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AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C. 20523

# PROJECT PAPER

INDONESIA: Rural Roads Maintenance Systems
(497-0353)

June 12, 1987

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AGENCY FOR INTERNATIONAL DEVELOPMENT

# PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: _____

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2. COUNTRY/ENTITY: INDONESIA

3. PROJECT NUMBER: 497-0353

4. BUREAU/OFFICE: ANE — 04

5. PROJECT TITLE (maximum 40 characters): RURAL ROADS MAINTENANCE SYSTEMS

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 08 DD 31 YY 95

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 87 B. Quarter 4 C. Final FY 92

8. COSTS ($000 OR EQUIVALENT $1 = )

| A. FUNDING SOURCE | FIRST FY 87 B. FX | C. L/C | D. Total | LIFE OF PROJECT E. FX | F. L/C | G. Total |
|---|---|---|---|---|---|---|
| AID Appropriated Total | 4,724 | 6,396 | 11,120 | 24,400 | 30,600 | 55,000 |
| (Grant) | ( 2,964 ) | ( 156 ) | ( 3,120 ) | ( 15,900 ) | ( 800 ) | ( 16,700 |
| (Loan) | ( 1,760 ) | ( 6,240 ) | ( 8,000 ) | ( 8,500 ) | ( 29,800 ) | ( 38,300 |
| Other U.S. 1. | | | | | | |
| Other U.S. 2. | | | | | | |
| Host Country | | 200 | 200 | | 22,850 | 22,850 |
| Other Donor(s) | | | | | | |
| TOTALS | 4,724 | 6,596 | 11,320 | 24,400 | 53,450 | 77,850 |

9. SCHEDULE OF AID FUNDING ($000)

| A. APPROPRIATION | B. PRIMARY PURPOSE CODE | C. PRIMARY TECH. CODE 1. Grant | 2. Loan | D. OBLIGATIONS TO DATE 1. Grant | 2. Loan | E. AMOUNT APPROVED THIS ACTION 1. Grant | 2. Loan | F. LIFE OF PROJECT 1. Grant | 2. Loan |
|---|---|---|---|---|---|---|---|---|---|
| (1) FN | 130B | 060 | 060 | | | 16,700 | 38,300 | 16,700 | 38,300 |
| (2) | | | | | | | | | |
| (3) | | | | | | | | | |
| (4) | | | | | | | | | |
| TOTALS | | | | | | 16,700 | 38,300 | 16,700 | 38,300 |

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 061 | 033 | 242 | 721

11. SECONDARY PURPOSE CODE: 240

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

| A. Code | BR | BF | TECH | PART | TNG | | |
|---|---|---|---|---|---|---|---|
| B. Amount | | | | | | | |

13. PROJECT PURPOSE (maximum 480 characters)

To develop effective and sustainable systems of road maintenance and management at the district level.

14. SCHEDULED EVALUATIONS
Interim MM 12 YY 90 | MM YY | Final MM 05 YY 95

15. SOURCE/ORIGIN OF GOODS AND SERVICES
[x] 000 [x] 941 [x] Local [ ] Other (Specify) _____

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a _____ page PP Amendment.)

17. APPROVED BY
Signature: for William P. Fuller — James M. Anderson
Title: Director USAID/Indonesia
Date Signed: MM 06 DD 12 YY 87

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION
MM DD YY

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

# PROJECT AUTHORIZATION

INDONESIA

RURAL ROADS MAINTENANCE
SYSTEMS PROJECT
PROJECT NO. 497-0353

1. Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Rural Roads Maintenance Systems Project (the "Project") for Indonesia (the "Cooperating Country") involving planned obligations of not to exceed Thirty Eight Million Three Hundred Thousand United States Dollars ($38,300,000) in loan funds and Sixteen Million Seven Hundred Thousand United States Dollars ($16,700,000) in grant funds, over a five year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process to help in financing certain foreign exchange and local currency costs for the Project. The planned Project Assistance Completion Date (PACD) is August 31, 1995.

2. The Project will develop effective, sustainable systems of road maintenance and management for up to eleven districts in the provinces of South Sulawesi and Nusa Tenggara Timur (NTT). It will test and demonstrate the means and benefits of applying maintenance and improved approaches to managing district road networks. The Project will initiate maintenance management systems in each district; finance the rehabilitation of selected road links to a maintainable standard; provide equipment, training, workshops and technical assistance, including engineering and related services, for achieving targets in each of these areas; and will assist the Cooperating Country to define and resolve financial, institutional and other policy constraints to effective maintenance and efficient management of district road networks nationwide. It will assist to develop and apply appropriate policies for planning, organization, and finance so that public investments in district roads can be sustained and effectively promote the growth of agriculture, rural industry and trade for the rural populations that district roads serve.

3. The Project Agreement which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

4. a. Interest Rate and Terms of Repayment. The Cooperating Country shall repay the Loan to A.I.D. in United States Dollars within forty (40) years from the date of first disbursement of the Loan, including a grace period of not to exceed ten (10) years. The Cooperating Country shall pay to A.I.D. in United States Dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years, and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

b. Source and Origin of Commodities, Nationality of Services. Commodities financed by A.I.D. under Project loan funding shall have their source and origin in the Cooperating Country or in countries included in A.I.D. Geographic Code 941, or if grant-funded, in the United States or the Cooperating Country, except as A.I.D. may otherwise agree in writing. Except for ocean shipping, suppliers of commodities or services shall have their nationality in countries included in Code 941 or Indonesia if loan-funded, and if grant-funded, shall have their nationality in the United States or Indonesia, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States if grant-funded, or Indonesia, the United States and other Code 941 countries if loan-funded.

Signature: Julia Chang Bloch
Julia Chang Bloch
Assistant Administrator

Date: July 29, 1987

Clearance:

| | | |
|---|---|---|
| DAA/ANE:JNorris | | Date 7/29/87 |
| ANE/PD:RVenezia | | Date 7/27/87 |
| ANE/DP:BSidman | (Draft) | Date 7/24/87 |
| ANE/EA:RGomez | (Draft) | Date 7/27/87 |
| ANE/TR:BTurner | (Draft) | Date 7/27/87 |
| GC/ANE:JSilverstone | (Draft) | Date 7/27/87 |

ANE/PD/EA:JRogers:ms:07/16/87:Doc 1681o

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## GLOSSARY

| | | |
|---|---|---|
| ALKAL | - | Province-level equipment and supplies workshop for public works |
| APBN | - | National government budget (Anggaran Penerimaan dan Belanja Nasional) |
| BANGDA | - | (Pembangunan Daerah) The Directorate General of Regional Development at the Ministry of Home Affairs |
| Bina Marga | - | Directorate General of Highways at the central government level. Highway or road organization at other levels of government |
| Bupati | - | The appointed head of the Kabupaten (district) unit of government |
| DPUK | - | District Public Works Service |
| DPUP | - | Provincial Public Works Service |
| EMS | - | Equipment Management System |
| GOI | - | Government of Indonesia |
| IFY | - | Indonesian fiscal year |
| Inpres | - | A special fund established by Presidential Instruction to be used for financing local development projects |
| Inpres Dati II | - | An Inpres program designed primarily for district infrastructure development and allocated based upon population |
| Inpres Penunjangan Jalan | - | A program designed specifically for the development of district roads |
| Kabupaten | - | A district. The governmental unit below a province, an administrative grouping of subdistricts |
| MMS | - | Maintenance Management System |
| NTT | - | Nusa Tenggara Timur — an Indonesian province |
| Padat Karya | - | Labor intensive, refers to a program for small-scale labor intensive rural infrastructure projects managed by the Ministry of Manpower |
| PBB | - | Land and buildings tax |
| PMU | - | Project Management Unit, a unit established by the Ministries of Public Works and Home Affairs to manage the implementation of donor district road projects |
| Repelita | - | Rencana Pembangunan Lima Tahun (Five Year Development Plan) |
| RRMS | - | Rural Roads Maintenance Systems |
| VIN | - | Very Important Network |

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## EXECUTIVE SUMMARY

The Rural Roads Maintenance Systems project (RRMS) is a $77.85 million project conducted with the Ministry of Home Affairs and extending over an eight-year period (August, 1987 to August, 1995). Project funds consist of $55 million from AID ($38.3 million in loan funds and a $16.7 million grant) and $22.85 million from the Government of Indonesia.

The goal of the project is to increase growth in agriculture, rural industry and trade. The project's purpose is to develop effective, sustainable systems of road maintenance and management at the district level. To achieve this, the project will focus on eleven districts in the provinces of South Sulawesi and Nusa Tenggara Timur (NTT) to test and demonstrate the means and benefits of applying maintenance and improved approaches to managing district road networks. It will initiate maintenance management systems in each district; finance the rehabilitation of selected road links to a maintainable standard; provide equipment, training, workshops and technical assistance for achieving targets in each of these areas; and will assist the GOI to define and resolve financial, institutional, and other policy constraints to effective maintenance and efficient management of district road networks nationwide. In addition, the project will assist to develop and apply appropriate policies for planning, organization and finance so that public investments in district roads can be sustained and effectively promote the growth of agriculture, rural industry and trade for the rural populations that district roads serve.

The road rehabilitation component will return a core network of economically viable roads in each district to maintainable condition. The road maintenance component will apply maintenance programs to these and other maintainable roads. It will determine the most effective ways for districts to: define maintenance funding requirements, assign priorities to maintenance tasks, plan and budget, organize and manage, and evaluate program effectiveness. Force account, contract, "roadman" and community participation approaches to conducting maintenance will be tested and compared. Five categories of equipment will be provided by the project: each district will receive maintenance equipment, support equipment for road monitoring, workshop equipment, and equipment for miscelleneous survey and design needs. Two districts will receive a small rehabilitation fleet which will be used for training purposes.

Training will be conducted entirely in-country, focusing primarily on planning, management and supervision skills as well as field work methods. A limited number of in-country Masters-level engineering degrees will be provided to increase the general quality of staff technical knowledge at the district level.

Technical assistance will provide the road planning, transport economics, institutional development and engineering expertise to develop systems and capabilities at the district level and policy improvements at the national level.

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# 1. PROJECT BACKGROUND, RATIONALE AND DESCRIPTION

## 1.1 BACKGROUND AND RATIONALE

### 1.1.1 Problem Statement

During the past 20 years, Indonesia has achieved rice self-sufficiency, lower middle income status ($520 per capita), and more than 70% literacy. Population growth rates have been reduced to 2.1% and infant mortality to 98/1000 live births. A seriously run-down system of infrastructure has been transformed into a reasonably widespread, functioning network of roads, electricity, air and sea transport, communications and irrigation.

Recent declines in oil prices raise a serious challenge to Indonesia's ability to make further advances in these areas. With 55% of government revenues, 70% of export earnings and 20% of GDP derived from petroleum products, the decline of oil prices means the country faces a severe economic downturn. GDP growth was close to zero or slightly positive in 1986, will be only marginally higher in 1987, and slow in recovering through 1990. Per capita income growth is expected to be negative to zero for a four to five year period as population growth rates continue at about 2.1%. The government has responded prudently to the decline in its revenues by reducing the development budget by 20% in real terms for IFY 1986/87 and by an additional 28% in real terms for IFY 1987/88.

Declining revenues have encouraged reform to use resources more efficiently, to develop alternative sources of revenue and to restructure the economy. Since 1983 the Government of Indonesia (GOI) has instituted important banking and interest rate modifications, effected tax reforms, devalued the rupiah, liberalized trade by removing quotas and reducing tariffs, and improved foreign investment opportunities. The GOI is now initiating the privatization of a number of state enterprises and is accelerating reforms to encourage trade and export development. There is a perceptible shift toward reduced government involvement and increased private sector participation in all sectors of the economy for the long term.

Rural roads are one subsector of the economy where public sector involvement will continue but where there is a serious need for more efficient use of public resources. Budgets for rural district (kabupaten: the administrative level below the province) roads have been sustained despite sharp reductions in GOI allocations to almost all other activities. But without appropriate management and regular maintenance, much of the roughly $180 million invested annually in district roads is wasted. Roads deteriorate rapidly and require expensive follow-on investments in rehabilitation. Follow-on rehabilitation drains resources that could otherwise finance maintenance. Poorly maintained roads contribute to Indonesia's high-cost economy, increasing transportation costs for agricultural inputs and produce, and limiting access to competitive markets.

TABLE 1. INDONESIA'S ROAD DEVELOPMENT, 1965-1985 (Km)

| | 1965 | 1971 | 1975 | 1980 | 1985 |
|---|---|---|---|---|---|
| National | 10,167 | 10,628 | 11,267 | 12,152 | 12,016 |
| Provincial | 22,068 | 24,466 | 28,196 | 33,164 | 34,278 |
| District | 51,031 | 51,170 | 58,651 | 88,920 | 146,102 |
| | 83,266 | 86,264 | 98,114 | 134,236 | 192,396 |

Source: Biro Pusat Statistik.

National and provincial restoration programs had two phases--returning a road to trafficable condition and improving a road to a maintainable condition, optimal for the anticipated traffic. The resources available from oil revenues in the late 1970s permitted increased attention to district networks. The primary instrument for the policy shift was Inpres Penunjangan Jalan, a program initiated in 1979 which has provided about $80 million annually for district road development, mostly in the Outer Islands. Transmigration, nucleus estate and Ministry of Manpower Padat Karya (labor-intensive) projects also built or upgraded roads that were later transferred to district jurisdiction.

The fourth Five-Year Development Plan (Repelita IV, 1984-1989) projected that the improvement of existing national and provincial roads would continue, with a target of 60-70% in maintainable condition by 1989. A gradual shift of emphasis toward maintenance was anticipated. The Plan was less specific on the status of the district road network. It appears that more growth was expected but, although some maintenance programs began in 1984, a major shift toward maintenance was not expected.

Development Budget and Expenditures. During the 1970s the government allocated about 14% of the development budget to roads. With the rapid growth of development funds in the early 1980s, the share for roads decreased, even though nominal allocations increased steadily (Table 2).

Since 1984, the GOI has increased the priority of roads, particularly district roads. This reflects a policy to promote rural employment and a perception that transportation services must be preserved, despite the economic downturn and severe cutbacks in almost all other sectors. The Inpres budgets for district roadwork have grown since 1984, and though reduced in real terms by about 9% (including devaluation effects), the nominal IFY 1987/88 budget will increase again even given a reduction in the nominal value of the GOI development budget overall.

