current market value; more dependable yields, due to an improved plant environment; additional farming activities, such as animal husbandry and fishponds; better access to markets; better access to inputs; higher farmgate prices, due to improved transport; and additional processing opportunities.

Landowners in the lowlands will benefit from some of the improvements, but relatively less than upland farmers. Sharecropping and renting are believed to occur more in lowlands than in uplands; thus sharecroppers and renters can be expected to obtain benefits similar to those of lowland farmers, except to the extent that they work as laborers and avail themselves of new employment opportunities which develop on the uplands.

Public officials on the village, sub-district and district levels will also benefit directly from the program in various ways. Some officials, especially sub-district officials, will undergo training and receive new authority and responsibilities. Village officials will receive training and new responsibilities, but they will also obtain access to new forms of assistance to help their people. District officials will have added responsibilities for providing assistance, for coordinating, and for planning. Furthermore, the program will create many new positions in district and sub-district offices. Some jobs will be temporary, such as field staff and some specialists and program administrators, but others will become permanent. Some field staff will remain as upland PPLs; the sub-district soil and water conservation officers will become permanent employees; and some additional technical

staff people will be absorbed into regular hierarchies. Participants in the program will obtain valuable planning, coordinating and communications skills, as well as decision-making skills. They will have the opportunity to become responsive, responsible, imaginative public officials. To the extent that they take advantage of the opportunity, they can make great contributions to the welfare of Citanduy River Basin residents.

Additional jobs will be created in conjunction with efforts to build the infrastructure, of which road construction will undoubtedly involve the most people and resources. Infrastructural development would probably proceed without the program, but at a slower pace, with less systematic integration.

Numerous people will benefit indirectly from the Upper Watershed Program: merchants, middlemen, transporters, and others who live or trade in the uplands; consumers in the immediate area and in urban markets; and thousands of people downstream who now suffer the consequences of erosion in the uplands.

The increased disposable income of upland farmers will have significant multiplier effects in the local economy. Farmers will produce more and buy more. Changes in production should stimulate the growth of rural industries, as well as processing, marketing, and transport facilities.

Local and urban consumers will enjoy the fruits of the program, literally and figuratively, in the amounts of upland rice, grain, legumes, tubers, wood, fruit, meat and fish that end up in markets. And greater amounts of locally processed goods will reach consumers. The amounts and types of produce to be marketed will vary from one part of the Upper Watershed to another, and it will vary over time. Ultimately, farmers should be producing much less cassava and more crops which yield higher returns for their investment of time and energy and do not produce the same destructive ecological results.

Thousands of people downstream currently experience the secondary effects of erosion in the Upper Watershed: quick run-off and sedimentation of the riverbeds cause flooding over large areas; heavy siltation clogs irrigation systems, reducing their efficiency and longev-

ity; low water infiltration and retention in the Upper Watershed shortens the annual irrigation season and magnifies the impact of droughts. The Upper Watershed Program will significantly reduce these effects over time, to the enormous benefit of the lowland population and of the whole Indonesian population. Even if the upland farmers did not benefit from the program, the potential beneficial impact on the lowlands is sufficient to justify initiation of the watershed management program.

The Upper Watershed Program could have one adverse social consequence -- the decline of cassava production and processing. Many people now earn a considerable amount of their cash income by raising cassava for processing and/or by working in processing plants. The work is tedious, time-consuming, and very low paying, all along the line. The crop takes a long time to mature; yields are low because of low input levels and the cumulative effects of cropping year after year; peeling off the toxic skin takes a lot of time; farmgate prices are very low; and factory jobs pay low wages. Nevertheless, cassava is frequently the only feasible crop under prevailing conditions. Generally, people stick to cassava out of necessity, not choice, and the concentration of cassava is greatest in the poorest parts of the Upper Watershed. There is no justification for an immediate ban on cassava production, and attempts to curtail the production must proceed by offering a more profitable alternative cropping system. Cassava can also be raised by conservation farming methods to reduce erosion and land deterioration problems.

The Upper Watershed Program will present farmers with cropping options they do not have now, which should lead to some natural decrease in cassava production. At first, farmers should be encouraged to intensify cassava production on flat areas, away from the lips of terraces, while they experiment with additional crops. With improved practices and inputs, they should be able to increase total yields on much decreased surface area. Eventually, they will undoubtedly concentrate on other crops, instead of cassava. Ultimately, many people who peel and process the cassava will need to find other income sources. It is anticipated that the transition will be relatively easy and gradual. In the meantime, program field staff should not pressure farmers to discontinue cassava production until they develop high yielding and profitable alternative crops.

Anticipated Consequences

This and the next section attempt to schematically outline the principal consequences and characteristics of the Upper Watershed Program. Much of the following is extracted from previous discussions, modified to review the institutional impact, to study changes within villages, and, finally, to analyze the employment affects.

Institutional Changes. Six major institutional changes will result from the program: First, the direction of agricultural support to farmers will be modified to focus broadly on problems of small scale upland farmers. This will mean adding advisors on cropping systems and soil and water conservation to sub-district staffs, and incorporating the ongoing research programs in the pilot watersheds into day-to-day administration and support.

Second, the new direction in agriculture will be funneled through a new conservation farming technical staff. They will have a broad mandate to work with many elements of upland farming systems, thus they will need broader training than regular PPLs, and will have to have closer access to district and sub-district agricultural specialists than regular PPLs enjoy. Their training should include soil and water conservation, as well as upland cropping, animal husbandry, fishpond technology, and other specialties as needed. They will need continued training in new technology and research results.

Third, the district planning officers will have achieved higher skill levels as the result of program experience.

Fourth, sub-district authority will have expanded to include coordinating the work of ministerial agencies (such as Agriculture and Public Works) directly, rather than by going through the district.

Fifth, concurrently, the skill and competency of sub-district officials will be broadened to include planning, administration, and various technical areas relevant to rural development.

Finally, the sub-district-village rapport will be strengthened through collaboration on the program. Tailoring the program to meet local needs will require close interaction between officials at both levels, in a stronger give-and-take relationship than generally exists currently.

Community Adjustments. Besides technical inputs and anticipated production increases, the villages will be modified in four ways as the result of the Upper Watershed Program. First, different kinds of leaders will be involved in new shared responsibilities. Some villages already have planning committees, and the program will give them experience and resources they have not had before, thus increasing their competency. Additionally, the LSD would be integrated more directly in broad village questions, whether or not there is a separate planning committee in any village.

Second, the function and prestige of the PTD will increase markedly. Presumably, the PTD would be the local day-to-day program chief and would assist the village head and field staff. Close interaction with Project staff will enable the PTDs to develop various technical and organizational skills.

Third, upland farmers will be tied into a new information and assistance network through the upland PPL. Given the previous neglect of support to upland farmers, this should make a qualitative improvement in many things.

Finally, the upland farmers associations will become multi-purpose grass-roots organizations. In many villages, this will be an important innovation. The aim of the associations should be to consolidate farmer interest and resources and turn them into a vehicle for wide-range development, starting with cooperatives.

Employment. The program will have variable employment impact, depending on local circumstances. Short-and long-term employment impact will be different.

Terrace and waterway construction will provide employment possibilities for landless and other people in some villages. Where farmers own both upland and lowland tracts, and must commit themselves to paddyland jobs, they may need to hire laborers to build terraces for them. Such employment will be minimal where upland farming predominates, however. Although it is preferable to organize farmers into teams and have them do the construction themselves, where it is not possible to expect this to occur, the terracing subsidy should be adjusted to guarantee that all hired laborers receive a regular day's wage for the work. Landowners need not receive wages (the subsidy) equal to the same wage rates because their benefits will be long-lasting; however, landless laborers should not be expected to subsidize the terracing by working for exessively low wages.

Long term employment changes will occur in three principal areas. First, the farm labor required for the intensification of upland cropping will vary with different cropping patterns, both seasonally and absolutely. Second, the employment generated by secondary manufacturing, processing, or storage, will also vary. Finally, transport, commerce, and other jobs will increase, also depending on circumstances. In sum, the program will produce jobs for new people in some villages, in others it will have had a distinct impact if it merely stimulates enough employment to keep people in the village who might otherwise be forced to emigrate to make a living.

Spread Effects

One of the greatest strengths of the Upper Watershed Program is the fact that it will be carried out within regular administrative channels, some of which will be strengthened through its implementation. Thus it will have built into it many mechanisms through which to communicate information, transmit lessons, transfer benefits, and expand focus. Three questions are relevant to the topic of diffusion: Who is involved? How is information transmitted? What happens afterwards?

The principal actors in the Upper Watershed Program will be the farmers who build the erosion control structures and then are encouraged to maintain them by the benefits they derive from them. The supporting cast consists of people who promote, organize, and execute the program and who provide back-up support of various sorts. The supporting cast concerns us here. District planning officers are central to current program discussions, and they will assume progressively more important roles as the program turns from erosion control to an integrated upland development program. At each stage in that progression, the main communications will go from planning officers through sub-district officers to village heads. At each step, the responsible person will have to respond to others in the chain-of-command, as well as coordinate and direct the involvement of people from other administrations, such as Agriculture and Public Works, who provide the substance of program input.

It will be difficult to maintain the delicate balance between bureaucratic exigencies and program demands, which will be more flexible. To do so will require great dedication on the part of village heads, sub-district heads, and district planning chiefs, whose bonds with each other will have to be strengthened. General direction and enthusiasm will come from district people, but the sub-district and village people will have to be strongly committed for the program to succeed. This analysis has assumed that such commitment will be easy to obtain. It should be, but it will not be automatic. The commitment must be fostered assiduously and strengthened by real collaboration, not mere consultation. Until such dedication is achieved, this district--sub-district--village linkage will be the weakest part of the program; once achieved, it will be its strongest part. The program will demand much from village leaders, some of whom may not think that local problems are bad enough to warrant the effort. Other officials will have to foresee the possibility of such a response and plan an appropriate strategy when people refuse to participate.

Information will travel through normal official channels within the project and outside of it. This will also be a strength. In addition, new channels will be created between regular administrators and project specialists, and between field staff and village officials and farmers. Field staff must identify informal village leaders, include

them in mini-training programs, and utilize them, as well as official leaders, for communicating with villagers.

Farm radio broadcasts have potential value for communicating with participants, but many upland farmers may not be attuned to the broadcasts at the outset because of their current emphasis on paddy production. Therefore, direct contact and example must be relied upon initially.

Another strength of the proposed structure is the fact that district, sub-district, and village officials already have authority over the activities in their territory of people from different ministries. Thus to recommend that the control be strengthened, and that their activities be coordinated into a program, is to propose a change in intensity but not in direction. Such control and coordination will be absolutely necessary if farmers are to obtain the information and inputs they need when they need them. An alternative strategy would be to create new structures, but that would be totally counterproductive.

Meanwhile, the true tests of the program's impact in the Citanduy Upper Watershed will be the extent to which terraces are maintained over time, the extent to which waterway structures are replaced as needed, and the extent to which upland farmers have increased the size of their incomes and diversified their income sources.

The Citanduy River Upper Watershed Program is an important upland development initiative, both in its own right, because of the need for it and its potentially great benefits, and as a prototype. Erosion must be controlled in Java, but to date there are no good models to show how it can be done through a government program. If this program proves effective, it will constitute a valid model which can be adapted to other areas, just as it must be adapted to localized conditions within the Citanduy River Basin. Moreover, compared to other programs -- existing and potential -- this program puts much greater emphasis on developing a permanent administrative structure which is technically and organizationally competent to identify and resolve future, as well as existing, problems in the area.

Social Assessment

Clearly, the program will provide a badly needed erosion control program and facilitate upland farmer support services to assist many poor, small-scale upland farmers. As the result of the program, the farmers will increase and diversify production and raise their incomes. Many more people who live downstream will also benefit from the ecological consequences of the program. Four topics are covered schematically in the following sections: program assets, problem areas, recommendations related to the program itself, and suggestions relating to survey data collection.

Assets

The Upper Watershed Management Program will be the first step in an integrated upland development program. Perhaps its greatest asset will be the fact that the program itself sets the foundation for future developments. Other assets are listed below, going from general to more specific, as they relate to the general direction of the program or its impact on the village level.

First, the program will represent productive, relevant investment with long-term value. The major investments will be in people: staff, direct farmer support, and trained farmers. Staff people will be employed and trained, most of whom will have a permanent commitment to local problems; they will not disappear from the area at the conclusion of the program, thereby vitiating the investment. Farmer support will consist of subsidies for construction, income guarantees during the transition, and the provision of various inputs.

Second, the program will flow through regular channels and lead to an improvement in the way regular public activities are planned, coordinated, and executed.

Third, it will direct attention to the problems of a long-neglected group of people -- upland farmers.

Fourth, the program will include a demonstration and research element which, out of design as well as necessity, will generate needed information relevant to upland farmers in different locations within the Citanduy Upper Watershed.

Fifth, the program will strengthen the district planning offices and staff, providing valuable practical experience and important responsibilities. This will have positive impact in their areas of responsibility.

Sixth, it will expand sub-district authority and responsibilities and capabilities to plan and execute rural development programs.

Seventh, it will increase sub-district and district advisory staffs, particularly those concerned with upland problems.

Eighth, the program will result in the development of a new group of upland PPLs with ongoing responsibilities and relevant competencies.

Ninth, and very importantly, the program will manifest itself on the village level as a community program, with a wide range of supports available from the sub-district and district levels.

Tenth, within the village, it will expand local competencies in upland resource management and utilization, particularly those of the PTD and the trained farmer team leaders.

Eleventh, the program will be tailored to local conditions, a process which will involve various formal and informal leaders, thus up-grading their planning and administrative skills.

Twelfth, it will have hydrological units as work units, which will be formalized and perpetuated through upland farmers associations. They are expected to lead to the formation of cooperatives and other collective efforts to improve the well-being of upland farmers and their families.

Thirteenth, through the program, farmers individually and collectively will learn new production methods, adopt new crops, and experiment with different forms of agriculture. This should lead to higher, more dependable farm incomes, greater employment opportunities,

and additional secondary income sources.

Problems

Despite its strong points, the program will not achieve its goals easily. Most of the problems encountered will be organizational, rather than technical, and most will result from the difficulty of mobilizing people who have several responsibilities, of which project activities may be only a part. Six major problems are identifiable:

First, and foremost, is the problem of coordination. The institutions to be involved are bound to each other by fragile linkages which need to be strengthened substantially. However, strengthening the controls of sub-districts and districts to enable them to coordinate effectively will generate considerable resistance among the people to be coordinated, as well as among their superiors at higher administrative levels. Ironically, the greatest resistance to the program can be expected to come from various types of governmental officials who will not want to relinquish the relative independence they enjoyed before the advent of the Program. This problem must be faced directly and immediately, or it could undermine the Program.

Second, it will not be easy to provide appropriate recommendations and to obtain required inputs when they are needed. Many recommendations will have to be generated within the Project area because few outside sources can be expected to be useful, and that takes time. Many inputs will have to be brought into the areas, which takes time. Yet the practical lead time may be short in many cases, which will accentuate the problem. Such problems cannot be avoided, but they are a critical consideration, because if advisors fail to live up to their promises, farmers may refuse to participate.

Third, building enthusiasm for the program among village leaders and farmers is vitally important. It will require sensitive and careful planning. Above all, however, the involvement of villagers in defining the program must be genuine, not a mere public relations gimmick, or it will fail.

Fourth, scheduling can be expected to be a recurrent problem in the field. The program will have to fit in with other ongoing village activities, and inputs must arrive as scheduled. Scheduling rigidity will be self-defeating, as will irregular deliveries. And both may be interpreted as violations of the attempt to make the program a local program.

Fifth, it will not be easy to create independent, self-motivating farmers associations. It will take time, skill, and sensitivity on the part of local staff. If developing associations is treated as a residual, rather than a primary activity, it will probably fail. Such failure may drastically shorten the lives of the erosion control structures, so the prospect must not be taken lightly.

Finally, program impact in some parts of the Watershed will be severely limited by infrastructural deficiencies. They must be identified at the outset and overcome before they inhibit the program and perhaps destroy momentum for continued development.

Recommendations

Eight principal recommendations emerge with regard to the potential problems listed above and elsewhere here:

First, from the very outset, plan the Upper Watershed Conservation Program in light of the goals and requirements of an integrated upland development program. That is, create the sub-district and district offices as real development offices that have real authority to plan, organize, and execute the immediate program, as well as broader ones. This will enable the offices to be expanded in later phases rather than be replaced. The effect will be to stimulate the imagination and energies of program staff from the beginning and to provide important continuity over the long run.

Second, let the first task of the program be to conduct detailed surveys in each village to inventory resources, determine resource distribution, assess resource utilization levels and utilization efficiency, and identify any other patterns relevant to program planning. This can be done by the field staff, and will provide them with a good introduction to the villages, as well as a solid basis for assessing

needs.

Third, based on the survey, identify infrastructural deficiencies and set a program to overcome them.

Fourth, set implementation schedules and subsidy levels in flexible terms that allow field staff to adjust them to local conditions, based on the results of the survey and their own familiarity with the villages. Above all, do not tie schedules or subsidies to the annual budgeting calendar, which is unlikely to correspond to local agricultural calendars.

Fifth, prepare for the creation of farmer associations by emphasizing their importance in field staff training programs and including appropriate training. Even technical staff should become acquainted with community development and of forming cooperatives.

Sixth, emphasize community involvement and inter-community cooperation by making farmer field leader cadres an integral element of the program. Give the cadres adequate training and then give them the responsibility to lead and train their fellow villagers and people in neighboring villages.

Seventh, aim from the outset to formalize the rank of Upland PPL in the Agriculture hierarchy. A realistic definition of work tasks, range of territory, and so on, can emerge through the process of implementing the program, based on empirical criteria.

Finally, let the district planning offices monitor the program, evaluating its progress periodically, measuring its impact, identifying problem areas, assissing strategies, and suggesting modifications where appropriate.

Survey Data Suggestions

The survey conducted in each target area before final planning phases of the program should serve two purposes: to identify specific conditions to which the program should be directed; and to set a baseline from which to measure the impact of the program. The general characteristics to be identified and enumerated are: infrastructural components; agricultural products; labor status and work calendar;

upland/lowland landholding units; the use of inputs; nutritional status; and relative isolation of population groups. This information can be obtained rather easily through systematically interviewing as much of the upland population as possible and through careful field observation.

Further, a number of indicators of change resulting from the program should be monitored. For these, a random sample of upland farmer families should be interviewed periodically. All members of the family who contribute income should be interviewed. At least seven indicators should be monitored periodically through the sample: aggregate family income; income sources -- specific crops, non-agricultural tasks; remuneration for different work tasks; income-producing alternatives; land use; crop and animal yields; and product marketing. If the project is successful, the following changes are expected to occur: income levels will rise both absolutely and relatively; income sources will diversify; people will concentrate their energies on activities that offer better remuneration and will cease work that pays poorly; the number of income generating activities from which to choose will increase; land will be used more intensely for higher-yielding and more valuable crops; crop and animal yields will increase; families will market a greater proportion of production; and marketing terms will improve vis-a-vis the farmers.

Some of these areas of inquiry will not yield useful data if the questions posed are simple and general and require detailed recall of information several months old. For example, rather than asking an interviewee "Which crops do you grow?", the interviewer should list all likely possibilities. Thus the interview schedule must contain long lists of alternatives which the interviewers must review in each case to make sure that different income elements, alternatives, crops, and so on, are not missed. Survey schedules of the Rural Dynamics Study Group, Agro-Economic Survey, Bogor, will offer useful models to aid in preparing schedules for the project surveys.

TABLE V-1

SUMMARY STATISTICS

District	Sub-Districts	Villages	Population 1977	Area (Km^2)	Population Density#	Percent Distribution: Sub-Districts	Villages	Population	Area
Ciamis	19	123	798,247	1,469.0	543	51.4	40.9	41.0	44.3
Cilacap	8	84	612,477	1,197.1	512	21.6	27.9	31.5	36.1
Tasikmalaya	8	83	495,272	559.1	886	21.6	27.6	25.5	16.9
Kuningan	2	11	39,165	90.7	432	5.4	3.6	2.0	2.7
Total	37	301	1,945,161	3,315.9	587	100.0	100.0	100.0	100.0

*This, and all other tables in this chapter, includes the upper watershed villages. Excluded from district totals are all sub-districts located outside of the Citanduy Basin, 39 lowland villages in Ciamis district which lie within the Citanduy Basin, and 13 villages within the Administrative Center of Tasikmalaya.

#Persons per square kilometer

Source: Village data compiled by District Planning Offices

TABLE V-2

SUB-DISTRICT SUMMARY STATISTICS

District	Sub-District	Villages	Area (Km^2)	Pop. Density (Persons/Km^2)	1977 Population Total	1977 Population % 15 yrs.	Pop. % Increase 1966-1976
Ciamis	Ciamis	10	54.5	862	46,963	29	3.4
	Cikoneng	8	43.9	874	38,345	42	24.9
	Cijeungjing	8	51.1	556	28,426	33	16.9
	Kawali	9	66.7	770	51,329	26	25.7
	Panawangan	7	87.1	520	45,281	29	11.8
	Rajadesa	8	90.4	613	55,419	34	3.8
	Buniseuri	6	74.7	774	51,794	37	23.0
	Panumbangan	7	43.6	862	37,595	40	16.8
	Panjalu	10	107.4	528	56,685	35	19.8
	Cihaurbeuti	6	30.3	874	26,487	34	22.7
	Banjar	1	19.7	451	8,890	24	85.6
	Cisaga	6	94.9	358	33,931	28	13.3
	Rancah	7	118.3	483	57,087	29	9.4
	Cimaragas	6	69.6	383	26,633	22	13.9
	Banjarsari	7	178.6	480	85,667	39	16.6
	Pamarican	7	157.2	398	62,483	36	24.8
	Lakbok	1	30.0	491	14,733	45	10.9
	Padaherang	6	106.5	494	52,594	20	4.6
	Kalipucang	3	44.5	402	17,905	33	14.5
Cilacap	Sidareja	10	147.5	667	98,396	38	34.0

(Continued Next Page)

TABLE V-2 (Continued)

District	Sub-District	Villages*	Area (Km^2)	Pop. Density (Persons/Km^2)	1977 Population Total	1977 Population % 15 yrs.	Pop. % Increase 1966-1976
Cilacap	Kedungreja	7	144.5	706	102,002	46	8.3
	Gandrungmangu	7	110.9	703	77,920	34	23.5
	Karangpucung	12	113,3	494	56,015	40	32.0
	Majenang	13	226.8	396	89,826	41	23.9
	Cimanggu	12	138.4	515	71,237	38	19.7
	Wanareja	11	177.0	448	79.228	48	24.3
	Dayeuhluhur	12	138.7	273	37,853	37	13.8
Tasikmalaya	Cibeureum	9	65.5	1,331	87,196	44	21.6
	Cineam	8	102.3	426	43,584	44	27.7
	Indihiang	11	69.2	1,095	75,754	44	26.2
	Manonjaya	9	63.4	865	54,813	44	21.9
	Ciawi	12	74.4	825	61,397	44	18.4
	Cisayong	12	71.9	844	60,661	43	26.1
	Pagarageung	12	81.6	751	61,240	43	28.1
	Rajapolah	10	30.8	1,644	50,627	46	21.5
Kuningan	Selajambe	2	31.0	428	13,279	39	7.7
	Subang	9	59.7	434	25,886	38	8.5
Total	37	301	3,315.9	587	1,945,161	38	

*This compilation reflects our best efforts to isolate upper watershed villages. It does not include sub-districts or villages outside of the watershed, to the best of our reckoning, nor all villages within the Citanduy River Basin. Thirty-nine lowland villages in Ciamis District and 13 villages in Tasikmalaya (the Administrative Center) were excluded. The following sub-districts were affected in Ciamis--Ciamis (10), Cikoneng (6), Cijeungjing (2), Kawali (2), Cihaurbeuti (2), Banjar (4), Cisaga (2), Rancah (1), Cimaragas (1), Pamarican (1), Lakbok (4), Padaherang (1), and Kalipucang (3). However, it was not possible to identify all lowland villages in other sub-districts, or to disaggregate some from others. Some lowland villages in Cilacap remain included, in Sub-Districts Sidareja, Kedungreja, Gandrungmangu, Majenang, Cimanggu and Wanareja.

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-3

POPULATION

District	1961	1966	1971	1976	1977
Ciamis	613,901	683,709	735,613	790,266	798,247
Cilacap	469,474	507,236	577,227	609,861	612,477
Tasikmala	*	394,089	438,433	487,640	495,272
Kuningan	*	36,113	38,077	39,077	39,165
Total	*	1,621.147	.,789,350	1,926,844	1,945,161

	Percent Change				
District	1961-1966	1966-1971	1971-1976	1966-1976	1961-1976
Ciamis	11	8	7	16	29
Cilacap	2	14	6	20	23
Tasikmalaya	*	11	11	24	*
Kuningan	*	5	3	8	*
Total	*	10	8	19	*

*Not available; not calculable

Source: Village data compiled by District Planning Offices

TABLE V-4

POPULATION DENSITY

District	Area (Km^2)	Population per km^2				
		1961	1966	1971	1976	1977
Ciamis	1,469.0	418	465	501	538	543
Cilacap	1,197.1	392	424	482	510	512
Tasikmalaya	559.1	*	705	784	872	886
Kuningan	90.7	*	398	420	431	432
Total	3,315.9	*	489	540	581	587

*Not available; not calculable

Source: Calculated from village data compiled by District Planning Offices

TABLE V-5

AGE DISTRIBUTION - 1977

District	Total Population	Age Groups - Percent 0-4	5-9	10-14	15-24	25-54	55+	Total	Total Under 15
Ciamis	789,915	11	11	11	18	40	9	100	33
Cilacap	612,213	15	13	12	18	32	9	99	40
Tasikmalaya	493,360	13	16	14	19	31	7	100	43
Kuningan	39,077	11	14	14	15	20	26	100	39
Total	1,934,565	13	13	12	18	35	9	100	38

Source: Calculated from village data compiled by District Planning Offices

TABLE V-6

AVERAGE FAMILY SIZE - PADDYLAND FARMERS

District*	Persons per Family		
	Landowners	Cultivators	Total#
Ciamis	4.89	4.57	5.17
Cilacap	4.92	4.89	4.78
Tasikmalaya	4.86	5.17	4.96
Total	4.89	4.78	4.99

*Kuningan data not available.

#People who own land and also sharecrop or rent (both of the latter groups are "cultivators" here) are counted in each column, but only once in the total, hence the apparent discrepancies in totals.

Source: Calculated from village data compiled by District Planning Offices

TABLE V-7

EDUCATIONAL LEVELS ATTAINED - OVER 10 YEARS OLD

District	Distribution - Percent							
	No School	Some Elementary	Elementary	Middle	Secondary	Post-Secondary (Number)	Total	Number
Ciamis	8	27	60	3	2	(531)	100	614,890
Cilacap	30	29	37	3	1	(210)	100	434,579
Tasikmalaya	9	26	57	5	2	(461)	99	349,026
Kuningan	18	23	52	5	2	(24)	100	36,619
Total	15	27	52	4	1	(1,226)	100	1,435,114

Source: Calculated from village data compiled by District Planning Offices

TABLE V-8

EDUCATIONAL LEVEL - SUMMARY DATA

District	Population Over 10 Years - Percent			Post-Secondary
	Less than Elementary Certificate	Completed Elementary	More than Elementary	Per 10,000 Total Population
Ciamis	35	60	5	6.7
Cilacap	59	37	4	3.4
Tasikmalaya	35	57	7	9.3
Kuningan	41	52	7	6.1
Total	42	52	5	6.3

Source: Calculated from village data compiled by District Planning Offices

TABLE V-9

SCHOOLS

District	Number	Distribution - Percent						
		Level				Authority		
		Elementary	Middle	Secondary	Other	Public	Religious	Other
Ciamis	781	92	8	*	0	76	22	3
Cilacap	556	89	7	1	3	75	25	0
Tasikmalaya	452	93	7	*	0	79	21	0
Kuningan	54	96	4	0	0	85	15	0
Total	1,843	91	7	1	1	77	22	1

*Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices

TABLE V-10

STUDENTS AND SCHOOL ENROLLMENT RATIOS

District	Student Distribution - Percent				Number Students	Population 5-15 Years Old	Enrollment Ratio#
	Elementary	Middle	Secondary	Total			
Ciamis	92	8	*	100	125,707	167,735	74.9
Cilacap	90	9	1	100	103,379	154,594	66.9
Tasikmalaya	92	8	*	100	84,321	148,713	56.7
Kuningan	90	10	0	100	7,054	10,614	66.5
Total	91	8	1	100	320,461	481,656	66.5

*Less than 0.5%

#Number of students per 100 people aged 5-15 years.

Source: Calculated from village data compiled by District Planning Offices

TABLE V-11

HOUSING

District	Number	Distribution - Percent: Permanent	Temporary and Semi-Permanent	Total	Percent With Electricity
Ciamis	182,199	12	88	100	2
Cilacap*	129,503	77	23	100	2
Tasikmalaya	102,005	17	83	100	3
Kuningan	8,981	34	66	100	5
Total	422,688	34	66	100	2

*This data is clearly incorrect; the total of permanent houses is unlikely to be more than 15%.

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-1:

PUBLIC HEALTH SYSTEM COMPONENTS

District	Hospitals	Public Health Clinics	Hospital/ Clinic Beds	Mother/Child Clinics	Family Planning Clinics	Total Clinics	Doctors	Physicians Assistants	Nurses	Midwives	Total Personnel
Ciamis	4	8	75	37	22	67	11	38	59	16	124
Cilacap	0	13	59	17	15	45	7	27	27	18	77
Tasikmalaya	1	3	23	10	53	66	7	31	35	45	118
Kuningan	0	7	0	6	1	14	1*	2	1	1	5
Total	5	31	157	70	91	92	26	66	102	130	324

*Questionable data

Source: Village data compiled by District Planning Offices

TABLE V-13

PUBLIC HEALTH SYSTEM COMPONENT INCIDENCE

Component Units	Persons per Unit				
	Ciamis	Cilacap	Tasikmalaya	Kuningan	Total
Hospitals	199,600	---	495,000	---	389,000
Public Health Clinics	99,800	47,100	165,000	5,600	62,700
Hospital/ Clinic Beds	10,600	10,400	21,500	---	12,400
Mother/Child Clinics	21,600	36,000	49,500	6,500	27,800
Family Planning Clinics	36,300	40,800	9,300	39,200	21,400
Doctors	72,600	87,500	70,700	39,200*	74,800
Physicians Assistants	21,000	22,700	16,000	19,600	29,500
Nurses	13,500	24,500	14,200	39,200	19,100
Midwives	49.900	34.000	11.000	39,200	15,000
Total	798,247	612,477	495,272	39,165	1,945,161

*Questionable data

Source: Calculated from village data compiled by District Planning Offices

TABLE V-14

WORK FORCE PARTICIPATION

District	Population 15-55	Active Work Force	Total Participation Rate*	Agriculture Participation Rate*
Ciamis	459,667	426,105	93	84
Cilacap	306,933	281,377	92	66
Tasikmalaya	245,517	165,050	67	48
Kuningan	13,892	22,877	165	136
Total	1,026,010	895,407	87	71

*Work force (Total) or agricultural work force (Agriculture), as a percentage of the population within the official working age category (15-55), respectively.

Source: Calculated from village data compiled by District Planning Offices

TABLE V-15

OCCUPATIONAL DISTRIBUTION

District	Percent						Number
	Agriculture	Commerce	Public Administration	Pension	Other#	Total	
Ciamis	90	4	5	*	*	99	426,103
Cilacap	72	6	3	*	19	100	281,377
Tasikmalaya	72	11	5	*	12	100	165,050
Kuningan	83	2	3	1	12	101	22,87
Total	81	6	5	*	8	100	
Number	725,489	50,780	41,525	1,898	75,715		895,407

*Less than 0.5%

#Includes plantation workers (especially in Cilacap), and artisans (especially in Tasikmalaya and Kuningan), both of which often are indirectly part of the agricultural labor force, as well as others.

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-16

AGRICULTURAL WORK FORCE

	Percent						
District	Owners	Renters	Sharecroppers	Laborers	Other	Total	Number+
Ciamis	41	1	28	29	1	100	387,479
Cilacap	48	4	3	38	7#	100	267,556
Tasikmalaya	43	1	13	42	*	99	118,908
Kuningan	38	6	17	39	*	100	25,401
Total	44	6	17	34	3	100	
Number	348,223	19,049	138,197	273,560	20,315		799,344

*Less than 0.5%.

#Thought to be plantation workers, distinguished from laborers by the stability of their employment.

+These totals differ from the totals in Table V-12; Ciamis and Tasikmalaya are about equal in each table, but the totals for Cilacap and Kuningan represent about 75% of the totals in this table. The differences seem likely to reflect counting technique discrepancies, but we were unable to discern their basis.

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-17

AGRICULTURAL WORK FORCE - SUB-DISTRICTS

District	Sub-District	Percent Distribution						Number
		Owners	Renters	Share-croppers	Laborers	Other	Total	
Ciamis	Ciamis	53	-	11	35	-	99	17,281
	Cikoneng	49	2	27	22	-	100	12,412
	Cijeungjing	55	3	31	11	-	100	12,780
	Kawali	31	1	34	34	-	100	32,579
	Panawangan	24	-	24	52	-	100	25,333
	Rajadesa	51	-	1	47	-	99	21,714
	Buniseuri	40	1	20	38	-	99	19,537
	Panumbangan	56	3	29	11	-	99	16,840
	Panjalu	48	2	38	13	-	101	22,174
	Cihaurbeuti	47	1	28	23	-	99	9,646
	Banjar	84	-	13	2	1	100	3,653
	Cisaga	52	-	37	10	-	99	14,482
	Rancah	48	1	30	15	4	99	32,622
	Cimaragas	52	-	-	33	15	100	15,418
	Banjarsari	33	1	42	23	-	99	57,877
	Pamarican	29	2	5	65	-	101	29,646
	Lakbok	37	-	55	3	5	100	9,406
	Padaherang	28	3	33	36	-	100	24,366
	Kalipucang	61	1	15	23	-	100	8,124

(Continued Next Page)

TABLE V-17 (Continued)

District	Sub-District	Percent Distribution						Number
		Owners	Renters	Share-croppers	Laborers	Other	Total	
Cilacap	Sidareja	50	4	2	32	12	100	42,870
	Kedungreja	28	1	10	61	-	100	58,218
	Gandrungmangu	46	9	-	28	16	99	38,833
	Karangpucung	60	2	-	37	1	100	19,532
	Majenang	52	6	-	39	3	100	36,502
	Cimanggu	60	4	-	29	7	100	23,923
	Wanareja	55	2	4	36	3	100	30,081
	Dayeuhluhur	57	8	5	13	17	100	17,597
Tasikmalaya	Cibeureum	40	-	5	55	-	100	20,329
	Cineam	62	-	15	23	-	100	10,456
	Indihiang	22	-	11	67	-	100	8,902
	Manonjaya	30	-	8	62	-	100	11,268
	Ciawi	56	5	15	25	-	101	19,246
	Cisayong	30	-	16	54	-	100	12,634
	Pagarageung	48	2	23	27	-	100	19,339
	Rajapolah	46	-	12	42	-	100	16,734
Kuningan	Selajambe	49	6	12	30	-	100	5,932
	Subang	35	6	18	41	-	100	19,469
Total		44	2	17	34	3	100	799,344

- Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices

TABLE V-18

LAND USE

District	Percent Distribution						Total Hectares
	addy Rice	Home Gardens	Dryland Crops	Forests/ Plantations	Fish Ponds	Total	
Ciamis	22	9	59	8	2	100	141,826
Cilacap	26	15	35	24	*	100	114,911
Tasikmalaya	33	15	2	53	2	100	53,337
Kuningan	30	7	19	42	2	100	8,878
Total	26	11	40	22	1	100	
Total Hectares	81,870	35,851	126,780	70,640	3,811		318,952

*Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-19

LAND OWNERSHIP

District	Village	Percent Distribution				Total Hectares
		Private	State	Other	Total	
Ciamis	2	88	9	*	99	146,876
Cilacap	1	73	23	2	99	119,704
Tasikmalaya	2	85	11	3	101	55,907
Kuningan	5	60	35	*	100	9,069
Total	2	82	15	1	100	331,556

*Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-20

LANDHOLDING UNIT SIZE

District#	Percent Distribution Landholding Units					Number	Average Unit Size (hectares)
	0-0.5 ha.	0.5-1 ha.	1-3 ha.	3-5 ha.	Total		
Ciamis	70	20	8	2	100	153,727	0.84
Cilacap	63	24	11	2	100	123,522	0.63
Tasikmalaya	80	16	3	*	99	100,259	0.47
Total	70	20	8	2	100	377,508	

#Kuningan data not available.

*Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-21

LANDHOLDING CONCENTRATION

District#	Percent Distribution, Private Land					
	0-0.5 ha.	0.5-1 ha.	1-3 ha.	3-5 ha.	Total	Total Hectares
Cilacap	34	26	26	14	100	77,992
Tasikmalaya	58	28	12	3	101	47,449
Kuningan	59	25	16	*	100	5,476
Total	44	27	20	9	100	130,917

#Ciamis data not available.