Curtailment of New Construction and Increased Emphasis on Maintenance. Repelita IV projected that maintenance funding would increase to about 31% of total national and provincial road expenditures by 1989, up from 17% in 1984/85. For the first time, the Plan allocated maintenance funds for district roads. Budgets for IFY 1985/86 and 1986/87 halted national and provincial road construction, reduced betterment programs, and increased nominal and real maintenance levels. Districts are initiating less new

Planning systems are required which prioritize the former, increasing economic growth in the district and increasing the potential base from which to draw revenues for maintenance and for work on the rest of the networks.

Inadequate Enforcement of Design Standards. Underbudgeting, ineffective construction supervision, low-quality traditional construction practices, and poor contractor performance contribute to poor quality construction which cannot be maintained. Without maintainable roads, districts do not realize the potential economic return from the initial investment and may be obliged to revert to expensive rehabilitation.

Little Understanding of or Commitment to Maintenance. A lack of appreciation of maintenance benefits and techniques, as well as inadequate resources for it, reinforce the status quo. Budget austerity and donor efforts to encourage a reconsideration of priorities are effecting changes in attitudes, policies and budgets for maintenance. But until concepts and techniques for maintenance are introduced at the district level, even existing maintenance allocations will have little impact.

Limited Maintenance Funding. While the earmarking of district Inpres funds for maintenance and continued high budget levels for district roads (including funds for maintenance) are encouraging, the increased stock of roads has outpaced maintenance funds. Without more resources, over the long term the government will be unable to break the vicious circle where a shortage of funds for maintenance leads to road deterioration which in turn leads to the need for expensive rehabilitation.

Ineffective Institutional Arrangements. Responsibilities for district road work are complex (see the Institutional Analysis in Annex J). Clearer definitions and assignments of roles and responsibilities for roads with adequate incentives and personnel are needed for an effective management system. The GOI's recent decisions to reform institutional relationships for the management of public works at the district level is an encouraging step in the direction of improved district road management.

Insufficient Technical and Managerial Skills. Better trained technical and management personnel are needed at the district level to implement an effective road management and maintenance system. The lack of career mobility and job security for some skilled personnel contribute to district staffing problems. A recent GOI decision to post newly-hired central government engineers to district public works offices for a minimum two-year period will increase the technical skills available to the districts.

Lack of Appropriate Equipment in Good Condition. Many districts lack maintenance equipment and workshops. Available equipment is rarely efficiently used or maintained. The districts' lack of control over equipment acquisition, inadequate equipment management and maintenance skills and procedures, inefficient equipment rental policies, and inadequate funding for equipment maintenance are contributing factors.

1.1.1.4 Roads and Social and Economic Development. Good quality rural roads are important for the social and economic development of the 75% of Indonesians who live in rural areas. Poor roads impede access to

Reforms to improve institutional performance will concentrate on the district public works organization and will include measures to:

- establish clear lines of responsibility for district road planning, maintenance, rehabilitation and equipment management tasks;
- increase incentives for skilled technicians to be retained in district employment;
- improve systems to ensure quality work by contractors; and
- operationalize GOI decisions to make district public works offices accountable for their technical performance to provincial public works authorities.

Institutional Development. It is AID policy to complement assistance for infrastructure with assistance to develop institutional capabilities to sustain and to further the benefits infrastructure provides. To establish model district road maintenance and management systems the project will integrate capital assistance for road rehabilitation and the reforms above with efforts to strengthen the managerial, organizational and technical capability of district Public Works institutions. A combination of technical assistance at the provincial and district levels, training and Special Studies will focus on improving skills, procedures and organizational arrangements for district road networks.

Local Organizations. AID policy states that only through the sustained involvement of local institutions can long-lasting and self-supporting institutional development occur. The project will help to operationalize recent GOI decisions to give increased authority to provincial Public Works authorities to guide and support the technical performance of district road programs. This places the burden of responsibility for improving district capabilities within the province rather than in Jakarta and represents a significant decentralization of responsibility.

Recurrent Costs. AID policy recommends that host governments take sufficient action on project design and/or policy reform to correct the problem of recurrent costs. The project is predicated on a commitment by the GOI to develop, by the end of 1987 and with donor assistance, a nationwide strategy for conducting and financing the maintenance of district roads. The project will contribute to the development of the strategy by investigating the potential for increased local revenue generation or revenue sharing arrangements to finance road maintenance. Pilot revenue generation or sharing efforts will be included as a project activity.

Private Enterprise. AID encourages reliance on competitive markets and private enterprise. Although roads are primarily a financial responsibility of government, the project will use private contractors for road rehabilitation and will undertake pilot efforts to contract some maintenance tasks. A key to improved contractor performance is improved supervision skills for district Public Works employees. These will be developed through on-the-job and formal training. The project will also finance a review of contract formats and contract supervision procedures and investigate

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### 1.1.4 Relationship to Other Donors

Donors have provided over $3.0 billion in assistance to the roads subsector in Indonesia, of which about 90% has been for national and provincial roads. The World Bank, Japan and the Asian Development Bank (ADB) have accounted for three quarters of the total. Private overseas investors are financing additional investments in toll highways.

Assistance for national and provincial roads has been primarily for rehabilitation and upgrading and for bridge replacement. During the 1980s, increasing assistance has been provided for planning and institutional improvements, particularly to develop a Pavement Management System for national and provincial networks which the GOI is using to assess the impact of different patterns of expenditure on these roads. Since 1986, to support and further encourage the GOI's prioritization of road maintenance, the multilateral banks have initiated lending for periodic maintenance of national and provincial roads coupling this with the expansion of the PMS to new areas. A World Bank-financed Highway Maintenance and Betterment Project, initiated in mid-1986, provides $300 million for such work. The ADB is in the initial stages of planning a similar effort.

Donor assistance for district roads began in the early 1980s, and has also focused on rehabilitating or upgrading existing links. The first generation of projects, roughly 1981 to 1985, involved the World Bank, ADB and Japan. The World Bank and ADB projects were similar, lending $100 million and $60 million, respectively, for road rehabilitation, workshop construction, training, equipment and consultant assistance in 39 districts. Japan provided $14.2 million largely for workshop construction and equipment in an additional 19 districts, but provided no long-term assistance in the field and did not finance civil works.

All three donors anticipated a second generation of follow-on efforts to begin around 1985, to add a total of 110 more districts. But serious implementation problems resulted in the near cancellation of the first World Bank loan and delayed initiation of second phase activity by all three. The problems encountered were poor quality of civil works, poor management of equipment, a lack of follow-on road maintenance and administrative blockages to the flow of funds and reimbursement requests (see Annexes G and J). Pressure for reform, accompanied by growing GOI recognition of the problems, resulted in the earmarking of Inpres District funds in 1984, establishment of a Project Management Unit (PMU) to integrate the functions of the Ministries of Public Works and Home Affairs in implementing district road programs, and an intern program to second young Bina Marga engineers to the districts to assist in implementing district road projects.

These and other planned reforms have allowed these donors to proceed cautiously with preparing second generation projects. The ADB extended a $120 million loan in mid-1986 to cover 30 more districts. The World Bank, pending final agreement on further reforms, anticipates negotiating a $190 million loan in July, 1987 to cover an additional 40 districts and to continue assistance to its original 25. The Japanese are likely to lend, this year, $90 million for work in 38 districts and will add more money after three years. Second generation projects have several common

Explicit Focus on Maintenance. Other donors are increasing the emphasis on maintenance in their district road projects. The World Bank has worked with the GOI to increase the priority accorded to maintenance budgets and its consultants will assist project districts to prepare annual maintenance plans in the future. Other donor efforts remain, however, primarily rehabilitation projects with a secondary emphasis on maintenance. The RRMS focuses on testing alternative ways to implement maintenance in the field and financing maintenance from local resources.

Although small compared to other donors' activities, the RRMS project offers a new and complementary perspective by taking the individual district, its road network and financial status as the unit of analysis to determine sustainable strategies for road management nationwide. USAID's previous experience with local government development gives it an advantage over other donors. Experimental project activities and particularly the Special Studies program will be designed to draw on the experience of other donor projects and influence the third generation of donor projects which will begin in the early 1990s.

## 1.2 DESCRIPTION

### 1.2.1 Project Goal and Purpose

The goal of the project is to increase growth in agriculture, rural industry and trade. The purpose is to establish effective and sustainable systems of road maintenance and management at the district level. The project will focus on eleven districts to test and demonstrate the means and benefits of applying maintenance and improved approaches to managing district road networks. It will initiate maintenance management systems in each district; finance the rehabilitation of selected road links to a maintainable standard; provide equipment, training, workshops and technical assistance for achieving targets in each of these areas; and will define and resolve financial, institutional and other policy constraints to effective maintenance and efficient management of district road networks nationwide. The life of the project will be eight years.

### 1.2.2 Project Approach

Achieving a sustainable system for maintenance and management will require three steps: establishing a planning framework for roads in each district, improving procedures and skills to implement road work effectively, and expanding the financial base for sustaining the networks over the long term. Planning will be based on the concept of Very Important Networks (VIN)* which will be refined by the project to incorporate three categories: Very Important roads with high traffic levels, Very Important roads with little traffic, and other roads. Establishing the planning framework will take several years and will proceed in stages. First,

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* A GOI model for prioritizing district road links which the Ministry of Public Works has tried to develop since the early 1980s. Until now it has not included traffic as a measure of the demand for road service.

be initiated in selected districts by 1990. The revenue pilots, in concept, will capture a share of the road user savings created by improved road conditions for reinvestment into the road system.

Implementation will be phased: for the first four years, including three full GOI fiscal years, rehabilitation and maintenance programs will begin in only nine of the eleven districts. About 55% of rehabilitation funds will be provided in the second half of the project. After four years key issues, including the definition of VIN, district equipment policy, equipment procurement, DPUK organization and staff needs, and starting work in the remaining two districts will be reviewed and resolved. This will also be the time by which pilot revenue efforts and the testing of alternatives to force account maintenance will be underway. Finally, the fourth year coincides with the anticipated recovery of the GOI budget and the beginning of a third generation of district road projects by the major donors. It is thus a propitious time to implement definitions of VIN and to transfer the lessons learned to the efforts of other donors in the sector.

To assist in resolving key financial, economic and institutional constraints to the improvement of district road networks, the project will fund a series of Special Studies analyzing policy options and recommending policy adjustments to key decision makers for the sector.

### 1.2.3 End of Project Status

Two conditions will exist at the end of the project: the core characteristics of district road maintenance and management systems will have been identified and agreed upon, and the systems or elements of them will be in use in non-project districts.

### 1.2.4 Project Outputs

Project outputs will consist of four key elements of a sustainable program for ongoing management and maintenance of the networks:

Systems to Establish Work Priorities. For any level of funding, a reorientation of work priorities can increase the economic impact of expenditures for the networks. The systems established by the project will have several characteristics: 1) a higher priority to maintenance than at present, 2) procedures to select links for rehabilitation which prioritize high traffic roads, 3) the use of measured traffic volume to determine th standard for rehabilitation and the level of investment per kilometer, and 4) the application of maintenance in accordance with the condition of road features and the relative cost effectiveness of different maintenance tasks.

Systems to Balance Budget Resources with Network Needs. Balancing budget resources with network needs involves reconciling three variables: funds, network size, and the level of service desired for different links in the network. The immediate need is for sufficient funds to be in place to maintain the core of economically viable roads in each district network. To this end, the project will establish: 1) central budget funds for maintenance exceeding levels available from the 25% earmark of Inpres Dati

guidelines for drainage, acceptable to AID, will be issued prior to any AID commitment of funds for rehabilitation work.

Rehabilitation work will be conducted by private contractors registered in the project provinces. To assure that contractors have the equipment and staff skills to meet design requirements, only Class A and $B_1$ contractors will be eligible to bid on project works. In one district per province a Model Force Account Crew will be formed which will conduct, for training purposes, some of the rehabilitation work in the two districts.

Costs will vary depending on conditions, location and the type of work undertaken. Unit cost estimates used for project budgeting purposes are shown in Section 9 of Annex G. The costs of road rehabilitation will be shared. AID will pay 80% and the GOI 20% of the total cost of each eligible link rehabilitated. It is anticipated that GOI contributions will be made from each district's Inpres District budget. For the first four years, Inpres District funds not used up by counterpart funding requirements and any Inpres Roads funds available will be at the discretion of the district. Following mid-project agreement on definitions of Very Important Networks, GOI funds for non-project road work will be allocated in accordance with the priorities established by the VIN.

Road Maintenance: the maintenance component of the project will determine, through trial and experimentation, the most effective ways for districts to:

- determine the maintenance requirements of their networks;
- prioritize maintenance tasks in order of their cost effectiveness;
- plan and budget for annual maintenance programs;
- organize and manage labor, materials and equipment to implement maintenance programs; and
- evaluate the effectiveness of their programs and make improvements accordingly.

Maintenance will be defined as regular and repeated tasks performed in order to retain a road's design level of service for its full design life. The conventional distinction will be made between routine tasks (performed frequently, usually at least once a year) and periodic tasks (performed every few years).

The project will assist each district to develop a simple Maintenance Management System (MMS). The main elements of the MMS will be:

- periodic condition inventories, listing the condition of all network features (pavement, shoulders, drainage, bridges, etc.);

  a list of maintenance tasks, arranged in order of cost-effectiveness in sustaining road condition; and

  performance standards for each maintenance task which define the resources and the time required to complete each task for a given unit of work (kilometer of ditch, meter of bridge, etc.).

maintenance in accordance with the results of experience in the field. Members should include representatives of Bangda (the Directorate General of Regional Development in the Ministry of Home Affairs), the two DPUPs, and one or two DPUK chiefs.

To demonstrate maintenance benefits beyond the project districts, the project will prepare a series of articles for Indonesian engineering journals on the development of maintenance systems for low volume roads. It is expected that video materials, explaining the concepts and impact of maintenance to local government political leaders, will be produced and used both in the project and other districts. These activities will be assisted by project consultants and supported with AID funds from the TA budget.

Workshops. District workshops will perform preventive maintenance, adjustments and minor repairs (Bina Marga Level II and III) for DPUK equipment. Major repair work will be referred to ALKALs or private repair shops. Nine of the project districts already have workshops but they lack the facilities and tools to operate effectively. Each existing workshop will be upgraded during the first year of the project. The estimated construction cost of upgrading is $32,000 per workshop. AID funds will pay for 90% of the contracted cost of the upgrading. GOI funds will cover Public Works supervision expenses and any taxes.

The project will construct new workshops in two districts. The design being used for the ADB Phase II rural roads project will likely be used with minor modifications. The estimated cost is $82,000 per workshop. AID will finance 90% of the contracted cost of construction. The GOI will pay for any land acquisition costs, Public Works supervision expenses and any taxes. Each workshop will implement an Equipment Management System (EMS) to monitor equipment use, condition, operating and maintenance costs, and the efficiency of field equipment management. It is expected the EMS will be based on systems now in use at province ALKALs but simplified and adapted for district use with the assistance of project consultants. For the life of the project, the GOI will fund materials and supplies for workshop administration as well as all personnel costs.