*Less than 0.5%

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-22

SAMPLE VILLAGE COMPARISONS

Dimension	Village: Payungagung	Dayeuhluhur	Karanglayung	Cantilan	Bantarpanjang
Sub-Watershed	Citanduy	Cimuntur	Ciseel	Cijolang	Cikawung
Sub-District	Panumbangan	Kawali	Cineam	Selajambe	Cimanggu
District	Ciamis	Ciamis	Tasikmalaya	Kuningan	Cilacap
Population	6,519	5,787	9,416	3,252	5,598
Area (Km^2)	12.76	12.70	20.77	11.98	6.78
Pop. Density	511	456	453	271	825
Land--% Families:					
No Ag. Land	*	10	5	0	0
Only Lowland	(20)	10	(10)	0	0
Upland & Lowland	(50)	60	(30)	75	85
Only Upland	(30)	20	55	25	(15)
Farmers--%					
Landowners	44	35	96	98	70
Sharecroppers	47	57	0	0	0
Laborers	5	6	4	2	28
Labor Situation	Shortage	Surplus	Balance	Balance	Irregular
Seasonal Labor Migration?	Yes (in)	Yes (out)	No	No	Yes (out)
Local Handicraft Manufacture	(Baskets) (Mats)	(Baskets) (Mats)	Baskets (Mats) Furniture	Baskets (Mats) Brooms	Baskets (Mats)

*Not available.
( ) Estimate

Source: Field data and village data compiled by District Planning Offices

TABLE V-23

AGRICULTURAL PRODUCTS - SAMPLE VILLAGES

Products	Village: Payungagung	Dayeuhluhur	Karanglayung	Cantilan	Bantarpanjang
Lowland--					
Rice -- HYV	Some	Much	50%	(60%)	(50%)
-- Local	Preferred (altitude)	Preferred (resistance)	50%	(40%)	(50%)
Soybean				X	
Peanut		X		X	
Maize				X	
Reeds (for Mats)			X	X	
Upland--					
Rice		X	X	X	X
Cassava	X	X	X	X	X
Maize	X	X		X	X
Peanut		X		X	X
Soybean					X
Sweet Potato		X		X	
Pole Bean				X	X
Cucumber				X	
Chili		X		X	
Eggplant		X		X	
Taro		X			
Citronella		X			
Banana	X	X	X	X	X
Coconut	X	X	X	X	X
Bread/Jackfruit	X		X		
Salak			X		
Sugar Palm			X	X	X
Citrus				X	
Coffee			X	X	
Mango			X		
Cloves	X	X	X	X	X
Clove Seedlings	X				
Cardamon			X		
Stinky Bean		X	X		
Pepper				X	
Pandan				X	
Bamboo	X	X	X	X	X
Mat Palm	X	X	X	X	X
Mahogany	X	X			
Albizza	X	X		X	
Kaliandra		X			
Fish				X	

( ) Estimated

Source: Field notes

TABLE V-24

ADMINISTRATIVE HIERARCHY

Administrative Unit		Chief
English Language	Indonesian	
Province	Propinsi	Gubernur
Region	Wilayah	Residen
District	Kabupaten	Bupati
Area	Kawedanaan	Wedana
Sub-District	Kecamatan	Camat
Village	Desa	Lurah/Kuwu
Sub-Village	Kelurahan/Kebawan	Lurah/Bau
Neighborhood	RT	Kepala RT
Family	Keluarga	Kepala Keluarga

TABLE V-25

VILLAGE HIERARCHY - SAMPLE VILLAGES

Position/Function	Name (*)			
	Dayeuhluhur	Karanglayung	Cantilan	Bantarpanjang
Village Head	Kuwu	Kuwu	Kuwu	Lurah
Asst. Village Head	--	--	Ngabihi	--
Secretary	Jurutulis (2)	Jurutulis (4)	Jurutulis	Carik (2)
Treasurer	--	--	--	Tukang Uang
Police	Polisi Desa	Polisi Desa	Polisi Desa (2)	Polisi Desi (2)
Agriculture Officer	PTD	PTD	Raksabumi	PTD
Religious Officer	Amil	Amil	Amil	Kayim (2)
Sub-Village Head	Lurah (9)	Penduh (8)	Lurah (6)	Bau (6)
Public Works Officer	--	--	--	Kebayan (6)
Total	15	16	14	21

* ( ) Number, if more than one.
Source: Field Notes

TABLE V-26

COMPENSATION OF VILLAGE OFFICIALS

SAMPLE VILLAGES

Position	Dayeuhluhur	Karanglayung	Cantilan	Pantarpanjang *
Village Head	1.5 ha.	Rp. 144,000	5.0 ha.	5.0 T
Asst. Village Head	-	-	1.1 ha.	-
Secretary	0.5 ha.	#1 Rp. 108,000 #2 Rp. 93,600	2.0 ha.	2.5 T
Treasurer	-	-	-	1.4 T
Police	0.35 ha.	Rp. 72,000	0.5 ha.	0.9 T
Agriculture Officer	0.35 ha.	Rp. 72,000	0.5 ha.	0.5 T
Religious Officer	0.21 ha.	Rp. 57,600	0.5 ha.	0.5 T
Sub-Village Head	0.42 ha.	Rp. 72,000	1.1 ha.	1.0 T
Public Works Officer	-	-	-	0.7 T

* Wet stalk rice.

Source: Field Notes.

TABLE V-27

VILLAGE GROUPS - ZANJARANGSANA

Types
1. Water Users
2. Plant Protection
3. Fishpond Owners
4. Animal Husbandry
5. Radio Listeners
6. Food Storage
7. Home Economics
8. Self-Defense
9. Youth
10. Boy Scouts/Girl Scouts
11. Religious
12. Village Social Committee
13. Neighborhood Social Committee

Source: Field Notes

TABLE V-28

ROADS

District	Village	Percent Distribution District	Percent Distribution Province	Total	Total Kilometers	Km roads per km^2
Ciamis	86	9	5	100	1,994	1.36
Cilacap	88	9	3	100	1,346	1.12
Tasikmalaya	82	17	2	101	839	1.50
Kuningan	94	6	0	100	243	2.68
Total	86	10	4	100		1.33
Total Kilometers	3,811	447	165		4,423	

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-29

ROADS - SAMPLE VILLAGES

Village	Kilometers				
	Village	District	Province	Total	Km/km^2
Payungagung	22	2	0	24	1.38
Dayeuhluhur	6	4	4	14	1.10
Karanglayung	22	0	0	22	1.06
Cantilan	10	3	0	13	1.09
Bantarpanjang	11	0	2	13	1.92
Total	71	9	6	86	1.32

Source: Village data compiled by District Planning Offices.

TABLE V-30

VEHICLE OWNERSHIP 1975 - 1977

District	Motorcycle		Automobile		Becak		Microbus		Bus		Truck	
	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977	1975	1977
Ciamis	2,110	2,353	57	50	189	231	332	389	1	6	89	124
Cilacap	441	1,010	28	52	286	526	72	159	8	5	58	106
Tasikmal	1,311	1,506	68	90	276	282	147	229	22	26	58	72
Kuningan	15	42	1	1	0	0	4	12	0	0	0	0
Total	3,877	4,911	154	193	751	1,039	555	789	31	37	205	302
Difference	+27%		+25%		+38%		+42%		+19%		+47%	

Source: Village data compiled by District Planning Offices

TABLE V-31

VEHICLE OWNERSHIP - SAMPLE VILLAGES - 1977

Village	Motorcycles	Becak	Microbus	Trucks
Payungagung	2	0	1	0
Dayeuhluhur	6	0	1	2
Karanglayung	8	0	1	3
Cantilan	1	0	0	0
Bantarpanjang	3	1	1	0
Total	20	1	4	5

Source: Village data compiled by District Planning Offices.

TABLE V-32

PERSONS PER VEHICLE - 1977

District	Motorcycle	Automobile	Becak	Microbus	Bus	Truck
Ciamis	339	15,965	3,456	2,052	133,041	6,437
Cilacap	606	11,778	1,164	3,852	122,495	5,778
Tasikmalaya	329	5,503	1,756	2,163	19,049	5,879
Kuningan	933	39.165	--	3,264	--	--
Total	396	10,079	1,872	2,465	52,572	6,441

Source: Calculated from village data compiled by District Planning Offices

TABLE V-33

RADIO AND TELEVISION OWNERSHIP

District*	Number 1965	1970	1975	1977	1965	1970	1975	1977	1977 Persons per Unit Radio	Television
Ciamis	20,740	24,238	23,171	22.359	2	43	420	640	36	1,247
Cilacap	3,173	6,561	9,969	11,225	0	2	73	361	55	1,697
Tasikmalaya	3,176	5,149	7,302	15,235	104	169	343	673	33	736
Total	27,089	35,948	40.442	48,819	106	214	836	1,674	39	1,139
Difference	+33%	+13%	+21%		+102%	+291%	+100%			
Total difference		+80%				+1,479%				

*Kuningan data not available.

Source: Data and calculations from village data compiled by District Planning Offices.

TABLE V-34

RADIO AND TELEVISION OWNERSHIP

SAMPLE VILLAGES 1977

Village	Radio	Television
Payungagung	123	5
Dayeuhluhur	38	0
Karanglayung	346	0
Cantilan	*	*
Bantarpaniang	221	2
Total	728	7

*Not available

Source: Village data compiled by District Planning Offices.

TABLE V-35

STORES AND MARKETS

District	Stores			Markets			Persons per Unit	
	Food	Non-Food	Total	Weekly	Daily	Total	Store	Market
Ciamis	2,259	986	3,245	34	4	38	250	21,000
Cilacap	623	935	1,558	46	4	50	390	12,300
Tasikmalaya	296	425	721	7	5	12	690	41,300
Kuningan	26	17	43	4	1	5	900	7,800
Total	3,204	2,363	5,567	91	14	105	350	18,500

Source: Village data compiled by District Planning Offices.

TABLE V-36

STORES AND MARKETS - VILLAGE AVERAGES

District	Stores per Village			Villages per Market		
	Food	Non-Food	Total	Weekly	Daily	Total
Ciamis	18.4	8.0	26.4	3.6	31.0	3.2
Cilacap	7.4	11.1	18.5	1.8	21.0	1.7
Tasikmalaya	3.6	5.1	8.7	11.9	16.6	6.9
Kuningan	2.4	1.5	3.9	2.8	11.0	2.2
Total	10.6	7.9	18.5	3.3	21.4	2.9

Source: Calculated from village data compiled by District Planning Offices.

TABLE V-37

CASSAVA PRODUCTION

District*	Area (Hectares) 1965	1970	1975	1977	Production (Tons) 1965	1970	1975	1977
Ciamis	32,927	24,589	24,505	23,565	160,824	95,508	127,678	188,205
Cilacap	16,658	15,857	14,863	18,162	79,482	73,758	65,963	93,748
Kuningan	944	788	816	957	5,985	4,959	1,204	6,319
Total	50,529	41,234	40,184	42,684	246,291	174,225	194,845	288,272

*Tasikmalaya data not available

Source: Village data compiled by District Planning Offices.

TABLE V-38

INDUSTRIES

District	Number of Units			Employees			Employees per Unit		
	Rice Mills	Cassava	Other	Rice Mills	Cassava	Other	Rice Mills	Cassava	Other
Ciamis	513	56	62	,320	2,002	298	2.6	35.8	4.8
Cilacap	165	25	113	935	1,198	3,967	5.7	47.9	35.1
Tasikmalaya	295	29	274	551	263	821	1.9	9.1	3.0
Kuningan	16	0	7	65	0	24	4.1	-	3.4
Total	989	110	456	2,871	3,463	5,510	2.9	34.5	11.2

Source: Village data compiled by District Planning Offices.

TABLE V-39

BIMAS-INMAS ENROLLMENT

District	Total Paddyland (Hectares)	Percent of Paddyland Under BIMAS-INMAS: Target 1975-76	Target 1976	Target 1976-77	Target 1977	Actual* 1975-76	Actual* 1976	Actual* 1976-77	Actual* 1977
Ciamis	31,846	61	44	69	53	56	59	77	55
Cilacap	29,845	27	20	29	21	28	18	31	17
Tasikmalaya	17,539	79	64	105	50	55	63	91	44
Kuningan	2,640	20	11	64	13	19	26	64	27
Total	81,870	51	38	62	39	44	44	63	38

*Targets reached or exceeded are underlined.

Source: Calculated from village data compiled by District Planning Offices.

CHAPTER VI

UPPER WATERSHED MANAGEMENT ORGANIZATION, CONSERVATION PRACTICES AND TECHNIQUES

Introduction

The primary objectives of this chapter are to present to the Government of Indonesia a description of an integrated watershed management approach, a suggested organization for implementing the proposed program, and alternative conservation techniques that would permit development of effective land management decisions and conservation programs for the future. Recommendations are made with the knowledge that real nation-wide conservation program benefits are dependent on the degree of farmer and village involvement and acceptance. Recommendations are concentrated on farmer organization, educational programs, demonstration farms, conservation farming, reforestation or vegetation conversion and simple erosion control structures. The five-year program suggested is primarily a transition between the 6.1 ha Panawangan Pilot Watershed Demonstration Farm program and an integrated watershed management program for the entire Citanduy Watershed. This five-year program will not achieve dramatic changes in watershed conditions or the desirable reduction in erosion and sediment damages, but it can be implemented in the near future.

The watershed management approach to evaluating and developing conservation programs focuses on the total watershed (or hydrologic unit) as the planning and management unit. It also provides a logical method for inventory and evaluation of conservation and development factors within the priorities established by the Government of Indonesia and the local District Planning Offices. Ranking of specific criteria in watershed areas assists the manager or planner in the selection of areas requiring intensive investigation, analysis and treatment programs. The watershed management approach emphasizes land treatment practices by conservation farming.

A watershed comprises all lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream. The term "watershed" may be used to encompass a water problem or critical area, but it should never ignore the upstream contributing areas. Conversely, it is unwise to consider, or plan, an upper watershed area without considering the downstream effects.

Watershed Management

Watershed management emphasizes the study of hydrologic principles they apply to the watershed ecosystem. The four major concerns of watershed management are: (a) surface runoff or water yield from the watersheds, (b) erosion and sedimentation, (c) quality of water, and (d) occurrence of groundwaters. This report concentrates on the first two items because of its concern with soil conservation. The evaluation starts with the precipitation as it falls on the watershed and follows the water to its eventual disposition, as runoff from the watershed, as evapotranspiration, or as subsurface flow. The reader should remember that the greater distance a raindrop must travel, the less chance it has of becoming discharge from the country. Runoff from higher elevation watersheds is used by vegetation, evaporated from stream surfaces, used for municipal or industrial water, and used for irrigation. Water also goes into ground water storage and may or may not reappear in surface streams.

Sediment production has characteristics similar to those of surface runoff in that most sediment is deposited at some point rather than reaching the measuring station.

One reason we are interested in water is that it acts as the mechanism for detaching and transporting soil particles. Soil particles become sediment when they are detached and moved from their initial resting place. This process, which is called erosion, is prevented by protecting the soil with vegetation or other cover, or by reducing the velocity of moving water.

Objectives of Watershed Management

Watershed protection, management, and development have the following objectives:

1. To use each hectare of watershed land within its capability for sustained use, and to prevent its further deterioration;

2. To apply cultural, vegetative, and supporting structural practices on each hectare of land as necessary to prevent soil deterioration, and to obtain better soil, water, and vegetation management for maximum production from the land over time;

3. To stabilize runoff and control sediment by:

   a. Maximizing net economic damage reduction benefits from flood waters and sediment deposition;

   b. Reducing reservoir deposition (including the Segara Anakan) and other forms of sediment damage to stream channels and rice fields;

   c. Improving the water quality of the streams in order to promote health, recreation, industrial use and to reduce damage to fish, municipal and other related supplies; and

   e. To achieve a water management balance among the needs of each watershed hectare, considering the watershed as a water catchment area and the irrigation systems' water requirements.

Erosion and Sediment Control Principles

Five basic, common-sense stages are involved in the development and implementation of a sound soil conservation program for a watershed area in Indonesia include the following activities:

1. Inventory the physical and human resources and problems.

   a. Farmers' and government officials' interest in and attitude toward conservation

   b. Climate

   c. Physiography

   d. Vegetation type, condition, and use

   e. Erosion types and rates; sediment damages

   f. Hydrology, and water supply availability

2. Analyze and evaluate the data and factors found in the watershed inventory.

   a. Estimate total conservation needs for each land type and land capability unit

   b. Evaluate the present condition resource use and productivity

   c. Evaluate the improvement potential

   d. Evaluate the do-nothing alternative or what will happen if conservation is not applied

3 Develop and initiate a conservation education program to reach all age groups, both sexes, farmer leaders, influential citizens, and government officials.

a. Training program for Kabupaten staff farmer leaders and Desa Conservation Technicians

b. Village (Desa) meetings to discuss conservation proposals

c. Watershed development committee training and motivation

d. Educational programs in school system (Indonesia language and written by an expert in conservation motivation).

4. Plan the program to fit the attitudes and desires of the farmers as well as natural vegetation and land use patterns within the watershed.

a. Avoid treating symptoms without consideration of the underlying causes of erosion

b. Concentrate on revegetation of disturbed areas, conservation farming, crop yield improvement, livestock management, and protection of critical areas as well as reforestation

c. Where practical, rehabilitate and modernize existing terrace, waterway, and farming systems. Be innovative at improving existing soil conservation systems.

d. Use simple structures that can be built with local materials and labor when possible. Evaluate cost effectiveness and revise program

e. Keep the operations schedule flexible and revise periodically in light of experienced treatment effectiveness

f. Expose the smallest practical area for the shortest possible time during construction of terraces and other structures

5. Implement a thorough maintenance program before, during and after watershed land treatment and structural measures are installed. This may require a specific fund allocation.

The Integrated Watershed Management Approach

The integrated approach to watershed management is also known as "comprehensive," "conservation management," "multidisciplinary," "interdisciplinary," "basin-wide," or "multiple-use planning;" it does not matter which term is used specifically to describe the process. The term "multiple-use planning" seems to be coming into more common use in relation to watershed management and will be used to describe the process in the balance of this report. In simplistic terms, integrated watershed or multiple-use planning is the planning and application method that takes into account all the watershed resources and problems, and attempts to maximize the economic and financial returns over the long term while maintaining the watershed land and water resources.

Notably, in a developing country the integrated watershed management approach is the key to:

1. Efficient use of limited funds and trained manpower;

2. Maximizing use of available resources (physical, human and economic);

3. Coordination of the government programs to reach specific objectives; and

4. Maximizing long-term production from the watershed while protecting the land and water resources.

Historically, only lip service has been paid to the integrated approach in the actual watershed planning process.

Although multiple-use planning is one of the evolving features of watershed management programs, it complicates technical, administrative and polticial decisions. Technical decisions are intricate because, for the first time, the individual technical staff member is being asked how a practice in his field of expertise will affect the watershed's environment, land and water resources, economic return, and the well being of people. Rather obviously, this requires a higher level of training for the staff and the administrative coordinators of the program. It also requires a team efort from the staff simply because no one person has all of the knowledge required for true multiple-use planning and management.

From the administrative viewpoint, multiple-use planning is very difficult because it requires a blurring of the normal technical and administrative lines of authority. Individual governmental agencies cannot take independent action on the application of practices or the development of budgets if the multiple-use planning and management approach is to produce the desired results. Another administrative problem is that watershed boundaries seldom if ever match the political or administrative boundaries used by government agencies for program administration.

From the political viewpoint, the integrated watershed management approach creates extreme difficulty because it requirs a long-term dedication of specific funds and other resources. From the political viewpoint, it is easier to remain flexible in regards to agency fund allocations than provide long-term commitments of funds. There is also a problem that many of the results of the watershed management programs are not immediately apparent and may never be visible to the nontechnical individual. The belief that the implementation of a watershed management project will result in muddy streams becoming clear is not even remotely true.

Multiple-use planning and management, whether it is for an entire watershed or a hydrologic subdivision creates many special problems. It is particularly important that the mechanism for coordination between the numerous agencies provides a reasonable freedom for final decision and action. Multiple-use plans should always include several alternatives that will invite responsible public discussion (particularly from farmers) and will provide for the required revision of the plans. To the extent possible, multiple-use planning is best accomplished through an organization not directly attached to government agencies resonsible for application of the planned improvement measures. At the local level, farmers should be encouraged to organize small hydrologic units for both planning and operations. These units can then be aggregated into the plan for larger hydrologic units or subwatershed divisions. The administrative staff has the responsibility for adjustment and coordination between the technically correct conservation methods and the practically feasible operations of the farmers.

Recommended Organization For Citanduy Watershed Project Implementation

A review of the needs and problems for upper watershed management programs discloses that the governmental organizations currently concerned with programs for solving the upstream land and water resource degeneration problems are not meeting the program needs. No on individual governmental organization is directly concerned with the coordination and implementation of land and water resource development activities. This problem has been discussed with the Minister of Environment and many other government officials (Appendix G), and this chapter of the report contains two suggested organization charts for efficient implementation of the project features (Figure VI-1 and VI-2)

Organizations created to deal with downstream irrigation and water management problems neither understand the problems facing the upland farmer nor currently provide him with any real assistance. Upland farmer's problems are not the same as those of rice farmers and the methods for achieving the upstream watershed management objectives must be developed to accomplish different goals. The major difference between

the farmers of these two areas is that the upland farmers do not have the required resources (human, physical and economic) needed to accomplish the needed conservation practices. Therefore, the program has to concentrate on increasing food production and income for the upland farmers along with the installation of the conservation treatment measures and structures. It is also very important that the farmers think that the development is their project and not a government project.

The proposed organization, as presented in Figures VI-1 and VI-2, is designed to provide unified management, implementation and supervision of all watershed management activities. Integrated rural development programs require the active participation of private land owners and/or operators; people from various technical professions; and all existing sectoral, Presidential instruction, Provincial, District, Special Presidential Assistance, village, and farmer association projects. Because of the complexity of the problems and the methods of arriving at the solutions, the project should use the existing "command line" through the ministers, governor, Bupati, Camat, Kepala Desa, and Lurah. Instead of creating a new organization to accomplish the watershed management objectives, it is strongly suggested that the existing authorities be given the staff and necessary funds to accomlish the objectives, thus saving the overhead costs of creating a new bureaucracy.

One of the difficulties of initiating watershed or rural development projects is that the various independent government agencies have seldom or never worked together as a unified team on an integrated program or project and some of the agencies will resent what appears to be a loss of independence.

Development projects in upper watershed areas, particularly those directed towards the poorest farmers, require: unified, intensive extension work; farmer training; demonstration farms; research on specific practices; and a series of closely coordinated services including credit availability, marketing assistance, education, health programs and family living training. Adequate educational facilities are essential for the development of the integrated watershed management program. This will require staff training as the first increment, followed by training of local officials and key farmers, then the use of

demonstration farms and all types of extension adctivities involving the farmers and their families. The wives and children should be included because they do much of the conservation work, such as revegetating the terrace risers, and it does little good to train the farmer if he is not going to do the work.

There is also a great need for additional hydrologic, geologic, soils, climatic, economic, and other specific conservation data. Water management practices and other physical changes are difficult to measure and require the collection of precise physical data. Information on social and political processes, economic returns, the most effective methods of project implementation, and other factors is needed for a proper evaluation of the project effectiveness. The compilation and evaluation of this data must not be a part of the implementation program of the action agencies implementing the project because they are too directly involved. This function should be conducted by an outside group such as a university in cooperation with the experiment station as a part of the "Research National Level" program.

The functions and duties of the various governmental groups, as outlined in the proposed organizational charts, Figures VI-1 and VI-2, are discussed in the following sections.

Central Government Organization

A central governmental organization is urgently needed to finance, administer, stimulate, coordinate and supervise the watershed management program for the Citanduy Watershed, and ultimately, for all Indonesia. Currently, the soil and water resource development program involves many of the top officials and agencies including Bappenas, Dalam Negeri, Agriculture, Forestry, Animal Husbandry, Manpower, Education, Family Planning, Bank Rakyat Indonesia and private cooperative banks (Koperasi). In addition, there are research agencies working in the field of natural resources and special high level councils concerned with protection of the environment. The many demands on Senior Ministers and other high officials argues for the appointment of a high level council which could infrequently meet to consider reports and programs, make and review policy decisions, and evaluate progress. This group would, of

necessity, require a day-to-day coordinator to carry out its wishes and to follow-up on decisions. This coordinator should also be in charge of the "Research-National Level" feature that is shown on Figure VI-2.

It will be necessary to have a specific government agency in direct charge of project budgets and features and for coordination with the United States Agency for International Development if expected loan features are approved. It is suggested that the Citanduy Upper Watershed Development Project be under the direction of the Ministry of Public Works, Directorate General of Water Resources Development, Directorate of Rivers. This agency is currently developing irrigation projects in the Citanduy Basin and could provide direct engineering expertise for a coordinated system of reducing floodwater and sediment damages to irrigation systems and lowland rice areas of the Citanduy River Basin. The Directorate of Rivers is also responsible for the construction of most of the structural measures for streambank and channel stabilization and assists in the construction of checks for the development of additional rural irrigation systems.

The Minister of Home Affairs, through his administrative channels, from the Provincial level down through the Kabupaten, Kecamatan and Kelurahan, provides the overall guidance for the administration of the people in the Watershed. Therefore, it might be desirable to have the Citanduy Upper Watershed Development Project under his direction.

Whichever management system is selected by the Government of Indonesia, the success of the program will depend upon how efficiently that organization structure functions.

Provincial Government

The provincial government supervises and coordinates planning with the district BAPPEDA: coordinates project research programs; coordinates provisioning of such assistance items as seed, seedlings, fertilizers, etc.; establishes and supervises project nurseries, carries out periodic field inspections to ensure compliance with program objectives; and conducts training seminars for Kabupaten level personnel. It also arrange for and coordinates collection of the physical data -- soils and land use maps, land status records, vegetation, erosion rates,

slope factors, climatic records and other basic data -- to be used at the farmer level in developing multiple-use plans.

As indicated by Figure VI-1, the Citanduy Upper Watershed Project is expected to add three offices at the provincial level. The "Soil and Water Development Day to Day Coordinator" acts as the Governor's representative for coordinating all watershed development program functions. The "Conservationist" assists the coordinator in developing the planning and development policy and conservation methodology and also acts as the senior specialist for technical supervision and staff training. The third position is "Training and Education," which includes the establishment of a Training Center within the Citanduy Watershed. A training center is expensive to establish and operate, and it is suggested that it be at provincial level. More than two training centers would be redundant. As shown in Table VI-2 the estimated costs for the new positions and the training center for West Java is 92.0 million Rupiah for the first year and 262.3 million Rupiah for the five year project. The equivalent cost for Central Java, for the Citanduy Watershed, is estimated at 80 percent of the values shown for West Java.

Kabupaten Level

Most of the project features will be organized and directed at the Kabupaten (district) level; the Bupati's staff will also provide general liasion with provincial officials and assistance in program evaluation; they will schedule and coordinate all of the Kecamatan implementation centers, demonstration farms and major construction features such as the terracing programs.

All conservation activities within each district are coordinated and directed by the Bupati. He and the BAPPEDA staff are in the best position to use the many sources of funds and other assistance available to accomplish the watershed management objectives. It is beyond the scope of this report to examine all of the sources of funds and technical assistance available to the districts, but a five-year plan and organization charts for the Citanduy Action Program in the Ciamis District are given in Appendix F. The material in this appendix indicates the complexity of the coordination problems for the Watershed Program.

After a careful evaluation by the consultant (ECI), it is recommended that the Citanduy Upper Watershed Project provide the management goals, consultants and other technical assistance, funds for additional staff and equipment, and funds for farmer incentives and materials. The affected Kabupaten should directly manage the watershed development program with guidance from the farmers' advisory boards and supervision from provincial offices.

At the Kabupaten level, the Bupati is responsible for the day-to-day operation of the land and water development program. He and his staff coordinate and generally supervise the staff, governmental financial assistance at the Camat level and the ultimate assistance made available at the farmer level. The staff will be responsible for providing the physical, social, and economic data and the maps required in preparing the multiple-use land and water development plan for the mini-hydrologic units.

Implementation of the Citanduy Watershed Project will require the addition of three offices at the Kabupaten level and two in each Kecamatan (see Figure VI-2). Table VI-3 presents an estimate of the costs for all the new positions in Kabupaten Ciamis. Total expenses for the 5-year project are estimated at 322.8 million Rupiah for the Ciamis District. Costs for the other districts were estimated as a percentage of those developed for Ciamis.

The "Soil and Water Resources Development Day-to-Day Coordinator" acts as the Bupati's representative for coordinating all the Upper Watershed Management Project features in the District. The day-to-day coordinator will have the responsibility of scheduling technical assistance according to the planned needs of the Kecamatan. He will arrange for local financing and generally assist the Camat and farmers in obtaining private funds for work on their farms according to their ability to repay their loans. He will supervise the soil conservationist and all soil and water conservation work needed at the farm level. He will arrange for and schedule the agricultural agency assistance along with technical training required at the Camat level. He will assure that all functions at the Kabupaten level are coordinated with the policy, technical direction, and assistance from the Provincial level. Informa-

tion teams and various types of assistance will be scheduled as needed by the farmers.

The "Conservation Supervisor" is the chief conservation technical officer in the district and supervises all of the Kecamatan conservation officers as well as coordinating and scheduling the development of demonstration farms and bench terracing programs.

The district "Training Office and Education" function, Figure VI-2, is primarily for the training of farmers, farm families, village officials and the continued supervision and training of the Desa Conservation Technicians (Spot Workers), and PPL and PLP staff. Most of the district training activities will be in the villages, or on demonstration farms. The district training offices should work with the provincial training office to schedule the training and periodic retraining of their staff at the training center.

Nurseries. The greening and reforestation programs have demonstrated the need for nurseries close to where the nursery materials will be used. It was originally thought that all nursery stock and seeds could be supplied from a central location and the provincial level. Many planting materials have been lost, or were in poor condition, by the time they were removed and delivered to a distant planting site. Other stock was delivered too soon or too late. For these and other reasons, the nurseries have been placed under the direct control of the Bupati and his staff.

As the Upper Watershed Program expands from a demonstration program to a large, overall develoment program, there will be a greater demand for nursery planting materials and seeds. It will be necessary to expand the nursery facilities to meet this demand. The "Seeds Nursery" will be under the direction of the Soil and Water Resources Development Coordinator (Figure VI-2). The estimated cost for each central nursery is in Table VI-4. As the terraces and water control structures are completed, the demand for grasses and other planting materials will be reduced. When this demand decreases, the satelite nurseries can be closed and the constant demand taken up by the central district nursery. Temporary satelite or sub-nurseries should be established close to where the program is expanding to save transportation

costs. These nurseries will produce forest and fruit tree seedlings, grass seed and sprigs for the terraces and water control structures and improved seeds to be used in improving production on the bench terraces.

Kecamatan Level

The Camat has full responsibility for the day-to-day operation and development programs dealing with the various village and subvillage levels. He and his staff make direct contacts with farmer groups for all planting and operations on private lands. His staff will prepare the hydrologic unit multiple use plans and provide the necessary assistance to implement these plans. They will depend on the farmer group leaders to organize the farmers and to provide basic financial and economic data for each family being assisted. How well this rural program functions will depend on the leaders' education and training. How completely the technicians know their subject matter and can communicate it to the field workers and to the farmers will determine the success of the program.

At the Kecamatan level the "Assistant Soil and Resources Development Day-to-Day Coordinator" will coordinate and supervise the demonstration farms and the Desa Conservation Technicians; will carry out negotiation with the Bank Rakyat Indonesia; will supervise labor and incentive payments; and will assist in the evaluation of village erosion control requirements, in the planning of conservation measures, and in the preparaton and presentation of annual reports. To accomplish this work in the subdistrict, he will normally have one "Conservation Officer" and four "Spot Workers" or PLP assigned to his staff (Figure VI-2). In actual practice, the work will probably center around the specific demonstration farms as they are established. Most of the terracing and conservation practices and applications will be the result of the farmers' observing the results on the demonstration farms. The cost of all functions at the Kecamatan Level are included in the Kabupaten budget (Table VI-3).

Soil conservation practices and food crop producton will need to be planned on a cooperative basis for each of the mini-hydrologic units. The leadership should be carried by the soil conservationist and the agronomist. At the village and sub-village level, soil erosion control practices will generally be planned and developed in the small hydrologic units, depending on the number of farmers ready to start work.

Organization at the Farmer Level

The organization at the farmer level must have straightforward objectives and specific guidelines and instructions that address all aspects of the conservation program and applications of the conservation practices to individual farms. More importantly, the organization must be flexible to meet the specific needs of individual farmer groups.

It is suggested that the farmer units or groups be organized around hydrologic units of land, which may vary in size according to the dictates of the land and water resource management requirements. In general, these hydrologic units should be two to five hectares in size; they should have eight to ten families in the unit but should not exceed a maximum of 20 families. The name "Kelompok Conservation Action Unit" is suggested for these groups and they are referred to as such in this report. One key farm leader should represent each Kelompok Conservation Action Unit for planning, operations and scheduling conservation assistance. District specialists and Desa Conservation Technicians should assist and train the farmers of each selected unit in the principles of conservation farming.

Too often planning is done for rather than with people. As a result, the plans developed conform to the planners' perception of needs; if the farmer's perception differs, nothing happens and the plan dies.

Too often the farmers' participation in planning has been marginal or nonexistent, and the planner uses the program as a means of indoctrination and as a sales program for his own policies. Many of the "greening" program plans did not succeed because the farmers were not involved and did not understand the beautiful plan. The crux of the problem is that the plan must solve problems that the farmer and his

family understand; and it must use methods and goals that are within the resources available to the farm family. This is not to say that District Technicians, Desa Conservation Technicians, PPL and PLP agents should not teach the farmer to see problems such as erosion damage to his land, but it does no good to try to solve problems that the farmer does not understand. Truly, if the farmer does not understand that he has a problem, he does not -- it is the Government that has a problem.

If the educational aspect is to succeed, it must be low key and organized so that individual farmers and whole farm families are the recipients of the education. The average farmer is not sufficiently educated to read about the program; therefore, other methods must be used. The farmer also can not be expected to travel long distances to attend lectures or demonstrations. The farmer level training should be entirely at the village level and should involve the use of demonstration farms and training by the Desa Conservation Technicians or district technicians.

Experience gained from soil and water conservation programs throughout the world points out that there is a need for strong linkage (lines of communication) between the individual farmers and the erosion control management of watershed management projects. Discussion at the village, subdistrict, and district levels is essential for this linkage to become established. In these discussions the local people must come to realize they are important to the project's success. Ultimately, it is necessary that the request for actual project development come from the affected farmers.

The first step towards organizing and using demonstration farms is to identify, through personal contact with officials and key farmers, the line of authority within each Desa or Kelurahan. Local leaders must understand the need for, and must believe in, the conservation program before it can be established. This is particularly important for maintenance of the project measures. Initial contacts should explain the watershed management concept to the Camat, Kepala Desa and Lurah, to solicit their active support; those meetings should also make preliminary plans for a general meeting of all the people in the village to explain the soil conservation and watershed management project as it relates to their village.

The general soil conservation meeting in each village should be attended by the Camat and Kepala Desa or Lurah as well as all interested farmers. This meeting should be chaired by the highest official and after he has explained the purpose of the meeting it can be turned over to the Soil and Water Resources Development Coordinator, extension officials, and other staff members. The objectives of the soil and water resource development program for the Citanduy Watershed should be explained in general terms at this meeting. At the same time, the Kelompok Conservation Action Unit concept of organizing groups of farmers in mini-watersheds of hydrologic units for conservation activities should be explained. This meeting should be followed almost immediately by an attempt to organize a Desa Watershed Development Committee or the existing Rural Social Committee to supervise the work of the Desa Conservation Technicians and the Kelompok Conservation Action Units for the individual villages. This group would also provide an input to the farmer advisory group (Figure VI-2).

Farmer Advisory Board and Advisory Groups

There is an obvious need for an organized group of farmer leaders to provide advice to the Bupati and his staff on the farmers' needs and the farmers understanding of the problems in each program area. Therefore, it is suggested that each demonstration farm or organized hydrologic unit select a key farmer who would represent them on the "Farmers Advisory Group," which would in turn elect a member to the "Farmers Advisory Board" (Figure VI-2). This board would advise the Soil and Water Resources Coordinator and the technical staff on the farmers' desires and needs. These farmers are not government employees; they are advisors, and it is hoped that they will significantly contribute to the planning process. The advisory boards can provide a better perception of the problems being faced in the hydrologic units and a real educational function because they understand the erosion problem of their own areas.

Extension, Research, and Farmer Education

Introducti

This section summarizes the educational activities required to facilitate and expedite the planned conservation program in the Citanduy Upper Watershed. The organization and education of the farm families living in the Watershed in the responsibility of the district and provincial government and of the Agricultural Extension Agents (PLP) of the Ministry of Agriculture. Initially, however, the conservation supervisor and extension training office of the Watershed Management Project will have a very important role in establishing conservation demonstration farms and in teaching and training the people of the Watershed in the need for conservation activities and the necessity of reducing erosion with attendant soil fertility losses.

In essence, the local Bupati would be in charge of all educational activities and training for watershed management. The Watershed Development Committee and demonstration farm concepts discussed herein are only indications of the educational methods that can be used to achieve the primary objective, which is to develop a thorough understanding among the people for the need of a total program of conservation on their farms and throughout the Citanduy Watershed. To do this, they must accept responsibility for participating in planning, aplication, and maintenance of conservation measures. This understanding is necessary for the adoption of any extension program. Briefly stated, the extension program must:

1. Involve the people in action programs,

2. Be based upon conditions that actually exist in the watershed or village,

3. Work through an understanding of the culture and encompass all local political groups and farmer organizations,

4. Be aimed at people's needs and desires, not at those of the project staff,

5. Use local leaders as much as possible,

6. Help people to recognize their problems and needs,

7. Use any possible method of teaching, and

8. Value people more than things.

While this list is not exhaustive, it does establish a basis for organizing the demonstration farms and other activities and for using them as educational tools to achieve the desired level of soil conservation in the Citanduy Watershed.

The organizaton at the farmer level must have concise objectives and specific guidelines that cover all sectors of the conservation program, and they must show how the conservation practices may be applied to the family farm. The goal of the demonstration farms in subwatershed areas is to formalize a program of helping farmers with their problems, which will vary with each farmer group. It is very important that the focus of all the extension activities be towards helping the farmers solve the problems that they recognize, not necessarily the problems seen by the Project staff. With time the farmers will recognize the technical problems, and this will occur at a time when they will be receptive to the program for solving those problems.

It is planned that each demonstration farm have its own farmer organization, referred to as the Kelompok Conservation Action Unit, although it may well take some other form of organization in the actual application of the program. It is necessary to have an organization of local farmers to assist the staff in setting up meetings or seminars and to have a group responsible for obtaining and working with the owners of the demonstration farm. This farmer organization is

necessary for the self-operating concept which provides a means for the transfer of knowledge and skills required for conservation farming, production inputs, marketing facilities, and other factors that are needed to increase incomes and family living standards.

If the education aspect of the Project is to succeed, it must be organized so that the individual farmer is the recipient of the education, and (where possible) all of the education materials should be written in his dialect and matched to his level of educational attainment. The farmer cannot be expected to travel long distances to attend formal lectures and demonstrations. Instead, the program must be designed to utilize demonstration farms and programs in the individual village, or in smaller hydrologic units. The costs of the extension education functions are included in the overall Kabupaten budget (Table IV-3).

Functions of the Demonstration Farm

The most important function of the demonstration farm is to provide a system of communication with the people in the villages. The villagers are the principal land users in the Watershed, and therefore, they have the most to gain from the erosion control and educational features of the Project. Through this system the total educational program for soil conservation can be organized and implemented at the local level. It is important to recognize that the Desa Conservation Technicians and the demonstration farms provide a nucleus for developing a soil conservation program that is oriented to the people rather than to the government.

Conservation education, making and using soil surveys, resource planning, engineering design, proper construction of structural measures, soil fertility management, improved crop varieties and conservation farming techiques can all be demonstrated effectively in the farmers' own neighborhood. To this extent, the demonstration farm is a natural place for many of the farmer training sessions to take place. It is also the place where the farmer will naturally come to ask questions once he has been shown that the practices used on the demonstration farm really work. Conversely, there will be a lasting adverse effect on the

farmers if many unsuitable crops and techniques are attempted because of poorly trained or misguided local staff.

The demonstration farm and farmer education program will also introduce the individual watershed farmer to the measures and practices necessary for an effective conservation program, particularly to the necessity for maintenance of conservation measures. The individual farmer must also understand how the forest affects the income potential of the people in the Watershed, and particularly, how it affects his own livlihood. It is especially important for the people to understand the damages to and losses in soil fertility caused by clearing steep forest lands and planting cassava without conservation measures and farming methods.

The size of the demonstration farm areas is important. Experience with the 6.1 ha Panawangan Pilot Demonstration Farm indicates that they should definitely be small hydrologic units, two to five ha, with an average size of 3 ha. Large demonstration farms may be thourht of as more large government-initiated, sponsored, and financed projects, an attitude which may cause local farmers to delay adopting soil conservation measures in order to take advantage of government payments. Further, the effectiveness of larger projects may be exaggerated by the visitation of dignitaries and upper echelon government officials. Instead, the atmosphere should suggest that visitors are looking at the farmers' project, not at just another government project.

By using small 3 ha demonstration farms in a hydrologic unit, one part-time Desa Conservation Technician can actively supervise most of the conservation activities. By establishing smaller demonstration units in more village areas, there will be greater community involvement and permit the farmers to see the results of conservaiton measures without travelling great distances.

The suggested schedule for developing demonstration farms in the Citanduy Watershed is discussed in the next chapter of the report. This schedule proposes 10 farms for Year One and a total of 150 for the five-year Project. This is much slower than envisioned by some Indonesian Government units, but it is predicated on quality of results and the careful training of the staff to implement the demonstration farms.

Experience in other areas of the world has shown that the failure of results on demonstration farms becomes known over a wide area and may in fact result in the failure of the total conservation program. Table VI-3 provides an illustration of the staffing problems for demonstration farms and other conservation activities. By the fifth year the program calls for the addition of 120 positions in the Ciamis District, and all of these people must be trained specifically to assist upland farmers. In addition to this staff there would be one part-time Desa Conservation Technician for each demonstration farm that is established.

Table VI-5 breaks down the estimated cost for establishing a 3 ha demonstration farm with a 2 ha terraced area. The first year cost is estimated at 1.7 million Rupiah; the farmers would contribute an estimated Rp. 760,000 through their labor on the terraces and other conservation measures second through fifth year costs are estimated at Rp. 205,000 annually. Assuming that each demonstration farm would be funded for five years, the project cost would be Rp. 1,760,000 (Rp. 940,020 the first year and 205,000 for others).

Improving Technology Adoption Rates

The organization of the Kelompok Conservation Action Units, demonstration farms, and the provision of Desa Conservation Technicians is only one step in developing an effective means of disseminating all elements of a conservation and family living improvement program to the individual farmer. First of all, those who are planning and implementing the program and those for whom the program is planned must develop two-way communication. When the program begins solving local people's problems, the foundation of a training program can be established that will provide the farmers with an understanding for the seriousness of the erosion processes in the Citanduy Watershed. Without this communication the program will be just another government project, and the only local interest will be in what help, or jobs, it will provide while it is active.

A recent seminar on the problems of bridging the gap between the farmer and researchers provided some valuable guidelines in improving the adoption of new technology [1]. For effective dissemination of technology the following strategies are recommended:

1. Provide continued periodic multi-level training of extension personnel;

2. Carefully select recruits for extension work and require pre-service training;

3. Strengthen the sector on rural social sciences by employing more social scientists, strengthen the curriculum in rural social sciences in the agricultural educational system, and conduct more research in this subject area;

4. Make available more and better planned extension materials;

5. Provide adequate and properly timed logistical support in terms of funds, mobility and materials;

6. Improve complementary service through frequent communications and coordination between research and extension agencies;

7. Give awards to outstanding extension workers at local, regional, and national levels;

8. Offer attractive salaries competetive with those offered by other agencies and provide opportunities for advancement;

9. Assign extension workers in proper places to encourage better performance;

10. Develop or improve an effective monitoring system based on farmers' performance not on extension activities, build this into the working system of all extension personnel;

11. Provide incentives to farmers by: a) having a better production plan, b) establishing price supports, c) encouraging contract farming, and d) providing timely market information;

12. Provide incentives to farmers' organization and encourage them to participate in the selection and transfer of extension workers;

13. Integrate all existing farmers' organizations at the village level; and

14. Encourage the development of farmers' groups into learning groups or study clubs directed toward producton and economic achievements.

Although this discussion does not address the problem of improving the family living standard, such a goal will be an essential part of the final program. It is just as important to improve the knowledge and efficiency of the wife as a homemaker as it is to improve the farmer as producer of crops and livstock. The final program will also have a large section concerned with improving knowlege of forestry and encouraging the development of industries from the forest products.

The Bupati should take the lead in developing the specific training program for his district in consultation with the Farmer Advisory Boards. Specific plans will be required to educate and train both local leaders and technicians to carry out the objectives of the Watershed Management Program.

The local people should also contribute to the planning and budgeting of the conservation activities in their villages. Local people's participation should be encouraged as a means of training and developing a greater interest in their own affairs. With the technicians' help, the Desa Watershed Development Committee should develop a

coordinated budget and should schedule works of improvement for the demonstration farms and all other watershed areas.

Research Program

A research program is probably necessary to the development of an active soil and water development program for the Citanduy Watershed. Research and basic data collection have high priority on the implementation plans for the proposed Watershed Management Program. Recent area-based donor-funded projects such as the Solo Project, have already provided some of the "field research" results for the soil and water conservation aspects, as has the Panawangan Pilot Watershed Project. Research and project evaluation studies from other developing countries can also provide valuable guidance. A major upland watershed management research program should be established to pursue the following tasks:

1. A synthesis of existing information on soil conservation and upland area resource use, especially that already available from various area-based rural development and soil conservation projects that have been completed;

2. Analysis and synthesis of information -- from Indonesia, other tropical countries, and world research centers -- that can be adapted to local conditions;

3. Establishment of an applied adaptive research effort for existing conditions with an emphasis on upland crop production and of methods and techniques that will increase economic returns while protecting the soil resources.

4. A continuation and expansion of small watershed and weir area studies at Panawangan and Karang Pucung with the data carefully analyzed and published to make it available to field staff as soon as possible.

5. An evaluation program to determine the relative effectiveness and cost-effectiveness of erosion control structures and land treatment measures.

The research program needs a study of the socio-economic constraints to the adoption of new technology, together with recomendations for the best ways of solving the problems of low profit, high risks, lack of credit, and inadequate knowledge or skills. The individual researcher must become aware that the human element in farming or watershed management is generally more limiting to production than are physical or biological elements.

Admittedly, having research stations in every river basin, is impractical but the urgent nature of the problems in the Citanduy River Basin justifies an extension of the research being done at Bogor and elsewhere to the problems existing in this area. This station should be initiated with a specific charge to work on the urgent soil and water conservation problems of the Citanduy Upper Watershed.

An experiment station can also be used to train students and other scientists in solving the problems of upland agriculture and erodible areas. The staff of the experiment station can also provide valuable assistance and teaching support to the training centers, particularly for staff training.

The five-year project budget has a tentative allocation of 337.5 million Rupiah for establishment and operation of a land and water resource research center in the Upper Watershed area (Table VI-1).

In summary, specific research is needed for an upper watershed program to be successful, and it should be undertaken by research people trained in the fundamental techniques and procedures for evaluating and analyzing data, so that the results will be realistic and reproducible. Perhaps the most important feature of the research program, however, would be the review and documentation of past efforts together with an analysis of their applicability.

Protection of Cultivated Slopes

Cultivation of any land in the humid areas of the world will cause erosion and degradation of the soil. The steeper the land form, the higher the potential rate of erosion. Erosion not only results in the deterioraton of the productivity of the land, but it also results in the aggravation of sedimentation and flood damages in downstream area. No program will control erosion on steeply sloping upland crop areas -- it can only reduce the erosion to some acceptable level. Because erosion of upland crop areas is the major source of sediment in the Citanduy Watershed, a more complete discussion of the problem and technical design criteria for control is provided in Appendix D, "Protection of Cultiated Slopes," and the balance of this section provides only a generalized discussion of the solution to the problem.

In the Citanduy Watershed, the problems of erosion from upland crop area are compounded by the very high population density and the fact that the cultivators are poor farmers operating small parcels without the physical, human (education), or economic resources to solve the problems. The social dilemma is always there. The resettlement or transmigration of people from the land is a difficult process even when they are illegally squatting, but the watershed land and water resources will continue to deteriorate unless the process of cultivating even steeper lands can be stopped. Because people have to eat, the solution of the Citanduy Watershed's erosion problem really rests with transmigration and population control. Otherwise, the program suggested in this report can only reduce the rate of deterioration while feeding the existing population better; it will not solve the people problem of the Watershed.

All cultivated slopes require protection against erosion. The steeper the slope, the higher the potential for erosion and the more difficult it is to reduce erosion rates to some acceptable level. Mechanical methods of control must be fitted into the upland farming conservation program, and their success lies in the management and maintenance by farmers with some help from governmental technical services.

Six types of mechanical protection that can be used to reduce erosion: level basins (rice paddies), contour planting, strip cropping, conservation terraces, bench terraces and diversions. Many variations of these methods can be used, depending on the slope of the land, crops to be grown, and all of the climatic and soils factors discussed earlier in this report. With the general success of the bench terracing program on the Panawangan Pilot Watershed, many people have decided that bench terracing is the complete answer to the Citanduy watershed erosion problems. If for no other reason than the very high cost of bench terracing, this is not a true generalizaton. Insisting on bench terracing of all cultivated upland will simply mean that no conservation work will be applied to some lands.

Contour farming coupled with conservation terraces can be successful on slopes of up to 15 percent although most of this land is already used for riceland. Conservation terraces also have a useful application in the "greening" program and on areas being farmed to cassava in situations where the farmer is unwilling to go to bench terraces. It should be noted that bench terracing on slopes above 40 percent tends to be impractical because the narrow bench width limits the amount of arable land on a per hectare basis and because establishing terraces on steep slopes is very costly. Terraced slopes may also be unstable on slopes of about 50 percent, and a detailed soil analysis should be used when designing these critical slopes if there is any sign of land slumps in the vicinity. Level bench terraces used for flooded rice production may be unstable on slopes of 40 percent or less.

Structural protection proves expensive because of capital cost; which can exceed one million Rupiah per ha for bench terraces, and because of the cost of farming the narrow benches. Therefore, emphasis should be placed on the least costly means of protection should be used, and steeper slopes should be eliminated from cultivation (particularly cassava production) if at all possible. Vegetative controls are still the best means of controlling erosion since disturbed soils can never be completely protected.

Level Basins

Level basins are generally constructed on slopes ranging from 0 to 8 percent. In the Citanduy Watershed all known available land in this slope range has already been developed into rice paddies or terraces for flooded rice production.

Contour Cropping

Contour cropping should be practiced on almost all upland farming areas of the Watershed. In fact, one of the reasons for terracing is to force contour cropping. Contour planting is not done strictly on the contour, but rather on a slope of 0.5 to 1.0 percent to allow for adequate drainge and to reduce runoff velocities in furrows. A ridge-furrow system of planting should be used to increase soil moisture intake during light rains. Gradient of the contours can be varied across the slope to improve field and row alignment. Contour planting can be accomplished on slopes up to 15 percent, providing the downslope distance does not exceed 30 meters. On unterraced cassava fields, contour cropping should be instituted on very steep slopes to reduce erosion damages. Intercropping can also be used to increase the amount of ground cover from contour cropping.

There are no construction costs for contour cropping, since all that is involved is changing the direction of farm operations, but the extension service will require much time and effort to get the farmers to adopt this practice. They will also have to assist the farmer in laying out contour furrows in his fields.

Contour Strip Cropping

Contour strip cropping is the alternate planting of row crops and strips of crops with close-growing habits. Thus, if water breaks through a series of row crops, it is spread out in the close-growing crop, has a reduction in velocity, and sediments are deposited. It is recommended for slopes in the range from 8 to 15 percent. The width of the strips are a function of slope and are defined in Appendix D. Contour strip cropping will not be readily adopted in Indonesia because of the lack of economical close-growing crops as alternatives to

cassava. Upland rainfed rice could be used, but it is of doubtful value since it is generally planted as clumps and not drilled to provide a dense plant population.

On steeper land a special type of agroforestry with alternate strips of trees, grass and field crops has a large potential for reducing erosion rates, but it will require an intense extension program and incentives to cause the farmer to adopt the practice.

Conservation Terracing

A conservation terrace is a ridge and channel constructed across the slope on a gradient that will conduct surface runoff to a waterway at a non-erosive velocity. Conservation terraces are recommended on slopes of 4 to 25 percent where bench terracing is not contemplated. It is also recommended for many "greening" areas. The vertical and horizontal intervals depend primarily upon land slope. However, they also depend upon the soil and climate, crops grown, and machinery (if any) used (Appendix D, page D-27). The drain channels must discharge into a protected waterway. A conservation terrace does not disturb the cropping area, except for the drainage channels. Therefore, only a minimum amount of soil must be moved. The crops are grown on the contour between terraces. It should be recognized that conservation terraces can be converted to bench terraces during farming operations over a period of years and the farmer should be encouraged to do this where the need exists.

The development program for conservation terraces is not specifically scheduled because of data limitations. The areas developed will be small because at present this is not a common practice in the watershed. The only known use of conservation terraces has been as a part of the greening program. The estimated cost for constructing a conservation terrace on a 15 percent slope is Rp. 297,940 per ha (Table VI-6). Cost estimates include the cost of constructing grassed waterways to remove surface runoff to natural waterways.

Bench Terracing

Bench terraces are constructed by cut and fill, leaving a nearly horizontal bench and a steep riser, so that the system looks like stair steps. The benches have a back slope of 5 percent, with the drain channel constructed at the rear of the terrace in the cut area. The gradient of the terrace is 0.5 to 1.0 percent. The vertical interval between terraces should be limited to less than 2.0 meters. Land slope for bench terraces ranges from 15 to 50 percent. The 50 percent limit is due to a vertical interval limit of 2.0 meters and a need for a net farmable width of 1.50 meters. Widening the net farmable area reduces the maximum slope on which terraces can be constructed. For practical purposes, slopes above 40 percent are not particularly economical. The variation of bench width, vertical interval, and ground slope is in Figure VI-3. The effective crop area (net farmable) depends on ground slope and vertical interval as illustrated in Figure VI-4. The volume of excavation depends upon ground slope and vertical interval (Figure VI-5).

The proposed areas of bench terracing in the Citanduy Watershed are estimated to be 4,375 ha for the first five years, plus an estimated 300 ha on the 150 demonstration farms. The estimated average slope of the areas to be terraced is 25 percent. The cost estimate for terracing on a 25 percent slope is shown on Table VI-7. The total estimated cost of terracing is 588,000 Rupiahs per ha. It is assumed that the terraces will be constructed by the farmers or groups of farmers. The cost estimate is based upon data obtained from the terracing program in the Panawangan Pilot Watershed and from calculations summarized in Appendix D. The Rp. 588,000 per ha average cost also assumes that much of the terracing work in the Citanduy Watershed will consist of rebuilding the existing low quality terraces.

Bench terracing is an expensive method of protecting cultivated land, and total costs can easily exceed Rp. 1,000,000 per ha. Cost is primarily a function of vertical interval, although slope has an effect. The problem associated with use of minimum vertical intervals is that the terraces are narrower than necessary so a trade off has to be made. One of the needed studies for project development is a combination engineering and economic study to determine the most efficient design for various slopes.

Gully Stabilization

Gullies are active producers of sediment over much of the Watershed, as discussed in Chapter II and III. The erodibility of a gully is influenced by the nature of the side and bottom materials, channel gradient, and channel alignment. All of these factors also affect the type and cost of the control methods that should be used. There are three components to controlling gully erosion: stabilization of head cut; grade stabilization; and revegetation to stabilize the bare soil. Another way of solving the gully erosion problem is to divert the water away from the gully, but this water must be carried in diversions to natural non-erosive stream channels.

Bamboo wattling drop structures are the most common type of drop or check used in gully control. The average bamboo wattle check with an effective height of 0.4 m and a width of 2.0 m costs 6,545 Rupiah each, and the same size structure with a stone dissipator is estimated to cost Rp. 9,090 (Table VI-8 and Appendix B). Where stone is available, small rock drops or checks with 1.0 m^3 of stone can be built for Rp. 7,700; larger check drops with 4.5 m^3 of stone have an estimated cost of Rp. 33,960. More difficult sites may require a rubble masonry headcut structure, which will cost about Rp. 126,100 for treating a gully head with an average depth of 2 m and a width of 7 m. This same basic structure can be used as a check in small streams for rural irrigation system diversions.

For large and difficult gully headcuts or streambank erosion protection, stone gabion structures may be required. An estimated 7.0 m^3 gabion retaining wall would cost Rp. 90,150, or about Rp. 12,900/m^3.

The details of these cost estimates are in Appendix B, and the hydrologic and other design criteria are in Appendix D.

Protection of Noncultivated Slopes

Noncultivated slopes with erosion problems are generally adjacent to developed areas and the problems are the result of timber harvesting, road construction, village area runoff, or the runoff from cropland. In general, the forestry and plantation areas of the Citanduy Watershed have low erosion rates except during periods of disturbance, such as timber harvesting, the cropping period permitted during reforestation, and the plantation establishment period. Because their problems are less intense, noncultivated slope project features are limited during the project period by the necessity of working intensely with the upland crop area.

Erosion problems on noncultivated slopes are so varied that generalizations are impossible. Each specific problem area will require a specific analysis and a rehabilitation plan for it to be effective. Perhaps more importantly, the area will also require a long-term maintenance program to ensure that the project features remain effective.

Recommended Forestry Program

The forests in the Upper Watershed constitute one of the nation's most valuable natural resources. For these resources to serve the best interests of the Citanduy Watershed and the national economy, good conservation practices must be incorporated into the forest plantings and the adjacent upland farming areas. People in the upper watersheds should be encouraged to recognize, through an extensive educational program, the importance of good forests to their economy and their dependence on the good management of this resource for their wood and water supplies. Regulations should be fair, well developed, and strictly enforced. Some financial incentives should be provided to encourage active participation in reforestation, silvicultural and conservation practices.

Stabilized and clearly marked boundaries are needed to prevent undesirable and illegal conversion of forest lands to agricultural lands, particularly on lands with over 40 percent slopes. Because of pressures for land, farmers are moving into small forest tracts and then claiming these as private lands, many of which are now in court dispute. There are also areas in the critical erosion zones where encroachment is very active.

A survey or study should be made to determine those areas that are in small forest tracts that could be traded or exchanged for some of the critical private lands. This would tend to block out larger forest areas for better forest management and place the critical eroded lands into permanent forest management. Many of these lands are too steep to cultivate and would require extensive conservation measures to control erosion and fertility losses. The land currently in plantation and production forests should be carefuly selected and strict conservation plans developed for the after harvest period to prevent deterioration during the reforestation.

Some high elevation natural areas have been established, but others should be designated and set aside as quickly as possible so that they remain in a natural condition. Since these areas may contain unique plants and animals, their preservation should be undertaken before it is too late.

An inventory of all forest resources should be conducted through an integrated approach that would involve all governmental agencies with an interest in natural resources. A diversification of agencies is suggested because the survey should not include tree resources alone, but also wildlife, soil and land resources, genetic resources, and recreation.

A quick review of the production from forest reserves in [illegible] much better use could be made of the forest resources by multiple use planning. Forest use has been primarily focused on the extraction of timber, gum, and other commercial products such as oils, waxes, and turpentine. Paper production is being considered and pine species are included in the present planning. Research should be undertaken to determine what better and more rapid growing tree species are

available or could be developed or introduced.

Considerable attention should be given to the production of fuel wood. Calliandra is being planted for fuel wood, but in view of volume of fuel wood required, the area planted and volume produced are not sufficient to meet the local demand. Other species, such as Acacia aurecleformis and leucaena sp., that are fast growing and assist in improving the fertility of the soil should be tried.

Shortage of water during the dry season in the Upper Watershed magnifies the need to manage some areas for municipal and domestic water for the small villages in the upper watersheds as well as for flood mitigation and sediment control. Forests produce the best quality of water, and this will bring a premium in the years to come. Such areas should be carefully managed and developed to increase this essential resource.

The objective of the Forest Service and Perhutani is to manage the forest on a sustained yield principle and should be reflected in the equilibrium between harvest and reforestation. The forests set aside as a natural resource must be protected as this will affect the prosperity of the Indonesian people for years to come.

Many forest products can be satisfactorily harvested under close management and supervision. New systems of management should be tested and new methods of planting and harvesting will need to be developed if the forest lands are to meet the challenge of the future. Forest management practices such as new species and methods of planting, thinning, and logging, should be conducted to reduce and prevent erosion.

Uneven age silvicultural practices are not used as much as they should be to improve the forest production. Currently, silvicultural practices are designed primarily to produce teakwood and pine for gum. Very little attention is given to other forest values. Thinning practices do allow fuel wood to be cut and harvested during the rotation. In producing a teak stand for market, other products could be developed or raised underneath the stand during a part of its growth. For example, grass and other harvestable legumes could be grown and harvested but this requires good supervision and care. The tumpangsari system has been used

for reforestation and food crops provision. With good management, some food crops could be grown and would not interfere with the teak growth, even in the later years of the silvicultural cycle.

Roads and trails need improvement. The lack of adequate roads and trails for proper forest supervision creates one of the greatest management problems. Roads and trails now in use are sources of excessive sediment runoff because they are not properly drained and graded. Carefully planned road and trail systems should be developed and constructed in accordance with project goals.

Logging practices cause tremendous erosion and channel headcut development. The practices of skidding logs through stream channels and along drainage ways should be discouraged. Not only are these practices producing large amounts of erosion, but they are altering the stream temperatures and water quality for fish and biological growth.

One of the greatest gaps in our knowledge of sediment in streams is the ecological impact on the forest environment produced by logging and other destructive practices. Without this type of data it is impossible to accurately determine what damage the increased sediment loads are having on environmental conditions both upstream and downstream. No attention is being given to the importance of gravity and erosion energy. Logging trails are made down steep slopes because it is easier to drag logs down the slopes than across the slopes. Gravity is a critical factor in the movement of sediment on the steep slopes.

Most of these recommendations can be adequately implemented by existing governmental organizations. It is difficult, however, to estimate and prepare a budget without information on the physical rehabilitation requirements. Some of the programs are now partially financed through regular channels such as Perhutani, the Greening Program, and Reforestation Programs. They will require augmentation to solve the many problems that will be encountered when an active watershed program is in full progress, but because the problems on forest lands are so much less than on upland cropland, no additional budget is proposed for the initial project period.

Stabilization of Cut and Fill Slopes

There are two main methods of protecting cut and fill slopes: vegetative planting and diversion ditches. If proper care is taken in its establishment, vegetation is the most beneficial and durable soil stabilizer. It forms a protective cover that shields the ground surface from the direct impact of falling rain, and its roots bind and secure the soil particles. It also controls runoff by slowing the flow of water along the soil surface, and by enabling the soil to absorb more water, thus decreasing the ability of the water to remove and carry away detached soil particles.

Longterm vegetative stabilization is accomplished by the proper planting of various combinations of grasses, legumes, shrubs and trees. The type and mixture of individual plant species to be used in a specific situation will depend on soil and moistues conditions, climatic conditions, slope, aspect, erosional stresses, and adjacent land use.

Diversion ditches are used to divert water from a cut or fill slope. Runoff is intercepted before it reaches the slopes, and is disposed of at safe velocities. In handling concentrated flow, the objective is to detain the runoff by: (a) increasing the flow distance, (b) decreasing the flow gradient, and (c) obstructing the flow. Structures (including checks, energy dissipators, riprap lined drainageways, chutes, etc.) are generally necessary to control the velocity of the runoff.

Cut and fill slopes must be stabilized as soon as possible to control erosion and allow revegetation. Rill erosion, which occurs rapidly under the Citanduy high rainfall conditions, is very difficult to protect against and it can become a series of gullies within a year. Gullies require structures for control. Rill erosion is also responsible for the removal of the most fertile portions of the soil profile.

Brush, wood or mulch cover can be used on cut and fill slopes to permit the establishment of vegetative cover. Brush can be pegged down or held in place by low wattlings. Eroded slopes (rills) can be reworked and protected by brush or other mulching materials individually or in combination with wattling or benching.

Drainage from roads must be controlled by erosion proofing the drainage ditches; water must be carried across the road in culverts or in protected dips. The outflow areas must also be protected.

The cost of protecting cut and fill slopes cannot be generalized with any degree of accuarcy. Site conditions vary too much to allow the use of generalized costs.

Treatment of Road and Trail Damages.

This section describes some of the methods to be used in the control of accelerated runoff and erosion on and below the bare spots created by road and trail construction or by improper maintenance. The foremost method is to change the common practice of continually removing all vegetation (below the ground level) from the roadsides and road ditches.

Damage from runoff and erosion occurs both on the road and below it. Unpaved road surfaces, side ditches, the cut, overcuts, and fill slopes all have soil loss. Mud washed onto the road surface may make it dangerous for travel; slides may entirely block the road and require costly repairs. Below the road, gullied hillsides and gouged stream channels commonly result from runoff originating on the road or the slopes. This runoff and the debris carried by it increase flood and deposition damages downstream. Villages, farmlands, irrigation works, domestic water supplies, and other improvements are damaged by the deposition of silt and rock washed down from roads. Altogether, the flood and deposition damages downstream may be far greater than the erosion damage to the road itself.

The control of runoff and erosion on road surfaces and in road ditches is an engineering problem that can be solved largely by preventive location, design, and construction, or by installation of adequate drainage structures as the road is built. Some acceleration of runoff and erosion on the cut, overcast, an fill slopes is unavoidable. However, the most economical and effective control is provided by plant growth and litter. Moreover, such plant growth is needed to hide the

unsightly scars of road construction. The establishment of plant cover on road slopes, together with the installation of such temporary mechanical aids as may be required to make establishment possible is very important in reducing the sediment load in streams.

In the Citanduy Watershed there seems to be a general lack of understanding of the need for erosion proofing of roads and the associated drainage structures. The following discussion is designed to provide the correct name for structures or problem areas together with a brief description of the practice used on roads, trails, logging spurs, and skid trails. The erosion problems of roads and trails should be readily apparent to even a casual observer.

Slope Stabilization. Three requirements must be met before road slopes can be stabilized by planting: the road must be located on soils that do not become exceedingly saturated in wet weather; the slopes must lie at or below the angle or repose of the soil or rock material from which they are built; and drainage facilities must be provided to prevent concentrations of runoff from discharging onto slopes.

Road location on soils that remain reasonably stable during wet weather is a requirement of good engineering, yet it is often overlooked. Examples include roads built on soil types noted for instability when wet, and construction across slopes of sliding talus or through deeply fractured, loose bedrock. Both examples suggest the need for careful studies of location so that the cut, overcast, and fill slopes may be stabilized by vegetation, insofar as possible, without the aid of cribbing or other engineering structures.

Reducing slope steepness to or below the angle of repose in loose soil is essential to permit the establishment of plants. Slopes steeper than the angle of repose will slough off and prevent the effective establishment of vegetation. Moreover, it is impractical to apply topsoil, sometimes needed to help plants gain a foothold, to slopes that are steeper than the angle of repose. For loose soils, this angle is approximately 30 degrees, a slope of 1.5H:1.0V.

Adequate drainage must be provided to handle runoff from the road surface, the cut slopes, and the hillsides above, without letting this runoff spill onto the slope to be treated. Slope stabilization measures can take care of the rain that falls on the treated area, but they cannot resist concentrated flows.

The nature of the exposed soil and rock material and the steepness of the terain traversed by the road govern the requirements for treating cut slopes. Cuts in solid rock will stand nearly vertical, and they are usually stable without treatment. Cuts in shattered or weathered bedrock will often stand on 1:1 or steeper slopes; although they yield erosion debris, planting of such slopes is usually difficult if not impractical. Cuts in soil that is easily eroded and gullied should be sloped to gradient of 1.5H:1.0V or less, and planted immediately or when available soil moisture will support plant growth.

Deep cuts through soil in steep terrain are especially hard to control because back sloping them to 1.5H:1.0V may require excavating an extensive area of the mountainside above the road, a process which creates an even more serious erosion problem. In such places, a wall or crib may be required to raise the toe of the slope to permit gradient reduction without extensive excavation.

Overcast and Fill Slopes. Because they are built of excavated material, overcast and fill slopes are composed of loose soil and rock more or less compacted during construction. The surface is loose and erodible. Such slopes are not difficult to control because they contain some topsoil which can have favorable soil and moisture conditions for plant growth. They should be treated by covering with litter, wattling, or other means as the final step in road construction, and should be revegetated as rapidly as possible.

Road Shoulders. Road shoulders serve as collecting areas for rainfall, and paved roads' shoulders are often gullied by runoff from the road surface. The conditions are aggravated when the shoulders are wide.

Road shoulders should be treated for erosion control along with the overcast slopes, by spreading litter and seeding grasses to provide permanent cover. Most important in preventing road shoulder erosion is to train the maintenance crew not to clear cultivate the road shoulders and waterways.

Gully Treatment. Road slope gullies are of two classes: those developed at places where channels are permanently needed to carry runoff as a part of the road drainage system; and those cut by runoff that will be diverted and controlled upon the installation of adequate road drainage facilities. Gullies of the first type should be classed as watercourses and equiped with culverts or suitable drains in accordance with approved road construction and drainage practices. After this repair work, areas of disturbed soil will be covered with litter, seeded, and planted as needed to prevent accelerated erosion. Gullies of the second type will be filled and treated for surface control along with the rest of the slope.

Cross Dip. This consists of a broad, shallow depression in a road at a stream crossing designed to spread the water in a wide, thin sheet that is easily forded. The gentle slopes of this dip cause minimum jolting of vehicles. In steep terrain, a retaining wall and channel stabilization measures may be required at the dip outlet. The dip surface is sometimes paved to evenly spread the flow and prevent road surface erosion. Such dips may be used on roads or trails.

Grade-Dip. This short section of trail, generally not over 2 or 3 m long, is built with a grade slightly adverse to the prevailing grade of the trail. The trail is outsloped at the low point in the dip so that water flowing down the trail can be diverted. Such dips are most satisfactory when built during trail construction so that the designed grade allows for the sections of adverse grade. When grade-dips are built into existing trails, the upper portion is usually too steep for proper maintenance. Instead of building dips in an existing trail, it is customary to build waterbars.

Waterbar. Waterbars are generally made with a log of small diameter laid at a slight angle to the trail tread and staked in place. The tread downgrade from the waterbar is flush with the top of the log while upgrade the tread is kept well below the top of the log. The outside edge of the trail immediately uphill from the waterbar is cut down to spread the water on the natural slope below the trail. Waterbars cannot be used effectively on trails traveled by motorcycles or trail bikes.

For runoff and erosion control on logging spurs and skid trails, the commonly used road and trail-drainage structures will be too costly for installation. Moreover, the carefully designed structures required on a maintained road or trail are not needed to divert runoff from spur roads and trails that are abandoned. Instead, simple ditches dug across the traveled way at frequent intervals will suffice. Such ditches are defined according to their size and manner of construction. This is not true, however, where the area is cleared and upland crops are permitted for three years. These areas require a more intensive erosion proofing of roads and trails.

Cross-Ditch. A small ditch is dug at an angle across the tread, with the excavated earth piled along the downslope edge of the ditch. Such ditches are quickly made; they divert small flows of water and prevent damaging concentrations of runoff. Ditches are usually spaced 10 to 30 m apart, depending on the steepness of slope and the amount of runoff to be controlled.

Culvert Outfalls. On some roads the repair or erosion-proofing of culvert outfalls, properly the duty of the road-maintenance organization, may have to be constructed by the erosion control crew to halt or prevent slope undercutting. This condition cannot be seen by casual inspection from the road. The downhill position of culvert outlets makes this difficult to observe, and therefore, special time must be taken to climb down the slope and closely inspect them.

Maintenance and Repair

Constant inspection and maintenance of erosion control works on non-cultivated areas are especially important during the first rainy season after construction. At this time, the sown and planted vegetation is in the early stages of development, and the mechanical treatment must carry the entire burden of control. By the second season, damage from drainage failures should have been repaired, the plant cover should have a good grip on the soil, and the plants should be well established.

Immediate repair is essential where failures occur. Failures commonly cause two types of damage: gullied slopes resulting from spillovers of road surface water where drainage is inadequate or where drainage structures have been plugged by debris; and slides and slumps resulting from saturation and slipping of the soil mass. Culvert outfalls and the vegetation plantings should be inspected frequently and maintained as needed.

Stream Channel Improvement and Stabilization

General

Channel stabilzation involves the reduction of gradient, adjusting the flow distance through changes in alignment, and obstructing the flow. The principles are similar to controlling flows in gullies, but the size and complexity of structures are increased, and a specific engineering design is usually required. Riprap becomes larger as the force of water becomes greater. Vegetation can only be established on stream banks, due to the wet condition in the stream. Revetments are often required to protect stream banks. Riprap, gabions, and sand bags are also used for bank protection. Permanent control structures constructed from reinforced concrete are sometimes required.

Two methods are used to stop streambank erosion: First, the bank can be reinforced so that the velocity cannot erode it. Secondly, the fast current can be moved away from the bank.

Generally, it is of primary importance that continuity in river improvement is followed; that is, the improvements are provided over long reaches of river so that improvements in one reach do not cause damages in unprotected reaches either upstream or downstream. However, in mountainous valleys one may be able to tolerate spotty control -- control of a short reach next to a bridge or town, for example. There are not enough benefits to justify controlling long reaches of river. Each river problem must be assessed individually. Delaying channel improvements in reaches not yet troubled is less costly than making improvements in expectation of problems.

In designing river channel improvements and stabilization projects, full consideration should be given to the interrelated factors of river hydraulics, flood peak frequency, flood volume frequency, stream bank and bed materials, and suspended and bed-load transport.

Finally, there is the important consideration of maintenance. In rivers, small maintenance problems usually grow into large problems if timely repairs are not made. Therefore, an organization with adequate maintenance forces and budgeted money is necessary. If stream channel improvements are not to be maintained they should not be constructed, because their failure usually causes very large damages.

Channel Control Structures

The names used to describe river structures are not universal. Hence, the ASCE definitions and descriptions are included to provide a standard [3]:

Revetments. These are structures designed to protect the bank from erosion. The bank is sloped and shaped to the desired align, and then covered to resist the flowing water. Generally, revetment are of three types: blanket, pervious, and solid fence.

Blanket revetment is constructed with rock, concrete, asphalt, masonry, or mats of vegetation. In some cases, the revetment extends to the thalweg of the stream to prevent undercutting. In other cases, the revetment is keyed into the riverbed at the bank. Then, if the thalweg moves to the bank, the revetment does not fail. Probably a combination of gabions and rock riprap is the most feasible in this

watershed. Reports indicate that gabions can be destroyed by impact from gravel, cobbles, and boulders. If so, then rock riprap can be used near the bed and gabions higher on the banks.

Pervious revetments consist of open fence, pile structures, cable connected jacks or baskets and similar materials placed along the desired alignment to prevent bank erosion and to build up the bank by deposition. Pervious revetments work best in streams carrying much suspended load, such as the Citanduy and its tributaries.

Solid fences, usually one or more row, are used on steep stream slopes and must have strength to resist the large flow forces.

Groins. Groins are short, usually solid, structures extending from the banks at approximatley right angles to the flow. Groins keep the high velocities away from the bank. They promote some deposition in the lee between groins.

Rock groins capped with concrete are often used. The nose of the groins must be designed to resist very large velocities in steep mountain streams. Moreover, the foundation for the nose must be below the scour level that occurs at the nose. As with all river structures, maintenance is especially needed after floods.

Dikes are similar to groins but extend farther into the channel. Dikes guide the flow in a manner such that an effective channel is scoured and maintained along the desired alignment.

Rock Windrow. Dumping rock in a windrow along the desired bank alignment and then having the rock fall into the river as the bank erodes has been successfully used. The prerequisite is that the banks be noncohesive.

Use of rock windrows is probably not warranted in Indonesia since there is plenty of opportunity to work in the rivers during the dry season.

L-Head Revetment. To conserve length on fence-type revetment, gaps are left in the fence. Then, the revetment has the configuration "L" with the extremity of one leg attached to the bank, the same leg normal to the flow and the other aligned in the downstream direction.

Check Dams. Check dams promote deposition in the pool created by the dam. Check dams are used as sediment traps and as structures to prevent riverbed degradation and gully advancement. Just about everything has been used to build check dams. However, engineering principles must be adhered to. Otherwise failure of the sediment trap means all is wasted; the sediment trap has merely postponed movement of the sediment.

Very small check dams of branches and bush are used successfully to stop small gullies from advancing. Larger gullies require costly structures so they won't fail and be overtopped by floods.

The best place to employ check dams is at the point where the gully begins. Sometimes the whole basin upstream can be saved from erosion by one structure.

Channel Realignment. Generally the rivers in the Citanduy Upper Watershed are incised and relatively straight; therefore, no realignment would appear necesary or, for that matter technically feasible except for special problems related to irrigation diversion construction, etc.

Streambank Protection

Protection and stabilization of streambanks, gullies, or excavated channels against scour an erosion is a large and costly undertaking. Vegetative or structural means or a combination of the two have proved to be effective approach in stabilizing streambanks, gullies, and excavated channels. There are two general types of bank protection: those that retard flow along the bank and thereby promote deposition; and those that through some form of vegetation, protect the bank from direct erosion and scouring

Vegetation plays an important part in the control of streambank erosion. There are two problems to consider in using vegetation for protection: establishing a vegetative stand or cover; and stabilizing that section of the bank below normal water surface so that vegetation will not be undercut.

Vegetation is used most successfully above the waterline on properly sloped banks and on the flood plain to retard velocity. Vegetation should be used back of revetments and jetties in the area where silt deposition occurs, on the banks above design flows, and on slopes protected by brush mats. Many species of plants (shrubs and trees) are suitable for streambank planting.

Boulders and Branch Cuttings. Properly placed rock or boulder riprap is an effective method of gully or streambank protection. This, combined with branch cuttings of bamboo or trees like Glericidia sepium and Leucaena leucocephala, make a good combination of biological and structural erosion control. Boulders may be costly because of the difficulty of quarrying and transporting, but when these are locally available, erosion control can be effective.

The required size and gradation of the rock riprap depends upon size and magnitude of gully and streamflow. However, strict rules cannot be given. The recommendations below are empirical values derived from gully treatments in the Colorado Rocky Mountains and should be evaluated accordingly to suit local conditions. As a general rule, however, rock diameters should not be less than 10 cm and 25 percent of all rocks should be within 10-14 centimeters in size. The upper size limit will be determined by the size of the gully. Large gullies can include large rocks. Flat and round rocks should be avoided [2]. Both types slip out of a structure more easily than broken rocks, which anchor well with each other. In general, large gullies and flows will require larger rock sizes than small gullies. An effective rock gradation would call for distribution of size classes as follows:

Size	Percent of Total
10 - 14 cm	25
15 - 19 cm	20
20 - 30 cm	25
31 - 45 cm	30

Freshly cut branches should be planted between these boulders. This is usually done a little before the onset of the rainy season. The fill slope should be shaped from the top to the bottom. Guided contour lines should be laid out on the slopes. Staking (of fresh branches) should be started from the bottom of the slope where boulders were placed as part of the structure, with intervals of about 1.5 m between rows and 1.0 m within each row. One ha requires about 6,600 branch cuttings. The length of the branch cuttings (stakes) depends on the slope's overcasting materials; 1 m or 1.2 m length is sufficient. The diameter of the stakes should be 5 cm to 6.5 cm. All branch are sharpened at the bottom end for easy staking.

The correct angle for driving the stakes through the ground is approximately perpendicular to the inclined slope. A maximum of 15 cm is allowed to stick out of the ground. Any split ends should be sawed off.

Grass Sod and Branch Pitching. Grass sod and branch pitching is one of the cheapest methods of erosion control. It does not require factory-produced materials or highly specialized skills to perform the job.

This erosion control measure, just as any other measure, requires evaluation of the area prior to the start of any activity. Once this is accomplished, restoration work can start. Clearing and smoothing the ara by constructing some sort of steps in the form of small terraces are essential.

On slopes that are relatively gentle, about 20 degrees or less, the construction of steps furnishes a convenient place for planting grasses. The worse the conditions for grass growth, the wider and deeper the steps must be built and tilled[2]. If the steps are too wide and too closely spaced, much of the slope has to be cut off or excavated, thereby increasing the hazard of erosion. The standard vertical space between the steps is 1.0 to 1.5 m. If the slope is gentle and the soil is fertile, no downward soil support is needed. If the slope is steep, live stakes from tree branches with a diameter of 5 to 6.5 cm are used on the lower side of the step or terrace. Branch cuttings are sharpened at the bottom ends for ease in staking. The terrace should be 1 m wide for

steep slopes and about 3 m wide on more gentle slopes. On these terraces, grasses are planted to initiate early establishment of soil cover. Kikuyu grass, Bracharia brizantha, star grass, para grass, napier grass or any grass that easily grows on the site is desirable for planting on eroding banks. On steep slopes, grasses could be planted about 20 to 30 cm apart between and along rows. The stakes could be about 1 to 2 m along rows (usually on the lower edge of the terrace) and 1.5 m between rows or a total of 6,600 stakes per ha.