Equipment. Five categories of equipment are required. Maintenance equipment is needed for each district's force account maintenance crews. A rehabilitation fleet is necessary in each of the two districts which will operate Model Force Account Crews for rehabilitation. All districts require support equipment for field operations, primarily for transportation to work sites and condition surveying for maintenance. All require workshop equipment for service and repair of fleets. And most need small amounts of miscellaneous equipment including materials testing tools, drafting tables and surveying instruments. Equipment requirements for all but the miscellaneous category are listed in Annex P.

Heavy equipment now in the districts and in good operating condition will be used by the project and considerably reduce the need to procure new equipment. Existing equipment will remain in its present locations. Although most existing heavy equipment is now in good condition, it is at least five years old and will be at the end of its useful life around the mid-point of the project. It will be necessary to replace the equipment at

| Skill Areas | Target | Primary Source |
|---|---|---|
| PLANNING: | | |
| traffic counts, condition monitoring | DPUK general, BAPPEDA II | short-term |
| maintenance management | Section Chiefs | OJT |
| TECHNICAL: | | |
| work methods, recording/reporting, materials handling | foremen | short-term, OJT |
| design/specification reading, supervision techniques | contract supervisors | short-term, OJT |
| materials testing | materials staff | short-term |
| design | design staff | short-term, OJT |
| EQUIPMENT: | | |
| equipment familiarization | operators/mechanics | short-term |
| operation and maintenance | operators | short-term |
| maintenance and repair | mechanics | short-term |
| parts/warehouse management | storemen | short-term, OJT |
| equipment management | Equipment Section Chiefs | short-term, OJT |

Long-term training will be less important but up to two undergraduate civil engineering degrees per district will be financed for DPUK staff at the level of Section Chief or above, and up to eight Masters-level degrees in road maintenance management, planning or transport economics fields will be funded for DPUP or Bina Marga staff involved in district road programs. The project will not finance the training of contractors (see Annex D).

Technical Assistance. AID grant funds of $13.8 million will finance an estimated 197 person-years (47 expatriate and 150 Indonesian) of technical assistance. The large amount of TA is based on a review of other donors' experience and reflects the need for a strong field presence for on-the-job training, the additional requirements imposed by the RRMS's focus on maintenance, policy and institutional issues, the length of the project, and a concern that TA field staff should be sufficient to assure that difficulties with the road rehabilitation component do not divert the attention of central-level GOI authorities and USAID from the broader policy and institutional issues. Approximately one-half of the value of consultant services are for one-time investments in policy and system development and would not be required in follow-on replication efforts.

The majority of assistance will be provided under a long-term contract which will supply A & E services to the district, provincial and national levels. At the district level, local engineers in each DPUK have proved invaluable for on-the-job training under other donor rehabilitation projects and will perform similar functions in RRMS: assistance with design, civil works supervision and equipment management. A works supervisor will be attached to each of the two Model Force Account Crews. The function of each province-level team is to oversee development of maintenance systems, rehabilitation skills and equipment and workshop management programs in districts within their province and to develop a support role for their DPUP counterparts in each of these areas. The function of the national-level

District Equipment Policy: This study will review present district equipment practices including rental policies and the sources and adequacy of maintenance and repair funds.

Improving Performance of Small Contractors. This study will review policies toward small contractors under the Inpres programs and analyze their effectiveness in promoting quality performance and increasing the capabilities of the contractors concerned.

DPUK Organizational Structure and Personnel Needs. This study will analyze the effectiveness of DPUK organizational structures and recommend minimum elements for inclusion in all.

Budget Procedures and Work Delays. This study will assess the impact on work quality of delays caused by budget procedures and recommend specific improvements.

## 2. COST ESTIMATES AND FINANCIAL PLAN

### 2.1 BUDGET

The RRMS will be an eight-year project. The total cost will be $77.85 million, of which $55.0 million will be AID funded ($38.3 loan, $16.7 grant) and $22.85 million will be funded by the GOI. Tables 3 and 4 show project expenditures by project element, loan and grant funding, and by Indonesian Fiscal Year. Annex R provides a detailed breakdown of anticipated expenditures for each element over time and includes explanations of planned AID/GOI cost allocations for each project activity.

Expenditures were calculated by assigning a unit cost to each activity under each project element, determining which components were properly GOI and which AID funded (see below), which items of cost were foreign exchange and which local currency costs, and scheduling unit costs through the eight-year period in accordance with anticipated implementation. Contingency and inflation is a relatively low 8% of the base cost of the AID contribution. Given the large local currency component of the AID contribution ($28.7 million), the potential for Rupiah depreciation during the project life, and that unit costs for rehabilitation work include margins for error, 8% is considered adequate. All local currency costs were converted at an exchange rate of U.S. $1.00 = Rp. 1,640.

### 2.2 FINANCIAL ARRANGEMENTS

AID contributions are concentrated in the rehabilitation ($25.6 million), technical assistance ($13.8 million), equipment ($6.9 million), training ($2.1 million) and Special Studies ($1.5 million) elements. GOI contributions, including approximately $4.1 million of contributions in-kind, are 29% of the total project cost and are concentrated in the road maintenance ($6.5 million), road rehabilitation ($6.4 million), equipment ($6.3 million) and equipment maintenance ($2.1 million) elements. Complete details are provided in Annex R.

- Equipment: AID and the GOI will finance different pieces of equipment. A GOI contribution of $2.7 million (PL 480 Title I proceeds) will finance the procurement of equipment easily available within Indonesia (primarily trucks and vehicles). This procurement will take place during the first two years of the project. At the same time, AID loan funds of $1.0 million will finance heavy road equipment and miscellaneous field and office tools. A mid-project procurement of $5.9 million will be financed with AID loan funds. The depreciated value of existing district-owned equipment which will be used by the project ($3.6 million) is attributed to the GOI as an in-kind contribution.

- Equipment maintenance: equipment maintenance will be completely funded by the GOI.

- Training: AID loan funds will finance all allowable training costs with the exception of honoraria to committees organized to develop custom-designed courses. If this cost is incurred, it will be borne by the GOI.

- Special Studies: the Special Studies program will be entirely financed with AID grant funds.

- Technical Assistance: TA will be completely financed with AID grant funds.

- Planning and Monitoring: this component includes travel, per diem and honoraria costs for periodic traffic and road condition surveys and for DPUP staff to monitor and supervise DPUK operations. It includes these costs as well as materials and space rental costs for an annual budget preparation meeting in each province. AID loan funds will pay for the budget preparation meetings for the life of the project. Traffic and condition surveys and DPUP supervision expenses will be financed with AID loan funds through IFY 1990/91 but financed by the GOI thereafter.

- Evaluation/Audit: these expenses will be completely financed from the AID grant.

## 2.3 METHODS OF FINANCE

| Activity | Method of Financing | Approximate Amount Grant (U.S. $ million) | Approximate Amount Loan (U.S. $ million) |
|---|---|---|---|
| Road Rehabilitation | Direct Reimbursement to GOI | | 25.60 |
| Workshops | Direct Reimbursement to GOI | | 0.45 |
| Equipment | Direct Payment to Suppliers | | 6.90 |
| Training | Direct Reimbursement to GOI/ Direct Payment to Suppliers | | 2.10 |
| Special Studies | Direct Payment to Suppliers (for Studies)/Direct Reimbursement to GOI (for field trials) | 1.50 | |
| Technical Assistance | Direct Payment to Suppliers | 13.80 | |
| Planning and Monitoring | Direct Reimbursement to GOI | | 0.25 |
| Evaluation/Audit | Direct Payment to Suppliers | 0.30 | |
| Contingency | N/A | 1.10 | 3.00 |
| TOTAL | | 16.70 | 38.30 |

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## 2.4 RECURRENT COSTS

The principal recurrent costs created by the project are for road and equipment maintenance. The costs for these activities during the life of the project are estimated to be $6.5 million and $2.1 million, respectively, and are incorporated into the project budget as GOI contributions in order to institutionalize GOI responsibility for recurrent expenses. The project as a whole aims to increase the budget priority accorded to maintenance. Planning approaches established in project districts will include projecting future recurrent costs as an integral part of planning for all road capital investments. Finally, the mobilization of local government revenues to meet maintenance funding requirements in the long term will be initiated prior to beginning Phase II of the project.

Recurrent cost of much smaller magnitude will be created by the program of DPUP field support to DPUKs and by the potential addition of new personnel to the DPUKs. The field support program is experimental and will be supported by AID funds during Phase I at a total cost of $100,000. Assuming the benefits of active DPUP assistance in the field are adequately demonstrated, the cost of continuing through Phase II and after the project will be borne by the GOI. The recurrent costs of personnel are more difficult to assess. Once civil servants are tenured, budgets for salaries and benefits are assured. Pending a detailed review of personnel needs when long-term TA is in place, the only additional DPUK personnel anticipated are tenured province or national staff seconded to project districts. No new recurrent cost will be created. Two other types of new personnel may ultimately be required: staff moved from temporary to tenured employee status, and new hires. Recurrent cost implications of both will be considered at the time personnel needs are assessed. The cost, if any, is not expected to be large.

# 3. IMPLEMENTATION PLAN

## 3.1 PROJECT PHASING

This eight-year project will be implemented in two phases. In Phase I, maintenance and rehabilitation activities will begin in nine districts (seven in South Sulawesi, two in NTT). Pending satisfactory development of institutional, financial and VIN issues, in IFY 1991/92 Phase II will continue work in the original nine districts and initiate rehabilitation and maintenance programs in an additional two districts in NTT. Figure 1 shows an overall view of the phasing of activities. The anticipated accomplishments or conditions prevailing at the end of Phase I are listed below.

## 3.3 AID RESPONSIBILITIES

AID and GOI roles are structured to give to the GOI the maximum responsiblity for civil works implementation which the capabilities of implementing agencies permit. This will allow greater USAID attention to be paid to the policy and institutional aspects of the project but will require both a large TA field presence and an effective Project Management Unit to focus on civil works.

Within this structure, AID will have three primary responsibilities: the award and management of TA contracts, oversight of GOI procurement of equipment and contractor services, and monitoring the institutional development and policy goals of the project. These functions are discussed in detail in Section 5 of Annex K. Of particular note are the delegation of design approval and rehabilitation certification responsibility to AID direct contractors (with USAID involved in spot checks only) and a special focus of USAID attention to developing the impact of the Special Studies agenda and developing the role of the DPUP to guide DPUK improvements.

## 3.4 GOI RESPONSIBILITIES

GOI roles are discussed in detail in Section 1.2 of Annex K. Briefly, the GOI, with consultant assistance, will be responsible for the full range of civil works management of the project. DPUKs will perform road condition and traffic surveys, select and design rehabilitation works, develop and implement Annual Maintenance Plans, select and supervise contractors for rehabilitation work, manage force account and non-force account maintenance programs, and manage equipment. DPUPs will monitor the development of DPUK programs in each of these areas, approve designs and Annual Maintenance Plans, conduct quality control inspections of work in progress as the basis for payment to contractors, assist AID consultants' inspection of works for AID reimbursement, supervise and assist DPUK management of equipment, and second staff and/or assist to provide training where specific DPUK inadequacies are identified.

At the national level, the PMU will monitor civil works progress and the financial status of the project. The Equipment Directorate of the Ministry of Public Works, on behalf of the Ministry of Home Affairs, will procure and distribute equipment. Bina Marga's Bureau of Planning, with TA, will develop planning policy for maintenance development and Very Important Networks while the Highway Steering Committee will review, with USAID, project progress toward policy and institutional goals, appropriate actions to be taken in light of Special Studies findings, and will provide guidance and assistance to develop pilot efforts for local government revenue generation or revenue sharing for maintenance.

## 3.5 PROCUREMENT PLAN

### 3.5.1 Technical Assistance

Three major AID Direct Mission-issued contracts for technical assistance are planned: an 8(a) contract for Architect-Engineering services to bridge the gap between project obligation and the arrival of the long-term

FIGURE 1

LIFE OF PROJECT SCHEDULE

| | IFY 87/88 | IFY 88/89 | IFY 89/90 | IFY 90/91 | IFY 91/92 | IFY 92/93 | IFY 93/94 | IFY 94/95 | IFY 95/96 |
|---|---|---|---|---|---|---|---|---|---|
| | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM | AMJJASONDJFM |
| Calendar Year | (1987) | (1988) | (1989) | (1990) | (1991) | (1992) | (1993) | (1994) | (1995) |
| LIFE OF PROJECT | XXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXX |
| PHASE I ACTIVITIES (9 DISTRICTS) | | | | | | | | | |
| ROAD REHABILITATION | | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | | | | | |
| ROAD MAINTENANCE | | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | | | | | |
| WORKSHOPS | | | | | | | | | |
| - UPGRADING (7) | | XXXXXXXXXXXX | | | | | | | |
| - CONSTRUCTION (2) | | XXXXXXXXXXXX | | | | | | | |
| EQUIPMENT PROCURE ($[illegible].7 MILL) | | XXXXXXXXXXXX | | | | | | | |
| PHASE II ACTIVITIES (11 DISTRICTS) | | | | | | | | | |
| ROAD REHABILITATION | | | | | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | | |
| ROAD MAINTENANCE | | | | | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | |
| WORKSHOPS | | | | | | | | | |
| - UPGRADING (2) | | | | | XXXXXXXXXXXX | | | | |
| EQUIPMENT PROCURE ($5.9 MILL) | | | | | XXXXXXXXXXXX | | | | |
| TECHNICAL ASSISTANCE | | | | | | | | | |
| BRIDGING CONTRACTOR | XXXX | XXXXXXXXXXXX | | | | | | | |
| LONG-TERM CONTRACTOR | | XXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | | |
| PSC CERTIFICATION SERVICE | | XXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | | |
| TRAINING | | | | | | | | | |
| SHORT TERM | XXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | |
| LONG TERM | | | | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | |
| SPECIAL STUDIES | XXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | |

3.5.1.5 Gray Amendment Considerations. It is planned that the bridging TA contract will be set aside for 8(a) firms. This contract will be negotiated and awarded by the Mission through an informal competitive process approved by OSDBU in AID/W. For the long-term contract, the participation to the maximum extent possible of small business concerns, small disadvantaged business concerns, and women-owned small business concerns as contractors or sub-contractors will be encouraged in accordance with Part 19 of the Federal Acquisition Regulation. Solicitations for the competitively bid long-term A&E contract will include language to this effect and will indicate that if, at the time of evaluation, ratings against other selection criteria are found equal, the participation of such firms may become a determining factor for selection. While A&E firms would be free to choose their own prospective subcontractors, it is anticipated that the 8(a) bridging contractor, if successful to date, would make itself available as a potential subcontractor to all interested proposers. This would present an opportunity for the continued involvement of a capable 8(a) contractor as a subcontractor to the successful long-term A&E firm. If host country contracting takes place, bidding procedures will be the same as above so long as they do not conflict with Indonesian regulations. In executing the Project Paper facesheet, the Mission Director certifies that the use of Gray Amendment entities to implement the project has been considered to the maximum practicable extent.