Gentle slopes require fewer branches for staking. Along rows with 1 m spacing and 3 m between rows would require about 3,330 cuttings per ha. Using 20 to 30 cm spacing for grass, i.e. Bracharia brizantha grass, about four truck-loads are required per ha.

This type of critical area planting is estimated to have an average cost of 541,940 Rupiah per ha (Table VI-8 and Appendix B).

Grass Sod and Mats. In providing stabilization and stream channel protection against scour and erosion by vegetation, the principal causes of erosion should be considered. These may be classified as geologic, climatic, or hydrologic although there may be a very close relationhsip between them[4]. Living vegetation provides effective and relatively cheap materials for protecting, matting and stabilizing stream channels. Before going into the actual job of placing the protection materials, investigations on the behavior of the stream conditions should be conducted.

As part of streambank and channel improvement and stabilization the removal of such debris as stumps, fallen trees, sediment bars, or other obstructions is essential. Leveling the surface is important prior to the planting of grasses. It is much better to plant perennial grasses than to plant annuals. Many species of grasses are suitable for protection planting. Using mats with grass plantings will give very good results but it requires the use of some fastening materials to hold the mats in place.

The construction procedure first requires placing a rock toe, using it as base for the mat. Here brush or bamboo mat is recommended. The rock toe should be carried to the point of the channel and be at least 45 cm thick to remove the danger of displacement during flood

flows. It is not practical to use a rock toe in streams subject to channel scour during flood flows because it is seldom feasible to place enough rock to compensate for the downward movement caused by the temporary deepening of the channel[4]. The cleared channels or sloped bank should be planted before the mat is placed. The best time to plant is during the early part of the rainy season.

The mat should be placed over the exposed soil as soon as possible after planting grasses. Grass plantings should be spaced about 20 cm apart between and along rows or a total of 25 hills per m^2. The mat should be 15 to 45 cm thick, depending upon the size of the channel. The mat is held in place by driving stakes at an angle across each other in pairs or by driving stakes straight into the ground with a spacing of about 70 cm on center and interlacing with number 9 galvanized wire[4]. After the wire is attached, the stakes are driven deeper, which tightens the wires and firmly binds the mat.

Inspection and Maintenance of Structures

The success or failure of properly designed and constructed erosion control structures, terraces or diversions depends upon proper and timely maintenance. When terraces, waterways and diversions are constructed when permanent seeding or sodding cannot be completed, a seeding of a temporary cover crop is recommended. Vegetation on all filter strips requires regular cutting of the vegetation and fertilizer to maintain uniform plant cover.

The first two or three years after construction are the most critical for maintenance problems with most structural measures. Therefore, physical periodic inspections by supervisory staff should be scheduled for at least the first two years after construction. For bench terraces this should include a careful supervision of the crops grown to prevent the use of unstable terrace areas for flooded rice production.

After each major storm, all structures (including terraces) are to be inspected by project personnel, their damage evaluated and repair initiated. Concurrent with terrace construction, farmers should be trained in inspection, proper use, maintenance and repair of

terraces, drop structures, and waterways on their property.

Periodic checks should be made of all gully control works. The following maintenance practices are important:

1. Protect all vegetative plantings from grazing or harvesting until established and then allow limited use;

2. Eliminate competition from undesirable weeds and grasses in vegetative plantings;

3. Protect all plantings from trampling and fire

4. Make immediate repairs of breaks or low spots in terraces, diversions, or structures;

5. Remove trash from drop inlets or weirs;

6. Sod or seed spot failures in vegetative plantings;

7. Apply fertilizer to vegetation as required; and

8. Inspect sides, corners, and wingwalls of all structures and repair cracks caused by settling, rodent burrows, dry weather, etc., before the structure is weakened.

Considerable damage, as well as loss of structures may result from failure to protect and properly maintain the structures. Providing minor maintenance in a timely manner often saves costly repair jobs when an unusual storm occurs.

Conservation Farming

General

The Citanduy Watershed is a food deficit area. Upland arable and tillable lands compose only a small percentage of the total Watershed area's food producing capability, and the projected population increase (Chapter II) further accentuates this food deficit. To meet this shortage of food, the usual practices are to increase the hectarage of food crops, increase the yield per hectare, and to tap other food sources.

The potential for additional agricultural expansion (increased hectarage) is quite limited. Very little suitable land is available for new agricultural development.

Increasing yields per hectare offers the greatest opportunity, however, this will not, by itself produce an adequate food supply for the inhabitants. In order to achieve increased yields, the primary requirement is not research into new methods, but the increased application of techniques and practices which are already known or have become available. Other requirements are improved strains, more research into local conditions, more fertilizers, more capital, and reduction of wastage from pests and disease. The immediate problem is to increase yields of the subsistance agriculture by the application of elementary agronomy and soil conservation practices. Theoretically, this should be simple, but available evidence indicates it is much more difficult to achieve this increase in subsistance productivity than to increase production in the more developed countries. The reason is that the upland farmer of this watershed simply does not have the resources, either his own human resources or the economic resources, to take advantage of the "green" revolution technical inputs and knowledge.

Without a major resource development program, it appears that there are limited opportunities for expanding conventional food supplies in the Citanduy Upper Watershed. The disparity between future supply and demand also focuses attention on the vital need for conserva-

tion farming to prevent the depletion of soil resources and the decreased productivity that is rapidly creating a critical situation.

Types of erosion and slope protection problems have been described elsewhere in this report. However, the question of which form of erosion is the most serious remains. This is important if a conservation program has limited resources which are insufficient to tackle the whole erosion problem and must therefore, be used against a selected part of the watershed. There is no simple answer to the question because the basic data is not available to determine either sediment sources or the economic losses associated with upland soil losses.

Multiple Use Planning

Multiple-use, or conservation, planning is a process of planning the soil, plant cover and water management, and conservation practices that can control erosion on farms, plantations, or other operating units, in a given watershed (catchment) or problem area.

The planning process must offer the farmer treatment alternatives for the problems of erosion, excess water, etc. This gives the land user opportunity to select a treatment plan in accordance with his or her physical and economic capabilities. These alternatives are actually combinations of practices for various land uses. They will attain all of the management and conservation objectives and therefore are complete treatments in themselves.

Planning is decision making. The plan is a record of decisions. Only the land user can decide how he will use and treat his land. Hence, he is the planner. Government technicians can only teach, demonstrate, and provide cash on input incentives to accomplish the desired governmental conservation objectives.

One of the major objectives of conservation farm planning is to help the farmers to understand the erosion and water problems on their farms and how they can correct these problems while still using the land in accordance with its capabilities. The land use and capability maps are used by the technician in assisting the farmers to decide which are the best uses of his land and what conservation practices will be required.

In the Citanduy Upper Watershed area the most frequent land misuse is the cultivation of cassava on steep slopes. The steeper the slope, the greater the land damage from cultivation. Many steep slopes currently being cultivated are badly damaged and gullied. Gullies started in banks of natural waterways are often eroded to a great depth, and they grow deeper as they advance up the slope. This branching continues until a network of gullies covers the upland fields and the area is ultimately abandoned.

The first step in controlling erosion in the hydrologic unit is to develop a multiple-use plan for the farm so as to make the best possible use of the land. This includes making an inventory of the steep and eroded lands that can be properly terraced and converting slopes greater than 40 to 50 percent to permanent cover or agroforestry. Only moderately sloping land should be used for cultivated crops without terracing and other structural measures. The multiple-use plan has the goal of producing the maximum net return from the farm over the longest period. Where it is to the government's advantage to have certain practices applied that do not directly benefit the farmer, the government should pay for the practice or provide other incentives.

The most economical and best methods of controlling or preventing erosion are vegetative controls, such as mixtures of grass and legumes, and the combination of vegetation and engineering controls. The use of engineering controls, such as terracing, water disposal structures and check dams should always be used in combination with good and proper vegetative practices.

The cost of controlling erosion on steep gullied land and the protection required should be considered in relation to the use that can be made of the land, the farmer's needs, and his willingness to apply conservation practices. In many cases his needs are not compatible with the land capability, especially in steep upland areas. Or his needs and land capability may be compatible, but the resources required are frequently beyond his economic ability. For both of these conditions, it requires a decision by Government as to whether subsidization is feasible or desirable in order to stabilize the agricultural activity and attempt to control erosion.

It is emphasized that the farmers must be trained and educated to assume the responsibility of installing and following a conservation farm plan. It is essential that he understands his individual responsibility to use conservation farming practices, to maintain terraces, check dams, etc., and to repair any damage that occurs. Where farmers do not understand their responsibilities or are not willing to cooperate, conservation practices become damaged to the point that they are no longer effective. The government may be willing to initiate conservation structures and farming practices, but if it does not become the farmer's project, all efforts become futile.

Some necessary steps in preparing a conservation farm plan for a small watershed include:

1. The technician should point out the ability of the soil to produce crops, current erosion problems, and measures for proper management of the soil and water resources available to the farm.

2. The technician should explain what is meant by land capability and why it is necessary to make changes in the management of the land.

3. A hydrologic unit map should be prepared showing land ownership of each farm lot and a plan on how to control erosion, changes necessary to manage water, changes in cropping systems, structures required, and finally what will be expected of each land owner or land operator.

4. A map and plan on how the plan will be accomplished should be prepared and kept on file in the Desa office. This plan should show what will be done on each field and when it will be done: crops to be grown, trees and shrubs to be planted, structures, terraces, and other engineering measures needed to meet the conservation objectives.

The planning process consists of nine essential steps:

1. Pre-planning preparation by technician and land user;

2. Soil, plant, and water resources appraisal;

3. Conservation and management needs identification;

4. Treatment alternatives development;

5. Analysis of treatment alternatives on farming operations and income

6. Decisions on measures to take; by the landowner and/or operator decision

7. Record of the decisions of the land user and/or owner

8. Development and record of the soil water conservation and management plan

9. Keeping the plan up-to-date

During the planning process it must be recognized by the technical and administrative staff that there is a considerable area of farmer owned land that must be placed under the permanent vegetative cover in the interest of proper land use. The change from annual food cropping to agro-forestry methods, including grass and trees, creates problems. It is not known whether the introduction of a tree-grass-food crop or a tree-grass-livestock program will be technically sound and economically workable. However, even if it be so proven, it is believed that this innovation will be resisted for a partly physiological reason that the farmer ceases to be a free agent with his land, which has been growing annual food crops. Instead he is being requested to dedicate his land in perpetuity to the growing of trees and other crops. It may be shown that the practice can provide an annual income equal to or more than that obtained from annual cropping, but it does not directly produce

food for his family. The technician must be able to develop a strategy to overcome this objection.

Water Management.

Water management is an indispensable part of modern upland agriculture. In water management, the ultimate target of any knowledge transfer is individual farmers, for it is on farm land where production resources, including water, climate, soil, crop fertilizer, and management, are all integrated into an upland agricultural system. The transition from traditional upland farming to conservation farming methods will be difficult and costly; however, this is necessary if runoff and siltation is to be controlled. Part of this expensive process will be preparation of farm land to receive and store or dispose of water, a process which may include: bench terraces, conservation terraces, rural irrigation system development; diversion channels and waterways to dispose or surplus runoff. Improvement of the entire physical system is a requisite to a conservation water and soil management program.

The ultimate objective of an upland agricultural water management program is the upland farmer's awareness of his problems. To obtain this objetive it will be necessary to train farm management advisors, soil conservationists, and administrators. The farmer can be provided with necessary technical advice, seed, fertilizer, and management procedures; but unless he understands and can see a profit in his efforts, it will be difficult to get him to alter his traditional methods. Capital is scarce and labor relatively abundant; therefore, the conservation farming and watershed program must focus on the adaptability of technology to conditions that the farmer understands and can achieve. More importantly, he has to be reasonably certain that it will pay him to adopt the conservation farming approach.

A particular advantage of a modern upland water management program is that it has a considerable amount of management built into it and the farmer is automatically led to correct decisions in the application of soil and water conservation measures. A farmer will make fewer mistakes with a well planned system than a farmer lacking the technical input regarding water management. Continued focus on improved water

management must become a new way of life for the upland farmer if he is to continue using the upper watershed soils.

Crops

Terracing or any other type of mechanical pratice by itself, generally will not increase crop yields. Because of depleted condition of the soils the timely use of commercial fertilizer will have to be increased to improve crop yields. In addition to the traditional crops (cassava, rice, corn, sweet potato, and peanuts), it would be advisable to try some other dry-season crops that are more drought resistant (such as sorghum). Unfortunately, to date the Panawangan Pilot Demonstration Farm is the only source for specific upland farming recommendations for the Citanduy Watershed.

Root crops should not be planted on the lip of the terraces because this will damage the terrace lip when the crop is harvested. The terrce lip and riser should be planted, where possible, to grass or a grass and legumg mixture for use in a cut and carry livestock program.

Crop rotations will have to be planned with the farmer after taking into consideration soil conditions, the steepness of the land, and the needs of the family. The farmer should understand why it is necessary to retire some land to grass and trees, and why it is necessary to use conservation measures to conserve soil.

Intercropping should be given preference over sequential planting because it usually ensures greater economic returns and a better income stability for the farmer by protecting him against the risk of a total crop failure and against the wide price fluctuations of a one crop system. It should confer almost the same benefits as a crop rotation with regards to its effects on the soil. This is especially true if the legumes are included in the combination even though the legume may be removed for fodder. The fine root system with nodules remain in the soil to decay and supply nutrients for following crops.

Fertilizer and Lime

Mixing the soil during terrace and contour constructions as well as the inherent low soil fertility level make it necessary to apply fertilizer. Additional fertilizer trials will have to be established to determine the recommended rates of application for different crops and soils throughout the Watershed.

Fertilizer inputs should be provided by the Government for a predetermined number of years as an incentive for the farmers to participate in the program. It is suggested that free fertilizer be provided only in the year of construction for practices such as terracing. Rates of application will change after experimental data are available, however, it is known that farmers recognize the benefit of fertilizer.

Soil Fertility Maintenance

The end result of total soil removal is easily recognized, but the reduction in soil productivity or soil fertility as the soil is being removed is less commonly understood. This has been named "fertility erosion", and it is caused by the action of water which sorts out and removes the light-weight fertility bearing portion of the soil, leaving behind parent materials, sand, and other heavy material. The amount of topsoil that may be materially reduced by the removal of coarser materials over the years is considerable, but the most fertile portion of the soil is usually the first to be removed by water. It is also evident from the limited laboratory analyses made for the Panawangan area that fertility erosion has occurred and will continue to play a major role in impairing the productivity of the upland croplands in the Watershed.

REFERENCES

1. Philippine Council for Agriculture and Resources Research, 1978. Monitor, Vol. VI, No. 3, p.2, Los Banos, Philippines.

2. B.H. Heede, 1977. Gully Control Structures and Systems. In Guidelines for Watershed Management, FAO Conservation Guide No. 1, Rome.

3. ASCE, 1975. Sedimentation Engineering. Manuals and Reports on Engineering Practice, No. 54. V.A. Vanoni, ed., New York.

4. USDA-SCS, 1969. Engineering Field Manual for conservation Practices, Washington, D.C.

TABLE VI-1

RESEARCH EXPERIMENTAL STATION COSTS

Thousand Rupiah

Position	Yearly Cost Per Staff Member	Year 1	Year 2	Year 3	Year 4	Year 5	Total for 5 years
Personnel Costs							
Research Director @ 225,000/mo	2,700	2,700	2,700	2,700	2,700	2,700	13,500
Asst. Director @ 175,000/mo	2,100	2,100	2,100	2,100	2,100	2,100	10,500
Student Assistant		4,680	6,240	7,800	9,360	9,360	37,440
Laboratory Asst. @ 85,000/mo	1,020	1,020	2,040	3,060	3,060	3,060	12,240
Secretarial, Administrative, Farm Labor and Misellaneous		1,500	3,000	4,500	4,500	4,500	18,000
Subtotal		12,000	16,080	20,160	21,720	21,720	91,680
Capital Costs							
Land 10 ha @ 150 Rp/m^2		15,000					15,000
Buildings and Laboratory 15 x 50 = 750 m^2 @ 80,000 Rp/m^2		20,000	40,000				60,000
Furnishing and Equipment		15,000	22,500				37,500
Laboratory Instruments		5,000	1/ 5,000	2,500	2,500		15,000
Farm Tools and Equipment		2,000	3,000				5,000
Automatic Absorption Spectrophotometer					4,375		4,375
Library 1,250,000/yr		1,250	2,500	1,250	1,250	1,250	7,500
Visual Aids 1,250,000/yr			1,250	1,250	1,250	1,250	5,000
Cars and Jeeps @ 5,000,000 Rp.		10,000	5,000				15,000
3 ton trucks @ 7,000,000 Rp		7,000	7,000				14,000
Small tractors @ 1,875,000 Rp		1,875	3,750				5,625
Subtotal		77,125	90,000	5,000	9,375	2,500	184,000

TABLE VI-1 (Continued)

Position	Yearly Cost Per Staff Member	Year 1	2	3	4	5	Total for 5 years
Other Costs							
Staff Travel Expenses		1,200	1,600	2,000	2,100	2,100	9,000
Operation, Maintenance, replacement and travel cost.		5,100	8,700	8,700	8,700	8,700	39,900
Materials, Seeds and Planting Stock		4,000	4,000	4,000	4,000	4,000	20,000
Allowances 25% of Personnel Costs		3,000	4,020	5,040	5,430	5,430	22,920
Miscellaneous and Contingencies		2,000	2,000	2,000	2,000	2,000	10,000
Subtotal		15,300	20,320	21,740	22,230	22,230	101,820
Total		104,425	126,400	46,900	53,325	46,450	377,500

1/ Includes Cost of Meteorological Station of 3,485,882 Rp. from Appendix Table B-1.

TABLE VI-2

ESTIMATED COST OF NEW POSITIONS AND TRAINING CENTER FOR WEST JAVA

(Thousand Rupiah)

Position	Year 1	2	3	4	5	Total
Personnel Cost						
Soil and Water Development						
Coordinator @ 100,000 Rp/mo	1,200	1,200	1,200	1,200	1,200	6,000
Conservationist @ 75,000	900	900	900	900	900	4,500
Senior Training Officer @ 75,000 Rp/mo.	900	900	900	900	900	4,500
Training Officer @ 50,000 Rp/mo	600	1,200	1,200	1,200	1,200	5,400
Administrative Officer @ 28,000Rp/mo	335	335	335	335	335	1.675
Secretarial and Typing	276	552	552	552	552	2,484
Drivers @ 20,000 Rp/mo	480	960	960	960	960	4,320
Subtotal	4,691	6,047	6,047	6,047	6,047	28,879
Capital Cost						
Land 2ha @ 225 Rp/m^2	4,500					4,500
Training Center 500m^2@ 80,000Rp/m^2	30,000	10,000				40,000
Furnishing and Equipment	15,000	12,000				27,000
Office Equipment	5,000	5,000				10,000
Audio-Visual equipment	9,000	6,095				15,095
Library	1,250	1,250	250	250		3,000
Supplies and visual aid materials	1,225	2,400	3,125	3,125	3,125	13,000
Jeeps @ 5,000,000 Rp	10,000	10,000				20,000
Motor Cycles @ 80,000 Rp.	2,400					2,400
Subtotal	78,375	46,745	3,375	3,375	3,125	134,995
Other Costs						
Training Center Costs						
Lodging and meals	1,050	4,200	7,000	7,000	7,000	26,250
Snacks and pocket money	225	900	1,500	1,500	1,500	5,625
Travel expenses	30	120	200	200	200	750
Field Trip Expenses	90	360	600	600	600	2,250
Miscellaneous Training Expenses	300	1,200	2,000	2,000	2,000	7,500
Staff travel expenses	500	600	600	600	600	8,900
Operation, maintenance, replacement and travel costs	5,580	10,080	10,080	10,080	10,080	45,900
Allowances @25% of Personnel Costs	1,172	1,512	1,512	1,512	1,512	7,220
Subtotal	8,947	18,972	23,492	23,492	23,492	98,395
Total	92,013	71,764	32,914	32,914	32,664	262,269

TABLE VI-3

ESTIMATED COST FOR NEW POSITIONS AND OPERATIONS COST FOR KABUPATEN CIAMIS

(Thousand Rupiah)

Position	Yearly Cost per Staff Member	Year 1	2	3	4	5	Total 5 year Project
Personnel Cost							
Soil and Water Resources Coordinator @ 85,000/mo	1,020	1,020	1,020	1,020	1,020	1,020	5,100
Training Offocer @ 50,000/mo	600	600	600	600	600	600	3,000
Asst. Training Officer @ 35,000/mo	420	420	840	840	1,260	1,260	4,620
Conservation Supervisor @ 45,000/mo	540	540	540	540	540	540	2,700
Asst. Soil and Water Coordinator @ 60,000/mo	720	1,440	2,880	5,040	7,920	13,680	30,960
Soil Conservation Officer @ 35,000/mo	420	840	1,680	2,940	4,620	7,980	18,060
Spot Workers or PLP @ 23,000/mo	276	2,208	4,416	7,728	12,144	20,976	47,472
Administrative Officer	335	335	335	335	335	335	1,675
Secretarial and Typing	276	480	960	960	960	960	4,320
Drivers	240	240	720	720	720	720	3,120
Subtotal		8,123	13,991	20,723	30,119	48,071	121,027

TABLE VI-3 (Continued)

(Thousand Rupiah)

Position	Year 1	2	3	4	5	Total 5 year Project
Capital Cost						
Motor Cycle @ 800,000/ea	4,000	8,000	12,000	8,000		32,000
Jeeps @ 5,000,000/ea	5,000	10,000	10,000			25,000
Bicycles @ 30,000/ea	240	360	360	840		1,800
Office Equipment	4,000	4,000				8,000
Supplies and Visual Aid Materials	2,000	2,250	2,250	2,400	2,500	11,400
Subtotal	15,240	24,610	24,610	11,240	2,500	78,200
Other Costs						
Operation, Maintenance and Replacement Cost	2,700	8,100	14,700	17,100	17,100	59,700
Allowances at 25% of Personnel Cost	2,031	3,498	5,181	7,530	12,018	30,258
Training and Education	450	1,700	2,800	2,800	2,800	10,550
Field Demonstration and Meeting Costs	1,000	1,500	2,500	2,500	2,500	10,000
Miscellaneous equipment and tools	655	1,430	3,000	5,342	2,607	13,034
Subtotal	6,836	16,228	28,181	35,272	37,025	123,542
Total	30,199	54,829	73,514	76,631	87,596	322,769

TABLE VI-4

ESTIMATED COST FOR CENTRAL AND SATELITE NURSERIES

(Thousand Rupiah)

Item	Year 1	2	3	4	5	Total
Capital Costs	43,200					43,200
Indirect Costs	12,000	12,000	12,000	12,000	12,000	60,000
Production of Forest Trees	9,000	12,000	18,000	18,000	18,000	75,000
Production of Fruit Trees	37,500	37,500	45,000	45,000	45,000	210,000
Production of Grass Sod		5,250	10,500	15,750	21,000	52,500
Seed Multiplication			6,750	9,000	18,000	33,750
T o t a l	101,700	66,750	92,250	99,750	114,000	474,750

Source : Based on estimated costs for each function and Greening Program standard Costs for Nurseries.

TABLE VI-5

ESTIMATED COSTS FOR 3ha DEMONSTRATION FARM WITH 2ha TERRACES

(Rupiah)

Item	Project	Farmer	Total
First Year Cost			
Preparation and Assistance Cost			
Organization of Watershed Development Committee	25,000		25,000
Meeting Place for each Village	100,000		100,000
Desa Conservation Technician 10,000 Rp/mo. for part time position	120,000		120,000
Record keeping costs	7,000		7,000
Soil surveys 3.27ha @ 3,060 Rp/ha	10,000		10,000
Maps and Aerial Photographs (6,000 Rp/ha)	18,000		18,000
Subtotal	280,000		280,000
Terracing Costs (with Waterways)			
Surveying & staking	72,000		72,000
Terrace Construction		455,000	455,000
Constracting Waterways and Diversions	5,000	50,000	55,000
Constructing drop structures	5,000	60,000	65,000
Revegetating water ways and terrace risers		73,000	73,000
Materials (bamboo, stone and grass sod)	183,000		183,000
Subtotal	265,800	638,000	903,800
Other Conservation structures 1/	50,000	122,000	172,000
Agricultural Inputs (based on 1.28 ha cropped bench)			
Improved Seeds (25,516 Rp/ha x 1.28 ha)	32,660		32,460
Fertilizer (550 kg/ha @70Rp/kg x 1.28 ha)	49,280		49,280
Insecticides (3 liters @ 1,500 Rp/1 x 1.28 ha)	5,760		5,760
Sprayer @ 50,000 Rp.	50,000		50,000
Honeybee Hives (2 @ Rp.17,000)	34,000		34,000
Livestock (sheep) 16,000 Rp. each x 5	80,000		80,000
Fingerlings 100 kg @ Rp 925/kg	92,500		92,500
Subtotal	344,200		344,820
Total first year cost	940,000	760,000	1,700,000
Second through Fifth Year Annual Cost			
Dosa Conservation Technician (10,000 Rp/month)	120,000		120,000
Record Keeping costs	5,000		5,000
Watershed Development Committee Costs	10,000		10,000
Farmer Tour and education costs	23,000		23,000
Improved seeds (26,000Rp/ha x $\frac{1}{2}$ x 1.28 ha)	16,280		16,280
Fertilizer (300Kg/ha @ 70Rp/kg x 1.28 ha)	26,880		26,880
Insecticides (2 liters @ 1,500 Rp x 1.28 ha)	3,840		3,840
Total per year	205,000		205,000

1/ May include fishponds, diversions and gully control structures.

TABLE VI-6

CONSERVATION TERRACE COST ESTIMATE

15 PERCENT SLOPE AND 2 METER VERTICAL INTERVAL

	Unit	Unit Cost	Quantity	Total Cost Rp/ ha	Project Rp./ha	Farmer Rp./ha
Field Preparation-						
surveying	md	500	30	15,000	15,000	
Staking Fields	md	500	5	2,500	2,500	
Terrace Construction 1/	md	500	250	125,000		125,000
Constructing waterways and diversions	md	500	30	15,000	1,000	14,000
Construction Drop Structures	md	500	45	22,500	1,500	21,000
Revegetating Terrace Channels	md	500	5	2,500		2,500
Subtotal, Labor		500	365	182,500	20,000	162,500
Materials						
Bamboo for drop and staking	pc	200	100	20,000	20,000	
Stone 1/	m^3	3,700	4	14,800	14,800	
Grass for sodding and sprigging	m^2	12	200	2,400	2,400	
Subtotal, Materials				37,200	37,200	
Total Estimated Cost				219,700	57,200	162,500
Contingencies (5%)				10,985	10,985	
Eng. Design (5%)				11,535	11,535	
Eng. Supervision & Adm. (10%)				24,220	24,220	
Total Structural Cost				266,440	103,940	162,500
Incentive Agricultural Inputs						
Improved seeds or plants				16,000	16,000	
Fertilizer 200 kg @ 70 Rp./kg				14,000	14,000	
Insecticides 1 liter @ Rp. 1,500/l				1,500	1,500	
Subtotal				31,500	31,500	
Total Cost of Conservation Terracing				297,940	135,440	162,500

1/ Based on 750 m^3/ha and a production rate of 3.0 m^3/md

2/ Stone cost estimated at Rp. 1,200/m^3, plus hauling 10 km @ Rp. 250/km/m^3.

TABLE VI-7

BENCH TERRACING COST ESTIMATE
(25% slope and 120 cm vertical interval)

Item	Unit	Unit Cost Rp.	Quantity	Total Cost Rp/ha	Project Rp/ha	Farmer Rp/ha
Labor						
Field Preparation-Surveying	md	500	64	32,000	32,000	
Staking Fields	md	500	8	4,000	4,000	
Terrace Construction 1/		500	455	227,500		227,500
Constructing Waterways and Diversions	md	500	55	27,500	2,500	25,000
Constructing Drop Structures	md	500	65	32,500	2,500	30,000
Revegetating Waterways and Terrace Risers	md	500	73	36,500		36,500
Subtotal, Labor			720	360,000	41,000	319,000
Materials						
Bamboo for Drops and Staking	pc	200	150	30,000	30,000	
Stone 2/	m^3	3,700	7.0	25,900	25,900	
Grass for Sodding Risers and Waterways	m^2	12	3,000	36,000	36,000	
Subtotal, Materials				91,900	91,900	
Total Estimated Cost				451,900	132,900	
Contingencies (5%)				22,600	22,600	
Enginering Design (5%)				23,700	23,700	
Engineering Supervision and Administration (10%)				49,800	49,800	
Subtotal, Structural Cost				548,000	229,000	319,000
Incentive Agricultural Inputs						
Improved seeds (25,000 Rp/ha x 0.64)				16,000	16,000	
Fertilizer (300 kg @ 70 Rp/kg)				21,000	21,000	
Insecticides (2 liters 1,500 Rp/l)				3,000	3,000	
Subtotal				40,000	40,000	
Total Cost/ha of Bench Terracing				588,000	269,000	319,000

1/ Based on Panawangan experience of 455 md/ha, or a production rate of 3.0 m^3/md and 1,356 m^3/ha (Appendix D).

2/ Stone cost estimated at 1,200 Rp/m^3, plus hauling 10 km @ 250 Rp/km/m^3.

TABLE VI-8

ESTIMATED COST OF STRUCTURAL MEASURES

(1979 Rupiah Values)

Structure	Unit	Estimated Cost	Contin-gencies	Engineering Design	Engineering Supv. & Adm.	Total Cost
Bench Terraces 1/	ha	451,900	22,600	23,700	49,800	548,000
Conservation Terraces 1/	ha	219,700	10,985	11,535	24,220	266,440
Critical Area Planting	ha	501,000	25,050	5,260	10,630	541,940
Diversions	km	231,000	11,550	12,100	25,450	280,100
Gully Control Structures :						
Ruble masonry (7.0 m^3 average)	no	103,950	5,200	5,450	11,500	126,100
Loose Rock Drop/Checks (4.5 m^3 ave)	no	28,000	1,400	1,470	3,090	33,960
Looose Rock Drop/Checks (1.0 m^3)	no	6,350	320	330	700	7,700
Gabions (7.0 m^3 ave.)	no	74,350	3,700	3,900	8,200	90,150
Bamboo Wattle Checks	no	5,400	270	280	595	6,545
Bamboo Wattle Checks with stone dissipators	no	7,500	375	390	825	9,090
Erosion Proofing Existing Road		2,681,600	134,080	140,780	295,650	3,252,110
Constructing New District Road		7,778,000	388,900	408,300	857,500	9,432,700

1/ Includes the cost of waterways and drop structures but not the cost of incentive agricultural inputs.

Detailed cost estimate calculations are contained in Appendix B.

TABLE VI-9

REFORESTATION PLAN FOR THE CITANDUY WATERSHED

CRITICAL LANDS OUTSIDE THE FOREST UNDER PELITA III

FOR THE GREENING PROGRAM

(Hectares)

District/Subdistrict	Critical Area at start of Pelita III	Year 1 1979-80	2 1980-81	3 1981-82	4 1982-83	5 1983-84
Tasikmalaya						
Ciawi	950		450	500		
Cineam	300		300			
Cisayong	(25)					
Indihiang	(42)					
Manonjaya	757	157	300	300		
Pagerageung	780	45	335	400		
Cibeureum	510	331	179			
Subtotal	3,297	533	1,564	1,200		
Percent	100.0	16.2	47.4	36.4		
Ciamis						
Panumbangan	1,691	223	668	800		
Panjalu	1,744	669	575	500		
Panawangan	595	180	265	150		
Kawali	495	495				
Cipaku	200	200				
Rajadesa	808	725	83			
Rancah	1,624	300	824	500		
Cisaga	577	75	502			
Banjar	843	110	423	310		
Cimaragas	4,083	230	953	1,600	1,300	
Pamarican	7,743	250	2,150	2,500	2,843	
Cihaurbeuti	712	125	287	300		
Ciamis	1,319		319	500	500	
Cikoneng	2,361		1,000	1,361		
Kalipucang	2,000	641	659	700		
Padaherang	4,289	477	812	1,500	1,500	
Banjarsari	5,444	196	1,248	2,000	2,000	
Cijeungjing	1,457		457	600	400	
Subtotal	37,985	4,896	11,225	13,321	8,543	
Percent	100.0	12.9	29.6	35.1	22.4	

TABLE VI-9 (Continued)

District/Subdistrict	Critical Area at start of Pelita III	1 1979-80	2 1980-81	3 1981-82	4 1982-83	5 1983-84
Kuningan						
Subang	234	128	106			
Percent	100.0	54.7	45.3			
Majalengka						
Cikijing	520		520			
Percent	100.0		100.0			
Cilacap						
Dayeuhluhur	1,627	603	1,024			
Wanareja	2,170	1,035	1,135			
Majenang	1,525	866	659			
Cimanggu	3,170	478	692	2,000		
Karangpucung	3,961	3,291	670			
Sidareja	222	222				
Gandrungmangu	150		150			
Subtotal	12,825	6,495	4,330	2,000		
Percent	100.0	50.6	33.8	15.6		
Total	54,861	12,052	17,745	16,521	8,543	
Percent	100.0	22.0	32.3	30.1	15.6	
By Sub-basins:						
Upper Citanduy	9,425	493	4,261	4,671		
Cimuntur	5,292	1,929	1,563	900	900	
Cijolang	4,127	1,351	2,126	650		
Cikawung	11,341	5,887	3,454	2,000		
Ciseel-Lower Citanduy	24,676	2,392	6,341	8,300	7,643	
Total	54,861	12,052	17,745	16,521	8,543	

Source: Planning, Reforestation and Greening Project for the Citanduy River Basin

FIGURE VI-1

UPPER WATERSHED DEVELOPMENT PROGRAM
SOIL AND WATER RESOURCES

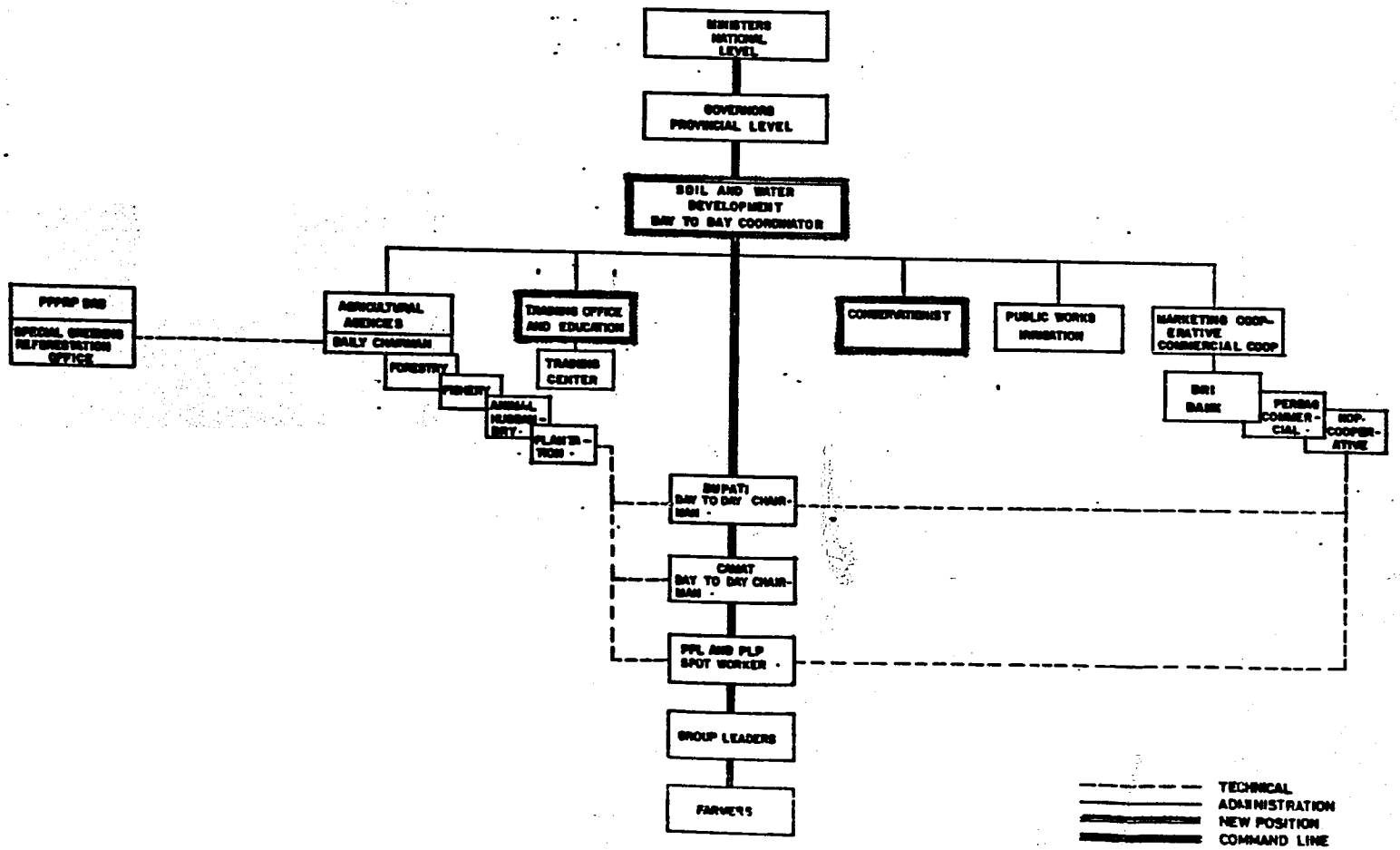
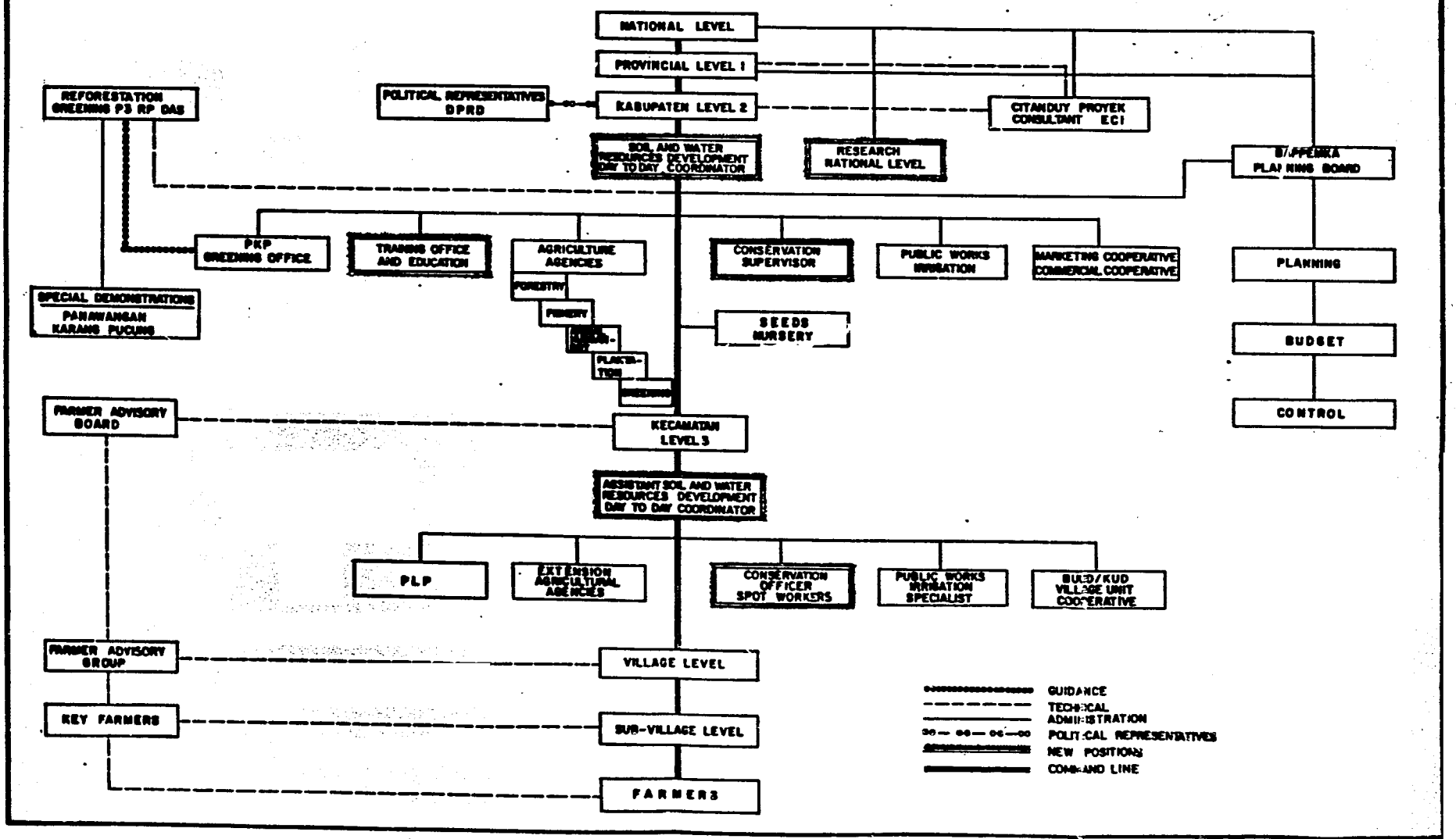
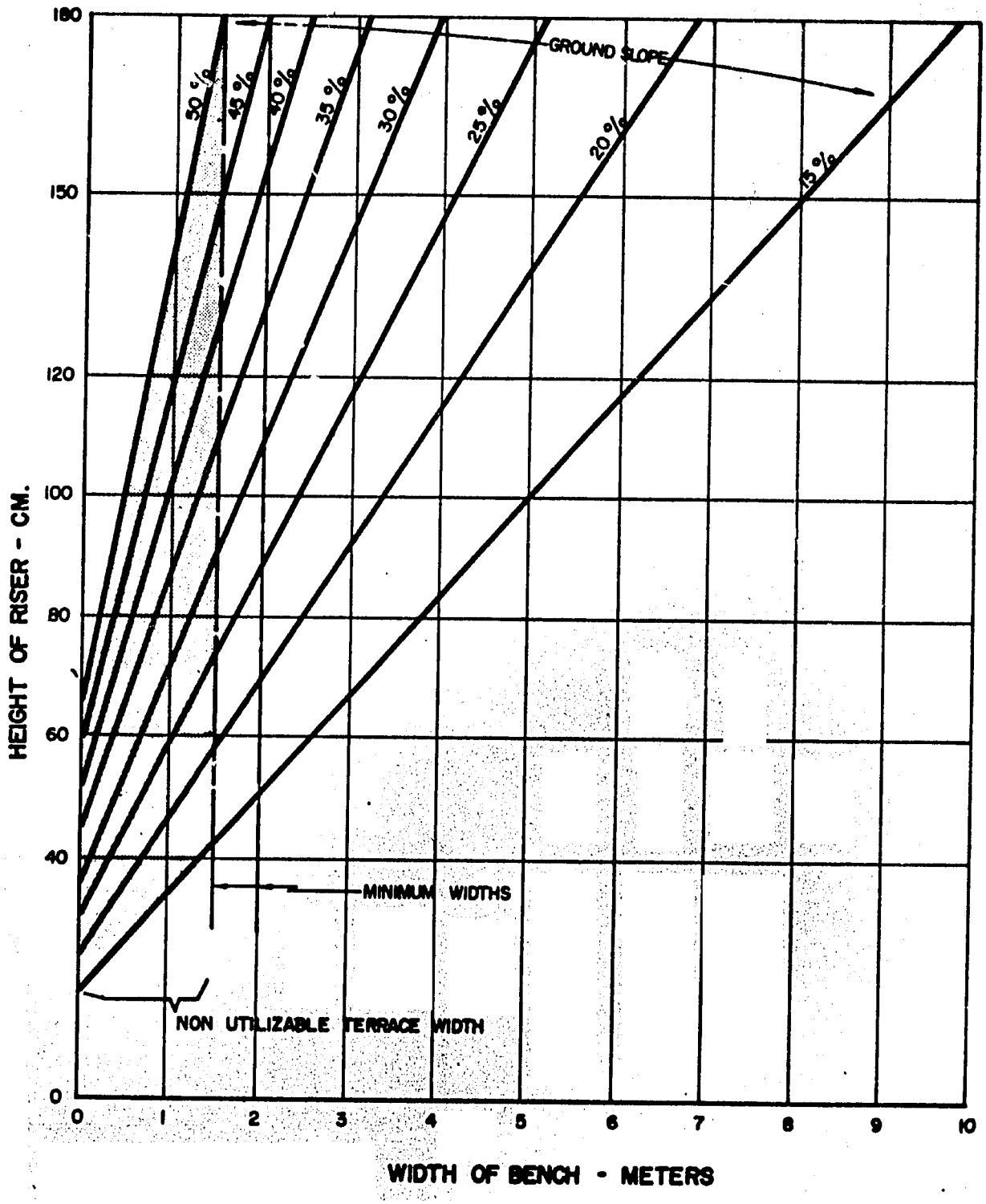