### 3.5.2 Equipment Procurement

The equipment requirements of the project are divided into several types: road maintenance and rehabilitation equipment, support equipment, workshop equipment, and miscellaneous office/field tools. These will be provided to each district except that rehabilitation equipment will be provided only to the two districts with Model Force Account Crews.

Major procurements will be conducted in two phases. Phase I will procure equipment to complement existing fleets for the initial nine districts. Phase II in the fourth project year will procure equipment for the two additional districts and replace equipment now in place whose service life will end. Minor procurements (miscellaneous office and field tools, workshop equipment) will be conducted in year two.

AID Loan funds ($6.9 million) and GOI contributions from PL 480 Title I proceeds ($2.7 million) will be used for equipment needs. The timing, costs and source of funds for procurement are summarized in Table 5.

It is anticipated that the PL 480 contribution will fund purchases of primarily locally available equipment. This procurement will be carried out by Bina Marga on behalf of Bangda since the funds for this procurement will be in Bandga's budget. Under GOI regulations, vehicles and trucks, with an approximate value of $1.0 million, are procured directly by the State Secretariat. This procedure takes about five months and is not expected to adversely effect the project. AID will reserve approval rights on the equipment specifications for all project equipment, including that purchased with PL 480 funds. The AID loan will finance the cost of the remaining Phase I and all Phase II equipment. The Phase I items for loan financing are generally those not available locally or for which inadequate competition exists in the local market. Since this equipment will be used in the

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# TABLE 5. TIMING, COSTS AND SOURCES OF PROCUREMENT FUNDS

| ITEM | TOTAL NUMBER | UNIT COST* | TOTAL COST** | YEAR 1 PROCUREMENT NUMBER | YEAR 1 TOTAL COST | YEAR 1 FUNDING SOURCE LOAN | YEAR 1 FUNDING SOURCE PL480 *** | YEAR 2 PROCUREMENT NUMBER | YEAR 2 TOTAL COST | YEAR 2 FUNDING SOURCE LOAN | YEAR 2 FUNDING SOURCE PL480 | YEAR 4 PROCUREMENT NUMBER | YEAR 4 TOTAL COST | YEAR 4 FUNDING SOURCE LOAN | YEAR 4 FUNDING SOURCE PL480 | ANTICIPATED SOURCE/ORIGIN (FOR LOAN-FUNDED YEAR ONE PROCUREMENT ONLY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINTENANCE & REHABILITATION EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Bulldozer 90 HP, 12 tons, w/ripper | 1 | 110,000 | 130,075 | 1 | 130,075 | 130,075 | | | 0 | | | 0 | 0 | 0 | | 941 |
| 2. Motorgrader, 100HP | 19 | 70,000 | 1,572,325 | 5 | 413,875 | | 455,263 | | 0 | | | 14 | 1,158,850 | 1,158,850 | | |
| 3. Wheelloader, 1.2 m3 | 11 | 70,000 | 910,525 | 3 | 248,325 | 248,325 | | | 0 | | | 8 | 662,200 | 662,200 | | 941 |
| 4. Roller, Vibratory 6 tons | 15 | 60,000 | 1,064,250 | 1 | 78,950 | | 78,045 | | 0 | | | 14 | 993,300 | 993,300 | | |
| 5. Asphalt Sprayer, 800 ltr | 10 | 9,500 | 100,513 | 8 | 80,410 | 80,410 | | | 0 | | | 2 | 20,103 | 20,103 | | 941 |
| 6. Dump Truck, 5 tons | 8 | 25,000 | 236,500 | 8 | 236,500 | | 260,150 | | 8 | | | 0 | 0 | 0 | | |
| 7. Water Tank Truck, 4000 ltr | 15 | 25,000 | 443,439 | 11 | 325,199 | | 357,705 | | 0 | | | 4 | 118,250 | 118,250 | | |
| 8. Flatbed Truck, 3.5 Tons | 11 | 19,900 | 258,849 | 10 | 235,318 | | 258,849 | | 0 | | | 1 | 23,532 | 23,532 | | |
| 9. Dump Truck, 3.5 ton | 71 | 20,000 | 1,579,150 | 4 | 94,500 | | 104,650 | | 0 | | | 67 | 1,584,550 | 1,584,550 | | |
| 10. Hand Compactor | 14 | 1,200 | 19,366 | 1 | 1,419 | | 1,561 | | 0 | | | 13 | 18,447 | 18,447 | | |
| 11. Multipurpose Tractor w/attach. | 20 | 39,000 | 922,350 | 9 | 415,059 | 415,059 | | | 0 | | | 11 | 507,293 | 507,293 | | 941 |
| 12. Gasoline Engine Jack Hammer | 20 | 3,000 | 70,950 | 9 | 31,928 | 31,928 | | | 0 | | | 11 | 39,023 | 39,023 | | 941 |
| 13. Jeep Towed Trailer, 2 ton | 40 | 1,500 | 70,950 | 13 | 31,928 | | 35,120 | | 0 | | | 22 | 39,023 | 39,023 | | |
| 14. Mini Vibro Roller, 1 ton | 20 | 10,000 | 236,500 | 9 | 106,425 | 106,425 | | | 0 | | | 11 | 130,075 | 130,075 | | 941 |
| 15. Concrete Mixer, 0.1 m3 | 40 | 900 | 42,570 | 18 | 19,157 | | 21,072 | | 0 | | | 22 | 23,414 | 23,414 | | |
| 16. Concrete Vibrator | 40 | 550 | 26,015 | 18 | 11,707 | 11,707 | | | 0 | | | 22 | 14,308 | 14,308 | | |
| 17. Sheep Foot Roller-Towed | 2 | 3,000 | 7,095 | 2 | 7,095 | 7,095 | | | 0 | | | 0 | 0 | 0 | | |
| Sub-total | 357 | | 7,792,320 | 125 | 2,459,955 | 1,031,022 | 1,571,926 | 0 | 0 | 0 | 0 | 222 | 5,332,366 | 5,332,366 | 0 | |
| SUPPORT EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Pick-up Utility | 24 | 15,000 | 425,700 | 11 | 195,113 | 0 | 214,624 | | 0 | | | 13 | 230,588 | 230,588 | | |
| 2. Pick-up 1 ton | 24 | 10,000 | 283,800 | 11 | 130,075 | 0 | 143,093 | | 0 | | | 13 | 153,725 | 153,725 | | |
| 3. SSB Radio | 27 | 2,900 | 92,590 | 27 | 92,590 | 0 | 101,849 | | 0 | | | 0 | 0 | 0 | | |
| 4. Motor Cycle 100 cc | 70 | 1,200 | 99,330 | 32 | 45,408 | 0 | 49,949 | | 0 | | | 38 | 53,922 | 53,922 | | |
| Sub-total | 145 | | 901,420 | 81 | 453,185 | 0 | 509,504 | 0 | 0 | 0 | 0 | 64 | 438,235 | 438,235 | 0 | |
| WORKSHOP EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. New Workshop | 2 | 100,000 | 236,500 | 2 | 236,500 | 0 | 260,150 | | | | | 0 | 0 | 0 | | |
| 2. Existing Workshop | 9 | 40,000 | 425,700 | 7 | 331,100 | 0 | 364,210 | | | | | 2 | 94,600 | 94,600 | | |
| Sub-total | 11 | | 662,200 | 9 | 567,600 | 0 | 624,360 | 0 | 0 | 0 | 0 | 2 | 94,600 | 94,600 | 0 | |
| MISCELLANEOUS OFFICE/FIELD TOOLS | | | | | | | | | | | | | | | | |
| Average estimated cost of package per district | 11 | 2,000 | 22,000 | | | | | 11 | 22,000 | 22000 | | | | 0 | | |
| Actual need determined by rear one Survey | | | | | | | | | | | | | | 0 | | |
| Sub-total | 11 | | 22,000 | 0 | 0 | 0 | 0 | 11 | 22,000 | 22,000 | 0 | 0 | 0 | 0 | 0 | |
| Grand-Total | 524 | | 9,377,940 | 225 | 3,490,740 | 1,031,022 | 2,705,590 | 11 | 22,000 | 22,000 | 0 | 289 | 5,865,200 | 5,865,200 | 0 | |

*CIF Jakarta, no spareparts included **CIF Ujung Pandang and Kupang, also includes an additional 15% of CIF Jakarta price for spare parts *** Includes Tax (PPn) 10%

Note : Figures do not add because tax is included in the cost for equipment procured with PL 480 proceeds

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82,000 km reported that 63% fell into the latter two categories; visual inspection by consultants indicates that the actual condition is generally lower than reported. The road network on the outer islands where the project provinces lie is sparse (39 km per thousand sq km of land versus 269 km on Java/Bali) and only 13% is paved, with over half of the total comprised of earth roads. South Sulawesi and NTT have about 15% of Indonesia's total length of district roads.

### 4.1.1 Traffic Volume and Composition

Traffic counts are not conducted on district roads. Thus, district decisions on road geometry, pavement type, pavement thickness and the selection of roads to be improved are not based on traffic data. Traffic counts conducted in detailed feasibility studies by other donors are available for representative districts in the project provinces: overall, the majority of links carry less than 200 motorized vehicles per day. The number of links with ADT exceeding 50 vehicles is significantly higher in South Sulawesi than NTT.

During the first year of the project, detailed traffic surveys will be conducted on the networks covered by the project. To assure a valid baseline count, the first-year survey will be conducted by a contractor. Subsequent surveys will be conducted periodically by district staff after they receive appropriate training.

### 4.1.2 Current Road Design, Construction and Maintenance Practices

Most district roads were constructed before adequate standards were established or under road programs that used standards below those established for districts. Over the past five years, most technical standards and guidelines for district road construction and data collection have been written or improved and are adequate (although they are applied only in districts where a donor is involved); others are in various stages of development. Standards for geometrics and pavement are complete and acceptable. Those for drainage are in draft and will need to be approved by USAID. Several standards and guidelines for maintenance are not yet available or are inadequate.

Several serious design shortcomings have been experienced. There is a pronounced tendency to focus on the running surface to the exclusion of substructure, shoulders, ditches and other drainage features. Road construction is frequently undermined by the lack of subsoil drainage through natural shoulders. Last, design is rarely adjusted to account for variations along the length of the road.

Traditional construction practices are seriously deficient. First, there is little recognition of the importance of shaping and compaction in the construction of subgrades. Second, even if pavement designs specify layered pavement construction, field crews are unlikely to follow the specification, and structural failure of the riding surface is common. Third, pavement seals and reseals are usually done using the penetration macadam method because so many roads deform and thus require surface treatment. Poor results are assured by the uncontrolled heating of bitumen over open fires, the primitive method of bitumen application, and the

long-term alternatives to the present system that can be left in place once AID involvement ends. For AID-specific purposes and until alternative contract formats are devised, each road design will be approved by a consultant engineer, contracts will hold contractors to all design specifications, certification will be made on the basis of adherence to designs, and be made jointly by a direct AID contractor and DPUP and DPUK representatives. Finally, a Model Force Account Crew for rehabilitation will be formed in one district in each province to introduce new techniques and work methods and to serve as a training mechanism for operators, foremen, and particularly for supervisors of contractors. Staff from other districts in the province will rotate through the Model Crew.

A simple maintenance management system will be introduced to each DPUK and used as the basis for planning, budgeting, and controlling work in the field. For maintenance work, GOI policy is to use force account. The RRMS project will start from this base. Initially, all maintenance work will be performed by force account to give DPUK staff first-hand experience in work methods and in crew and equipment management. This may take several years. Then, alternative approaches will be introduced. First, some less critical maintenance activities will be contracted to small firms, operating under established production standards and supervised by the now-experienced force account crewman. Second, pending the results of Special Studies, both the roadman system and efforts to enlist local communities to maintain their own roads will be tried on a pilot basis and expanded into other project districts as appropriate. With some maintenance being performed by contract, roadmen, or local communities, the personnel and equipment needed for force account maintenance will not increase the number of maintainable kilometers from the project rehabilitation program. However, some maintenance work of all types should still be performed by force account to check the production rate and unit cost of each maintenance activity.

### 4.1.4 Organizational Structure and Staff

DPUK organizational structures may vary depending on needs and local capacity. At a minimum, each DPUK should have a distinct section with clear responsibility for the district's road development and management program. In addition, it should have a subsection with full-time staff responsible for road maintenance. For districts which do not yet have a distinct workshop unit, one will be required. Evidence will be required that these units are in place and staffed before rehabilitation works begin.*

Field staff in both provinces are primarily temporary employees for whom the rate of turnover is high. Under present district work practices and standards, most of these jobs do not require skilled workers. A maintenance management system, however, will require skilled workers in both maintenance implementation and rehabilitation supervision. The potential need for additional staff is assessed in Annex G. It appears that NTT will have minimal need for additional staff but the potential need in South Sulawesi is as many as 62 permanent staff, primarily mechanics, design technicians and maintenance supervisors. Apparent shortages, however, are

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* The GOI authorized a reorganization of all DPUKs in late 1986, consistent with this minimum structure. The issue is whether this has yet been implemented in every district.

### 4.1.7 Work Programs and Budgets

The project will utilize annual traffic-based screening procedures to determine which links are eligible for rehabilitation financing. Because only partial traffic data were available for estimation purposes before the completion of this Project Paper (a complete traffic counting exercise will be required in the first year of the project and periodically thereafter), the following calculations are illustrative only. The illustrative calculation applies the simplified Table (see the Economic Analysis) to traffic data from representative districts in the project provinces and projects the percentage of each type of road which would qualify for rehabilitation in these districts to the known length and surface type of roads in the project districts. Detailed calculations are shown in Annex G.

TOTAL ROAD MAINTENANCE AND REHABILITATION PROGRAM

| | South Sulawesi | | NTT | |
|---|---|---|---|---|
| Year | Total Km Maintained | Total Km Rehabilitated | Total Km Maintained | Total Km Rehabilitated |
| 1988/89 | 428 | 80 | 116 | 48 |
| 1989/90 | 437 | 120 | 145 | 71 |
| 1990/91 | 485 | 160 | 196 | 96 |
| 1991/92 | 574 | 160 | 272 | 95 |
| 1992/93 | 663 | 160 | 348 | 95 |
| 1993/94 | 751 | 120 | 423 | 71 |
| 1994/95 | 800 | 0 | 475 | 0 |
| Total | 138 | 802 | 1,975 | 475 |
| Cost--AID | 0 | $13.6 millon | 0 | $5.8 million |
| GOI* | $5.2 million | $ 3.4 million | $1.8 million | $1.4 million |
| Total Cost | $5.2 million | $17.0 million | $1.8 million | $7.2 million |

* The total estimated maintenance cost of $7.0 million is above the $6.5 million budgeted as the GOI contribution for maintenance. The discrepancy developed as the Project Paper was being finalized and after the GOI contribution had been negotiated. Given the uncertainties of determining maintenance requirements, the difference is not considered significant.

afford to rehabilitate, on average, only 70% of each district's most heavily travelled roads. Therefore, should any particular link not have the required volume of traffic, it is more than likely that another link will suit the RRMS criteria.

It should be noted that the value of RRMS lies in its rational approach to decision-making in the field of road maintenance and rehabilitation. Under the selection criteria established for this project, there is a large universe of road links to choose from which would fully comply with section 611(a) requirements.

## 4.2 ECONOMIC ANALYSIS

### 4.2.1 Macro-Economic Outlook

Indonesia is in the midst of an economic recession that has worsened substantially with the decline in average oil prices from $25/BBL in 1985 to $12/BBL in 1986. This drastic decline poses significant adjustment burdens on balance of payments, government budgets, growth, incomes and employment and is expected to last 3-4 years because of the relatively unfavorable medium-term outlook for oil prices and the relatively long lead time for structural adjustment policy measures to have substantial impact.

The IBRD projects that real GDP growth will average less than 2.5% until 1990 and that real per capita income will decline by an average 0.7% per year. On the basis of these projections and historical employment-output elasticities, less than 40% of the 10 million new entrants to the labor force during the period 1986-90 will find employment.

Real budgetary expenditures, excluding debt service, may fall by as much as 40%, compared to their 1985/6 levels, by 1990/1. Real development expenditures will probably fall over 50%. The current account deficit is expected to substantially worsen, rising from $1.8 billion in 1985/6 to an estimated $4.8 billion in 1986/7, before falling to a projected $2.9 billion in 1987/8 and $1.2 billion in 1988/9. External financing requirements will double to almost $7 billion by 1986/7, ease slightly to $6 billion by 1987/8, and probably stabilize between $4-5 billion in 1988/9-1990/1. The growing debt service burden is a major factor in the continuing need for large amounts of external financing (see Annex H).

### 4.2.2 Economic Rationale for Maintenance

The micro-economic analysis of district road reconstruction and maintenance is provided in Annex H, which develops a simplified screening procedure to select roads for reconstruction and maintenance. At an aggregate level this procedure would provide most of the required information to allow road budget allocation priorities to be set.

By changing from rehabilitation with no maintenance to a system of routine and/or periodic maintenance, using a simplified road selection procedure based on traffic counts, and using a minimum IRR cut-off of about 12%, the GOI can achieve several objectives. The average rate of return on roads budgetary allocations will rise, the average proportion of roads in good condition will rise, budgetary requirements for maintaining a given proportion of the inventory in good condition will fall, and the same level of expenditure will produce a greater employment impact (because of the greater labor intensity of maintenance).

Nationwide replication of the simplified selection procedures and the implicit budgetary allocation priorities has enormous implications for district road systems and rural areas. Table 6 shows that routine and/or periodic maintenance alternatives can produce benefit-cost ratios 2 to 9 times higher than the rehabilitation with no maintenance option. Also these returns are obtained for about one-third to one-eighth of the budgetary outlay required for the option of rehabilitation with no maintenance.

TABLE 6. COMPARATIVE BENEFITS AND COSTS OF ALTERNATIVES
(NPV at 12%; period, 10 years; Rp. 000/Km)

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT 550 | 364 | 127 | 364 | 29 | |
| 1. Rehabilitation with no Maintenance | | | | | |
| Savings | 13,772 | 25,325 | 8,689 | 91,924 | 3,461 |
| Costs | 13,624 | 19,551 | 13,329 | 27,876 | 1,678 |
| Ratio | 1.01 | 1.29 | .65 | 3.27 | 2.06* |
| 2. Routine Maintenance without Periodic Maintenance | | | | | |
| Savings | 6,885 | 2,498 | 12,035 | 32,952 | 2,969 |
| Costs | 3,143 | 2,819 | 1,918 | 3,229 | 1,599 |
| Ratio | 2.19* | 2.66* | 6.27* | 10.20* | 1.85 |
| 3. Incremental Values of Periodic Maintenance | | | | | |
| Savings | 3,508 | 12,225 | 1,689 | 23,732 | 590 |
| Costs | 1,291 | 2,588 | 1,723 | 4,280 | 694 |
| Ratio | 2.72* | 4.72* | .98 | 5.54 | .85 |
| 4. Routine and Periodic Maintenance Combined | | | | | |
| Savings | 10,393 | 19,723 | 13,724 | 56,684 | 3,559 |
| Costs | 4,434 | 5,407 | 3,641 | 7,509 | 2,293 |
| Ratio | 2.34* | 3.64* | 3.76 | 7.54 | 1.55 |

* Selected as preferred.

Note: Item 1 includes as costs the loss of vehicle cost savings afforded by routine maintenance up to the year of rehabilitation.

### 4.2.3 Project Rationalization in the Face of Declining Budgets

Because the medium-term economic and budgetary outlook is unfavorable, it is necessary to consider whether the GOI can (or is likely to) provide agreed-upon counterpart funding and cover subsequent recurrent costs (see the Financial Analysis in Annex I).

Summary. Although a risk exists that sufficient funds will not be available to cover counterpart funding and recurrent cost requirements, it appears minimal given the GOI's demonstrated commitment to road funding and its guarantee for the life of the project. Further, the projections on which the macro economic outlook are based are conservatively pessimistic and the economy's actual performance is more likely to be better than worse. It is also anticipated that excess world production capacity for oil will have dissipated by 1990-1991, resulting in significantly strengthened export and budgetary revenues. For these reasons, including the relatively minor size of the project maintenance budget shortfall ($3.0 million), we believe the budget risk to be minimal. Under a worst-case scenario, where additional maintenance funds are not made available, the impact of increasing the effectiveness with which existing maintenance and rehabilitation funds are used would nonetheless be substantial.

### 4.2.4 Selecting Road Links for AID-Financed Rehabilitation

Districts do not use formal or consistent procedures to assign priority to road links for rehabilitation. Formal pre-screening methods have been developed to evaluate and rank road projects at the district level under donor-funded projects, but have required outside consultants to apply them. These methods have attempted to incorporate measures of producer surplus as a complement to the conventional consumer surplus (vehicle operating cost savings) screening indices but have proved very complex, produced inconclusive results, and in the end have always necessitated resorting to traffic counts and vehicle cost savings as the basis for selection.

TABLE 7. SAMPLE SIMPLIFIED SELECTION TABLE

(Rp. 000/Km) Base-Year Rehabilitation/Upgrading Costs:

| | 11648 | 14560 | 17472 | 20384 | 23296 | 26208 | 29120 | 32760 | 36400 | 40040 | 43680 | 47320 | 50960 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IRR % | Base Year ADT Volume: | | | | | | | | | | | | |
| 6 | 46 | 58 | 70 | 82 | 94 | 105 | 110 | 128 | 146 | 160 | 173 | 186 | 199 |
| 7 | 49 | 62 | 75 | 87 | 99 | 111 | 118 | 137 | 155 | 170 | 184 | 198 | 212 |
| 8 | 52 | 65 | 79 | 92 | 105 | 118 | 126 | 145 | 164 | 180 | 195 | 210 | 225 |
| 9 | 55 | 69 | 83 | 97 | 111 | 124 | 134 | 154 | 173 | 190 | 206 | 222 | 238 |
| 10 | 58 | 72 | 87 | 102 | 116 | 131 | 145 | 164 | 182 | 200 | 217 | 234 | 251 |
| 11 | 60 | 76 | 92 | 107 | 122 | 137 | 151 | 171 | 191 | 210 | 228 | 246 | 265 |
| 12 | 63 | 80 | 96 | 112 | 128 | 143 | 155 | 177 | 199 | 219 | 239 | 259 | 279 |
| 13 | 66 | 83 | 100 | 117 | 134 | 150 | 167 | 188 | 208 | 229 | 250 | 271 | 291 |
| 14 | 69 | 87 | 105 | 122 | 139 | 156 | 175 | 196 | 217 | 239 | 261 | 283 | 304 |
| 15 | 72 | 90 | 109 | 127 | 145 | 163 | 185 | 206 | 226 | 249 | 272 | 295 | 317 |

* Motorized vehicles only.

(10-year period, ADT growth rate 5% implied, Rp. 1640 = US$1)

calculations of the present value of expenditure for a maintenance regime versus an alternative in which rehabilitation is repeated frequently (an approximation of current practice) indicate that the maintenance option not only results in better road condition but is also cheaper to implement.

A funds flow analysis of counterpart contributions for road rehabilitation concludes that, despite extreme assumptions about the impact of austerity on GOI budgets for district roads, the GOI will be able to meet commitments to finance its share of the road rehabilitation program. District roads are almost exclusively financed from two block grants to district governments, and GOI policy has been to preserve these two grants. The funds flow model assumes that even if one of the two grant programs is terminated, the districts, though stretching their resources in the middle three years of the project, can nevertheless provide their share of rehabilitation funding in each year of implementation.

Assessing the GOI's ability to finance recurrent costs of district road work is complicated by problems in measuring need. Maintenance does not pay on deteriorated roads and most of the present district networks are below maintainable condition. But the cutoff point between a maintainable and non-maintainable road is difficult to specify, and the present data base on road condition is inadequate to allow a specification to be applied. Moreover, at any given time, a network's need for maintenance funding depends on its size, distribution of surface types, and desired level of service of different links as well as their condition. Over time, each of these variables changes, making it difficult to formulate generalized prescriptions to assure adequate funds for maintenance in each district.

Despite these uncertainties, the financial analysis suggests that funds available for the maintenance of district roads are about 70% of the amount required nationwide. The available funds consist exclusively of a 25% earmark of Inpres District. Since Inpres District is allocated on a per capita basis, maintenance funds are disproportionately allocated to Java and Bali, and shortages are most acute in the Outer Islands. Over time, as roads improve, the need for additional funds will increase everywhere.

The recurrent maintenance cost requirements generated by the RRMS road rehabilitation program will be $3.0 million greater, over the life of the project, than the anticipated levels of earmarked Inpres District funding. Although the GOI is committed to provide these additional funds to the project, recurrent requirements after the project is completed are not addressed by this allocation. Equally important will be the need for additional funds, beginning five years after the project is over, to rehabilitate roads that have been rehabilitated by the project but are at the end of their 10-year design life. Although this is technically new investment rather than recurrent maintenance, it is still a necessary consideration in an effort to create a sustainable system. The magnitude of both these funding needs will require reordering budget priorities toward maintenance, net increases in total funding for roads, and examining revenue generation for roads in general and the potential to tap local resources to finance district road maintenance.

5. The introduction of comprehensive road condition surveys and of maintenance management to project districts will provide the data base from which more precise estimates of maintenance funding needs can be made in the future.

## 4.4 INSTITUTIONAL AND SOCIAL SOUNDNESS ANALYSIS

This section presents an institutional analysis, a socio-cultural assessment, and general commentary on project feasibility. Emphasis is given to institutional factors here, for it is in institutions that the greatest behavioral change will have to occur (see Annex J). At the initial stages, participation by local populations will be negligible, providing sufficient time to develop culturally-appropriate means of encouraging and sustaining community involvement in road maintenance.

### 4.4.1 The Institutional Setting

The district Public Works (DPUK) is the institutional target of the RRMS project. The DPUK operates within a larger institutional framework which constrains what can be achieved in the district and establishes other targets the project must focus on in order to overcome DPUK problems.

The key constraint to developing DPUK capabilities is its isolation from more technically capable Public Works organizations at the provincial or national level. The problem is rooted in the organizational structure of government and funding procedures for district roads.

The structure of government creates both horizontal and vertical cleavages that impinge on the DPUK. Horizontal cleavages are established by the three-tiered layer of government administration. Within the umbrella of national government, provincial and district authorities represent "autonomous" administrations. Each layer has its own administrative apparatus which corresponds but is not responsible to the national government Ministries. The district DPUK, for example, answers to the district political chief (Bupati) and the provincial Public Works department to the provincial Governor. Neither has a direct link to the other and neither has a link to the Public Works Department in Jakarta. Communications between these organizations are transmitted only through the political channel in which the Bupati reports to the Governor who reports to the Ministry of Home Affairs. Since each organization is responsible for distinct parts of the nation's infrastructure (national roads, provincial roads and district roads), there is no compensating overlap at an operational or field level.

Budgeting procedures can soften the hard edges of the system and open channels between technical counterparts at different levels of government. National Ministry budgets are the dominant source of finance for development activities across the country. Where responsibility to implement activities funded by these resources is delegated downward, funds and communications travel between, for example, the Ministry of Public Works and the provincial Public Works departments and a measure of cross-fertilization develops. Work on district roads, however, is funded almost exclusively from Inpres grants which flow directly from the Ministry of Home Affairs to DPUKs. One result

information to improve performance, and the ad hoc nature of, as well as the time pressure to utilize, "projectized" annual development budgets to fund road maintenance and rehabilitation activities. DPUKs have also had an additional problem of being unable to attract qualified engineering staff. Because district employment precludes transfer to Public Works organizations in other districts or at the provincial or national level, graduate engineers will not work for DPUKs and the quality of work suffers.

Some of these constraints are inherent in the GOI administrative system and cannot be resolved by the RRMS project alone. But the GOI has taken steps to address the personnel issue and the problem of time constraints on annual projects. An intern program has been introduced in which newly-hired graduate road engineers will be posted to DPUKs for at least two years before assuming duties in Jakarta. The program is untested but has significant potential to improve DPUK performance, particularly in road design. One intern will be posted in each RRMS district. A second initiative is budgeting road design in the fiscal year prior to road work implementation. This reduces the pressure to design and implement in the same year, and improvements in design quality have already been noticed.