FIGURE VI-2

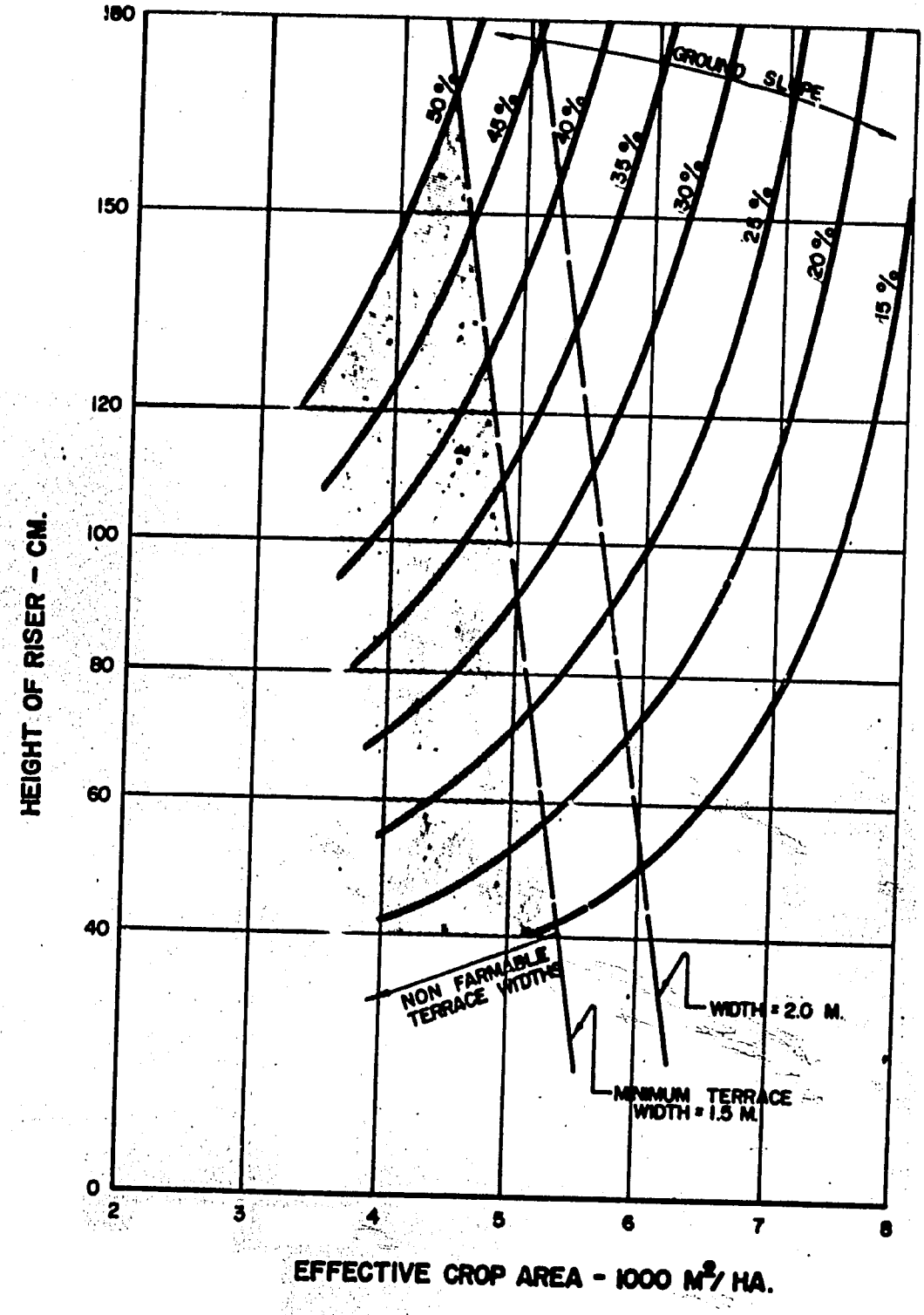
UPPER WATERSHED DEVELOPMENT PROGRAM
SOIL AND WATER RESOURCES





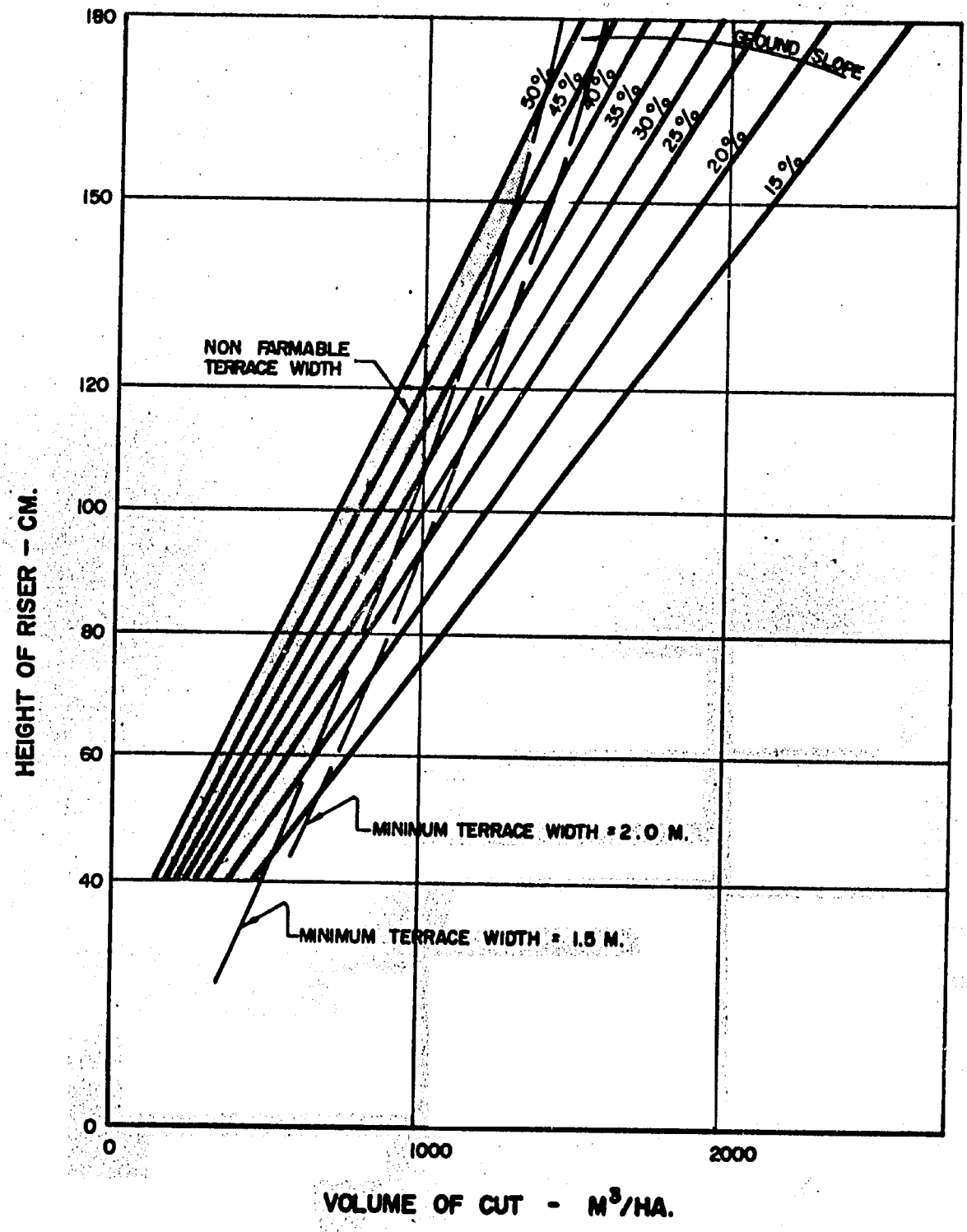
CITANDUY UPPER WATERSHED PROJECT

EFFECTIVE CROP WIDTH
REVERSE SLOPE BENCH TERRACES



CITANDUY UPPER WATERSHED PROJECT

EFFECTIVE CROP AREA
REVERSE SLOPE BENCH TERRACES



CITANDUY UPPER WATERSHED PROJECT

VOLUME OF EXCAVATION

REVERSE SLOPE BENCH TERRACES

CHAPTER VII

PROPOSED INTEGRATED WATERSHED MANAGEMENT PROJECT

Introduction

The integrated watershed management program for the Citanduy River System was developed with an awareness that the watershed problems are really "people problems" that have physical and technical constraints on their solution. The Citanduy Watershed has an estimated population of 2.2 million people in 1979, and it is increasing at about 27,000 people per year. The general average population density is 639 people per km^2, but in the Upper Citanduy Subbasin it is about 1,100 people per km^2. The well being of these people was the central consideration in developing the Watershed Management Program for the Citanduy Watershed.

The Citanduy Watershed is a complex, interrelated system; consequently, it is logical to develop the Watershed Management Plan for the entire 350,000 ha watershed as a unit. This concept parallels the "one river one plan" concept requested by the Minister of the Environment, Dr. Emil Salim. Using this approach, the "Upper Watershed" is defined as all areas lying above the lowland rice fields, or those subject to erosion. This definition is strengthened by the fact that most villages, and many of the farmers, have both lowland rice fields and upland crops or home gardens. Therefore, the proposed integrated Watershed Management Project was developed for the entire Citanduy River Watershed of 350,000 ha but without any inputs to the irrigated and rainfed ricelands. The Watershed includes land in the Tasikmalaya, Ciamis, Kuningan and Majalengka Districts of West Java, and the Cilacap District of Central Java. The present condition land use by subbasins is summarized in Table VIII-1.

Time did not permit a detailed examination of all the specific conditions and data that will be required to develop a complete soil and water conservation development program, even less a total watershed management program. At a very minimum it will take at least ten years to begin solving the watershed management problems that have been developing over the last fifty years. Then constant vigilance and maintenance will be required to ensure that deterioration of the watershed condition does not begin again.

Existing development programs in the Citanduy Watershed are complex, costly, and not documented in a manner that permits an analysis of even the total annual expenditures. After considerable effort, the consultant determined that this analysis was not feasible and perhaps not relevant to the Project development. Therefore, the Project development and budgeted costs do not include any funds for existing programs. Although this approach could lead to some duplication of funds, it is unavoidable. Since the primary direction of activities is through the Bupati this duplication will not be serious, because he and his staff can make needed corrections in the specific budget allocations. The exception to this cost analysis was to include the estimated cost of the greening programs on private lands at an estimated cost of Rp.35,000 per ha for all of the lands listed in Pelita III planned program for years two through five as listed in Table VI-9. This amounted to 1,498.3 million Rupiah (Table VII-8) and did not specifically include any of the overhead or administrative costs associated with the program at other than the local level.

A complete upland soil and water conservation program system requires special techniques and direct assistance to the land operator and is more complicated than downstream irrigation and water management programs. The costs and risks involved are determined by the soils, hydrologic requirements, and the conservation measures required to control the destructive factors of erosion, sedimentation and flooding within the watershed. The cost of implementing such a program will depend on how rapidly the farmers can accept and apply conservation measures and development, which in turn is a function of their individual resources (physical, human and economic) availability. To attempt to move faster would very likely be a waste of funds, scare resources, and a

possible loss of the program.

The farmers' welfare requires that the entire land and water resources conservation development program be analyzed to make certain that the farmer operator can continue to satisfy the needs of both his family and the land with the resources available. To accomplish this community action by all local people will be required. Government cooperation of both technical and administrative personnel, together with educational assistance and development incentives will be required to carry out a unified soil and water resource development program. However, all of the financial and technical assistance that can be provided by the government will be of little value if the support and cooperation of the provincial, district, village authorities, and the farmers themselves is not first obtained. The Panawangan Pilot Watershed Project has shown that, to be successful, Project features must be adopted by the farmers as their own rather than as the government's project. To accomplish this it is absolutely necessary that the Project features be developed from the farmer level upward, rather than the common government practice of developing projects from the top downward.

As previously stated, a review of the needs and problems of the upper watershed program clearly discloses that the present governmental organizations and current programs for solving the watershed problems do not meet its needs. There are a number of reasons for this, but foremost among them is the multiplicity of programs involved. There are literally so many programs that it is almost impossible for the Bupati or the planning board to keep track of them. Secondly, all of these programs are underfunded and understaffed with qualified people. Since each of these programs must show progress, each attempts to show that it is successful and to conceal any failures from the officials at higher levels in the government. The technical knowledge and potential benefits from the greening programs are not passed on to the farmers, the assistance in maintenance is given for only one year; land taxes are still levied at agricultural cropland rates, and ultimately much of the land is back in upland crop production without conservation practices. These factors have resulted in a situation where during Repelita II the number of hectares reported as being rehabilitated was over two times the original critical area, and the critical area outside the forest at the

end of Repelita II was 172 percent of the amount at the beginning (Table II-19).

In addition, many provincial government officials tend to regard forest products as a means of income and tend to allow timber harvesting where it would be better to preserve the timber resource. The people's traditional use of wood for fuel in their households or manufacturing activities (tiles, lime, brick making, etc.) is widespread and requires the clearing of a significant area of forest or plantations each year. There is a real need for a program to develop fast growing fuelwood species for vegetation activities. There also needs to be a concurrent program to show farmers of steep upland areas that they can make good returns on a system of agroforestry, providing they have sufficient land. Where the land units are too small the government programs will need to focus on providing the farmers with economic units.

Multiple-Use Planning

In looking at the complex problems of the Citanduy Watershed it is apparent that the government action programs to date have not been sufficient to solve the problems of these areas as they develop. There is no specific assurance that the proposed integrated Watershed Management Program will solve the problems of the Watershed; its success depends upon long term commitment to the program with sufficient funding and staffing by qualified administrators and technical people.

As previously stated, the Integrated Watershed Management Program proposed for the Citanduy Watershed will require multiple-use planning to fully utilize the resources of the basin in solving the upland watershed problems. It is also recognizably difficult to bring the upland farmer into the multiple-use planning process; consequently this term, "multiple-use", probably should not be used with farmers. The important feature that should be stressed to the farmer is that this planning provides a possible means for him to do a better job of farming so his family can live better. In this context, multiple-use planning can be seen as making maximum use of the farmers' resources, while at the same time protecting the environment and reaching as many specific governmental goals as possible. The important goal of the process is

that with the farmer's knowledge of the reasons why he is making the changes it becomes his plan. Therefore, the government's objectives will not be reached rapidly, but the gains that are made are more apt to be permanent.

In the initial stages the multiple-use planning should concentrate on planning for the small hydrologic unit of the demonstration farms, then expand to other farm groups that also wish to participate in the planning and application of conservation measures and improved agronomic practices to their farms in the mini-watershed area.

Research and Demonstration

A research and demonstration program is needed to develop an understanding of the relationship of climate, natural and land use factor to runoff and erosion as well as to determine the best methods of reducing damages to the environment. But a larger need exists to develop additional high yielding crop varieties and cropping systems that produce a maximum income to the upland farmer while providing better ground cover and reducing soil losses from erosion. Also there is a need for a great deal of farm management information on costs and returns for specific production practices on all of the upland for both traditional and upland crops. Information is also needed on the specific benefits and costs that can be expected from bench terracing various slopes in different parts of the watershed. Social surveys to determine program acceptability and development progress are also a must for the Watershed Management Program to succeed.

Demonstration of research results is perhaps as important as the research itself. This is one of the reasons why the research farm should be implemented in the Citanduy Watershed even though the specific direction for the Program would be at the national level. It is very important for the district technical staffs to visit the experimental farm areas and to obtain the newest information and varieties from the research staff. The research staff must document its results and publish the results of both successful research, and the failures that always occur and are so often kept a secret. Current and complete knowledge is important, both for the implementation of successful practices and to

prevent the use of conservation practices or crop varieties that are known to have failed.

The development of an interdisciplinary research program and research station is very difficult even in developed countries, which is one of the reasons why the specific direction should be handled at the national level. The inclusion of socioeconomic researchers in the staff will bother many of the older traditional staff members, as will the procedure of reviewing and testing the results of other countries' research for specific applications to the Citanduy Watershed. Dedicated applied researchers are needed who are looking for specific ways to help the upland farmers -- not researchers who are looking for the opportunity to do earth-shaking basic research that will establish their reputations. It is also very important that the interdisciplinary staff of the station be officed together so that through communication each of the technical specialities can make a maximum contribution towards improving the well-being of the Watershed residents.

The qualifications of the Agricultural Research Institute at Bogor (Lembaga Pusat Penelitian Pertanian or LP_3) are well known. The consultant has not made a recommendation for an organization to supervise the research experiment station because this decision should be made by the central government of Indonesia.

Criteria that should be considered in the selection of the research station site for the Upland Watershed include:

1. Eroded areas should be representative of major soil types and land capability classification units;
2. Variation in slope should be great enough to include the steeper slopes as well as the intermediate and flatter slopes;
3. The most difficult land conditions should be on the research station site, or on specific substations;
4. The research station should not be located in or near a densely populated area;

5. A dependable water supply is needed;

6. Access to the station headquarters should be by an all weather road; and

7. Station site conditions must be representative of the Upper Watershed area.

Participation Incentives

Participation incentives are recognized as being essential to securing cooperation in the application of many conservation practices, and in some cases for the adoption of new crop varieties or cropping systems. They are easily justified if the Project requires a farmer to make a change that may not be advantageous to him. Hence, the government should compensate the farmer for any losses he may incur. The government is also interested in the long-term use of resources while the farmer has a much shorter term viewpoint. In the United States and other developed countries it has been found that this cost sharing or participation incentives sometimes amount to one-half the total cost of the conservation practices application. This should probably be considered the upper cost limit of incentive project participation for the Citanduy Upper Watershed.

The participation incentives should definitely be kept to a minimum level that will still encourage the farmers to participate because of the danger that the farmers may decide that it is a government project, whereby it will also be the government's responsibility to perform maintenance, repairs or even operate the system. This is the reason why the government's contribution to the cost of bench terracing was set at Rp. 269,000 out of a total estimated cost of Rp. 588,000 per ha (Table VI-7). But the specific cost sharing rates should remain flexible until enough experience is gained to identify the individual beneficiaries of the practice with sufficient accuracy to determine the proper cost allocation. Certainly, in the case of upland farmers the ability to pay is a definite criterion. Most farmers are extremely limited in their ability to pay for purchased inputs, but they may be able to provide much of the necessary labor for installation of project conservation measures.

With the information available, specific incentive payments were only suggested for erosion proofing of roads and trails, bench terracing and the establishment of demonstration farms. The balance of cost sharing was listed "other conservation measures" and the cost estimated as being equal to 20 percent of the cost for bench terracing. Obviously, the smaller the government incentives the more project measures that can be installed with the limited funds available. At the same time smaller incentives prevent the farmer from expecting continued incentive payments after a practice has become adequately established. In many cases, after the farmers begin to adopt a practice on their own, the incentive payment should be completely discontinued because this practice pays for itself and there is no need for the government to encourage its continued adoption.

Complementary Supporting Activities

To broaden the scope of the work in the Watershed from strictly an erosion control project to that of a true integrated Watershed Management Project will require the addition of many supporting activities. Included in the primary project support activities would be the research experiment station costs, the nursery costs, farm credit program, and the general category of infrastructure improvement costs. All of these special purpose programs and activities will be needed to support the establishment of the conservation works in the Watershed. In a sense, all of the national, provincial, and Kabupaten staffs also provide a form of support activity to the direct application of project measures.

Since the Upper Watershed area provides only a subsistence standard of living for most of the population, the growth in application of conservation measures correlates with the success of the project in raising the standard of living. The farmer must have at least the potential for a surplus above his basic needs before he can accept the risk involved in adopting new practices. The present trend in the Citanduy Upper Watershed area is towards a constant soil degradation due to exploitive land use. If this type of use continues, the productive capacity of much of the land will be irrevocably lost through erosion and soil destruction.

The challenge in overcoming the relatively high erosion rates is great in both the short and long term development period. National awareness of the erosion problem on upper watersheds is growing but there is a serious tendency to underestimate the problem and to believe that all that is needed is a good program and the streams will run clear again. In watersheds such as the Citanduy, this can never happen because population pressures are too great. In fact, without a long term committment to the integrated Watershed Management Program, together with the appropriate fiscal and monetary policies, there will not be a long term reduction in erosion damages for the Citanduy Watershed.

Education, health and population control are the most important complementary activities to the Watershed Program, and they must be given increasingly higher priorities in the government programs. The economic and social benefits from this investment in upgrading human capital will be considerable, including the assurance of better use of all the potential and available resources of the Watershed.

An adequate physical infrastructure providing roads, water, electricity, and local manufacturing industries is obviously necessary for economic growth in the area and the long-term improvement in the quality of life of the residents. One of the serious social problems of the area is the lack of economic opportunity outside of agriculture. Therefore, all infrastructure development programs are complementary to the Watershed Management Program.

The importance of expanding employment opportunities exclusive of agriculture cannot be overemphasized. Village employment opportunities can be expanded by the creation of an electric supply to run sewing machines or to develop cottage industries. The small hydro-electric system constructed above the village of Guranteng in the Taskimalaya District is a good example of this needed development. This unit plus the distribution system reportedly cost 3.5 million rupiah and provides electricity for 250 families, and during the day provides the water power for threshing rice. There are many sites in the upland where a diversion weir and a low head hydro-electric generator system can provide low cost electricity and greatly improve the standard of living

of the villagers. Other infrastructure development projects of this type should be developed as a part of the total economic development program for the Upper Watershed areas.

Watershed Management Program Development

A Watershed Management Program requires an interdisciplinary approach and the coordination of all government and private groups or agencies toward the concurrent development of the physical land resources, the human resources, and the local, district, provincial, and nation infrastructure. No single existing agency, group, or department of government has the expertise or administrative jurisdiction required to improve the physical and social conditions necessary to conduct the required soil and water development program. For Indonesian conditions, however, it is strongly suggested that this program be accomplished by strengthening the existing governmental structure and not by creating a new agency to solve the erosion problems of areas such as the Citanduy Watershed.

It should be recognized that for lasting improvement, the first step in planning a soil and water conservation development program, is to improve the economic and social well being of the farmers and the community as a group. This often involves improvement in the educational level of the people so that they can understand the necessary improvements and the need for the conservation approach. For lasting improvements it is necessary that the people become involved in the total program so that it can become their program.

One of the first major activities of the watershed program development is to make an inventory and analysis of the resource base upon which the development programs must be based. This base-line data not only provides the basis for optimum project development, but it is also the standard from which to base an evaluation of project accomplishments during the project period. Fortunately, the U.S. Agency for Internation Development has plans to initiate a socio-economic base-line survey in the Citanduy Watershed in 1979. This will provide a starting

point for program development for infrastructure development and identification of people problems. After project implementation a great deal of soils, land capability, agronomic, animal husbandry, fisheries, forestry, and farm management data will be required. This is one reason why it is very important to research the available data to avoid duplication of effort and waste of limited funds.

The use of existing governmental line organization through the provincial governor and the Bupati's will prevent duplication of effort from different agencies at least to some extent. Nevertheless, this is almost certain to be a problem in the early phases of the program development, and it will require strong leadership on the part of the governor's and the Bupati's to minimize the problem of interagency conflict.

A complete soil and water resource development program requires a reorientation of the whole structure of extension education and assistance to the upland farmer. In part, it may be an advantage that this has been non-existant because the program can be developed from inception. The land owner and/or the operator must be a part of the decision-making process because he will be the person to put the plan into operation. This cooperative approach with the farmer can enhance and smooth the implementation of all economic, social and education activities together with the new cropping practices, bench terraces, erosion control structures, and other technological improvements. Improvement in the standard of living by the farmer and his family will also improve the structure of the communities and their ability to use the cooperative approach to solving their problems. The objective of this approach is to get the Watershed Management Project developed from the bottom up instead of by edict from the government bureaucracy.

Training Programs

The training of the professional and non-professional staff for the Citanduy Upper Watershed Management Project is one of the more critical items for project implementation. If the professional staff members do not understand the causes and effects of soil loss, the proper use of bench terraces and other conservation measures, and the agronomic techniques for increasing upland crop production while protecting the land, the proposed integrated watershed management project cannot be accomplished. More important, the staff needs to be truly interested in helping the upland farmers and the rural communities to solve their problems and in educating all of the people to recognize the erosion problems of the watershed. Perhaps the most difficult problem to overcome is the natural elitist attitude of the college graduate to the point of where he personally works directly with the farmers to develop a true multiple-use plan for the demonstrations farms that reflect the farmers' viewpoint. Exclusive communication between technical professionals is very satisfying, but it will solve very few problems for the upland farmers. Only when all of the staff really work with the farmers can the training and motivation of the farmers be accomplished.

There are very few trained people in the field of upland agriculture. In fact, there are only a few courses in the best universities that can be directly recognized as essential in producing the professionals required to lead a large scale program. Therefore, it must be recognized that several years will be required to develop a cadre of people who are well qualified to lead the integrated Watershed Management Program for the Upper Citanduy Watershed.

Foreign Training

There is a real need to train managers and technical staff to supervise and train others for the implementation of an intergrated Watershed Management Program. These people should all be intermediate level executives of the Indonesian Government. Staff chosen for this training should initiate their advanced technical or administrative training program in the early years of the project so that they would be

able to assume executive positions while the consultants are still available for advice and further training.

It is recognized that local educational institutions have not been able to satisfy the demand for highly trained specialists in some fields, and that there is no program to specifically train upland agronomists, watershed managers, resource economists or agricultural engineers for solving the special problems of upland watersheds. Most of the foreign training component should occur in these fields. It is not uncommon, however, to find overtrained experts who discover that their skills learned in the United States, or other developed countries, cannot be applied in their home country. This situation should be avoided by a careful training program specifically designed to train the individual for the specific position. There should also be a commitment by both the Indonesian Government and the trainee that the individual selected for training would serve in the specific position for a certain time period. It does little good to train a person in a specific field, then make a general administrative staff member of him. At the same time this should not be allowed to discourage the development of the individual's managerial capabilities.

The foreign training program is concerned with human development, and while the cost estimates were based on attendance at state institutions in the United States, the specific courses and type of training should be tailored to fit the qualifications and requirements of each candidate. Where possible, training in upland agronomy, forestry, and conservation practices should be conducted at a school which specializes in tropical conditions. The University of the Philippines is a noteable example, with the advantage that it would be possible to send about twice as many people for a specific cost.

The cost estimate was based on 10 man-years of attendance at formal courses in recognized institutions (Table C-6). The foreign training program is estimated to have a total cost of 104.4 million Rupiah (US $167,000). This expenditure was scheduled over the first three years of the project in the belief that the trainees should all complete their training and return in time to have the opportunity of working with an experienced consultant before they are on their own in the new position.

Staff Training

The specific program for staff training can be developed by the Provincial Soil and Development Day-to-Day Coordinator and the Senior Training Officer only after the Project has been funded and most of the staff hired. To a large extent the same problem will be faced by the district training officers, but they will have the provincial training program to assist them. In general, the staff members will all need considerable training in the interdisciplinary approach to watershed management and improvement in upland crop production together with the specific knowledge of the causes of erosion and the available means of reducing it.

The training component will have to be conducted by the available technical staff, the consultants staff, individual specialists from the research station, and to some extent by the university specialists. Staff training is a continuing need, both to aid in the development and promotion of existing staff to positions of greater responsibility, and to train new staff as they enter the system.

Staff training as will be primarily a function of the provincial training office and center. It is strongly suggested that these training centers be established within the Watershed. The specific reason for using provincial training centers is that they are less expensive than district operation. During project implementation the West and Central Java Provinces may even find it advantageous to develop a single training center. While staff training and retraining is the principal function of the provincial training centers, they should be used to develop conservation handbooks for staff training and to develop special educational materials for the schools.

It is very important that the staff training program attempt to develop an interdisciplinary approach using all technical fields of knowledge to solve the farmers' problems, and to develop among the staff a respect for the capabilities of the other disciplines providing a contribution to the Program.

Farmer Training

The farmer and family training program should be relatively continuous and low key, and it should always be pitched at the individual level of understanding and vocabulary. The initial training program should concentrate on directly benefiting the farm family by means that are within the resource capabilities of the individual family and by the assistance available from government incentive programs. If the program shows some success, even though small, it can do much to sell the later phases of the Watershed Management Program.

The demonstration farm is a valuable farmer training device, which is the reason why it is so important that it be successful. The governmental declaration plus a sign signifying the fact does not make a demonstration farm unless it happens to be a demonstration of what not to do. The Panawangan experience shows that constant interest, dedication, and application of many technical specialists are required for the demonstration farm to be successful.

School System Training

Some districts already have a conservation education program in their school system, which is very important because children teach their parents by discussing what they have learned in school. Therefore, it is very important that the teachers of conservation receive adequate training and educational materials to make the children's education and understanding of erosion and surface runoff problems factual and interesting. Without this training and availability of training materials, conservation education in the schools often amounts to only a tree planting exercise.

Agricultural

The proposed project for agriculture and forestry was based on the concept that the primary control of soil and water problems is exerted by vegetation and that all efforts at improvement should be based on increasing the vegetative cover for control of erosion and runoff. Even land that is bench terraced will suffer erosion damage if

it is not protected by a good vegetative cover. It should be noted that the real reason for bench terracing is to improve the condition of the land resource for crop production. Terrace are not built to prevent erosion, they are built to increase the production of food crops over the long-term. Unfortunately, the building of terraces actually reduces the net croppable area so that it is necessary to use a complete agronomic development package to produce the desired increase in net production.

A reduction in erosion rates (soil loss) is accomplished by protecting the soil with vegetation or other cover, and/or by reducing the velocity of moving water. The agricultural program also recognizes that the increased erosion rates in the Citanduy Watershed are caused by man-caused imbalances between vegetative cover and the soil-climate-landform conditions of the watershed. The agricultural development program is, therefore, directed at improving the educational attainment of the farmers as a primary means of reducing the losses from soil erosion and of improving the quality of life for the watershed residents.

The Panawangan Pilot Watershed and the 6.1 ha Demonstration Farm has demonstrated the way to increase agricultural production while protecting the land resources, but it is only the initial effort in this respect. Further, in expanding the Program to the Watershed it will not be possible to provide the personal attention of the consultant staff, the leaders and staff of P_3RP-DAS Citanduy, and the Ciamis planning and technical staff. Even with concentrated effort on the Panawangan area, there were many individual crop failures, structural measures that were improperly installed or never completed, and land areas that were not protected from erosion. If the expanded watershed program is to be implemented in the Citanduy Watershed it will require a specific build-up and learning period. To be successful the agricultural development program must accomplish the transition from one demonstration farm to an estimated 150 demonstration farms, or bench terracing 54.8 ha in two years to bench terracing an estimated 2,250 ha per year. It is somewhat easier to visualize the problem involved if we consider the number of trained technical people required for the Upper Watershed Management Program. Table VI-3 indicates that by the fifth year of the project there would be 120 new technical positions in the Ciamis District, and this can be extrapolated to 270 new positions in the water-

shed. These positions range from the soil and water Resources Coordinator to the spot workers and PLP, but it does not include the Desa Conservation Technicians assigned directly to the demonstration farms.

Also, the development of a true interdisciplinary approach to the Watershed Management Project requires more technical specialists and fields of knowledge than the project budget can provide. The project will have to use the technical expertise of all government agencies, universities, and research stations in Indonesia to solve the many problems that arise. The following sections describe a suggested budget for staff and budgeting that would be needed to implement the Upper Watershed Soil and Water Resources Development Program shown in Figures VI-1 and VI-2, and assumes that existing program funding for other activities in the Watershed will be continued.

Integrated Watershed Management Program Cost

National Level

At the ministerial level, the total cost for the necessary general direction, high level coordination, policy review and decisions, budget preparation, and administrative functions is difficult to ascertain. In lieu of specific estimates for the possible additional costs for the Citanduy Upper Watershed Management Program, a budget of 50 million Rupiahs (US $80,000) annually is suggested (Table VII-8). This would include the cost of the central government day-to-day coordinator necessary to carry out the wishes of the coordination council and to generally supervise the research program at the national level.

The research experiment station cost from Table VI-1 amounts to 377.5 million Rupiah (US $604,000) for the project period. While this experiment station will be directed from the national level, it should definitely be physically in the Citanduy Upper Watershed area, if it is to provide a maximum input to the Watershed Management Program. Total national level costs for the 5-year project, including the experiment station, is estimated at 627.5 million Rupiah (US $1.0 million).

Provincial Level

The proposed budget for the cost of new positions and the training component for West Java is shown in Table VI-2. Because Central Java is only 25 percent of the total area, but has a proportionately larger share of the problems, it is estimated that the Central Java budget should be 50 percent of that specifically budgeted for the West Java Provincial Government Program. Total provincial level budgets for the project period are estimated to amount to 393.4 million Rupiah (US $629,446), which includes the cost of maintaining and operating the two training centers previously described. Each province would have a Soil and Water Resources Development Day-to-Day-Coordinator to specifically supervise the Watershed Management Program in each province, and he would have a Senior Conservationist to assist him (Figure VI-1). The major cost, and in many respects the principal function, at the provincial level is the training center and training program to provide trained staff to implement the integrated Watershed Management Program in each province. As previously stated, the training centers should be located in the Citanduy Upper Watershed portions of Central and West Java.

Kabupaten Level

The major focus of the integrated Watershed Management Program is at the district (kabupaten) level with the specific programs designated by subbasins and ultimately to the individual hydrologic units. All of the staff and equipment for conservation activities within the district are budgeted at the district level to permit the Bupati and his staff to schedule the implementation in the subdistricts and special areas as needed to solve critical problems. This will also enable the Bupati to only implement the program in a subdistrict or hydrologis unit when the people ask for the program and are, in his judgment, ready to take an active part in the planning and development of the Program.

Specific project cost estimates were based on a detailed budget estimate for Kabupaten Ciamis (Table VI-3). The budgets for the other districts were based on the following percentages of the Ciamis budget: Tasikmalaya (45%), Kuningan (10%), Majalengka (5%), and Cilacap (65%). The cost build-up during the 5-year project period was based on

development of the demonstration farm and bench terracing program, which in turn was developed at the rate possible to train the necessary staff to adequately provide the needed technical assistance, supervision, and farmer training, and planning assistance. Total estimated cost for the 5-year project at the Kabupaten level amount to 726.2 million Rupiah (US 1.2 million).