The project will introduce additional improvements focusing on internal management and monitoring/planning procedures. Many of these will be the direct results of introducing maintenance management systems. Internal management improvements will include: 1) establishing a minimum organizational structure for planning and managing maintenance, rehabilitation and equipment, 2) defining office tasks and establishing systematic procedures to implement them, and 3) introducing standards of work for maintenance and equipment management. Planning and monitoring improvements will include: 1) establishing a framework for annual road rehabilitation programs (including introducing traffic-based procedures to determine priorities and assisting the GOI to devise definitions of VIN that can be sustained over the long term), 2) introducing maintenance management systems that allow districts to assign priority to maintenance tasks, and 3) introducing routine condition surveys and traffic counts that permit the impact of district work to be evaluated and future needs identified. Finally, the technical and management skills of all district Public Works staff will be improved through both formal and on-the-job training.

Several constraints internal to the district Public Works office will affect project activities. Districts in South Sulawesi, as in most of the country, have a DPUK responsible for the roads, water resources and urban infrastructure under the district authority. Competing demands for staff between the three sectors can create problems compounded by the frequent rotation of lower-level staff between office divisions. This inhibits the development of a core of expertise in any one area. Because roads are by far the dominant focus of outer island DPUKs, the problem may be less acute than on Java. But project efforts to establish a core staff skilled in maintenance, road and equipment management will need to keep this in mind.

As in about one-fifth of the districts nationwide, NTT now has no DPUKs. Instead, the local branch office (Cabang Dinas) of the DPUP implements district road work along with its responsibilities for any province road links in the district. While this will facilitate developing

may be achieved. In addition, easier access to health care may help to decrease mother and child mortality rates. There are no obvious reasons to assume either men or women will be harmed by the project.

Employment impact is expected to be either neutral or positive. Success in achieving the project goal of increased growth in agriculture, rural industry and trade will, all else equal, increase employment opportunities. Although the project will introduce more equipment-intensive techniques for both rehabilitation and maintenance than at present, project-financed rehabilitation and maintenance work will directly employ a large number of skilled and unskilled workers. Further, the project provinces are areas of relative labor shortages rather than surplus, and maintenance - regardless of the techniques employed - is inherently more labor-intensive than either new road construction or road rehabilitation.

### 4.4.3 Project Feasibility

The new linkage between the DPUK and DPUP will enable better technical criteria to be used in decision-making and improved skills applied to implementation. Under conditions of budget austerity the GOI itself is becoming more interested in maintaining its capital investments and in more efficiently allocating its limited resources. The government is thus receptive at this time to enact innovative solutions if these promise to increase long-term resource utilization.

Theoretically, rural citizens have a say in how budgets are allocated by working through the Village Security Institution to influence Bappeda II and I and ultimately central funding decisions. The RRMS hopes to involve them in maintaining roads once roads have been rehabilitated. The roadman system and other community initiatives will be explored in order to transfer some responsibility for labor and costs of maintenance over to rural users. While the self-help ethic is not as strong off Java as on, citizens of South Sulawesi and NTT have shown they will adopt innovations which they deem beneficial and will cooperate for a perceived common good (a reported success in community road maintenance in Belu District in NTT will be one activity investigated as pilot trials for non-force account maintenance are developed). Improved supervision procedures for controlling contractors' performance will be developed, providing greater accountability to local citizens. More research on local conditions, values and behaviors will be undertaken before decisions are made on how to motivate local ethnic groups to help with road maintenance.

## 4.5 ADMINISTRATIVE ANALYSIS

The Administrative Analysis assesses the legal status and sanction, the division of responsibilities, and management capabilities for GOI agencies implementing the RRMS project. It describes the USAID resources to be made available for project administration. Legal sanction for new GOI institutional arrangements to manage district road programs was provided in a reform effected by government decrees issued in May, 1987. The reform increases the responsibility of DPUPs in the implementation of district road programs, and thereby mitigates a number of concerns about the administrative capability of DPUKs acting on their own. The legal framework for public

DPUK staffing levels are discussed in Section 4.1.4 of this Project Paper. Staff levels of other implementing agen ies are not a concern. However, assurances are required (see Section 6, Conditions Precedent) that the change in the PMU's status effected by the May 1987 reform will not reduce its staff levels or capabilities.

Within USAID the project will be managed by the Office of Agriculture and Rural Development as part of its portfolio of rural infrastructure/ institutional development projects. A full-time USDH project officer, anticipated to be a rural development officer with considerable experience with infrastructure projects, will be assigned to the project. He/she will be assisted by two full-time FSN engineers with considerable experience in various types of development and construction projects, AID and GOI policies and procedures, procurement of goods and services, and the direction and management of technical assistance contracts. In addition to applying their own experience, these full-time staff will be able to draw on the support and experience of other staff within the ARD Office on issues of local government, administration and local revenue mobilization and allocation.

An OE-funded, experienced, US PSC engineer will assist with project management for one year - 1988 - until the full time USDH project officer is assigned, settled in and has completed language training (anticipated to be by September 1988). The GOI has agreed that up to two years of the services of an additional PSC may be funded from the contingency portion of grant funds to supplement AID "in-house" staff resources if necessary.

## 4.6 ENVIRONMENTAL ANALYSIS

Three categories of project activities are analyzed for environmental effects. For the first - technical assistance, training, special studies and other activities - no direct environmental effects are anticipated.

For the second category - workshops and equipment - design criteria and TA oversight will stress environmental issues, especially potential problems resulting from waste from the equipment and equipment workshops.

The third category - the rehabilitaton of 1600 km of rural roads and the maintenance of that portion of the district network that meets basic agreed-upon economic criteria - is the primary focus of Mission environmental concerns. In accordance with AID/W directions, there will be no new roads, no penetration roads and, generally, no realignments. The project will not upgrade the design capacity of the roads. However, roads that have become unmaintainable because of inadequate design and/or construction will be rehabilitated to meet current traffic requirements. Particular attention will be paid to the inspection and design of road elements that commonly cause poor road performance and environmental damage. Routine maintenance will be limited to clearing drains and culverts, filling potholes and reshaping the pavement. Repair beyond these activities will require the same design and environmental scrutiny that will be set as criteria for the rehabilitation program.

To date, project designers visiting areas of South Sulawesi and NTT have not found undegraded forest. Should such areas be delineated, the Mission

implement monitoring activities, including the kinds of instruments required, how information will be collected and how it will be used. The monitoring and evaluation approach (Special Studies excepted) will rely largely on information generated by the systems put into place by the project (road condition inventories, maintenance and equipment management, etc.) rather than by external data-gathering exercises. However, six person-months of technical assistance is anticipated for a mid-project evaluation of the impact issues above, with a similar amount of assistance expected for a final evaluation in the last project year.

Although RRMS project activities directly support the project goal of increased growth in agriculture and incomes, the methodological difficulties, cost and time required to isolate the impact of RRMS activities on these variables from the impact of other development efforts in project areas would be prohibitive. The outlined approach to monitoring and evaluation therefore focuses on input, output and purpose-level achievements of the project. However, since a large number of complementary AID projects are located in the same two provinces, the Mission plans to conduct a program evaluation, about halfway through the RRMS project, of the combined impact of USAID activities in the project areas. RRMS project funds may be used to support this evaluation.

## 6. CONDITIONS AND COVENANTS

### A. Conditions Precedent to First Disbursement

1. An opinion of the Minister of Justice of the Borrower that this Agreement has been duly authorized and/or ratified, and executed on behalf of the Borrower/Grantee, and that it constitutes a valid and legally binding obligation of the Borrower/Grantee in accordance with all of its terms; and

2. A statement of the name of the person holding or acting in the office of _____ specified in Section 9.2 of the Loan Agreement and Section 8.2 of the Grant Agreement; and of any additional representatives, together with a specimen signature of each person specified in such statement.

### B. Condition Precedent to Disbursement for Project Activities Other than Technical Assistance

Prior to disbursement of funds for project activities other than technical assistance, the Borrower/Grantee shall, except as A.I.D. may otherwise agree in writing, provide a description satisfactory to A.I.D., of the structure, staff, and responsibilities of the Project Management Unit, including the names of persons and responsibilities within the Project Management Unit assigned to assist the project.

2. issue to project districts definitions of a Very Important Network model, satisfactory to A.I.D., for application in subsequent year road rehabilitation planning;

3. provide a plan, satisfactory to A.I.D., to increase the share of project rehabilitation funds allocated to districts which have performed well in developing road maintenance and equipment management programs.

G. Covenants

1. The Borrower/Grantee agrees to provide sufficient funds to maintain equipment furnished under the Project.

2. The Borrower/Grantee agrees that, unless otherwise agreed in writing by A.I.D., equipment furnished under the Project will not be rented to other parties.

3. The Parties agree to establish an evaluation program as part of the Project. Except as the Parties otherwise agree in writing, the program will include, during the implementation of the Project and at one or more points thereafter: (a) evaluation of progress toward attainment of the objectives of the Project; (b) identification and evaluation of problem areas or constraints which may inhibit such attainment; (c) assessment of how such information may be used to help overcome such problems; and (d) evaluation, to the degree feasible, of the overall development impact of the Project.

# RURAL ROADS MAINTENANCE SYSTEMS PROJECT

## PROJECT PAPER: ANNEXES

JUNE 12, 1987

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# ANNEX A

# GLOSSARY

## GLOSSARY

| | | |
|---|---|---|
| AADT | - | Average annual daily traffic |
| ADB | - | Asian Development Bank |
| ADT | - | Average daily traffic |
| ALKAL | - | Provincial equipment and supplies center |
| APBD | - | Local government budget (APBD I - Provincial Level, APBD II - District Level) |
| APBN | - | National government budget (Anggaran Penerimaan dan Belanja Nasional) |
| Aspal | - | Asphalt |
| Aspal Buton | - | Natural asphalt from Buton Island |
| AWCAS | - | All weather crushed aggregate surface or, by Indonesian definitions, all weather crushed aggregate subgrade |
| Baja | - | Steel |
| Bangda | - | (Pembangunan Daerah) The Directorate General of Regional Development at the Department of Home Affairs |
| Bantuan | - | Assistance |
| BAPPEDA | - | (Badan Perencanaan Pembangunan Daerah) Regional Planning Board |
| Bappeda Tk I | - | Provincial Development Planning Board |
| Bappeda Tk II | - | District Development Planning Board |
| Bappenas | - | (Badan Perencanaan Pembangunan Nasional) National Development Planning Board |
| Beton | - | Concrete |
| Biro Pembangunan | - | Regional Development Office at the Governor's office - provincial level |
| Bina Marga | - | Directorate General of Highways at the central government level. Highway or road organization at other levels of government |
| Bipran | - | Directorate of Planning under the Directorate General of Highways |
| Biro Perhubungan dan Parawisata, BAPPENAS | - | Bureau of Communication and Tourism at the National Development Planning Board office - Ministry of Public Works backstop office at Bappenas |
| BRI | - | Bank Rakyat Indonesia |
| BPS | - | Bureau of Statistics |
| Bupati | - | The appointed head of the Kabupaten (district) unit of government |
| Buton | - | An island near South East Sulawesi that produces natural asphalt |
| Cabang Dinas | - | Branch office of the provincial Public Works office |
| Cipta Karya | - | Directorate General of Urban Development in the Ministry of Public Works |
| Dalam Negeri | - | Department of Home Affairs |
| Dinas | - | A provincial or district agency |
| DIP | - | Daftar Isian Proyek (an approved GOI project budget) |
| DPU | - | Dinas Pekerjaan Umum (Public Works Service) |

| | | |
|---|---|---|
| DPUK | - | District Public Works Service |
| DPUP | - | Provincial Public Works Service |
| DURP | - | (Daftar Usulan Rencana Proyek) - A document that includes detailed plans and cost estimates for a proposed project |
| EMS | - | Equipment Management System |
| GOI | - | Government of Indonesia |
| Gubernur | - | Governor, the head of a province |
| GVW | - | Gross vehicle weight |
| HSC | - | Highway Steering Committee |
| IBRD | - | International Bank of Reconstruction and Development (World Bank) |
| IFY | - | Indonesia Fiscal Year |
| INMEN DAGRI | - | Instruksi Menteri Dalam Negeri (Instruction Letter of Minister of Home Affairs) |
| Inpres | - | A special fund established by Presidential Instruction to be used for financing local development projects |
| Inpres Dati II | - | An Inpres program designed primarily for district infrastructure development and allocated based upon population |
| Inpres Penunjangan Jalan | - | A program designed specifically for the development of district roads |
| IPEDA | - | Iuran Pembangunan Daerah (local land taxes) |
| ITB | - | Institute of Technology - Bandung |
| ITS | - | Institute of Technology - Surabaya |
| Jalan | - | Road |
| Jembatan | - | Bridge |
| Kabupaten | - | A district. The governmental unit below a province, an administrative grouping of kecamatans |
| Kantor Wilayah (KANWIL) | - | A regional office of a central government department |
| Kecamatan | - | A subdistrict. An administrative unit of government subordinate to the kabupaten |
| Kerikil | - | Gravel |
| Kontraktor | - | Contractor |
| Konsultan | - | Consultant |
| Lelang | - | Tender, Bid |
| Mandor | - | Foreman |
| MMS | - | Maintenance Management System |
| Menteri | - | Minister |
| Mesin Gilas | - | Roller |
| Mesin Pemadat | - | Compactor |
| NPV | - | Net present value |
| NTT | - | Nusa Tenggara Timur — an Indonesian province |
| Padat Karya | - | Ministry of Manpower program for small labor-based infrastructure projects |
| PBB | - | Land and buildings tax |
| Pedoman | - | Guideline |
| Pengadaan | - | Procurement |

| | | |
|---|---|---|
| Pengairan | - | Water resources |
| Pengawas | - | Supervisor |
| Peralatan | - | Equipment |
| PMU | - | Project Management Unit, a unit established by the Ministries of Public Works and Home Affairs to manage the implementation of donor district road projects |
| P.O. | - | Petunjuk Operasional (operational guide for implementing a GOI project) |
| Pusdiklat | - | Ministry of Public Works Training Department |
| RRMS | - | Rural Roads Maint |
| RTC | - | Regional Training |
| Ruas | - | Link |
| PU Seksi | - | A branch office of the DPUP (The older term PU Seksi has been change to Cabang Dinas) |
| Rencana | - | Plan |
| Repelita | - | Rencana Pembangunan Lima Tahun (Five Year Development Plan) |
| Rutin | - | Routine |
| SDRR | - | Subdirectorate of Rural Roads |
| SIAP | - | Sisa Anggaran Pembangunan (Development Budget Pipeline) |
| SKO | - | Surat Keputusan Otorisasi (expenditure authorization document) |
| TPPBPP | - | Tim Pengendali Pengadaan Barang/Peralatan Pemerintah (Central Government Procurement Team) |
| VIN | - | Very Important Network |
| VOC | - | Vehicle operating cost |
| VOCs | - | Vehicle operating cost savings |

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ANNEX B

STATUTORY CHECKLIST

## 5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A includes criteria applicable to all projects. Part B applies to projects funded from specific sources only: B(1) applies to all projects funded with Development Assistance; B(2) applies to projects funded from Development Assistance loans; and B(3) applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

Yes. See Annex VIII, Agriculture and Rural Sector Program (497-0357) PAAD.
Yes. See 5C(3) of this Annex.