Conservation Works

A number of the specific conservation activities that will be carried out in the individual districts were cost estimated in program development and are discussed in this section.

Critical Area Surveys. One of the most serious deficiencies in the available information is the lack of detailed maps and statistical data defining the extent of critical areas and the type and magnitude of the specific problems in each area. To provide this information for detailed planning and scheduling of project measures will require a concerted effort by a interdisciplinary and interagency team. Critical area surveys are estimated to cost 74.25 million Rupiah (US $118,800) as shown in Table VII-2. To some degree, this activity would be continuous as new problem areas develop and as experience indicates that certain problems are more significant than others. This interagency team should also be charged with the responsibility of determining if the problems in a critical area had been solved or if more treatment was needed.

Detailed Soil Surveys. The cost of detailed soil surveys for demonstration farms, bench terracing areas, and small hydrologic units with an active program were based on an estimated field survey cost of Rp. 3,060 per ha surveyed, plus Rp. 1,240 per ha for base maps and aerial photographs. As previously noted, it has been assumed that aerial photographic coverage of the entire Citanduy Watershed would be available from the Ministry of Agriculture. Table VII-3 provides an estimated schedule for providing detailed soil surveys on over 6,500 ha during the project period at a total cost of 28.2 million Rupiah. If sufficient trained soil surveyors become available this activity should be expanded.

Upland Demonstration Farms. The need for upland demonstration farms has been discussed in previous chapters, and the Panawangan Pilot Demonstration Farm has demonstrated the effectiveness of the demonstration farm approach. The average demonstration farm was assumed to be 3 ha in size with 2 ha terraced. As developed in Table VI-5, the first year cost of each demonstration farm was estimated to be 1.7 million Rupiah, of which Rp. 940,000 was a project cost and Rp. 760,000 was estimated to be the farmer cost of constructing the bench terraces and other conservation measures. Demonstration farms were assumed to be effective for a period of five years with the recognition that this would vary considerably in actual experience. The second through the fifth years of the life of a demonstration farm are estimated to cost Rp. 205,000 annually in estimating the project budget (Table VI-5). After that time they are assumed to revert to normal small hydrologic units.

The schedule for developing demonstration farms is of necessity based on the availability of trained technicians to implement the farms with an assurance of success. In addition to the planning, organization and technical advice, the demonstration farm will normally require the installation of high quality bench terraces with waterways plus other applicable conservation measures. Then, technical assistance and production incentives must be available to allow the farmers to adopt a wide variety of improved agronomic practices for demonstration purposes. Therefore, the proposed schedule for initiating demonstration farms calls for 10 the first year, and a total of 150 for the 5-year project period (Table VII-4). Using this schedule, and the cost estimates for individual demonstration farms, results in an estimated total cost of 296.0 million Rupiah, of which 182.0 million Rupiah is project cost, and the estimated farmer cost of applying the conservation measures is 114.0 million Rupiah (Table VII-5). The project cost of 182.0 million Rupiah (US $288,000) assumes that by the end of the project period there would be 150 active demonstration farms, which in itself would require the terracing of an estimated 300 ha of upland cropland and working intensively with an estimated 900 upland farmers. While this is less than half of one percent of the farmers in the Watershed, they would be very important to the project success. If the demonstration farms are successful their use should be continued and expanded after the project period.

Bench Terracing. The Panawangan Pilot Watershed experience shows that bench terracing is very effective in reducing erosion, and if properly operated and maintained terraces can increase the productivity of the land resource over time. In scheduling the build up of the bench terracing activity it was assumed that the project bench terracing program would closely parallel the development of demonstration farms in the individual subbasins or districts. Table VIII-6 indicates a bench terracing program of 50 ha the first year, and by the fifth year it is estimated that it will be possible to bench terrace 2,250 ha per year, for a total of 4,375 ha during the project period. The Panawangan experience shows that some additional hectares of land will be terraced or have traditional terraces improved by farmers observing the project terracing activities.

The bench terracing program is estimated to have a total cost of 2,572.5 million Rupiah (US $4.1 million) at a cost of Rp.588,000 (US $940) per ha. Of this amount, the project cost is 1,176.9 million Rupiah (US $1.9 million), and the farmer's cost is 1,395.6 million Rupiah, which is 54 percent of the estimated total cost (Table VII-7). The estimated project cost amounts to Rp. 269,000 (US $430) per ha.

Other Conservation Measures. Necessary information is lacking to schedule the application of other conservation measures in the Citanduy Watershed. While these measures have been specifically cost estimated in Table VI-8 and Appendix B, they cannot be scheduled without the critical area surveys and other determination of specific erosion problems. Therefore, when the budget for other conservation measures is estimated by allocating an amount equal to 20 percent of the scheduled bench terracing costs, the project cost would amount to 235.4 million Rupiah (US $376,600). If this amount is not necessary for installing the other conservation measures, the resources should be applied to the application of bench terraces in the Watershed.

Because many of the other conservation measures have not been applied to any extent in the Citanduy River Basin, it is suggested that all of these measures be attempted in the initial phases of project implementation and that a careful evaluation program be conducted to determine their success or failure. This evaluation will permit project

planners to apply the most effective measures to specific problems. In many cases it may be necessary to move some of the farmers from steeper upland crop areas that cannot be treated adequately. These lands would then be returned to permanent cover through agroforestry and the remaining farmers given economic size units through a sale or lease program of these lands.

Road and Trail Erosion Proofing. The roads and trails of the Watershed are suffering considerable damage from erosion, and they are one of the major sources of sediment to the streams and rivers. In most cases it is short segments of road that produce the greatest amount of sediment, and, while it is recognized that the segments suffering severe erosion are mostly on the village roads, there are examples on the provincial roads that need erosion prevention. Without a specific cut slope and drainage ditch survey for erosion damages it is not possible to estimate precisely the needs for erosion proofing. Therefore, the approach taken was to estimate the number of kilometers that could be erosion proofed per year. The estimate was that about 3 kilometers could be erosion proofed the first year, 30 kilometers by the fifth year, and a total of 78 kilometers during the project period. It should be emphasized that this would involve only the treatment of critical erosion road segments not a continuous length road rebuilding program.

As shown in Table VI-8 the estimated total cost of erosion proofing one kilometer of existing road amounts to Rp. 3,252,110. As shown in Appendix Table B-14 the villagers would be expected to provide Rp. 1,084,020 worth of labor, and the project would contribute an estimated Rp. 2,168,090, or 66.7 percent of the cost. The project cost of erosion proofing the planned 78 kilometers of road would be 169.1 million Rupiah (US $270,566), and the villagers would contribute an estimated 84.6 million Rupiah worth of labor.

Nursery Costs. Ideally, in view of the need for planting stock and seeds to establish the soil and water development program, a central nursery would be established in each Kabupaten. Because there are many existing nurseries in the watershed the cost of additional nurseries was estimated based on the function being served (Table VI-4). This cost includes the development of satellite nurseries, necessary to

reduce the cost of transportation and dead seedlings due to distance and communication problems.

Land for the satellite nurseries should be rented, and as they are closed the land returned to upland crop production and the equipment moved. These temporary nurseries can be used for growing out seedlings started at the central nurseries, production of forest and fruit tree seedlings, and grass for sodding drop structures and terrace risers. The central nurseries can also provide for multiplication of new seed varieties.

The location of the central nurseries cannot be projected with the information presently available, but at least one nursery should be built in each subbasin. Total estimated costs for central and satelite nurseries is estimated at 474.5 million Rupiah (US $759,120).

Special Majalengka. As previously noted, data for the Majalengka District was not collected, and this prevented the direct scheduling of conservation measures to this district. Therefore, a single budget item of 18.6 million Rupiah is included for applying necessary conservation works in the Majalengka district.

Infrastructure Improvement

Infrastructure Development. Specific infrastructure improvement needs noted in the evaluation of Upper Watershed problems are primarily related to the provision of nonagricultural employment opportunities. This is also the opinion expressed in the Basic Plan of the Ciamis Second Level Regency Development [1]. Specific infrastructure improvement activities should be concentrated on the promotion of labor intensive activities using local resources in their production. One of the more promising projects for the Upper Watershed development would be the building of small scale hydroelectric plants, or combination irrigation diversions and hydroelectric plants, to provide electricity to villages that can develop a dependable water supply for power. This electricity can be used in many types of small industry, or cottage industries, and could be a major factor in increasing the quality of life in some villages. Development of small irrigation diversions, tea plantations, clove processing plants, small manufacturing plants, roads

to isolated villages, or even special skills training schools are some of the development programs that have been suggested. Certainly, there are more deserving infrastructure development projects that could be developed than there are funds for implementation.

It is suggested that the funds of infrastructure development be put in a special fund for that purpose, to be administered by the national committee, with specific approval of the lending agency for fund disbursement. The suggested amount for this fund is 468.8 million Rupiah (US $750,000). It is further suggested that grants from this fund will always be matched by at least an equal input from the local people, and that all approved projects be with cooperative groups or government unit sponsored.

Farm Credit Program. One of the greatest needs of the upland farmers in developing a good soil and water conservation program with new agronomic technology to increase crop yields is an upland agriculture credit system. The specific program will need to be similar to the BIMAS program, which provides inputs to grow paddy rice. It is reported that the Pelita III program has provisions for providing similar services to upland farmers, but no specific information has been obtained on this program. The alternative is to work with the commercial banks (PERDAG) or the small cooperative banks (KOPERASI).

A fund of 300.0 million Rupiah (US $480,000) is suggested to develop the upland credit system and to provide some of the needed funds for loans to upland farmers. It is suggested that a Farm Credit Consultant be retained to assist in the successful development of this program. As shown in the Panawangan Pilot Watershed the introduction of bench terracing, high yielding varieties, new agronomic practices together with high inputs of fertilizers and biocides, and the use of livestock to utilize the grass on the risers has a high cash input requirement. The change from almost no cash requirement in traditional agriculture to one needing as much as 100,000 Rupiah per ha of purchased inputs can only be accomplished by making credit available. Then the farmer can apply the technology that will make the construction of bench terraces both economically and financially feasible.

Other Costs

Reforestation and Greening Program

The greening program plan under Pelita III is shown in Table VI-9. Since this is an existing program for the Citanduy Watershed it is possible that it should not be considered in the project budget even though it is a principal program on upland areas. Therefore, the costs for this program are listed separately, if it is considered to be a separate program. More properly it should be considered a complementary program to the rest of the integrated Watershed Management approach. At the same time, a review of the greening program's historical successes, failures, and problems indicates that it has not been able to solve Upland Watershed problems on private land. Perhaps it should also be noted that even if the greening program could meet its stated objectives it would at best halt the general deterioration in watershed quality. It would not solve the people problems that are causing an ever higher amount of upland crops being grown on unsuitable land or the continued invasion of farmland into forest areas.

An analysis of Pelita II accomplishments show that the reforestation and greening on 2.45 million ha in Indonesia had a project cost of 89,745.5 million Rupiah (Appendix Table C-2). A regression analysis of this data indicates that the basic administrative cost of this project is about 246.6 million Rupiah per year, and the cost per ha treated is about Rp. 36,100 (R^2=0.96). Plans for Pelita III call for treating 3.44 million ha at a cost of 60,400.0 million Rupiah, or a cost of about Rp. 17,600 per ha [2].

Evaluations conducted for the Citanduy Watershed Greening Program indicate a need for a higher level of funding. These funds would be used to improve the level of technical assistance, for additional fertilizer inputs, and for replanting or additional fertilizer to increase the tree growth. Therefore, the amount of Rp. 35,000 per ha is included in the budget for the greening program activities scheduled in Table VI-9 in years 2 through 5 of the Pelita III program in the Citanduy

Watershed. At the same time, it is recognized that the present schedule is too optimistic for actual practice. It plans to solve all problems by the fourth year of Pelita III when, historically, this program has not reached its objectives. In general, this will mean that the funds may be spent more slowly than scheduled. As shown in Table VII-8 the reforestation and greening program is estimated to be 1,498.3 million Rupiah (US $2.4 million). Based on the planned schedule there would also be an expenditure of 421.8 million Rupiah in the year 1979-80 fiscal year.

Pilot Demonstration Projects

As noted in Chapter IV, the Panawangan Pilot Watershed Project was originally a part of the Citanduy River Basin Development Project of the Directorate of Rivers. Through changes in policy and administrative decisions, most of the conservation works were completed by the P_3RP-DAS staff of the Forestry Department. This also holds true for the Karang Pucang Pilot Watershed, which has since been initiated. As shown in Figure VI-2 it is suggested that these current relationships be maintained and the Panawangan and Karang Pucang special demonstration project continue to be implemented by P_3RP-DAS with assistance by the staff of the Directorate of Rivers, and guidance and assistance from the Ciamis and Cilacap Districts respectively. The completion of the Panawangan Pilot Watershed work is estimated to cost 20.6 million Rupiah, and the Karang Pucang 94.4 million Rupiah, for a total cost of 115.0 million Rupiah (US $184,000). The specific yearly expenditure of these funds is suggested in Table VII-8.

The 1979/1980 P_3RP-DAS project budget for the pilot demonstration areas is 34.7 million Rupiah.

Economic Cost of Fertilizer Subsidy

The economic cost of fertilizer subsidies was evaluated separately for convenience but primarily to indicate the magnitude of this subsidy. An analysis of the fertilizer incentives recommended for project implementation shows that the demonstration farms would require 182.4 tons, the bench terracing program 1,312.5 tons, and other conservation measures are estimated to require 263.0 tons for a total of 1,757.9

tons. This does not include any of the fertilizer that the farmers would purchase for crop production or that used on the research farms or in the project nurseries.

An analysis of the economic price of urea fertilizer shows that the real economic cost to society, or the national economy, is about Rp. 140 per kilogram while the farmer pays Rp. 70 per kilogram. The equivalent price for Triple Super Phosphate (TSP) is a cost to the national economy of about Rp. 120 per kilograms, and the farmer again pays Rp. 70 per kilograms. (Table VIII-4). Since these two fertilizers will be required in approximately equal amounts, it was decided to use an estimate of Rp. 60,000 per ton for evaluating the cost of fertilizer subsidy. Actually, this is an underestimation in the cost of the demonstration farm and conservation practice incentive payments to farmers.

The estimated economic cost of fertilizer subsidies amounts to 105.5 million Rupiah (US $168,750) as shown in Table VII-8.

Consultants

The extent and cost of consulting services required must finally be developed together by the Indonesian Government, the lending agency funding the project, and the consultant selected to implement the project. Therefore, the estimates contained in this report should be considered only as guidelines. The principal problem is that the number and variety of technical specialists needed to carry out the proposed integrated Watershed Management Project are so great that the costs could be extreme. Needed consultant specialties include: watershed management, soil conservation, conservation education, upland agronomy (crops), soil science, agricultural engineering, development economics, farm management, resource economics, marketing, rural sociology, agricultural extension, animal husbandry, ecology, environmental impact, and project administration. The only solution to the problem is to hire experienced consultants with a maximum of interdisciplinary training and experience. The relative strength or weakness of the project's staff training will influence the requirements for consultants.

The project manager should definitely be a watershed manager or agricultural engineer with experience in land treatment and structural measures for erosion control. Other consultant specialists necessary are upland tropical agronomist, agricultural engineer, farm manager or resource economist, and extension training specialist. The consultant staff should be scheduled to provide maximum assistance in the first three years of the project. Then, as the project staff is capable of taking over, consultants should be phased out. During the last year of the project the consultant staff should be primarily concerned with progress evaluation and in assisting to develop the plan for the next project period.

Total cost of the consultant services is estimated at 867.0 million Rupiah (US $1.4 million) as shown on Table VII-8.

Foreign Training

As previously noted, the objective of any training program should be the application of knowledge and skills after the training program is completed. In no case is this more important than in the relatively expensive foreign training component. The individual training program should be carefully tailored to both the person being trained and the position to which he will return. As discussed earlier in this chapter, the total cost of the foreigh training component is estimated at 104.4 million Rupiah (US $167,000).

Cost Summary

The success or failure of the proposed integrated Watershed Management Project for the Upper Citanduy Watershed rests almost entirely on the degree to which it becomes the project of the individual farmers and village officials. While recognizing this, it is almost impossible to measure the total contribution of the farmers and/or villagers in accomplishing the proposed 5-year soil and water development program. The alternative selected was to estimate the direct farmer contribution to the installation of specific conservation measures for

which project costs had been estimated. As shown in Table VII-9 the estimated or village cost of project features amounts to 3,496.9 million Rupiah (US $5.6 million). This value was based on the specific inputs suggested for farmers on the demonstration farms, bench terracing, and road erosion proofing, and an amount equal on the project cost for the other conservation measures and the reforestation and greening programs. The specific accuracy of these estimates is not important in that it is certain to underestimate the true contribution of the farmers and villagers of the watershed. It is, however, important to note that with these limited estimates of the farmers' contribution the local people will be assuming over 29 percent of the total cost of the Watershed improvements suggested for the first 5-year project.

Table VII-9 provides the estimated distribution of costs to the National, Provincial, Kabupaten and farmer level. These costs can be summarized as follows:

Description	1979 Price Base Million Rp.	Percent
National 1/	3,563.0	29.6
Provincial		
West Java	262.3	2.2
East Java	131.1	1.1
Sub total	393.4	3.3
Kabupaten		
Tasikmalaya	623.5	5.2
Ciamis	2,785.6	23.1
Kuningan	165.3	1.4
Majalengka	53.0	0.4
Cilacap	956.1	7.9
Sub total	4,583.5	38.0
Total Project Cost	8,539.9	70.9
Farmers and Village Cost	3,497.0	29.1
Total Watershed Improvement	12,036.9	100.0

1/ Includes all costs not directly apportionable.

Implementation Program

In a sense, the Watershed treatment activities of the Citanduy Watershed have been going on since the start of Pelita I, but these approaches have not solved the problems as they have developed. Therefore, while the program will hopefully be implemented through the existing governmental structure, there are many preproject activities that can be initiated. These include, but are not limited to, the recruitment of qualified technical and administrative personnel, procurement of supplies and materials, preparation of quarters and office accomodations, initiation of the training centers, and development of the detailed operation plan for all required services. The definition of the specific organizational and agency responsilbility for project administration is the most important specific factor to expedite project implementation. Ultimately, it is also the most important factor in the project's success, but this definition can only be done by the central government of Indonesia.

It is strongly suggested that maximum use be made of the experience gained from the Panawangan Pilot Watershed Project and the 6.1 ha Pilot Demonstration Farm, and from the existing Citanduy Project Steering Committee. The working relationships that have developed among the districts plus the suggested plan for implementation of the Citanduy Upper Watershed Project contained in Appendix F can materially aid in the rapid development of the proposed project once funding becomes available.

Legal Jurisdiction of Soil and Water Development

The widespread public interest in the problems of upstream watershed protection and development is due at least in part to a recognition that existing laws and programs are not achieving a solution to the complex problems of Indonesia's watersheds. Certainly, the application of existing national programs is not progressing fast enough to solve the pressing needs of the upland farmers to preserve and develop their soil and water resources. It is recognized that proper legislation

and jurisdiction are important to the success and stability of any development program, but it is also recognized that existing legislation and programs are sufficient to enable the development of an integrated Watershed Management Program for the Citanduy Watershed. The problems are related more to coordination, definite policy development, and the lack of sufficient funding to carry out existing or new programs.

Some people think that additional legislation is needed to define property rights and responsibilities of farmers and landowners in situations where conservation measures are needed. Can the government compel landowners to carry out improvements to conserve the soil and water resources for the common good? If so, what the legal steps needed to cause landowners and/or operators to cease using their land to the detriment of other citizens? When the majority of a group of farmers agree to construct terraces and waterways, can a minority, perhaps one landowner, prevent proper implementation of the program desired by the majority? These and other legal problems must be anticipated as the Upper Watershed Program is developed and implemented.

There are a number of land laws in Indonesia that give right of land ownership to private Indonesian nationals ("hak milik" is the most complete for of land ownership). This right of ownership has no time limit; the landowner also has the right to convey the use of his land to another party by granting secondary rights on the land, or he may convey his right to another party or parties upon his death, (BAL art. 4). This has caused many farm holdings to be divided into small parcels of 0.5 ha or less, which complicates the land management and development problems. It also makes for uneconomic units that can provide the farmer and his family only a subsistence living.

With respect to use of land and water, the Constitution clearly dedicates their use to the people. Article 3, paragraph 33 states, "The land and the water and the natural riches contained therein shall be controlled by the State and shall be made use of for the people." More directly, the Water Resources Development law No. 11/1974 states that, "Water, water resources, waterworks and structures shall be permanently conserved and protected, to this purpose the following shall be undertaken:

a. soil and water resources conservation;

b. the control of harmful effects or water and water resources and on the environment;

c. the control of water pollution harmful to water uses and to the environment;

d. the conservation and protection of waterworks and structures in order to ensure their permanent operation (Chapter VIII Article 13).

A review of the requirements for an effective land and water management program for the Citanduy Watershed prompts many questions concerning the need for efficient operation of an upstream soil and water development program. Experience with over-populated upstream watersheds and the extreme demands of an excessive population prompted an urgent need to study the problems of upstream watersheds, to develop new statutes to improve the operation of the watershed program, and to give it the prestige that it merits. While some additional statutes or regulations may be advisable to aid in the solution of certain problems, there are already sufficient laws and regulations to carry out an upper watershed management program within the present government structure. In fact, the principal problem may be that there are too many programs and laws on the subject. What is needed is a clearly defined policy statement on the line of authority (or command line) from the ministerial level to the farmer. Subsequently, this policy statement must be funded at a level competent to complete the entire integrated upper Watershed Management Program. A budget is the ultimate statement of policy in any governmental organization.

The review by the consultants staff reached the definite conclusion that the Constitution and the regulations already in effect are sufficient in scope to allow the Government of Indonesia, through its various Ministries, to develop and implement an effective integrated Watershed Management Program for the Upper Citanduy Watershed. If deficiencies become apparent during the project period, new legislation or policies can then be developed to strengthen the Program.

REFERENCES

1. Rancangan Pola Dasar Pembangunan Kabupaten Daerah Tingkat II Ciamis, 1979. "Badan Perencanaan Pembangunan Kabupaten Daerah Tingkat II Ciamis".

2. Menteri Negara Pengawasan Lingkungan Hidup, 1979. "Laporan Kualitas Lingkungan Hidup Indonesia 1979".

TABLE VII-1

PRESENT CONDITION (1979) LAND USE FOR CITANDUY WATERSHED SUBBASINS

(Hectares)

Land Use	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel-Lower Citanduy	Total	%
Cropland							
Irrigated Rice Land							
Technical Systems	4,759	376	1,400	3,268	8,929	18,732	5.4
Rural Systems	11,429	8,342	4,101	8,381	4,514	36,767	10.5
Rainfed Rice Land	6,671	3,111	4,446	8,320	8,755	31,303	8.9
Subtotal	22,859	11,829	9,947	19,969	22,198	86,802	24.8
Upland Cropland	26,152	22,593	13,296	21,184	37,283	120,508	34.4
Home Gardens 1/	7,020	3,848	2,341	7,507	7,476	28,192	8.1
Total Cropland	56,031	38,270	25,584	48,660	66,957	235,502	67.3
Plantations	2,796	13,060	5,517	2,979	20,196	44,548	12.7
Forest	10,786	4,350	11,170	10,898	6,845	44,049	12.6
Other Uses							
Residential	2,730	1,260	600	1,190	1,480	7,260	2.1
Roads and Trails	391	255	282	433	423	1,784	0.5
Rivers and Streams	990	794	353	443	2,068	4,648	1.3
Other 2/	276	2,011	4,494	5,397	31	12,209	3.5
Subtotal	4,387	4,320	5,729	7,463	4,002	25,901	7.4
Total	74,000	60,000	48,000	70,000	98,000	350,000	100.0
Percent	81.1	17.2	13.7	20.0	28.0	100.0	
Critical Areas							
Forest	2,937	937	1,312	1,250	2,250	8,686	2.5
Upland	5,157	6,592	7,335	7,222	24,522	50,828	14.5
Total	8,094	7,529	8,647	8,472	26,772	59,514	17.0

1/ Includes homes and yards.
2/ Other includes fishponds, swamps, marshes, and other undefined land uses.
Source: Based on data from District (BAPPEMKA) Offices and Consultant Staff Estimates.

TABLE VII-2

ESTIMATED COST OF CRITICAL AREA SURVEYS

(Thousand Rupiah - 1979 Values)

Item	Year 1	2	3	4	5	Total
Districts						
Tasikmalaya	250	1,000	1,250	600		3,100
Ciamis	4,280	17,100	21,400	10,700		53,485
Kuningan	400	1,600	2,000	1,000		5,000
Cilacap	1,020	4,000	5,100	2,550		12,670
Total Cost	5,950	23,700	29,750	14,850		74,250

Based on a cost of 1,250 Rupiah/ha of present critical areas.

TABLE VII -3

ESTIMATED COST FOR DETAILED SOIL SURVEYS BY LOCATION

(Thousand Rupiah)

Location	Year 1	2	3	4	5	Project Total
Districts						
Tasikmalaya		161	564	1,307	2,338	4,370
Ciamis	258	935	2,274	4,547	8,321	16,335
Kuningan		65	226	484	806	1,581
Cilacap	65	290	806	1,725	3,048	5,934
Total Cost	323	1,451	3,870	8,062	14,513	28,220
Subbasins						
Upper Citanduy		258	903	2,096	3,693	6,950
Cimuntur	258	774	1,484	2,387	3,483	8,386
Cijolang		97	564	1,419	2,451	4,531
Cikawung	65	257	661	1,371	2,451	4,805
Ciseel-Upper Citanduy		65	258	790	2,435	3,548
Total Cost	323	1,451	3,870	8,063	14,513	28,220
Hectares Surveyed	75	337	900	1,875	3,375	6,562

Source : Estimated cost of soil surveys Rp. 3,060/ha (Appendix Table B-4) plus Rp. 1,240/ha for base maps and aerial photographs for a total of Rp. 4,300/ha

TABLE VII-4

SCHEDULE FOR DEVELOPMENT OF DEMONSTRATION FARMS

(Number)

District	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel Lower Citanduy	Total
Year No. 1						
Tasikmalaya						
Ciamis		8				8
Kuningan						
Cilacap				2		2
Total		8		2		10
Year No. 2						
Tasikmalaya	5					5
Ciamis	3	4			2	9
Kuningan			2			2
Cilacap			1	3		4
Total	8	4	3	3	2	20
Year No. 3						
Tasikmalaya	5					5
Ciamis	3	4	6		3	16
Kuningan			2			2
Cilacap			2	5		7
Total	8	4	10	5	3	30
Year No. 4						
Tasikmalaya	8					8
Ciamis	5	4	3		9	21
Kuningan			2			2
Cilacap			2	7		9
Total	13	4	7	7	9	40
Year No. 5						
Tasikmalaya	1				4	5
Ciamis	5	4	1		26	36
Kuningam			1			1
Cilacap				8		8
Total	6	4	2	8	30	50
Total Number Demonstration Farms						
Tasikmalaya	19				4	23
Ciamis	16	24	10		40	90
Kuningan			7			7
Cilacap			5	25		30
Total	35	24	22	25	44	150

TABLE VII-5

ESTIMATED COST FOR DEMONSTRATION FARMS BY LOCATION

(Thousand Rupiah)

Locations	Year 1	2	3	4	5	Project Total
Districts						
Tasikmalaya		8,500	9,525	15,650	12,190	45,865
Ciamis	13,600	16,940	30,685	42,465	72,270	175,960
Kuningan		3,400	3,810	4,220	2,930	14,360
Cilacap	3,400	7,210	13,130	17,965	18,110	59,815
Total Cost 1/	17,000	36,050	57,150	80,300	105,500	296,000
Subbasin						
Upper Citanduy		13,600	15,240	25,380	16,145	70,365
Cimuntur	13,600	8,440	9,260	10,080	10,900	52,280
Cijolang		5,100	17,615	14,565	7,500	44,780
Cikawung	3,400	5,510	9,525	13,950	17,085	49,470
Ciseel-Lower Citanduy		3,400	5,510	16,325	53,870	79,105
Total Cost 1/	17,000	36,050	57,150	80,300	105,500	296,000
Project Cost	9,400	20,850	34,350	49,900	67,500	182,000
Farmer Cost	7,600	15,200	22,800	30,400	38,000	114,000

1/ Based on a total cost for demonstration farms (Table VI-5) Rp. 1,700,000 the first year and Rp. 205,000 for the next four years and the schedule for development of demonstration farms from Table VII-4.

TABLE VII-6

ESTIMATED SCHEDULE FOR BENCH TERRACING BY SUBBASINS[1/]

(Hectares)

District	Upper Citanduy	Cimuntur	Cijolang	Cikawung	Ciseel-Lower Citanduy	Total
Year No. 1						
Tasikmalaya						
Ciamis		40.0				40.0
Kuningan						
Cilacap				10.0		10.0
Total		40.0		10.0		50.0
Year No. 2						
Tasikmalaya	25.0					25.0
Ciamis	15.0	120.0			10.0	145.0
Kuningan			10.0			10.0
Cilacap			5.0	40.0		45.0
Total	40.0	120	15.0	40.0	10.0	225.0
Year No. 3						
Tasikmalaya	87.5					87.5
Ciamis	52.5	230.0	30.0		40.0	352.5
Kuningan			35.0			35.0
Cilacap			22.5	102.5		125.0
Total	140.0	230.0	87.5	102.5	40.0	600.0
Year No. 4						
Tasikmalaya	202.5					202.5
Ciamis	122.5	370.0	90.0		122.5	705.0
Kuningan			75.0			75.0
Cilacap			55.0	212.5		267.5
Total	325.0	370.0	220.0	212.5	122.5	1,250.0
Year No. 5						
Tasikmalaya	342.0				20.0	362.5
Ciamis	230.0	540.0	162.5		357.5	1,290.0
Kuningan			125.0			125.0
Cilacap			92.5	380.0		472.5
Total	572.5	540.0	380.0	380.0	377.5	2,250.0
Summary						
Tasikmalaya	657.5				20.0	677.5
Ciamis	420.0	1,300.0	282.5		530.0	2,532.5
Kuningan			245.0			245.0
Cilacap			175.0	745.0		920.0
Total	1,077.5	1,300.0	702.5	745.0	550.0	4,375.0

1/ Does not include approximately 300 ha bench terracing on demonstration farms.

TABLE VII-7

ESTIMATED COST FOR BENCH TERRACING BY LOCATION

(Thousand Rupiah - 1979 Values)

Location	Year 1	Year 2	Year 3	Year 4	Year 5	Project Total
District						
Tasikmalaya		14,700	51,450	119,070	213,150	398,370
Ciamis	23,520	85,260	207,270	414,540	758,520	1,489,110
Kuningan		5,880	20,580	44,100	73,500	144,060
Cilacap	5,880	26,460	73,500	157,290	277,830	540,960
Total Cost	29,400	132,300	352,800	735,000	1,323,000	2,572,500
Subbasin						
Upper Citanduy		23,520	82,320	191,100	336,630	633,570
Cimuntur	23,520	70,560	135,240	217,560	317,520	764,400
Cijolang		8,820	51,450	129,360	223,440	413,070
Cikawung	5,880	23,520	60,270	124,950	223,440	438,060
Ciseel-Upper Citanduy		5,880	23,520	72,030	221,970	323,400
Total Cost	29,400	132,300	352,800	735,000	1,323,000	2,572,500
Project Cost	13,450	60,525	161,400	336,250	605,250	1,176,875
Farmer Cost	15,950	71,775	191,400	398,750	717,750	1,395,625

TABLE VII-3

ESTIMATED COST SUMMARY FOR PROJECT MEASURES IN THE CITANDUY UPPER WATERSHED

(Thousand Rupiah-1979 Values)

Item	Year 1	2	3	4	5	Total
National Level:						
Administration	50,000	50,000	50,000	50,000	50,000	250,000
Research Experiment Station	104,425	126,400	46,900	53,325	46,450	377,500
Subtotal	154,425	176,400	96,900	103,325	96,450	627,500
Provincial Level:						
West Java	92,013	71,764	32,914	32,914	32,664	262,269
Central Java	46,007	35,882	16,457	16,457	16,332	131,135
Subtotal	138,020	107,646	49,371	49,371	48,996	393,404
Kabupaten Level:						
Tasikmalaya (45%)	13,590	24,673	33,081	34,484	39,418	145,246
Ciamis (100%)	30,199	54,829	73,514	76,631	87,596	322,769
Kuningan (10%)	3,020	5,483	7,351	7,663	8,760	32,277
Majalengka (5%)	1,510	2,741	3,676	3,832	4,380	16,139
Cilacap (65%)	19,629	35,639	47,784	49,810	56,937	209,799
Subtotal	67,948	123,365	165,406	172,420	197,091	726,230
Conservation Works:						
Soil Surveys-Detailed	323	1,451	3,870	8,063	14,513	28,220
Critical Area Surveys	5,950	23,700	29,750	14,850		74,250
Upland Demonstration Farm	9,400	20,850	34,350	49,900	67,500	182,000
Bench Terracing	13,450	60,525	161,400	336,250	605,250	1,176,875
Other Conservation Measures	2,690	12,105	32,280	67,250	121,050	235,375
Road & Trail Erosion Proofing	6,504	16,260	32,520	48,780	65,040	169,104
Nursery Cost	101,700	66,750	92,250	99,750	114,000	474,450
Special Majalengka	380	1,349	2,940	5,250	8,732	18,651
Subtotal	140,397	202,990	389,360	630,093	996,085	2,358,925
Infastructure Improvements:						
Development Program	68,750	100,000	100,000	100,000	100,000	468,750
Farm Credit Program	3,400	15,400	41,100	85,700	154,400	300,000
Subtotal	72,150	115,400	141,100	185,700	254,400	768,750
Total Est. Cost	572,940	725,801	842,137	1,140,909	1,593,022	4,874,809
Contingencies (20%)	114,588	145,160	168,427	228,182	318,604	974,961
Total Direct Cost	687,528	870,961	1,010,564	1,369,091	1,911,626	5,849,770

TABLE VII-8 (Continued)

(Thousand Rupiah-1979 Values)

Item	Year 1	2	3	4	5	Total
Other Costs						
Reforestation and Greening	621,075	578,235	299,005			1,498,315
Pilot Demonstration Project	41,000	33,000	25,000	10,000	6,000	115,000
Economic Cost of Fertilizer Subsidy	1,506	5,964	14,916	30,072	53,016	105,474
Consultants	289,000	202,300	173,400	115,600	86,700	867,000
Foreign Training	41,750	41,750	20,875			104,375
Subtotal	994,331	861,249	533,196	155,672	145,716	2,690,164
Total Cost	1,681,859	1,732,210	1,543,760	1,524,763	2,057,342	8,539,934
U.S. $ x 10^6	2.7	2.8	2.5	2.4	3.3	13.7

TABLE VII-9

ESTIMATED DISTRIBUTION OF COSTS TO NATIONAL, PROVINCIAL, KABUPATEN AND FARMER LEVEL

(Thousand Rupiah - 1979 Values)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
National Level						
Administration	50,000	50,000	50,000	50,000	50,000	250,000
Research Exp. Station	104,425	126,400	46,900	53,325	46,450	377,500
Infrastructure Improvement	72,150	115,400	141,100	185,700	254,400	768,750
Economic Cost of Fertilizer Subsidy	1,506	5,964	14,916	30,072	53,016	105,474
Consultants	289,000	202,300	173,400	115,600	86,700	867,000
Foreign Training	41,750	41,750	20,875			104,375
Pilot Demonstration Projects	41,000	33,000	25,000	10,000	6,000	115,000
Physical Contingencies	114,588	145,160	168,427	228,182	318,604	974,961
Total National	714,419	719,974	640,618	672,879	815,170	3,563,060
Provincial Level						
West Java	92,013	71,764	32,914	32,914	32,664	262,269
Central Java	46,007	35,882	16,457	16,457	16,332	131,135
Total Provincial	138,020	107,646	49,371	49,371	48,996	393,404
Kabupaten Level						
Tasikmalaya						
District Budget	13,590	24,673	33,081	34,484	39,418	145,246
Demonstration Farms		4,700	5,725	9,570	8,390	28,385
Bench Terracing		6,725	23,537	54,473	97,512	182,247
Reforestation and Greening	54,740	42,000				96,740
Nursery Costs	20,340	13,350	18,450	19,950	22,800	94,890
Other Conservation Works	900	5,758	13,025	21,474	34,848	76,005
Subtotal	89,570	97,206	93,818	139,951	202,968	623,513
Ciamis						
District Budget	30,199	54,829	73,514	76,631	87,596	322,769
Demonstration Farms	7,520	10,100	18,525	26,505	44,910	107,560
Bench Terracing	10,760	39,005	94,823	189,645	347,010	681,243
Forestation and Greening	392,875	466,235	299,005			1,158,115
Nursery Costs	50,850	33,375	46,125	49,875	57,000	237,225
Other Conservation Works	9,942	32,340	57,815	74,856	103,739	278,692
Subtotal	502,146	635,884	589,807	417,512	640,255	2,785,604

TABLE VII-9 (Continued)

(Thousand Rupiah-1979 Values)

Item	Year 1	2	3	4	5	Total
Kuningan						
District Budget	3,020	5,483	7,351	7,663	8,760	32,277
Demonstration Farm		1,880	2,290	2,700	2,170	9,040
Bench Terracing		2,690	9,415	20,175	33,625	65,905
Reforestation and Greening	3,710					3,710
Nursery Costs	5,085	3,337	4,613	4,990	5,700	23,725
Other Conservation Works	400	3,937	6,277	8,121	11,867	30,602
Subtotal	12,215	17,327	29,946	43,649	62,122	165,259
Majalengka						
District Budget	1,510	2,741	3,676	3,832	4,380	16,139
Special Majalengka	380	1,349	2,940	5,250	8,732	18,651
Reforestation and Greening	18,200					18,200
Subtotal	20,090	4,090	6,616	9,082	13,112	52,990
Cilacap						
District Budget	19,629	35,639	47,784	49,810	56,937	209,799
Demonstration Farm	1,880	4,170	7,810	11,125	12,030	37,015
Bench Terracing	2,690	12,105	33,625	71,957	127,103	247,480
Reforestation and Greening	151,550	70,000				221,550
Nursery Costs	25,425	16,688	23,062	24,935	28,500	118,610
Other Conservation Works	4,225	11,481	21,303	34,492	50,149	121,650
Subtotal	205,399	150,083	133,584	192,319	274,719	956,104
Total Districts	829,420	904,590	853,771	802,513	1,193,176	4,583,470
Total Project Costs	1,681,859	1,732,210	1,543,760	1,524,763	2,057,342	8,539,934
Farmer or Village Cost						
Demonstration Farm	7,600	15,200	22,800	30,400	38,000	114,000
Bench Terracing	15,950	71,775	191,400	398,750	717,750	1,395,625
Other Conservation Measures	2,690	12,105	32,280	67,250	121,050	235,375
Road Erosion Proofing	9,756	24,390	48,780	73,170	97,560	253,656
Reforestation and Greening	621,075	578,235	299,005			1,498,315
Total Local Cost	657,071	701,705	594,265	569,570	974,360	3,496,971
Total Cost of Improvement	2,338,930	2,433,915	2,138,025	2,094,333	3,031,702	12,036,905

CHAPTER VIII
PLAN EVALUATION AND RECOMMENDATIONS

Introduction

Evaluation of watershed management projects is necessary to determine their value to the area, region, or country where they are located. This evaluation enables decision makers to compare the relative merits of various projects competing for use of capital and other resources required for the project's implementation.

A watershed project evaluation employs certain basic economic concepts on which decisions can be based. First, what is project economics? It is simply the science of applying economic criteria to the selection of project features to ensure that they meet minimum profitability criteria and to provide a system of measurements that enable decision makers to select the best alternative. Economics in this sense is not a field of study; it is a way of thinking that is more commonly understood by accountants and businessmen than by water resource planners. Specifically, economics is the science of analyzing human behavior in terms of the relationship between ends and means; economic theory provides the framework for evaluation and weighing of project benefits and costs.

Economic evaluation methodology has been developing for some time and is available from standard reference sources. Unfortunately, these sources always assume data availability and relatively perfect knowledge. The important feature is that the method must provide a systematic process of evaluation of all projects in a consistent manner so that the results can be understood by the decision makers. Policy makers are busy people, and they tend to rely on the economic evaluation to summarize details of the project in a consistent and understandable manner for their consideration. Unfortunately, the quality of the economic analysis is directly related to the ability and integrity of the technician making the individual evaluation, and it is easily possible to

distort the evaluation results by overestimating benefits and underestimating costs. An example of this distortion would be taking the benefits from agricultural production increases in a project area without including the cost of the extension program and the agricultural incentives that make the projected increased yields possible.

The following sections of this report were developed with an awareness of the complex interrelationships in a program for upland watershed management. Some of the total benefits that can result from the integrated program described in the previous chapter will be indicated.

Evaluation Methodology

Introduction

Any evaluation effort must employ a certain set of concepts upon which judgments are based. Since the primary objective of a project feasibility evaluation is to compare project costs and project benefits, it is necessary to have reliable data to make this comparison valid. In the case of the Citanduy Watershed, the necessary specific data are definitely lacking. Therefore, the feasibility evaluation for the Upper Watershed development is admittedly somewhat limited and is largely developed from secondary sources. This limited evaluation can only be excused by the necessity of initiating an upper watershed management program in the Citanduy Watershed and the informed judgment that the basic system developed in the Panawangan Pilot Demonstration Watershed definitely improves the well being of the farmers while preserving the soil resources for future generations.

The assumption of this evaluation is that watershed management provides for the protection, improvement, and use of available land and water resources according to the principles of watershed management and human resource development assuring their highest economic and social benefits over time. Unfortunately, the direct benefits of both human and watershed development are not always apparent, and they may in

fact take many years to become visible. This is particularly true in areas where the land resources are currently deteriorating rapidly.

Watershed management and conservation are practiced to maintain and/or improve the quality of the land resources for both short-term and long-term use. Ideally, these practices allow achievement of long-term national goals while maintaining or enhancing the short-term productivity of the land for the resource user. Recognizing that many necessary physical and economic factors for evaluating this approach would not be available, the project development relied to an unusual extent on the least-cost method of initiation of a watershed management program for the Upper Citanduy based on the Panawangan experience. This approach makes it necessary to use a large degree of empiricism in the development of project features and their evaluation, but it was a necessary step in initiating a program for the 350,000 ha Citanduy Watershed.

Benefits and cost, when possible, were evaluated from the viewpoint of national economic objectives, but the overlapping and poorly defined subsidy system of Indonesian development schemes made this difficult. Ideally, all evaluations of project features and benefits would reflect economic values free from artificial externalities such as subsidies, price controls, customs duties, and taxes. This was not possible within the time and staff constraints of this study. Therefore, basically no attempt was made to adjust for this factor other than to indicate the extent of double subsidization in accounting for fertilizer incentives given to farmers on demonstration farms and in bench terrace areas. These limitations, however, are not sufficent to change the decisions that might be made from the evaluation of project feasibility.

Another project evaluation problem is related to time span. The Citanduy Watershed has taken at least 50 years to develop the current overpopulation pressures and consequent erosion and degradation problems, and it will take several decades to restore, or even improve, the watershed's productivity. The watershed management viewpoint, in this case, must definitely be long term, with a 15-to 25-year program and permanent maintenance or replacement of improvements will be necessary. In fact, if the population growth problem cannot be solved, neither can

the watershed management problems. Only the government of Indonesia can decide to make the necessary long-term commitments towards solving the people problems of watersheds like the Citanduy. Certainly, the programs initiated to date have not reduced the rate of deterioration in the forest and land resources of the Watershed.

Since only the initial 5-year project is included in this report, it was decided to evaluate the proposed project and the potential cropland benefits from a complete watershed management project. Because project implementation rates are not directly definable, it was decided to lag project benefits to the extent that no benefits would be taken in year one and that benefits would then increase linearly to year ten, after which benefits would remain constant for years 11 through 25 for the initial project. To simplify the evaluation of potential benefits it was decided to use the same benefit stream as for the proposed project for years 1 through 10, then a constant increase in benefits to year 25. Recognizably, this methodology will understate the potential benefits from a complete Upper Watershed Program, but this is not serious because the potential cropland benefits are evaluated only to provide a preliminary estimate of their magnitude.

The evaluation of primary benefits was limited to increased net returns on upland crop and home garden areas. Other primary benefits noted, but not evaluated, include increased net returns from irrigated crop production, backyard livestock and fisheries production, increases in forest products, reduced damages to roads and settlements, reduced downstream flooding and sedimentation, and to some extent the improved employment opportunities in the Watershed. Other direct benefits not evaluated include improvement in stream fisheries streams and the Segara Anakan, reduced costs of irrigation system operation due to reduced sediment loads and flood damage, reduced transportation costs from better roads, reduced costs for agricultural marketing, and improved nutritional opportunities for the Watershed residents that will permit them to be more productive and to have better health. The educational and leadership development programs included in the project also have a large potential impact for raising quality of life and the contributions to society by the local citizenery.

Even though limiting the primary benefit evaluation to the estimated increases in net returns from upland crop production has the affect of understating project benefits, it was necessary considering the data and time limitations. This approach is also logical in that the entire focus of the proposed project is toward improving upland crop production, conservation farming methods, and improved living standards for the upland farm families.

Viewpoint of Economic Analysis

Economic analysis of the project provides a measure of the economic soundness of the proposed improvements prior to direct investment by the government. This economic analysis can be applied to a single watershed development component or to the total development plan. The analysis approach taken for this project proposal, however, includes the total Integrated Watershed Management Project for upland crop areas. Because of the close interrelationship of the individual parts, reliable estimates of the returns to specific components are not possible.

Economic studies for project justification are made from the national viewpoint; therefore, only "real" costs are included. Transfer payments, such as taxes, customs duties and social welfare payments, are disregarded. The national viewpoint assumes the absence of wars, severe economic depressions or inflation, and deals only with known technology. Economic prices reflecting world markets are used where possible, but in a relatively controlled economy such as Indonesia's many of the subsidies are hidden, and it is recognized that many of the farmgate prices used in evaluation of upland crops (palaweji) are in truth at least partially controlled by government agencies.

As long as the beneficial and adverse effects of the project are internalized in the economic study, the incidence of benefits and costs is immaterial to the national viewpoint. It is, however, of considerable interest to the national social viewpoint whether the benefits are distributed among the lower income groups of society. While the proposed Upper Watershed Project is directed specifically toward the upland farmer, who is generally a member of the poorest segment of the local society, it is recognized that a number of government employees

will benefit directly from the project. Many others will be indirectly affected by economic expansion and increased crop production, including the associated increase in demand for technical inputs for crop production.

The primary objective of the proposed project is to improve living standards of upland farmers by providing a system of conservation farming that will stabilize and increase agricultural production in the Upland Watershed areas. The evaluation recognizes that downstream benefits from reduced sedimentation and flood peaks will not become apparent from the initial 5-year project, but it does attempt to analyze the potential for these benefits. Direct benefits from erosion proofing roads, developing infrastructure, or lengthening stream flow periods were beyond the analysis capabilities of this evaluation, other than to recognize their existence.

The "With" and "Without" Principle

When we contemplate an important action, we must consider both the alternative of doing nothing and the alternative of doing something else. Thus, in evaluating a project, the state of society must be anticipated for three alternative conditions: (1) the state of society without the project; (2) the state of society with the project; and (3) the state of society without this particular project, but with some other project obtainable with similar expenditure of resources. Only if we can say that (2) is superior to both (1) and (3) can we say that project (2) is feasible and desirable. In reality, the political process usually makes the choice between (2) and (3). It must always be recognized that many more desirable projects may be competing for the limited resources available. This is particularly true in developing countries.

Careful evaluation of the do nothing alternative is very important in project evaluation because it informs as to the possible consequences without the project. This evaluation is the basis for developing the project alternatives, watershed improvement features, and an accurate project evaluation.

Project evaluations in this report were conducted with a full awareness of the difference between the "before" and "after" approach and the "with" and "without" approach. Consequently, improving crop yields and adoption of technology trends are assumed for without project conditions to avoid erroneously counting benefits that would have occured without the project. Lack of specific baseline information for the Citanduy Watershed has admittedly limited the accuracy of all project evaluations.

Human Resources Development

Community development (human resources) is an essential feature of any watershed management project. Lasting improvements can be accomplished only by group action and, to the greatest extent possible, by the local people by their own decision, using their tools and technology. It must become their project before they will take care of the protection measures. Ignoring this characteristic of people's attitudes has wasted many millions in resource development projects around the world. One of the most difficult things in the world to teach government workers is to respect the opinions and desires of local people and to teach them to work with local people to help them to solve their problems. The myth of the educated elite with the ability to solve all problems dies very slowly. The function of the project staff is to lead and educate the Watershed residents in understanding their problems and to develop solutions to these problems within the capabilities of the local people. This, of course, includes incentive payments to aid people in applying needed conservation measures or other improvements, but not at such a high level that would encourage the people to think that it is a government project which should be continuously supported by the government.

While the ultimate success or failure of a watershed management project depends directly on the project's becoming the local people's project, there is no way to predict this result in advance. The only way to determine a project's success is to have a post-project evaluation to analyze the project's level of accomplishment and to use its successful features in the development of future projects.

As noted in the discussion of watershed problems, the productivity of upland farmers is so low that the returns are not sufficient to start the cumulative process of rising production and prosperity. Therefore, improvement of economic conditions on a significant scale is necessary to produce conditions for a true conservation farming program. Decisions on the best program to produce this additional return must be based on available human resources, abilities, special wishes of the people in the Kelompok Conservation Action Unit and available land resources. The key feature must always be the interest and cooperation of the local people. The extension education, demonstration farms, and Conservation Technicians are necessary to act as catalysts and to provide needed information. Economic incentives can provide some of the needed inputs to make the adopted program economically possible. Of utmost importance is for the farmer's ability to see an opportunity to improve his family's welfare while he is preserving the soil resource. He will only adopt conservation farming if he is reasonably certain that he has something to gain.

Watershed Land Use Changes

Calculation of benefits and costs for a proposed watershed management project requires a careful tabulation of all land uses and changes in use from one type to another that will occur over time. Because it had been decided to use a 5-year preliminary project ending in 1985 and a 25-year project evaluation period which would end in 2005, these years were used as target projected years for "without" and "with" project conditions. Data on trends is not sufficient to specifically define probable land use and cover conditions for these time frames; therefore, the future "without" project condition projections of land use in the Citanduy Watershed shown in Table VIII-1 are somewhat empirical, but they are less so than are the "with" project condition estimates. The value of these projections is that they prevent double counting of benefits and specify the changes in land use being evaluated in the time frames. The projections also force a type of interdisciplinary evaluation, because any increase or decrease in land use must be accompanied by a corresponding increase or decrease in other uses.

To avoid taking unearned benefits to the Upper Watershed Management Project, the "without" and "with" project conditions for total cropland were held the same for the specific time periods. For present conditions there are about 235,502 ha of cropland; for 1985 it is projected to grow to 245,000 ha; and for 2005 it is projected to be 261,000 ha. This increased cropland will come primarily from decreases in plantation areas, as has occurred in the past, but a portion of the increase may come from further invasion of the forested areas.

No project benefits were taken for the potential development of additional irrigation systems on the 18,732 ha presently irrigated or on the potential new irrigation systems amounting to 6,434 ha [Appendix Table A-14] in the Citanduy Watershed, and the 20,400 ha of the Sidareja-Cihaur Project of the Segara Anakan Watershed. At the same time the long term success of these irrigation projects will in part be determined by the success of the watershed management, because they provide employment and food production for the large population.

The irrigated and rainfed riceland areas are projected to grow from the present 86,802 ha to 90,000 ha by 1985 and to 95,500 ha by 2005. These areas were also held constant for "without" and "with" project conditions. This procedure prevents taking benefits to the Watershed Management Project that will be the result of irrigation system development and the rehabilitation and improvement of existing rural systems. The potential benefits from the Watershed Management Program are evaluated by taking a 5% higher net return from the riceland areas as a result of higher quality water, extended flow periods, and reduction in flooding.

Cropping Systems and Yields

Available statistics do not provide even a useful estimate of present upland cropping systems, crop yields, or costs and returns for upland farms of the Watershed by location. Particularly lacking is information on cropping intensities and areas of idle or wastelands in the upland cropping areas. Many reasons explain this lack of information, but the lack of detailed base maps of the area for ownership and land use, the very large number of small farms involved, the lack of

standard data collection system, and the tendency of government officials to report successes of government programs without proper documentation or verification are predominant. The tendency of statistical data to be modified when moving upward through the larger governmental units is a particular contribution to error. There are also too many governmental units collecting and analyzing basic agricultural statistics, and the different units seldom approach agreement. Also, the farmers generally do not know how much cropland they have devoted to each crop because of intercropping and multiple cropping. He does not know how much he has produced because it was not weighed and recorded at harvest. Because most the farmers are poorly educated, they have no records of cash inputs or costs and returns from upland crops. There are also very large differences in cropping intensities within the individual subbasin areas or elevation zones of the Watershed. This is particularly true for the dry season crop production where some areas do not attempt a dry season crop.

Recognizing that cropping systems for upland farms are extremely varied and largely dictated by family food demands, availability of planting materials, and to only a limited extent by market potential, the cropping systems were generalized to those for ricelend (irrigated, rainfed, and upland), cassava, palawiji crops, home garden areas, and intercropped bench terrace areas. Considerable overlapping occurs within these definitions, and there is admittedly a large degree of empiricism involved in estimating the individual crop areas. Problems of cropping intensities and idle lands are handled by estimating annual crop yields for the entire cropping system.

The upland crop production for the Ciamis District during two recent years is summarized in Table VIII-2. This information plus data collected from the other districts was used to estimate present crop yields. Crop yields were projected based on experienced yields in other areas and on trends in the area.

Table VIII-3 summarizes the estimated crop yields for present and future conditions (1990 and 2005) without and with the project. These estimates include differences in cassava yields for traditional terraces, without conservation measures and for severely

eroded areas. For palawija crops they differentiate between the traditional terraced areas and the areas without conservation measures. For bench terrace areas the intercropping yields are based on a system of cassava, upland rice, maize, and peanuts with the recognition that the systems that will actually develop will be much more complex and will include more high value crops.

Resource Economics

The central economic sector of the Citanduy Watershed's economy is agriculture, and is also the major employer with 83.1% of the work force (Table II-17). After a careful evaluation of the resources available, it is obvious that sustaining the projected population of the area will require increasing both irrigation and agricultural production to the maximum extent. The irrigation project development and rehabilitation of existing sytems is currently being carried out by Project Citanduy under the Directorate of Rivers. Project Citanduy is also currently at work on the downstream flood control works. Therefore, the only consideration given to the riceland areas in this chapter will be to indicate the probable increase in irrigated area and the net returns over the next 25 years.

Most proposals to implement soil conservation programs indicate that, without the project, watershed lands will be totally destroyed and that the project will result in dramatic increases in crop and forage yields. However, in the Citanduy Watershed this is definitely not the case. Much of the watershed has deep, relatively fertile soils, and the existing programs and research dissemination are currently increasing crop yields. But the upland farmers have been isolated from much of the new technology and technical inputs that they have never experienced the green revolution.

Contrary to the expressed opinions of some government planners, agricultural specialists, and trained technicians, the upland farmer using traditional methods is, in fact, a rational being when he considers the economic realities confronting his life. Recognizing this,

the yield targets contained in this report, while physically attainable, will not develop unless a major effort is made to change the economic, social and educational attainments of the farmers involved. To this end, the technical staff must attempt to implement the program work directly with the farmers to find out what problems they want solved first. Also necessary are demonstration farms where the farmer can observe improved practices. Finally, it is necessary to remove the economic and physical constraints from the purchase of improved seeds, fertilizers, and biocides that are needed to improve crop yields.

Prices Paid and Prices Received by Farmers

The 1979 inflation rate for Indonesia is reported to be as high as 30 percent on an annual basis, which makes it extremely difficult to price project measures and to evaluate costs and returns for crop production. To counteract this problem all prices were checked and revised to July 1979 prices where necessary.

Prices Paid. Prices paid by local farmers vary widely by time periods and by subbasin areas. Because of the government food production programs, prices of fertilizers and certain other inputs are subsidized to stimulate increases in food production. Table VIII-4 shows the world market, or economic, price for fertilizers and the common financial price to farmers. For urea and triple super phosphate the farmer was paying Rp. 70 per kg in 1979, while the economic price was about Rp. 140 and 120 respectively. Information on the subsidies for other input items was not available, and were consequently ignored for budgeting purposes.

The commonly reported price for insecticides is Rp. 1,150 per liter and for rodenticides, Rp. 2,900 per liter; however, very little of either is currently being used by upland farmers.

Most of the seeds and planting materials are currently being obtained from the farmers' own stocks, which were held back from the previous crop. These were generally priced at 120 percent of the farmgate price for the crop, or in the case of cassava, at an estimated labor cost for obtaining the cuttings. For future conditions, the price of seed and planting materials was assumed to be 150% of the farmgate prices.

Labor costs for crop production vary widely in the upland areas and depend upon opportunities for employment. Because these variations by time of year and location were inestimable the average wage rate was assumed to be Rp. 450 per man-day (md). This assumed rate may result in an over-estimation of labor costs because there are areas in the Watershed where the common wage rates are reportedly as low as Rp. 250 per md, and women normally receive about Rp. 50 less per day than men. Since water buffalo (kerbau) are not common in the upland areas, all plowing, or cangkuling, is assumed to be done by hand. Because of the current labor surplus in the watershed area it is assumed that this will also be true for future conditions with and without the project. In fact, it is doubtful if even very small tractors could be economically used on the type of bench or traditional terraces being applied in the upper watershed areas.

In reality, little of the labor for producing upland crops is hired, and the labor charge in the crop budgets is mostly a form of income to the farm family.

Prices Received. Most of the farm products sold by farmers are subject to at least some type of price controls or marketing arrangements. The upland farmer under present conditions actually markets a very small portion of his crop production because most of it is necessary for feeding the family. As previously noted, the upland farmer is not a part of the market economy. For this reason, it is very difficult to obtain realistic farmgate prices for upland crops without an extensive farm survey throughout the Watershed. The alternative chosen was to take the average prices for upland crops in the Ciamis District (Table VIII-5) as the best estimate of farmgate prices, although these are actually prices in the local town markets. This approach ignores the cost of transportation to the market and the profit margin of any middlemen involved. It was adopted as a means of reflecting the inflationary effects on the prices of farm products.

Rough rice (gabah) was excepted from the standard of using local market prices to represent the economic price for farm products, because it is widely traded in international markets and is commonly imported to Indonesia. Therefore, from the economic viewpoint it should

be valued at its import substitution value of Rp. 144/kg. This shadow price reflects the real economic cost to society and to the Indonesian economy. For consistency with irrigation project evaluations currently being conducted in the Citanduy Watershed the economic price projections are at 1978 constant dollars (Table VIII-6). This value is not greatly different, however, from the current market price of Rp. 120/kg for rough rice in the Ciamis District markets.

Crop Budgets

Crop budgets for the riceland areas were based on the recent irrigation project studies by the consultant in the Sidareja-Cihaur and Central Java Projects adjusted to the higher crop yields estimated for the riceland areas of the entire Citanduy Watershed. Project net income was estimated for irrigated rice with technical irrigation systems and rural systems, and for rainfed rice production (Table VIII-7). These riceland crop production costs and returns underestimate the true net returns because they do not include the values for dry season production of palawija crops on the riceland areas. This is not a serious ommission, however, because the returns to the riceland areas are used only to indicate the potential benefits from a complete watershed program in years 11 through 25 and are not taken for the project proposed in this report.

Individual crop budgets were prepared for each of the principal cropping systems and evaluation time frames. The crop budgets for the upland cropping areas are based on the Panawangan Pilot Demonstration Farm results, the Solo Watershed Project evaluations, and the limited production information obtained in the watershed. Information on returns to agroforestry and home garden areas was not sufficient for budgeting purposes, and the returns to these crops were estimated as a percentage of the returns to palawiji crops on traditional terraces. The crop budgets are available for inspection in the project files and are summarized in Table VIII-7. The large number of individual crops grown, the variation in production practices, and yield variations with elevation and soils make the budgeting process for watershed analysis much more complex than for irrigation project development.

The individual crop budgets were checked for internal consistency, and the apparent errors were corrected. While these budgets are suitable for project feasibility determinations, they are not appropriate for demonstrating the potential increased returns to upland farmers. Specific crop budgets should be developed by subbasin area, elevation zone and soil type for this purpose as one of the first steps in project implementation.

Cropland Benefits

Present Conditions. As shown in Table VIII-8 the project net returns to the entire 235,502 ha of cropland under present conditions amounts to an estimated 33,425.1 million rupiah in 1979 values. Net returns per ha vary from Rp. 227,750 (US $364) on the 86,802 ha of riceland, Rp. 92,990 (US $149) on the 120,508 ha of upland cropland, and an estimated Rp. 86,900 (US $139) per ha net return on the 28,192 ha home garden areas.

Future Without Project Conditions. As previously noted, there will be a signficant increase in crop yields even without the integrated Watershed Management Project proposed herein, although there will also be an increase in the area of seriously eroded land that will produce only small yields of cassava or will have to be planted with trees or soil conserving cover crops. Information on erosion rates or trends in land use for the Citanduy Watershed is simply not sufficient to define the true future condition with any degree of certainty.

Table VIII-9 shows the 1970 estimated future without project net returns to be 42,913.1 million Rupiah for a 28.4% increase over present conditions. The increase on ricelands returns amounts to 34.8% and that for upland crops and home gardens amounts to 19.1%. Much of the increase in net returns is the result of an estimated increase in riceland area of 3,198 ha between 1979 and 1990, an increase in upland crop area of 4,277 ha, and an increase in home garden of 2,023 ha in the same period. This 9,498 ha increase in cropland from 235,502 ha in 1979 to 245,00 ha in 1990 is part of the continuing trend toward a reduction in plantation areas and an increase in food crop production to feed the growing population.

By 2005 it is expected that a total of 261,000 ha will be devoted to cropland, with 95,500 ha to rice production and 165,500 ha to upland crops and home gardens for an increase of 10.0% in riceland and 11.3% in upland crop and home garden areas over present conditions. Much of this increased area is not suitable to use for crop production without the application of intensive conservation measures, which is absolutely necessary in view of the projected increase in population of 695,000 people by 2005 (Table II-15). The without project net returns for cropland in 2005 are estimated at 68,233.1 million Rupiah, or slightly more than double the present condition value of 33,425.1 million Rupiah. This increase is in line with the known adoption rate of existing technology and the trends in land use within the Watershed. It is also based on an increase in the effectiveness of other government programs for the Upper Watershed.

For evaluation purposes the with and without cropland areas are held the same to prevent a possible double counting of benefits. If the Watershed Management Project truly succeeds, however, there would actually be less area devoted to cropland, and more of the land better suited to trees or permanent cover would be used according to its land capability.

Future With Project Conditions

As shown on Table VIII-9, by 1990 the proposed 5-year Watershed Management Project is projected to increase the net returns on upland crops by 4,134.6 million Rupiah and the returns from home gardens by 686.0 million Rupiah. The total increase of 4,820.6 million Rupiah on upland areas amounts to an average of 31,100 Rp/ha (US $50) on the 155,000 ha of upland crops and home gardens. The 1990 with project net returns on upland crops and home gardens of 21,085.6 million Rupiah amounts to Rp. 156,190 (US $250) per ha on the 135,000 ha upland area. The equivalent without project value is Rp. 120,481 (US $193) per ha. This is a 29.6% increase in net returns for with project conditions. For evaluation purposes it was assumed that 5 years after the end of the proposed project would be required to reach this benefit level. This assumption recognizes that a number of years are required for the farmers to achieve maximum production on land terraced areas, or for farmers to

adopt the conservation farming technology and improved practices from the demonstration farms and educational programs.

Assuming that the Citanduy Watershed Project is fully implemented and that all the necessary treatment measures are installed, the Watershed net returns could be increased by 17,391.0 million Rupiah by 2005 (1979 Rupiah Values). This amounts to an average of Rp. 66,630 per ha (US $107) on the 261,00 ha of cropland projected for the Watershed.

The 5 percent increase in net returns on riceland areas is based on reduced flooding and sediment deposition, reduced irrigation system maintenance, and on increased the dry season stream flows in the Watershed. This increase in riceland net returns amounts to an estimated Rp. 23,848 (US $38) per ha.

The estimated potential increase in upland net returns amounts to 15,113.5 million Rupiah, or Rp. 91,320 (US $146) on the 165,500 ha of upland crops and home garden areas. This would be accomplished by raising the net returns from Rp. 137,046/ha to Rp. 228,366/ha, which is a 66.6% increase in net returns.

This increase in net returns is technically feasible without much question, but it requires a total integrated watershed management approach with continuous technological inputs, a high level of conservation farming method application, and a long-term maintenance program for Project measures. This potential increase can be accomplished only if the Government of Indonesia makes total watershed management a policy and recognizes it as a long-term program demanding continuous budgeting of technical staff and policy direction requirements.

Benefits and Impacts from the Watershed Management Project

The proposed Citanduy Watershed Management Project should be regarded as an important first step in the long-term solution of the watershed management problems of similar watershed areas. It is also an important first step in the difficult process of gaining local acceptance of the conservation program through the planning and implementation of

the project features in the small hydrologic units where all farmers must become involved. As one of the pilot watershed management and erosion control projects, it will also definitely accrue a number of research benefits and quite possibly result in the development of a less costly method of solving the rehabilitation problems of overpopulated watersheds.

Project Benefits on Cropland

The evaluation of benefits for the proposed integrated Watershed Management Project is shown on Table VIII-11. While these benefits include only the expected increase in net returns to upland crop and home garden areas, the consultant staff believes that they have adequately evaluated the impact of the initial project effort which is entirely focused on the upland crop areas. The benefit evaluation assumes that project benefits will increase yearly from zero in year one to 4,820.6 million Rupiah in year 10, then remain constant for years 11 to 25. With these assumptions, total project benefits for the 25-year evaluation period amount to 96,412.0 million Rupiah (US $154.3 million) with a net present value of 21,419.7 million Rupiah (US $34.3 million) at 12 percent interest.

Potential Project Benefits on Cropland

The potential project benefits on cropland within the Citanduy Watershed are shown in Table VIII-12. The evaluation period was limited to 25 years to provide a comparison with the proposed project although the potential project benefit period would be much longer. For simplicity, the evaluation also assumed that benefits during the first 10 years would be the same as the proposed project, then increase linearly to the evaluated potential in year 25. It is recognized that this will probably underestimate potential project benefits, which should increase rapidly during and immediately after the intensive project application period then level off rather than increase linearly.

Potential project benefits for the 25-year evaluation period amount to 196,975.2 million Rupiah (US $315.1 million), slightly more than twice the benefit for the proposed project. The limited nature of this evaluation does not reflect the fact that crop-land benefits could be much higher for a complete integrated watershed management project aimed at solving the problems of the Citanduy Watershed.

Other Project Benefits

Bench Terracing. The Project plans call for the direct installation of 4,375 ha of project bench terracing, about 300 ha of bench terracing on demonstration farms, and 125 ha of terracing by farmers without direct assistance. Added to the estimated 200 ha of existing bench terrace, this totals an estimated 5,000 ha of bench terracing for the Watershed by the end of the 5-year Project period.

Ideally, the benefits from bench terracing should have been evaluated separately, but information on the present land uses and returns was not available for the with and without evaluation. The direct cost of bench terracing is also only a portion of the total costs of Project measures that would be applied on the terraced areas in the integrated Watershed Management Project. Therefore, all that can be stated is a general reaffirmation of the Solo Watershed Project evaluation, which found internal rates of return of 23 to 26 percent on severely eroded soils with a 50 cm depth at elevations of from below 500 to 1,000 m and on slopes of from 5 to 30 percent [1]. The detailed evaluation of bench terracing benefits and costs in the Citandy Watershed should lead to similar results.

It is also important to note that the Solo Project evaluation concluded that: "for steep terrain (30-50% slope), critically eroded soils (soil depth below 50 cm), bench terracing for dryland cultivation is not justified from an economic point of view, as is illustrated by the internal rate of return for a 25 cm soil depth (from less than 6% to 7.5% according to elevation range)." This is a strong recommendation to return this type of area to permanent cover or forestry whenever possible.

The benefits from bench terracing come from an almost complete opportunity for soil and water conservation, together with the potential for a much higher level of cropping intensity on the terraces' benches at the same time. There is, however, a loss of net croppable area because of the land occupied by terrace risers, waterways, and other low value production areas. Design plans for the terrace area indicate that the average terrace area would have 64 percent effective cropland, which was the basis for estimating costs and returns on bench terraces lands in Table VIII-7 and other evaluation tables.

Integrated Farming Benefits. In a very real sense all agricultural benefits of the proposed project are integrated farming benefits because they can occur only if the complete project program is adopted. This would include complete farmer and family education, technical assistance demonstration farms, Kelompok Conservation Action Units, participation incentives, a farm credit program, and an infrastructure development program. As noted several times in this report, the upland farmers of the Watershed have not experienced the "green revolution," because of their relative isolation and lack of development programs. Although existing programs will accomplish most of the project improvements over time, the integated Watershed Management Program is designed to hasten the adoption of improved practices and save valuable soil resources at the same time.

Forestry and Plantation Benefits. The proposed Watershed Management Project does not include any specific funds for direct improvement on government-owned forest or plantation areas because these erosion problems are not as severe as on the upland crop areas. They also have direct departmental programs or funds from the Perhutani State Enterprise for improvement on these lands. A continuing Watershed Management Program should contain a specific program for improvement of government forest and plantation areas of the Upper Waterehed that is specifically designed to solve the problems that are defined during the proposed project period.

Tree planting and other improvements on private land will reduce the wood harvesting and forest or plantation area invasion problems of the watershed. Recommended forest boundary marking programs and exchanges of small forest tracts for critical private lands can also reduce damages to the forest areas and improve downstream water quality and quantity.

Road and Settlement Damage Reduction Benefits. Every major storm causes severe erosion, sediment, and flood damages to roads and settlements in the Watershed. Road damages are higher in the upland areas, and home or village damages are more common in lowland areas. The proposed Project has a budget of 169.1 million Rupiah for road and trail erosion proofing of critical areas, and the local people are expected to contribute an additional 253.6 million Rupiah to this program. This 422.7 million Rupiah (US $676,320) infrastructure improvement program is not designed to solve the transportation problems of the Watershed, but it should greatly reduce the road and trail erosion problems. Data are not available to estimate the monetary benefits of the program, but reduced transportation costs from savings in fuel, time, vehicle maintenance, and reduced merchandise damage would repay the cost several times over. The road to the Panawangan Demonstration area provides a good example of improved access to a difficult area along with very effective erosion proofing.

Reduced Downstream Flooding and Sedimentation Damages

The proposed Watershed Management Project would have the definite long-term effect of reducing downstream flooding and sediment deposition, providing the project is continued until the majority of the needed treatment practices are installed and properly maintained. It is doubtful, however, that any significant difference in downstream conditions will be discernable the first few years of the project. The Project benefits in these years will be to first to reduce the continuous worsening of erosion and sediment deposition problems, then to improve the Watershed conditions until floodwater and sediment damages are significantly reduced. One should recognize that initially improvements in one area will be offset by deterioration in another area, and this will cause difficulties in observing true downstream benefits.

On-site reduction in erosion, sedimentation and, to some extent, flood damages will be apparent in the treated watershed areas almost immediately although the benefits of maintaining the soil are sometimes not visible for many years.

Environmental Quality Benefits. The objective of the proposed Watershed Management Project is the improvement in quality of life for the 2,236,500 people living in the Citanduy Watershed and for an undetermined number of people affected downstream in the Segara Anakan Watershed. Data do not exist to evaluate the potential increase in quality of life for these people or for succeeding generations without a specific baseline survey to define present conditions. A post-project survey would also be necessary to determine true Project benefits to the population.

Any modern development or use of the natural ecosystem has great impacts because man now has the technical ability to extract or destroy natural resources. To a large extent, destruction of natural ecosystems is a function of human population versus natural resources of the area. In the case of the Citanduy Watershed, productive climate and natural resources have permitted development of a very high population density, but at the expense of destroying most of the natural forest ecosystem. This is an inevitable result of the extreme population pressures, and these lands can never be restored to their natural condition. Above all, the destruction of any more of the approximately 18,187 ha of natural protection forest remaining must be prevented (Table II-4).

Recognizing that it will be impossible, and not even desirable, to return to anything approaching the natural forest climax ecosystem, the present condition must be either maintained or improved in the forest areas.

Environmental quality benefits from the proposed Project will be primarily improved quality of the life for upland farmers and their families while protecting the land resource and natural values. These benefits are mostly related to increased incomes, better educational opportunities, better nutrition, increased long-term productivity of the farmers' lands, and it is hoped, a greater sense of participation in the activities of the Government. The population pressures of this

watershed are such that there would be little opportunity for improving conditions for wildlife, or maintaining natural ecosystems outside of protection areas.

Project Costs

The estimated Project cost flows for the proposed integrated Watershed Management Project are shown in Table VIII-13. All Project costs are charged at the baginning of the year because of the complexity of the administrative system for watershed management and the uncertainty of the specific implementation organization and Government fiscal policy indicates that the money would need to be allocated at the beginning of the year. An active monetary management program for the Project by the Indonesian Government could save considerable interest charges on borrowed funds by careful scheduling of cash flows to governmental units.

Operation, maintenance, and repair costs for the post-Project period were estimated at 7.5 percent of the 2,358.9 million Rupiah cost of the conservation works, or 176.9 million Rupiah per year. This would include the cost of supervision, inspection, farmer incentives, and government-conducted repairs to all conservtion measures except those for the reforestation and greening program. Within this framework, Project costs for the 25-year evaluation period are estimated to be 12,254.8 million Rupiah (US $19.6 million), which at 12 percent interest has a net present value of 7,702.1 million Rupiah.

Table VIII-14 presents the estimated total cost of the Project when the farmer and village costs are included. To keep the evaluation comparable, the operations, maintenance, and repair portions of the 1,998.7 million Rupiah farmer and village costs for conservation measures was estimated at 7.5 percent. The total conservation measures cost of 4,356.6 million Rupiah, therefore, would have an estimated OM&R cost of 326.8 million Rupiah annually.

Local costs of project measures are, in general, simply subtracted from project benefits rather than included in the project evaluation. In this case, however, an estimated 35.2 percent of the total costs of the Watershed Management Program would be borne by the farmers and villagers and should be considered in the Project evaluation to show their contribution. Further, because the initial 5-year program has very heavy expenditure for education and training at the Government's expense, the continuing Watershed Management Program could be expected to have much higher rates of local contribution. In fact, if the watershed management concept proposed in this Project is truly to work, the application of conservation works must become a local project for planning, construction, operation, and maintenance.

Project Justification

The objective of the economic analysis, or project justification, is to demonstrate that the expenditure for administration, planning, construction, operation, maintenance, and replacement are justified by the estimated improvement in future conditions that are attributable to the project.

As conducted, the economic analysis of the proposed Project is conceptually simple, but it presents a number of political and government agency problems in ascertaining the probability of realizing the potential benefits because most of the project benefits result directly from changing the way the Citanduy Watershed is being managed or mismanaged under present conditions. The major examples of this are the lack of programs to bring the inputs and knowledge for implementing the "green revolution" to the upland farmer.

Therefore, the proposed Project is evaluated with the recognition that it will take a major turn-around in the methods of project implementation by the Indonesian Government, and with the further recognition that the potential benefits are so great that the Government should at least attempt the preliminary project but that if the project is not fully implemented, the benefits will be much less or, in some cases, nonexistent.

Benefit-Cost Ratio

Comparison of project benefits and costs is one of the most important measures of project justification. Since the costs and benefits accrue at different time periods, it is necessary to reduce them to a common time basis by discounting all benefits and costs to the present. A 12 percent interest rate was employed in the discounting process to obtain the benefit-cost ratio and net benefit (excess of benefits over costs). As shown on Table VIII-15, the benefit-cost ratio for the project at 12 percent for the 25-year period of analysis is 2.78 to 1.00, and the net benefit is 13,717.6 million Rupiah (US $21.9 million).

When total costs, including those for farmers and villagers, are considered, the benefit-cost ratio for the 25-year project evaluation period is 1.91 to 1.00 when discounted at 12 percent interest; and the net benefit is estimated at 10,215.3 million Rupiah (US $16.3 million), which indicates the proposed project is evaluated to be very feasible at the 12 percent discount rate.

Internal Rate of Return

The internal rate of return (IRR) is often preferred as a measure of project justification because it measures the potential growth rate of the investment and automatically allows for the time factor without conferring any arbitrary advantage or disadvantage on projects that are slow in starting. The IRR procedure uses discounted cash flows to find the discount rate at which the net present value of the cash flows is equal to zero. In a sense, the internal rate of return represents the average earning power of the money used in the project over the life of the project.

Based on the benefit and cost flows shown in Table VIII-15, the internal rate of return for the proposed integrated Watershed Management Project is 29.3 percent. When Project benefit flows are compared with the total costs (including farmer and village costs), the internal rate of return to the Watershed Management Project drops to 22.2 percent. This is about the internal rate of return that would be expected from a complete integrated watershed management project in an

area, such as the Citanduy Watershed, with a high potential for increased crop production. It is also in line with the Solo Project evaluations for the Kali Samin Watershed, which indicated an internal rate of return for the complete development plan of 22.4 percent. This high rate of return on the investment indicates that the project definitely should be implemented if development funds are available to the Indonesia Government.

Sensitivity Tests

Although the economic analyses were based on the best information available and the results were cross-checked when possible, there is still a large potential for error in specific sections of the evaluation, the result of the large number of projections and empirical assumptions that had to be made in the Project justification. Sensitivity, in this case, refers to the relative magnitude of the change in one or more of the assumptions on benefits or costs that would reverse the decision as to Project justification. The sensitivity analysis therefore, is performed to give the decision-maker an estimate of the reliability of the proposed Project's estimated profitability.

One of the most serious effects would be a lowering of crop prices, or Project benefits, relative to Project costs. It is not likely, however, that crop prices could be reduced by as much as 20 percent over the long run in consideration of Indonesia's and the world's population growth rates and increasing demand for food. If the Project benefits are reduced by 20 percent, the internal rate of return would be 24.6 percent and the benefit-cost ratio would be 2.22 to 1.00 at 12 percent interest. To further test the sensitivity of a reduction in benefits, the Project benefits were reduced by 50 percent. With this halving of project benefits, the internal rate of return would still be 16.6 percent and the benefit-cost ratio would be 1.39 to 1.00 at 12 percent interest for the discount rate. Even with this drastic reduction in the evaluated benefits, the project would remain economically justified, although the returns would be considered marginal. Specific calculations for this sensitivity analysis are shown in Appendix Table C-8.