### A. GENERAL CRITERIA FOR PROJECT

1. FY 1987 Continuing Resolution Sec. 523; FAA Sec. 634A. Describe how authorization and appropriations committees of Senate and House have been or will be notified concerning the project.

   A CN has been prepared. Obligation will occur following expiration of the notification period, without Congressional objection.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $500,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance, and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

   (a) Yes.
   (b) Yes.

3. FAA Sec. 611(a)(2). If legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

   No further legislative action is required.

4. FAA Sec. 611(b); FY 1987 Continuing Resolution Sec. 501. If project is for water or water-related land resource construction, have benefits and costs been computed to the extent practicable in accordance with the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See A.I.D. Handbook 3 for guidelines.)

   N/A.

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| 5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and total U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project? | Yes. See Annex F of this Project Paper. |
| 6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. | No.<br>N/A.<br>N/A. |
| 7. FAA Sec. 601(a). Information and conclusions on whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions. | Project will increase growth in agriculture, rural industry and trade by returning a core network of economically viable roads in each district served by the Project to maintainable condition. This growth will benefit the rural population that these district roads serve. (a)-(d) and (f) are not applicable. (e) definitely will be furthered. |
| 8. FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise). | U.S. engineering and related services, training, equipment, and Technical assistance in the form of special studies will be financed under the Project. |
| 9. FAA Secs. 612(b), 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars. | The GOI is contributing approximately 29% of the total project costs mostly in local currency. |
| 10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release? | No. |

11. FY 1987 Continuing Resolution Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity? N/A.

12. FY 1987 Continuing Resolution Sec. 558 (as interpreted by conference report). If assistance is for agricultural development activities (specifically, any testing or breeding feasibility study, variety improvement or introduction, consultancy, publication, conference, or training), are such activities (a) specifically and principally designed to increase agricultural exports by the host country to a country other than the United States, where the export would lead to direct competition in that third country with exports of a similar commodity grown or produced in the United States, and can the activities reasonably be expected to cause substantial injury to U.S. exporters of a similar agricultural commodity; or (b) in support of research that is intended primarily to benefit U.S. producers? N/A.

13. FY 1987 Continuing Resolution Sec. 559. Will the assistance (except for programs in Caribbean Basin Initiative countries under U.S. Tariff Schedule "Section 807," which allows reduced tariffs on articles assembled abroad from U.S.-made components) be used directly to procure feasibility studies, prefeasibility studies, or project profiles of potential investment in, or to assist the establishment of facilities specifically designed for, the manufacture for export to the United States or to third country markets in direct competition with U.S. exports, of textiles, apparel, footwear, handbags, flat goods (such as wallets or coin purses worn on the person), work gloves or leather wearing apparel? N/A.

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| 14. <u>FAA Sec. 118(c)</u>. Does the assistance comply with the environmental procedures set forth in A.I.D. Regulation 16? Does the assistance place a high priority on conservation and sustainable management of tropical forests? Specifically, does the assistance, to the fullest extent feasible: (a) stress the importance of conserving and sustainably managing forest resources; (b) support activities which offer employment and income alternatives to those who otherwise would cause destruction and loss of forests, and help countries identify and implement alternatives to colonizing forested areas; (c) support training programs, educational efforts, and the establishment or strengthening of institutions to improve forest management; (d) help end destructive slash-and-burn agriculture by supporting stable and productive farming practices; (e) help conserve forests which have not yet been degraded, by helping to increase production on lands already cleared or degraded; (f) conserve forested watersheds and rehabilitate those which have been deforested; (g) support training, research, and other actions which lead to sustainable and more environmentally sound practices for timber harvesting, removal, and processing; (h) support research to expand knowledge of tropical forests and identify alternatives which will prevent forest destruction, loss, or degradation; (i) conserve biological diversity in forest areas by supporting efforts to identify, establish, and maintain a representative network of protected tropical forest ecosystems on a worldwide basis, by making the establishment of protected areas a condition of support for activities involving forest clearance or degradation, and by helping to identify tropical forest ecosystems and species in need of protection and establish and maintain appropriate protected areas; (j) seek to increase the awareness of | Yes. See Section 4.6 of the Project Paper and Annex L.<br><br>(a) Yes.<br><br>(b) Possibly, through road crew employment.<br><br>(c) N/A.<br><br>(d) N/A.<br><br>(e) N/A.<br><br>(f) N/A.<br><br>(g) N/A<br><br>h) N/A<br><br>i) N/A<br><br>(j) N/A |

U.S. government agencies and other donors of the immediate and long-term value of tropical forests; and (k) utilize the resources and abilities of all relevant U.S. government agencies? N/A.

15. FAA Sec. 119(g)(4)-(6). Will the assistance (a) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity; (b) be provided under a long-term agreement in which the recipient country agrees to protect ecosystems or other wildlife habitats; (c) support efforts to identify and survey ecosystems in recipient countries worthy of protection; or (d) by any direct or indirect means significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas?

(a) Yes, engineering and related assistance will so support.

(b) No.

(c) Yes, to the extent applica- to a roads rehabilitation/ maintenance project.

(d) No.

16. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate sysem for accounting for and controlling receipt and expenditure of project funds (either dollars or local currency generated therefrom)? N/A

17. FY 1987 Continuing Resolution Sec. 532. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution? No.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Secs. 102(b), 111, 113, 281(a). Describe extent to which activity will (a) effectively involve the poor in development by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, dispersing investment from cities to small towns and rural areas, and

Growth in agricuture, rural industry and trade by returning district roads to maintainable condition will (a) directly benefit the rural poor by helping to develop local markets and employment.

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| insuring wide participation of the poor in the benefits of development on a sustained basis, using appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries. | (b) N/A.<br>(c) N/A.<br>(d) N/A. |
| b. FAA Secs. 103, 103A, 104, 105, 106, 120-21. Does the project fit the criteria for the source of funds (functional account) being used? | Yes. |
| c. FAA Sec. 107. Is emphasis placed on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)? | Yes. Appropriate technology will be utilized for road rehabilitation. |
| d. FAA Secs. 110, 124(d). Will the recipient country provide at least 25 percent of the costs of the program, project, or activity with respect to whch the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)? | Yes. Approximately 29% in cash or in kind. |
| e. FAA Sec. 128(b). If the activity attempts to increase the institutional capabilities of private organizations or the government of the country, or if it attempts to stimulate scientific and technological research, has it been designed and will it be monitored to ensure that the ultimate beneficiaries are the poor majority? | Yes. |

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| f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government. | Force account, contract, "roadman" and community participation methods to conducting maintenance will be tested and compared. Training will be conducted entirely in-country based mainly on planning, management and supervisory skills. |
| g. FY 1987 Continuing Resolution Sec. 540. Are any of the funds to be used for the performance of abortions as a method of family planning or to motivate or coerce any person to practice abortions? | No. |
| Are any of the funds to be used to pay for the performance of involuntary sterilization as a method of family planning or to coerce or provide any financial incentive to any person to undergo sterilizations? | No. |
| Are any of the funds to be used to pay for any biomedical research which relates, in whole or in part, to methods of, or the performance of, abortions or involuntary sterilization as a means of family planning? | No. |
| h. FY 1987 Continuing Resolution. Is the assistance being made available to any organization or program which has been determined to support or participate in the management of a program of coercive abortion or involuntary sterilization? | No. |
| If assistance is from the population functional account, are any of the funds to be made available to voluntary family planning projects which do not offer, either directly or through referral to or information about access to, a broad range of family planning methods and services? | N/A. |
| i. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise? | Yes. |

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| j. FY 1987 Continuing Resolution. How much of the funds will be available only for activities of economically and socially disadvantaged enterprises, historically black colleges and universities, and private and voluntary organizations which are controlled by individuals who are black Americans, Hispanic Americans, or Native Americans, or who are economically or socially disadvantaged (including women)? | No set percentage of funds will be available only for Grey amendment entities, but the implementation plan contemplates entensivd use of such organizations. See Section 3.5 of the Project Paper. |
| k. FAA Sec. 118(c)(13). If the assistance will support a program or project significantly affecting tropical forests (including projects involving the planting of exotic plant species), will the program or project (a) be based upon careful analysis of the alternatives available to achieve the best sustainable use of the land, and (b) take full account of the environmental impacts of the proposed activities on biological diversity? | N/A. Program will not significantly affect tropical forests. |
| l. FAA Sec. 118(c)(14). Will assistance be used for (a) the procurement or use of logging equipment, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner and that the proposed activity will produce positive economic benefits and sustainable forest management systems; or (b) actions which significantly degrade national parks or similar protected areas which contain tropical forests, or introduce exotic plants or animals into such areas? | (a) No.<br><br>(b) No. |
| m. FAA Sec. 118(c)(15). Will assistance be used for (a) activities which would result in the conversion of forest lands to the rearing of livestock; (b) the construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands; (c) the colonization of forest lands; or (d) the construction of dams or other water | (a) No.<br><br>(b) Some of the road to be maintained may pass through such lands.<br><br>(c) No.<br><br>(d) No. |

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| control structures which flood relatively undegraded forest lands, unless with respect to each such activity an environmental assessment indicates that the activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development? | Note: to date project designers visiting districts to be supported have not found undegraded forest. If such areas are found, the Mission will review the situation with the GOI and make a formal environmental determination as to what activities, if any, are permissible. |
| 2. Development Assistance Project Criteria (Loans Only) | |
| a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan at a reasonable rate of interest. | Indonesia has an unblemished record of loan repayments. |
| b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20 percent of the enterprise's annual production during the life of the loan, or has the requirement to enter into such an agreement been waived by the President because of a national security interest? | N/A. |
| c. FY 1987 Continuing Resolution. If for a loan to a private sector institution from funds made available to carry out the provisions of FAA Sections 103 through 106, will loan be provided, to the maximum extent practicable, at or near the prevailing interest rate paid on Treasury obligations of similar maturity at the time of obligating such funds? | N/A. |
| d. FAA Sec. 122(b). Does the activity give reasonable promise of assisting long-range plans and programs designed to develop economic resources and increase productive capacities? | Yes. |

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3. Economic Support Fund Project Criteria

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| a. | FAA Sec. 531(a). Will this assistan promote economic and political stability? To the maximum extent feasible, is this assistance consistent with the policy directions, purposes, and programs of Part I of the FAA? | Not ESF funded.<br>N/A. |
| b. | FAA Sec. 531(e). Will this assistance be used for military or paramilitary purposes? | N/A. |
| c. | ISDCA of 1985 Sec. 207. Will ESF funds be used to finance the construction, operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such country is a party to the Treaty on the Non-Proliferation of Nuclear Weapons or the Treaty for the Prohibition of Nuclear Weapons in Latin America (the "Treaty of Tlatelolco"), cooperates fully with the IAEA, and pursues nonproliferation policies consistent with those of the United States? | N/A. |
| d. | FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made? | N/A. |

## 5C(3) - STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

### A. PROCUREMENT

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|---|---|
| 1. FAA Sec. 602(a). Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed? | Yes. |
| 2. FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him? | Yes. |
| 3. FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company? | Indonesia does not so discriminate against U.S. marine insurers. |
| 4. FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If non-U.S. procurement of agricultural commodity or product thereof is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.) | N/A. |
| 5. FAA Sec. 604(g). Will construction or engineering services be procured from firms of advanced developing countries which are otherwise eligible under Code 941 and which have attained a competitive capability in international markets in one of these areas? (Exception for those | N/A. |

countries which receive direct economic assistance under the FAA and permit United States firms to compete for construction or engineering services financed from assistance programs of these countries.)

6. FAA Sec. 603. Is the shipping excluded from compliance with the requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 percent of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent such vessels are available at fair and reasonable rates?

No. Section 901(b) applies.

7. FAA Sec. 621(a). If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? will the facilities and resources of other Federal agencies be utilized, when they are particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

Yes.

8. International Air Transportation Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U.S. carriers be used to the extent such service is available?

Yes.

9. FY 1987 Continuing Resolution Sec. 504. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States?

All AID direct contracts will so provide.

10. FY 1987 Continuing Resolution Sec. 524. If assistance is for consulting service through procurement contract pursuant to 5 U.S.C. 3109, are contract expenditures a matter of public record and available for public inspection (unless otherwise provided by law or Executive order)?

Yes. Any such expenditures will be so available.