To further test Project evaluation sensitivity, costs were increased by 25 percent, which reduced the internal rate of return to 24.6 percent and the benefit-cost ratio to 2.22 to 1.00.

Finally, Project benefits were reduced by 50 percent and costs were increased by 25 percent. This extreme test reduced the internal rate of return to 13.3 percent and the benefit-cost ratio to 1.11 to 1.00 (Appendix Table C-9). Although the Project is barely feasible within these drastic assumptions, it strongly indicates that the Project is definitely justified and is not particularly sensitive to errors in the basic assumptions.

TABLE VIII-1

PRESENT AND PROJECTED LAND USE IN THE CITANDUY WATERSHED

Land Use	Present Condition	Future Without Project		Future With Project	
		1990	2005	1990 1/	2005 2/
Cropland					
Irrigated Riceland					
Technical Systems	18,732	25,166	28,000	25,166	28,000
Rural Systems	36,767	35,834	38,500	35,834	38,500
Rainfed Riceland	31,303	29,000	29,000	29,000	29,000
Subtotal	86,802	90,000	95,500	90,000	95,500
Upland Cropland					
Bench Terraced	200	460	10,000	5,000	50,000
Traditional Terraced	80,000	90,000	90,000	95,000	52,000
Without Conservation	30,000	21,925	13,960	8,750	2,400
Severely Eroded	7,008	7,900	6,100	5,250	2,100
Agroforestry	3,300	4,500	8,500	9,000	20,000
Subtotal	120,508	124,785	128,540	123,000	126,500
Home Gardens	28,192	30,215	36,960	32,000	39,000
Total Cropland	235,502	245,000	261,000	245,000	261,000
Plantations	44,548	35,000	17,000	35,000	17,000
Forest	44,049	44,000	44,000	44,000	44,000
Other Uses					
Residential	7,260	7,456	9,518	7,456	9,518
Roads and Trails	1,784	1,912	2,340	2,290	2,800
Rivers and Streams	4,648	4,650	4,650	4,650	4,650
Fishponds	2,968	3,000	3,000	3,850	4,450
Other Uses	9,241	8,982	8,492	7,754	6,582
Subtotal	25,901	26,000	28,000	26,000	28,000
Total Watershed	350,000	350,000	350,000	350,000	350,000

1/ Assuming that the Citanduy Upper Watershed Project continues only the initial five year project period.

2/ Assuming that the Citanduy Upper Watershed Project is completed and all necessary treatment measures installed.

TABLE VIII-2

UPLAND CROP PRODUCTION FOR CIAMIS DISTRICT 1976/1977 AND 1977/1978

Description	Units	1976/1977	1977/1978	Average
Upland Rice				
Area Planted	ha	3,764	3,723	3,743
Area Harvested	ha	2,351	2,855	2,603
Percent Harvested	%	62.5	76.7	69.5
Production	ton	6,273	10,187	8,212
Production per ha planted	kg	1,667	2,736	2,194
Cassava				
Area Harvested	ha	25,459	29,373	27,416
Production	ton	181,955	221,737	201,846
Production per ha	kg	7,147	7,549	7,362
Palawija Crops				
Area Harvested	ha	18,411	18,859	18,636
Production				
Corn	ton	7,954	6,161	7,057
Sweet Potato	ton	15,934	14,588	15,261
Peanut	ton	2,828	4,507	3,668
Soybeans	ton	1,525	1,374	1,450
Total Production	ton	28,241	26,630	27,436
Production per ha	kg	1,534	1,412	1,472
Total Area Harvested	ha	46,221	51,087	48,655

Source: District Planning Office Records

TABLE VIII-3

ESTIMATED ANNUAL CROP YIELDS FOR PRESENT AND FUTURE CONDITIONS (WITHOUT AND WITH PROJECT)

(Kilograms Per Hectare)

Item	Present Condition	Future Without Project		Future With Project	
		1990	2005	1990	2005
Rice (Dry Rough Rice)					
Irrigated Rice					
Technical Systems	3,800 1/	4,500	7,250	4,500	7,250
Rural Systems	2,750	3,250	4,750	3,250	4,750
Rainfed Riceland	1,667	2,200	3,000	2,200	3,000
Upland Rice (Wet Season)	975	1,100	1,500	1,800	2,100
Cassava					
Traditional Terrace	6,700	7,400	10,000	9,000	12,500
Without Conservation	5,360	5,900	8,000	6,500	8,800
Severely Eroded	2,500	3,000	3,500	3,300	3,900
Palawija Crops 2/					
Traditional Terrace	1,600	1,850	2,600	2,400	3,000
Without Conservation	1,280	1,480	2,080	1,920	2,400
Bench Terrace 3/					
Cassava	2,700	3,000	4,000	3,600	5,000
Rice	780	800	1,200	1,450	1,700
Maize	190	250	400	400	500
Peanuts	300	330	400	440	800
Total kg	3,970	4,380	6,000	5,890	8,000
Gross Value/ha (Rp) 4/	303,420	330,000	452,800	489,200	687,800
Ave. Value/kg Produced Rp.	76.4	75.3	75.5	83.1	86.0

1/ Based on Central Java Systems Survey.

2/ Based on intercropping systems of corn, sweet potato, peanut, and soybeans as shown in Appendix Table A-16.

3/ Intercropped net production for 64% Bench Area.

4/ Based on 1979 prices from Table VIII-3.

TABLE VIII-4

FERTILIZER PRICES FOR PROJECT PLANNING

(Rp./ton 1979 Price Base)

	Urea	Triple Super phosphate	Diammonium Phosphate	Potash
International Price (1979)	99,687	79,687	106,875	41,250
Ocean Freight ($27.00/ton)	16,875	16,875	16,875	16.875
Port Handling Charge ($7.50/ton)	4,687	4,687	4,687	4,687
Freight to User ($23.00/ton)	14,375	14,375	14,375	14,375
Handling at distribution center ($5/ton)	3,125	3,125	3,125	3,125
Estimated Farmgate Price	138,749	118,749	145,937	80,312
Economic Price/Kg at Farm-Rounded	140	120	145	80
Financial Price to Farmer	70	70	NA	80

Urea Price $159.50/ton - bagged, FOB N.W. Europe

Triple Super Phosphate Price $127.5/ton - bulk, FOB Florida

Diammonium Phosphate Price $171.00/ton - bulk, FOB Florida

Potash (Potassium Chloride) Price $ 66.00/ton - bulk FOB Vancouver

US $1.00 = Rp. 625

Source : World Bank, Economic Analysis and Projections Department.

TABLE VIII-5

PRICES OF AGRICULTURAL CROPS IN CIAMIS DISTRICT

(25 August 1979)

C r o p	Units	Rupiah
Rough rice	kg	120
Shelled corn:		
Yellow	kg	95
White	kg	90
Cassava:	kg	
Wet	kg	30
Peeled Roots	kg	35
Dried	kg	45
Peanut (In shell)	kg	310
Peanut (Shelled)	kg	500
Sweet Potato (field)	kg	50
Sweet potato (cleaned)	kg	60
Soybeans	kg	200
Vegetables:		
Potatoes	kg	250
Cabbage	kg	175
Carrot	kg	450
Red pepper	kg	900
Red onion	kg	500
Green bean	kg	550
Tomato	kg	300
Coconut	kg	60
Tea	kwt	95,000
Coffee (Aribica Java)	kg	800

Source: Economic Coordination Office Ciamis District

TABLE VIII-6

RICE AND SOYBEAN PRICE STRUCTURE, INDONESIA

(Metric Tons)

	Rice Rupiah	Soybeans Rupiah
International price, f.o.b. export point	217,500 1/	175,525 2/
Ocean freight and insurance	11,875	16,875
Imported price	229,375	192,500
Port handling charges	5,188	5,188
Transportation to selling center	1,556	1,556
Less transportation from mill	- 2,594	- 2,594
Price ex-mill	233,525	196,650
Conversion to gabah (x .63)	147,120	N.A. 3/
Less milling cost	- 2,594	- 3,113
Less transport farm to mill	- 1,038	- 1,038
Farm gate economic price	143,488	192,499
Rounded Price Per kg	144	193
Dollars (U.S.)	$ 229.58	$ 308.00

1/ IBRD projections at 1978 constant dollars for rice f.o.b. Bangkok $ 410/t for 5% broken, $ 348/t for local quality (20 - 25% broken)

2/ Soybeans f.o.b. Gulf ports USA $ 281

3/ Not Applicable

U.S. $1.00 = Rp. 625

TABLE VIII-7

COMPOSITE PER HECTARE CROP PRODUCTION COSTS AND RETURNS FOR PRESENT AND FUTURE (WITHOUT AND WITH PROJECT)

(1979 Rupiah Values)

Crop	Yield kg/ha	Farmgate Price Rp/kg	Gross Value of Production	Labor Costs	Other costs	Project net Income
Irrigated Rice - Technical System						
Present conditions	3,800	144	547,200	135,000	60,750	351,450
Future w/out (1990)	4,500	144	648,000	146,250	78,416	423,334
Future w/out (2005)	7,250	144	1,044,000	184,050	147,812	712,138
Irrigated Rice - Rural Systems						
Present condition	2,750	144	396,000	121,500	55,840	218,660
Future w/out (1990)	3,250	144	468,000	130,500	60,985	276,515
Future w/out (2005)	4,750	144	684,000	150,750	92,284	440,966
Rainfed Rice						
Present condition	1,667	144	240,048	65,250	22,142	152,656
Future w/out (1990)	2,200	144	316,800	74,250	33,995	208,855
Future w/out (2005)	3,000	144	432,800	83,250	51,786	297,764
Upland Rice -Palawija						
Present conditions	1,055	133	140,400	42,300	11,317	86,783
Future w/out (1990)	1,191	133	158,400	47,250	15,366	95,784
Future w/out (2005)	1,624	133	216,000	74,250	22,530	119,220
Future w/project (1990)	1,949	133	259,200	76,500	24,140	158,560
Future w/project (2005)	2,274	133	302,400	96,750	31,772	173,878
Cassava - Traditional Terrace						
Present conditions	6,700	30	201,000	44,100	33,400	123,500
Future w/out (1990)	7,400	30	222,000	46,300	37,660	138,040
Future w/out (2005)	10,000	30	300,000	54,425	53,460	192,115
Future w/project (1990)	9,000	30	270,000	51,300	41,425	177,275
Future w/project (2005)	12,000	30	375,005	64,300	101,140	209,560
Cassava Without Conservation Practices						
Present conditions	5,360	30	160,800	39,900	25,270	95,630
Future w/out (1990)	5,900	30	177,000	41,600	28,550	106,850
Future w/out (2005)	8,000	30	240,000	48,200	41,300	150,500
Future w/project (1990)	6,500	30	195,000	43,075	32,200	119,725
Future w/project (2005)	8,800	30	264,000	50,230	46,170	167,600

TABLE VIII-7 (Continued)

Crop	Yield kg/ha	Farmgate Price Rp/kg	Gross Value of Production	Labor Costs	Other Costs	Project net Income
Cassava - Severely eroded areas						
Present condition	2,500	30	75,000	30,970	7,895	36,045
Future w/out (1990)	3,000	30	90,000	32,500	10,930	46,570
Future w/out (2005)	3,500	30	105,000	34,100	13,970	56,930
Future w/project (1990)	3,300	30	99,000	34,780	12,750	51,470
Future w/project (2005)	3,900	30	117,000	36,200	16,400	64,400
Palawija Crops - Traditional Terrace						
Present condition	1,600	100	160,000	43,650	29,450	86,900
Future w/out (1990)	1,850	100	185,000	50,600	38,700	95,700
Future w/out (2005)	2,600	100	260,000	73,250	68,800	117,950
Future w/project (1990)	2,400	100	240,000	66,500	61,700	111,800
Future w/project (2005)	3,000	100	300,000	83,450	82,400	134,150
Palawija Crops - Without Conservation Measures						
Present condition	1,280	100	128,000	34,700	17,350	75,950
Future w/out (1990)	1,480	100	148,000	40,400	24,900	82,700
Future w/out (2005)	2,080	100	208,000	57,600	47,600	102,800
Future w/project (1990)	1,920	100	192,000	53,000	41,550	97,450
Future w/project (2005)	2,400	100	240,000	66,800	59,700	113,500
Bench Terrace - Intercropped 1/						
Present condition	3,970	76.4	303,420	62,800	73,000	167,620
Future w/out (1990)	4,380	75.3	330,000	69,150	79,500	181,350
Future w/out (2005)	6,000	75.5	452,800	94,200	105,300	253,300
Future w/project (1990)	5,890	83.1	489,200	92,500	103,500	293,200
Future w/project (2005)	8,000	86.0	687,800	125,200	137,100	425,500

Agro forestry - estimated as 80% of palawija crops on traditional terrace.

Home Gardens - estimated to be the same as palawija crops on traditional terrace on the basis that this area includes homes, yards and other uses, but is more intensively cropped, to fruit, vegetables and food crops.

1/ Net for 64% bench area of effective cropland.

TABLE VIII-8

PRESENT CONDITION NET RETURNS ON CROPLAND
FOR THE CITANDUY WATERSHED

(1979 Rupiah Values)

Description	Present Condition		
	Hectares	Rp. per Ha.	Total Million Rp.
Irrigated Riceland			
Technical Systems	18,732	351,450	6,583.4
Rural Systems	36,767	218,660	8,407.1
Rainfed Riceland	31,303	152,656	4,778.6
Subtotal Riceland	86,802		19,769.1
Upland Cropland			
Bench Terraced	200	167,620	33.5
Traditional Terraced			
Cassava	26,500	123,500	3,272.8
Upland Rice-Palawija	16,500	86,783	1,431.9
Palawija Crops	37,000	86,900	3,215.3
Without Conservation Practices			
Cassava	25,000	95,630	2,390.8
Palawija Crops	5,000	75,950	379.8
Cassava-Severely Eroded Areas	7,008	36,045	252.6
Agroforestry 1/	3,300	69,520	229.4
Subtotal Upland	120,508		11,206.1
Home Gardens 2/	28,192	86,900	2,449.9
Total Cropland	235,502		33,425.1

1/ Estimated as 80% of Palawija Crops on Traditional Terrace.

2/ Estimated to be same as Palawija Crops on Traditional Terrace.

TABLE VIII-9

NET RETURNS ON CROPLAND FOR 1990 CONDITIONS (WITHOUT AND WITH PROJECT)

IN THE CITANDUY WATERSHED

(1979 Rupiah Values)

Description	Future Without Project			Future With Project			Estimated 1990 Project Benefits
	Hectares	Rp per Ha	Total million Rp	Hectares	Rp per Ha	Total Million Rp	
Irrigated Riceland							
Technical Systems	25,166	423,334	10,653.6	25,166	423,334	10,653.6	
Rural Systems	35,834	276,515	9,908.6	35,834	276,515	9,908.6	
Rainfed Riceland	29,000	208,855	6,085.8	29,000	208,855	6,085.8	
Subtotal Riceland	90,000		26,648.1	90,000		26,648.1	0.0
Upland Cropland							
Bench Terraced	460	181,350	83.4	5,000	293,200	1,466.0	
Traditional Terraced							
Cassava	40,000	138,040	5,521.6	40,000	177,275	7,091.0	
Upland Rice-Palawija	10,000	95,784	957.8	15,000	158,560	4,472.0	
Palawija Crops	40,000	95,700	3,828.0	40,000	111,800	4,472.0	
Without Conservation Practices							
Cassava	18,925	106,850	2,022.1	7,750	119,725	927.9	
Palawija Crops	3,000	82,700	248.1	1,000	97,450	97.5	
Cassava-Severely Eroded Areas	7,900	46,570	367.9	5,250	51,470	270.2	
Agroforestry 1/	4,500	76,560	344.5	9,000	89,440	805.0	
Subtotal Upland	124,785		13,373.4	123,000		17,508.0	4,134.6
Home Gardens 2/	30,215	95,700	2,891.6	32.000	111,800	3,577.6	686.0
Total Cropland	245,000		42,913.1	245,000		47,733.7	4,820.6

1/ Estimated as 80% of palawija crops on traditional terrace.
2/ Estimated to be same as palawija crops on traditional terraces.

TABLE VIII-10

NET RETURNS ON CROPLAND FOR 2005 CONDITIONS (WITHOUT AND WITH PROJECT)

IN THE CITANDUY WATERSHED

(1979 Rupiah Values)

Description	Future Without Project			Future With Project			Estimated 2005 Project Benefits
	Hectares	Rp per Ha	Total Million Rp	Hectares	Rp per Ha	Million Rp	
Irrigated Riceland							
Technical Systems	28,000	712,138	19,939.8	28,000	747,744 3/	20,936.8	
Rural Systems	38,500	440,960	16,977.0	38,500	463,008 3/	17,825.8	
Rainfed Riceland	29,000	297,764	8,635.2	29,000	312,652 3/	9,066.9	
Subtotal Riceland	95,500		45,552.0	95,500		47,829.5	2,277.5
Upland Cropland							
Bench Terraced	10,000	293,200	2,932.0	50,000	425,500	21,275.0	
Traditional Terraced							
Cassava	30,000	177,215	5,318.3	10,000	209,560	2,095.6	
Upland Rice-Palawija	20,000	158,560	3,171.2	22,000	173,878	3,825.3	
Palawija Crops	40,000	111,800	4,472.0	20,000	134,150	2,683.0	
Without Conservation Practices							
Cassava	10,000	119,725	1,197.3	2,400	167,600	402.2	
Palawija Crops	3,940	97,450	384.0		113,500	0.0	
Cassava Severely Eroded Areas	6,100	51,470	314.0	2,100	64,400	135.2	
Agroforestry 1/	8,500	89,440	760.2	20,000	107,320	2,146.4	
Subtotal	128,540		18,549.0	126,500		32,562.7	14,013.7
Home Gardens 2/	36,960	111,800	4,132.1	39,000	134,150	5,231.9	1,099.8
Total Cropland	261,000		68,233.1	261,000		85,624.1	17,391.0

1/ Estimated as 80% of palawija crops on traditional terrace.
2/ Estimated to be same as palawija crops on traditional terrace.
3/ Estimated to be 105% of without project conditions.

TABLE VIII-11

ESTIMATED UPPER WATERSHED PROJECT BENEFITS IN THE CITANDUY WATERSHED

(Million Rupiah - 1979 Values)

Year	Without Project	With Project	Project Benefits	Present Value @ 12%
1	13,656.0	13,656.0	0.0	0.0
2	13,945.9	14,481.5	535.6	427.0
3	14,235.8	15,307.0	1,071.2	762.5
4	14,525.7	16,132.5	1,606.9	1,021.2
5	14,815.5	16,958.0	2,142.5	1,215.7
6	15,105.4	17,783.5	2,678.1	1,356.8
7	15,395.3	18,609.0	3,213.7	1,453.7
8	15,685.2	19,434.6	3,749.4	1,514.3
9	15,975.1	20,260.1	4,285.0	1,545.2
10	16,265.0	21,085.6	4,820.6	1,552.1
11-25	16,265.0	21,085.6	4,820.6	10,571.2
Total	393,580.0	489,992.0	96,412.0	21,419.7
Net Present Value at 12%	118,698.7	140,118.4	21,419.7	

TABLE VIII-12

POTENTIAL WATERSHED PROJECT BENEFITS ON CROPLAND IN THE CITANDUY WATERSHED

Year	Without Project	With Project	Project Benefits	Present Value @ 12%
1	33,425.1	33,425.1	0.0	0.0
2	34,479.3	35,014.9	535.6	427.0
3	35,533.5	36,604.7	1,071.2	762.5
4	36,587.8	38,194.7	1,606.9	1,021.2
5	37,642.0	39,784.5	2,142.5	1,215.7
6	38,696.2	41,374.3	2,678.1	1,356.8
7	39,750.4	42,964.1	3,213.7	1,453.7
8	40,804.7	44,554.1	3,749.4	1,514.3
9	41,858.9	46,143.9	4,285.0	1,545.2
10	42,913.1	47,733.7	4,820.6	1,552.1
11	44,601.1	50,259.7	5,658.6	1,626.7
12	46,289.1	52,785.8	6,496.7	1,667.5
13	47,977.1	55,311.8	7,334.7	1,680.9
14	49,665.1	57,837.8	8,172.7	1,672.3
15	51,353.1	60,363.8	9,010.7	1,646.2
16	53,041.1	62,889.9	9,848.8	1,606.5
17	54,729.1	65,415.9	10,686.8	1,556.5
18	56,417.1	67,941.9	11,524.8	1,498.7
19	58,105.1	70,467.9	12,362.8	1,435.4
20	59,793.1	72,994.0	13,200.9	1,368.5
21	61,481.1	75,520.0	14,038.9	1,299.4
22	63,169.1	78,046.0	14,876.9	1,229.5
23	64,857.1	80,572.0	15,714.9	1,159.6
24	66,545.1	83,098.1	16,553.0	1,090.5
25	68,233.1	85,624.1	17,391.0	1,023.0
Total	1,227,947.5	1,424,922.7	196,975.2	32,409.8
Net Present Value at 12%	326,453.4	358,863.2	32,409.8	

TABLE VIII-13

ESTIMATED 25-YEAR PROJECT COST FLOWS FOR PROPOSED INTEGRATED WATERSHED MANAGEMENT PROJECT

(Million Rupiah - 1979 Values)

Cash Flow Year 1/	Conservation Works	Other Project Costs	Total Project Costs	Present Value at 12%
1980-81 (0)	140.4	1,541.5	1,681.9	1,681.9
1981-82 (1)	203.0	1,529.2	1,732.2	1,546.6
1982-83 (2)	389.3	1,154.5	1,543.8	1,230.7
1983-84 (3)	630.1	894.6	1,524.7	1,085.1
1984-85 (4)	996.1	1,061.2	2,057.1	1,307.5
1986-2005 (5-25)	176.9 2/		176.9 2/	850.1
Total	6,073.8	6,181.0	12,254.8	7,702.1
Net Present Value at 12%	2,563.7	5,138.4	7,702.1	

1/ Project costs all assumed at the beginning of the year.

2/ Operation, maintenance and repair costs (including cost of supervision, inspection, farmer incentives and government conducted repairs to conservation measures) estimated at 7.5% of construction cost from year 6 through year 25. OM & R costs during project period are included in project costs.

TABLE VIII-14

ESTIMATED 25-YEAR TOTAL COST (INCLUDING FARMER AND VILLAGE COSTS) FLOWS FOR THE PROPOSED INTEGRATED WATERSHED MANAGEMENT PROJECT

Cash Flow Year 1/	Conservation Works	Other Costs	Total Costs	Present Value at 12%
1980-81 (0)	176.4	2,162.5	2,338.9	2,338.9
1981-82 (1)	326.5	2,107.4	2,433.9	2,173.1
1982-83 (2)	684.5	1,453.5	2,138.0	1,704.4
1983-84 (3)	1,199.7	894.7	2,094.4	1,490.8
1984-85 (4)	1,970.5	1,061.2	3,031.7	1,926.7
1986-2005 (5-25)	326.8		326.8	1,570.5
Total	11,220.4	7,679.3	18,899.7	11,204.4
Net Present Value at 12%	4,690.3	6,514.1	11,204.4	

1/ Project costs all assumed at the beginning of the year.

TABLE VIII-15

BENEFIT AND COST FLOWS FOR THE PROPOSED INTEGRATED WATERSHED MANAGEMENT PROJECT

(Million Rupiah - 1979 Values)

Year	Project Benefit	Project Cost 1/	Net Benefit	Net Present Value at 12%	20%	30%	29.3%
0	0.0	1,681.9	-1,681.9	-1,681.9	-1,681.9	-1,681.9	-1.681.9
1	0.0	1,732.2	-1,732.2	-1,546.6	-1,443.5	-1,332.5	-1,339.7
2	535.6	1,543.8	-1,008.2	-803.7	-700.1	-596.6	-603.0
3	1,071.2	1,524.7	-453.4	-322.8	-262.4	-206.4	-209.8
4	1,606.9	2,057.3	-450.4	-286.2	-217.2	-157.7	-106.1
5	2,142.5	176.9	1,965.6	1,115.3	789.9	-529.4	543.9
6	2,678.1	176.9	2,501.2	1,267.2	837.6	518.2	535.3
7	3,213.7	176.9	3,036.8	1,373.7	847.5	484.0	502.6
8	3,749.4	176.9	3,572.5	1,442.9	830.8	315.4	457.3
9	4,285.0	176.9	4,108.1	1,481.4	796.2	387.4	406.7
10	4,820.6	176.9	4,643.7	1,495.1	750.0	336.8	355.5
11-25	4,820.6	176.9	4,463.7	10,183.2	3,506.5	1,100.9	1,187.7
Total	96,412.0	12,254.8	84,157.2	13,717.6	4,053.4	-303.0	-6.6
Net Present Value at 12%	21,419.7	7,702.1	13,717.6				

Benefit Cost Ratio = $\frac{21,419.7}{7,702.1}$ = 2.78 to 1.00 at 12% interest.

Internal Rate of Return = 29.3%

1/ Project costs assumed at the beginning of the year.

TABLE VIII-16

PROJECT BENEFITS AND TOTAL COST (INCLUDING FARMER OR VILLAGE COSTS)

FLOWS FOR THE PROPOSED INTEGRATED WATERSHED MANAGEMENT PROJECT

Year	Project Benefit	Total Cost 1/	Net Benefits	12%	25%	22.2%
0	0.0	2,338.9	-2,338.9	-2,338.9	-2,338.9	-2,338.9
1	0.0	2,433.9	-2,433.9	-2,173.1	-1,947.1	-1,991.7
2	535.6	2,138.0	-1,602.4	-1,277.4	-1,025.5	-1,073.1
3	1,071.2	2,094.4	-1,023.2	- 728.3	- 523.9	- 560.7
4	1,606.9	3,031.7	-1,424.8	- 905.5	- 583.6	- 639.0
5	2,142.5	326.8	1,815.7	1,030.3	595.0	666.3
6	2,678.1	326.8	2,351.3	1,191.2	616.4	706.1
7	3,213.7	326.8	2,886.9	1,305.9	605.4	709.5
8	3,749.4	326.8	3,422.6	1,382.3	574.2	688.3
9	4,285.0	326.8	3,958.2	1,427.4	531.3	651.4
10	4,820.6	326.8	4,493.8	1,446.9	482.5	605.2
11-25	4,820.6	326.8	4,493.8	9,854.5	1,862.2	2,591.4
Total	96,412.0	18,899.7	77,512.3	10,215.3	-1,152.1	14.9
Net Present Value at 12%	21,419.7	11,204.4	10,215.3			

Benefit Cost Ratio = 21,419.7/11,204.4 = 1.91 to 1.00 at 12% interest

Internal Rate of Return = 22.2%

1/ Project costs assumed at beginning of the year.

CHAPTER IX
FINANCIAL ANALYSIS

Financial Analysis for Project Farmers

In addition to the economic justification from the national viewpoint, it is important to the success of an integrated watershed management project that the farmers, villagers, private businesses, and local governmental units that are to participate have sufficient incentives and suitable cash flows to enable their willing participation in the project. Unfortunately experience is insufficient to accurately evaluate the incentives, training programs, and other factors necessary for an integrated watershed management project and thereby determine whether they are adequate to really cause the farmers to shift to conservation farming and maintain the conservation measures installed as a part of the project. In fact, the only guidance available is the knowledge that the original Solo Project approach of installing all of the project measures for the farmers was not a success. The human motivation necessary to cause the Indonesian upland farmers to adopt true conservation (multiple-use) farming methods that maximize production and income while protecting the soil resource is definitely not understood. However, certainly the conservation farming approach can greatly increase the crop production and standard of living of the farmers involved. Unfortunately, if the population growth of the Watershed is not controlled, the demand for land will ultimately cause most upland farmers to live strictly at the subsistance level. As shown in Table V-16, only 44 percent of the present agricultural work force consists of owners, and many of these are actually merchants in town who own farms. As the demand for farmland rises, more farmers will become tenants, sharecroppers, or laborers for the land owners, a major disincentive to the proper maintenance of project conservation measures.

Given the data, time and staff constraints, the consultant recognized that despite its need, providing an analysis of the financial impact of the Project on upland farmers and other participants was impossible. Basic data on farming types, size of farms and variations in productivity, ownership and tenency patterns, and the actual number and growth rate in the number of upland farmers were insufficient. Information on land taxes, land rental or leasing rates, the type and percent of labor hired, water buffalo hire, credit costs and many other input factors were also unavailable for the different upland farming areas of the Citanduy Watershed. Since most of the upland farms are of the subsistence type, the largest portion of the crop production is consumed by the farm family. To some degree this makes the straight financial evaluation of the Project meaningless because the farmer is really only interested in feeding his family and selling enough of his production to pay for family living expenses and the necessary monetary crop inputs.

A careful examination of the budgeting problem for the farmer financial returns revealed a useful general relationship. The government subsidization of fertilizer, which permits the sale of fertilizer at Rp. 70 per kg for both urea and TSP rather than the economic price of 140 and 120 Rp. per kg, respectively, reduces that farmer's cost for fertilizer about the same amount as the cost of taxes and farm credit increase his cost over that budgeted in the economic evaluation. While this relationship is only generalized, it does permit an estimate in the increased farmer financial returns without complete financial crop budgets.

Information is not available on the amount of labor hired for crop production, so the approach taken was to view all labor costs to be a form of return to upland agriculture. This prevents any estimate of increases to the individual farmer but it does provide a measure of the increase in employment from project measures. The Watershed's rapidly increasing labor supply is an important feature to adoption of conservation farming by the local farmers because it acts as an additional income source, particularly to an under employed upland farmer. Also, since most of the people in agriculture are landless laborers generally paid a portion of the production, all increases in crop production provide a better chance for them to earn at least subsistence living from their labor.

The financial evaluation for the watershed farmers should include an analysis of the relative position of tenants, sharecroppers, and owners, but this is not possible with the available data. The concern in this case would be that whereas the 1960 Agricultural Act (Undang-Undang Number 2, 1960, TLN 1942) provides for a 50/50 crop share between the landlord and tenant, the tenant may not be able to afford from his share of the crop production the necessary technical inputs for conservation farming. This problem should receive specific attention during the project implementation to prevent it from reducing the acceptance of the conservation farming approach.

A comparison of the estimated farmers disposable income (including labor income) for present conditions and 1990 future with Project conditions is shown in Table IX-1. It might be noted that this evaluation used the farmgate price of Rp. 120 per kg for rough rice rather than the economic price of Rp. 144 per kg. An analysis of this data indicates that upland farmers were evaluated to have an increase in disposable income from the present 19,884.9 million Rupiah to an estimated 30,583.0 million Rupiah (1979 values) in 1990, for an increase of 53.8 percent. Undoubtedly, a portion of this increase would occur without the Project, but time did not permit the complete evaluation. A separate calculation indicated that the 1990 with-Project conditions for upland crop production with conservation farming methods would require a estimated 52 percent increase in farm labor requirements.

Because many of the riceland farmers of the Watershed also have upland crop areas, and to evaluate the potential total farmer financial situation for the Citanduy Watershed, Table XI-1 also evaluated a potential increase in farmer disposable income from the present condition to 1990. This evaluation shows there is a potential increase in riceland farmers' disposable income of about 32.3 percent above present conditions. It should be noted that these benefits would be the result of irrigation project developments and other factors, and not directly the result of the integrated Watershed Project. The evaluation of the increase in labor requirements on the riceland areas indicated a potential increase of about 21 percent above present conditions. This is as expected because the riceland areas are much closer to full production potential than the upland crop area.

The evaluation estimates that for all the Watershed's cropland, which is expected to increase from 235,502 ha to 245,000 ha by 1990, the expected increase in farmer disposable income is 42.3 percent and the expected increase in labor requirements is 34 percent. Since the agricultural labor force has been projected to increase from 858,200 in 1979 to 966,000 in 1990 (an increase of 12.6 percent), the 34 percent increase in labor requirements in the Watershed would materially benefit the agricultural work force.

On a per hectare basis, the upland farmer disposable cropland income was evaluated to increase from Rp. 133,725 (US $214) for present conditions to Rp. 197,315 (US $315) for 1990 with Project conditions. It should be noted that these results are based solely on crop cultivation. Historically, livestock production in the Upper Watershed area has not been a particularly significant source of income to the farmers. Experience with programs such as the Panawangan Livestock Improvement Program also indicate that disease and fertility problems make livestock profitability somewhat questionable. In the same way, no benefits are taken from the improvement in fisheries in the Watershed because it is felt this is a part of the infrastructure improvement program rather than a true benefit to the Watershed Management Program. It is recognized, however, that increased production from both livestock and fisheries will be a major factor in the success of the long-term Watershed Management Project, and improvement in these factors may even be one of the significant factors in the success of the proposed project.

The above analysis cannot guarantee that the proposed Watershed Management Project will improve the financial situation of the individual upland farmer sufficiently to enable him to adopt the desired conservation farming methods and to maintain the conservation structures installed on his land. More importantly, perhaps, it is impossible to determine whether the farmers, individually or as a group, will become conservation farmers. It is definitely possible to infer that if the projected changes in land use, crop yields, and net returns take place, the average upland farmer will be much better off financially. The question, in this case, is how much better off the crop share or tenant farmer will be for with-Project conditions.

Project Financial Analysis

The Project financial analysis covers cost allocation, scheduled construction expenditures, foreign and domestic currency requirements, and, where possible, the user charges planned and the repayment capacity of the Project beneficiaries.

Financial analyses for a project attempts to estimate the effect of inflation on project costs so that loan costs can be anticipated. The rapidly fluctuating inflation rate in Indonesia and even in the world markets at the time of report preparation makes this difficult. For this report the World Bank projections for international rates of inflation were used for the foreign exchange components and standard Indonesian projections for the domestic components as shown in Table IX-2.

Schedule of Project Costs

The project development and construction schedule for the initial phase of the integrated Watershed Management Project is five years. The rate of progress that has been scheduled requires the fullest effort and coordination at the national, provincial, district, and subdistrict levels. Project costs are scheduled to start in 1980-81 (year one) and to be completed in 1984-85 (year five), with total project costs (in 1979 Rupiah) estimated at 8,539.9 million Rupiah (US $13,664,000). The inflation adjusted price estimate for the Project is 12,955.7 million Rupiah, (US $20,729,000), which is 152 percent of the cost estimate in 1979 Rupiah values.

Domestic and Foreign Cost Breakdown

For capital budgeting purposes, the Project cost schedule is separated into domestic and foreign exchange components in Table IX-3. Foreign costs include the estimated costs for capital items that would have to be purchased outside of Indonesia plus the cost of expatriate consulting services. The estimated foreign exchange requirement for the project amounts to 2,063.9 million Rupiah (US $3,302,000) in 1979 values,

and 2,569.6 million Rupiah (US $4,111,000) in terms of projected inflation adjusted values. The estimated foreign exchange costs amount to 24.2 percent of the 1979 values and 19.8 percent of the inflation adjusted values. Foreign exchange costs for the Project are low because the project is deliberately labor intensive, and vehicle or construction equipment costs are kept at a minimum. The domestic costs are estimated to amount to 6,476.0 million Rupiah (US $10,362,000) in 1979 values and 10,386.1 million Rupiah (US $16,618,000) in inflation-adjusted values.

Project Repayment

The Government of Indonesia does not have a formal policy for repayament of irrigation or watershed management project costs. Historically, the capital costs were not expected to be repaid by irrigation project water users, but attempts were made to obtain some reasonable contribution toward the annual operation and maintenance expenses through land taxes. Landowners pay taxes to the subdistrict government in the form of an annual assessment levied against the land (IPEDA). The tax base is an approximate productivity classification, divided into eight classes. It is assumed that OM&R costs for the proposed integrated Upper Watershed Management Project will be obtained from the subdistrict tax base after the Project is completed in the area.

Given the historical relationsheip of irrigation and other project developments in Indonesia, it is assumed that the repayment ability for the proposed Upper Watershed Management Project will be based on the general revenues of the Government of Indonesia. For future development, however, the beneficiaries of the watershed management project should be identified, and at least a portion of the project capital costs should be collected from the upland and riceland area residents in proportion to the benefits they receive from the project measures.

TABLE IX-1

COMPARISON OF ESTIMATED FARMERS DISPOSABLE INCOME FOR PRESENT CONDITIONS AND 1990 FUTURE WITH PROJECT CONDITIONS

(1979 Rupiah Values)

Description	Present Condition			1990 Future With Project			Change from Present Condition
	Hectares	Rp. per ha	Total Million Rp.	Hectares	Rp. per ha	Total Million Rp	
Upland Cropland							
Bench Terraced	200	230,420	46.1	5,000	385,700	1,928.5	1,882.4
Traditional Terraced-Cassava	26,500	167,600	4,441.4	40,000	228,575	9,143.0	4,701.6
Upland Rice-Palawija	16,500	129,083	2,129.9	15,000	235,060	3,525.9	1,396.0
Palawija Crops	37,000	130,550	4,830.4	40,000	178,300	7,132.0	2,301.6
Without Conservation Practices							
Cassava	25,000	135,530	3,388.3	7,750	162,800	1,261.7	-2,126.6
Palawija Crops	5,000	110,650	553.3	1,000	150,450	150.5	- 402.8
Cassava Severely Eroded	7,008	67,105	470.3	5,250	86,250	452.9	- 17.4
Agroforestry	3,300	104,440	344.7	9,000	142,640	1,283.8	939.1
Home Gardens	28,192	130,550	3,680.5	32,000	178,300	5,705.6	2,025.1
Total Upland	148,700		19,884.9	155,000		30,583.9	10,699.0
Riceland							
Irrigated Riceland							
Technical Systems	18,732	395,250 1/	7,403.8	25,166	461,584	11,616.2	4,212.4
Rural Systems	36,767	274,160 1/	10,080.0	35,824	329,015	11,789.9	1,709.9
Rainfed Riceland	31,303	167,898 1/	5,255.7	29,000	230,005	6,670.1	1,414.4
Total Riceland	86,802		22,739.5	90,000		30,076.2	7,336.7
Total Cropland	235,520		42,624.4	245,000		60,660.1	18,035.7

1/ Based on a farmgate price of Rp. 120/kg for rough rice.

TABLE IX-2

PROJECTED INDEX OF INFLATION 1979-1986

		Index of Inflation			
		Domestic		International 1/	
Calendar year	Construction year	Yearly percent change	Compounding rate	Yearly percent change	Compounding rate
1979		15.0	1.000	6.5	1.000
1980		12.0	1.150	6.0	1.065
1981	1	10.0	1.288	6.0	1.129
1982	2	10.0	1.417	6.0	1.197
1983	3	10.0	1.558	6.0	1.268
1984	4	10.0	1.714	6.0	1.345
1985	5	10.0	1.886	6.0	1.425

1/ Based on IBRD Projections

TABLE IX-3

SCHEDULE OF DOMESTIC AND FOREIGN COSTS WITH INFLATION ADJUSTMENT

Project Year	1979 Price Values Million Rupiahs			Inflation Adjusted Prices Million Rupiahs		
	Total	Domestic	Foreign	Total	Domestic	Foreign
1980-81 (1)	1,681.9	1,111.4	570.5	2,075.6	1,431.5	644.1
1981-82 (2)	1,732.2	1,219.1	513.1	2,338.6	1,724.4	614.2
1982-83 (3)	1,543.8	1,148.9	394.9	2,290.6	1,789.9	500.7
1983-84 (4)	1,524.7	1,229.3	295.4	2,504.5	2,107.1	397.4
1984-85 (5)	2,057.3	1,767.3	290.0	3,746.4	3,333.2	413.2
Total	8,539.9	6,476.0	2,063.9	12,955.7	10,386.1	2,569.6
US $ x 10^6 1/	13.664	10.362	3.302	20.729	16.618	4.111

1/ US $1.00 = 625 Rupiah