B. CONSTRUCTION

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| 1. FAA Sec. 601(d). If capital (e.g., construction) project, will U.S. engineering and professional services be used? | U.S. A&E services will be utilized to the maximum practicable extent. Construction will be under GOI FAR. |
| 2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? | Yes. Under GOI FAR procedures. |
| 3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million (except for productive enterprises in Egypt that were described in the CP), or does assistance have the express approval of Congress? | N/A. |

C. OTHER RESTRICTIONS

| | |
|---|---|
| 1. FAA Sec. 122(b). If development loan repayable in dollars, is interest rate at least 2 percent per annum during a grace period which is not to exceed ten years, and at least 3 percent per annum thereafter? | Yes |
| 2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? | N/A |
| 3. FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries? | Yes |

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**Will arrangements preclude use of financing:**

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| a. | FAA Sec. 104(f); FY 1987 Continuing Resolution Secs. 525, 540. (1) To pay for performance of abortions as a method of family planning or to motivate or coerce persons to practice abortions; (2) to pay for performance of involuntary sterilization as method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization; (3) to pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning; or (4) to lobby for abortion? | (1) Yes.<br>(2) Yes<br>(3) Yes. |
| b. | FAA Sec. 483. To make reimburse-bursements, in the form of cash payments, to persons whose illicit drug crops are eradicated? | Yes. |
| c. | FAA Sec. 620(g). To compensate owners for expropriated or nationalized property, except to compensate foreign nationals in accordance with a land reform program certified by the President? | Yes. |
| d. | FAA Sec. 660. To provide training, advice, or any financial support for police, prisons, or other law enforcement forces, except for narcotics programs? | Yes. |
| e. | FAA Sec. 662. For CIA activities? | Yes. |
| f. | FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained? | Yes. A world-wide light weight vehicle waiver applies. |
| g. | FY 1987 Continuing Resolution Sec. 503. To pay pensions, annuities, retirement pay, or adjusted service compensation for military personnel? | Yes. |

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| h. | FY 1987 Continuing Resolution Sec. 505. To pay U.N. assessments, arrearages or dues? | Yes. |
| i. | FY 1987 Continuing Resolution Sec. 506. To carry out provisions of FAA section 209(d) (transfer of FAA funds to multilateral organizations for lending)? | Yes. |
| j. | FY 1987 Continuing Resolution Sec. 510. To finance the export of nuclear equipment, fuel, or technology? | |
| k. | FY 1987 Continuing Resolution Sec. 511. For the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights? | Yes. |
| l. | FY 1986 Continuing Resolution Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress? | Yes. |

# ANNEX C

# LOGICAL FRAMEWORK

## RURAL ROADS MAINTENANCE SYSTEMS PROJECT

### LOGICAL FRAMEWORK

| | NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | IMPORTANT ASSUMPTIONS | MEANS OF VERIFICATION |
|---|---|---|---|---|
| GOAL | To increase growth in agriculture, rural industry and trade | Reduction in transport costs<br>Increased trade in agricultural commodities<br>Growth of non-agricultural enterprise and trade | Transportation and marketing competitive<br>Market conditions favorable<br>Agricultural inputs available<br>Agro-climatic conditions favorable | |
| PURPOSE | To establish effective and sustainable systems for district road maintenance and management | Identification of and agreement on core characteristics of district road maintenance and management systems<br>Adoption of elements or entire project systems for use in non-project districts | Sufficient GOI budgets and/or systems optimize any level of budget resources<br>Core characteristics of maintenance and management systems appropriate to diverse conditions of Indonesia | Ministry of Home Affairs and Sub-Directorate of Local Roads (policy guidance)<br>DPUP and DPUK interviews (spontaneous) |
| OUTPUTS | Systems established in 11 districts to prioritize economic return in the budgeting of road funds | All maintainable roads (at least 1600 km.) maintained on a continuous basis by PACD<br>Maintenance implemented according to condition of road features and cost-effectiveness of maintenance task<br>Network management models incorporating VIN developed and applied in budgeting decisions<br>Core of high volume roads in each district (1600 km. overall) rehabilitated to maintainable standard<br>Design standards for rehabilitation applied in accordance with traffic volume | | Annual maintenance plans<br>Annual rehabilitation plans<br>Certification-for-payment records<br>Maintenance management records |
| | Procedures and skills established in 11 districts for effective implementation of road work | Monitoring of road feature condition and traffic volume performed on a routine basis<br>Maintenance management system utilized in planning budgeting and controlling work<br>Alternate means to conduct maintenance (force acct., roadman, contractor, community self-help) tested and applied<br>Simplified IRR link selection methodology adapted/utilized by DPUK staff | Sufficient roads meet selection criteria<br><br>Policy changes accepted and implemented by key agencies | DPUK periodic condition/traffic surveys<br>Annual maintenance plans<br><br>Special studies reports, MMS reports<br>Annual rehabilitation plans |

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| | NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | IMPORTANT ASSUMPTIONS | MEANS OF VERIFICATION |
|---|---|---|---|---|
| OUTPUTS (Cont'd) | | Alternate methods to control contractor performance tested and applied (contract formats, field supervision regimes, etc.)<br>Equipment management system utilized for management decisions<br>Materials testing performed routinely and utilized to control contract and force account work | Adequate staff available and able to receive training<br><br>Personnel management by objectives socially acceptable | Special studies reports, contracts, field records<br>Workshop records<br><br>Materials unit records |
| | Organizational structure, and institutional and individual incentives in place in 11 districts for effective implementation of road work | District organizational identity established for maintenance and workshops<br>Critical staff positions identified and filled by permanent employees<br>Defined work tasks and procedures for key DPUK organizational units and job descriptions for key positions<br>Standards of performance established for maintenance and equipment management and used in planning and controlling staff and equipment time and performance<br>DPUP providing active field support and guidance to DPUK staff | | District records (Susunan Organisasi), consultant interviews<br>District records<br>District records (Susunan Organisasi), annual work plans<br>Maintenance management and equipment management records<br>consultant interviews<br>DPUK and DPUP interviews |
| | Systems to generate additional road funds in accordance with network need | Central gov't grants for district maintenance increased over projected levels of 25% earmark of Inpres District<br>Local revenue sharing or generation providing growing share of district maintenance funds | | Annual Inpres budgets<br>APBD I and II budgets<br>Special studies reports, DPUK and consultant interviews |
| INPUTS | AID ($.000)<br>Road rehabilitation 25.6 m<br>Road maintenance 0<br>Equipment 6.90m<br>Equipment maintenance 0<br>Workshops 0.45m<br>Training 2.10m<br>Special studies 1.5 m<br>Planning & Monitoring 0.25m<br>Technical assistance 13.8 m<br>Evaluation/audit 0.3 m<br>Contingency/ Inflation 4.1 m<br>35.0 m | | Appropriate TA available<br>Appropriate equipment available<br>GOI counterpart budgets available | Project financial reports<br>Field inspections<br>Consultant reports<br>Evaluation |

ANNEX D

PID APPROVAL REQUEST

BEST AVAILABLE DOCUMENT

STATE (1986) 003508 & Mission Response
January 7, 1986
Indonesia - District Roads Maintenance Systems (497-0353) PID ANPAC Review

*1. The Asia and Near East Bureau Project Advisory Committee (ANPAC) reviewed the subject PID on December 23, 1985. ANPAC approved the PID, and Mission is authorized to proceed with the preparation of the Project Paper (PP) for AID/W review in FY 86. Mission is commended for a well-prepared PID. The following guidance is provided for PP development.*

*2. The Infrastructure Component: This component of the project appears relatively high. PP analysis should demonstrate that there is a reasonable balance between project funds going for infrastructure (restoration, maintenance) and those going to technical assistance and training. Additionally, PP should demonstrate that, within funds allocated for infrastructure, a reasonable balance is struck between portions going for restoration (i.e. rebuilding a road to its original standard) and those going for lower order types of maintenance (routine and periodic). Road betterment, i.e. improving a road above its original design standard) should be outside the scope of our project and should be left to the GOI. Our concern is that this project remain a maintenance systems project and not a road construction project.*

The magnitude of the infrastructure component (road rehabilitation and maintenance) has been reduced to $38.5 million ($25.6 AID, $12.9 GOI) from the PID estimate of $54.5 million. This reflects a reduction in the number of districts to be included in the project and, as discussed in the Financial Analysis, a reduction of the scope of rehabilitation work per district in line with the GOI's ability to finance recurrent costs. The balance between road rehabilitation and road maintenance has been carefully calculated and is documented in the Technical Analysis.

While infrastructure costs have been reduced, the budget for technical assistance and training has increased from $9.5 million to $15.9 million and a new component, Special Studies, has been added. The Mission believes that the allocation of funds between these components and infrastructure financing represents the appropriate balance to achieve the project purpose.

The approach to road betterment is to finance the rehabilitation of economically viable roads to maintainable condition within the standards established for district roads (Figure 1, Technical Analysis). While no new roads will be built and alignment changes will not be made unless minor change are necessary for environmental protection, surfaces may change, e.g., from earth to gravel, if traffic levels exceed the tolerances of the present surface. This is consistent with the ANPAC concern that the project remain a maintenance project (maintainability as the key to determining standards). It may conflict, however, with the ANPAC statement that improving a road above its original design standard should be outside the scope of the project and left to the GOI. There are several reasons for the Mission's position.

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First, the standards accepted for the project are new and have not been used by the districts before. Existing roads were not originally built to a consistent set of standards and whatever standards may have been applied to them most, if not all, would not pass a 611(a) review. Most important from the viewpoint of maintenance, traffic stress has not hitherto been an explicit consideration when districts have chosen the type of road to build or the level of rehabilitation to undertake. Thus, restoring a road to its original standard would rarely, if ever, be consistent with the objective of maintainability.

Second, the chronic problem with district road rehabilitation is under-building rather than over-building. This stems from a desire to spread limited road funds as widely as possible. Without project intervention, this will continue and will perpetuate the cycle in which frequent rehabilitation of unmaintainable roads diverts resources from maintenance. The danger is not that the GOI will exert pressure to upgrade roads needlessly but that roads which require upgrading will be left in their unmaintainable state.

Third, excluding AID from participation in upgrading as a part of rehabilitation would undermine the objective of establishing consistent decision-making systems at the district level which are based on sound engineering and economic considerations. The RRMS project seeks to demonstrate the value of such systems. Excluding a significant category of work from AID support, even when economic and engineering criteria indicate the work should be done, gives inconsistent signals from AID to the districts and the GOI.

Fourth, assigning sole financial responsibility for upgrading to the GOI would complicate project administration, adding to the USAID management burden. Given the ambiguities introduced by the difference between project standards and the standards of existing roads, distinguishing between "restoration to original standards" and "upgrading" would be difficult at best and a source of conflict through the life of the project.

Finally, if upgrading is defined as a change in surface, the amount anticipated is relatively small. Work program calculations in Annex G estimate that there will be surface changes for about 314 km out of the total 1600 km rehabilitation program.

*3. Replicability: The project as outlined in the PID raises serious questions regarding replicability, particularly since such huge amounts of money are required to restore district road networks. PP should include a thorough analysis demonstrating that the project as conceived will be replicable using GOI resources (particularly in view of the GOI budget crunch expected as a result of falling oil prices) and a reasonable level of donor participation over a reasonable period of time. Analysis should also create a sense of confidence that, of all available options for the development of a maintenance system, this is the most reasonable way to go in Indonesia at the district level.*

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The issue of replicability is complex. Key elements of the required analysis, such as how to approach road links which are not economically viable, will be addressed under the project's Special Studies program and are not known now. Several points are clear, however. First, although GOI budgets for district roads are being sustained despite the budget crunch, it is unlikely that any district outside of Java or Bali can overcome its district road problem without a major one-time infusion of donor funds and without the introduction of measures to capture a share of the growth these funds generate for reinvestment in the networks. Donor funds are likely to be available. The difficulty, and a target of the RRMS project, will be establishing mechanisms to mobilize revenues for follow-on maintenance and, in the longer-term, follow-on rehabilitation.

Second, of the total $77.85 million cost of the RRMS project, Special Studies costs ($1.5 million) and about half of the TA costs ($7.0 million) represent one-time outlays which would not be repeated under replication efforts. Although the costs of replication will vary tremendously from district to district depending on the districts' length of road, present road condition, and the level of road use (traffic), the balance of the project budget, about $6.3 million per district, can be taken as a very rough guide to the cost of replication and is consistent with the level of funds being provided to districts under other donor district road projects. The more important consideration is sustainability once a donor has left (discussed below).

Third, the approach to road maintenance and management is to establish systems to prioritize the allocation of resources for roads (maintenance versus rehabilitation versus new construction, ditch cleaning versus regravelling versus vegetation control, etc.) and to introduce procedures and skills for effective management of those resources. Like the Pavement Management System now being applied by the GOI on national and province networks, and similar systems in other countries, this permits optimization of expenditures for any budget level. From this perspective, replicability becomes an issue only if the level of resources available is so inadequate that it undermines reliance on these approaches.

Finally, with regard to whether the RRMS approach to developing a maintenance system is the most reasonable way to go at the district level, it should be stressed that there is no pre-defined package to introduce. Force account, contractors, roadmen and community self-help approaches will be tested. Equipment requirements, though based on experience with maintenance in Indonesia and in other countries, may be modified as the project proceeds, particularly in light of anticipated ILO testing of labor-based equipment in other parts of Indonesia. The only fixed element of the maintenance programs will be the use of a Maintenance Management System, an administrative tool to prioritize maintenance tasks and to control implementation in the field regardless of the mode of implementation used.

*4. Geographic Focus: ANPAC recommended that Mission examine appropriate project geographic focus. Although ANPAC is cognizant of Mission arguments in favor of concentration (e.g. management reasons, enough intensity to measure impact at provincial level) the need to test replicability may require wider geographic coverage. Major concern is that the funding requirements per district appear extremely high. Implications for replication should dictate the number of provinces and districts per province that project will cover, and the level of funding per district should determine ultimate project size.*

The PID plan to locate the project in two provinces has not been changed although the number of districts has been reduced from 16 to 11. Given Mission staff resources for project management and the focus of the project on developing a role for provincial governments to support the work of district public works offices, two is the maximum number of provinces that can be managed.

The two provinces are representative of the wide variety of conditions in the Outer Islands. South Sulawesi's geography, climate and level of development is roughly analogous to most of Sumatra and to the other three provinces in Sulawesi itself. NTT, considerably poorer and less densely populated, is representative of conditions in NTB and the Moluccas although NTT and NTB are unique in the dryness of their climate with attendant implications for roads.

The Mission believes that NTT and South Sulawesi provide a manageable range of environments for ultimate replicability to other parts of the Outer Islands. Financial replicability and sustainability are discussed above and below, respectively.

*5. Sustainability of Maintenance System: PP analyses should demonstrate that the proposed approach is a feasible one in financial and technical terms, and that the resulting system would be sustainable on a long-term basis with GOI resources at the district level. To that end, PP analyses should include (a) GOI agreement on gradual budget modifications that will result in more funding for maintenance and the timeframe for these modifications within the life of the project; (b) the final funding level likely to be available in the GOI's budget once these modifications are in place by the end of the project; and (c) that these budget resources are reasonably adequate to sustain the proposed maintenance system at the district level.*

Financial sustainability is addressed in detail in Annex I (Financial Analysis) with conclusions summarized in Section 6 of that Annex. Briefly, funds for district road maintenance nationwide are about 70% of the levels required but because these funds are skewed to Java and Bali, the Outer Islands face a particular shortage. Until improved maintenance practices are in place, however, even existing funds cannot be used effectively. As roads are rehabilitated to maintainable standards and the effectiveness of maintenance practices increases, the need for additional maintenance funds will increase.

The strategy to address the funding problem has several elements. First, the project will draw on existing maintenance funds until mechanisms are in place to effectively use additional allocations (expected to be IFY 1989/90). Second, the maintenance requirements of the RRMS project districts during the life of the project will be met by a special allocation by the GOI of Inpres Roads ($3.0 million) to top off the allocations from Inpres District which the project districts already receive (projected to be $3.5 million over the life of the project). The Inpres Roads funds will be provided in increasing amounts beginning in IFY 1989/90. Third, USAID will work with the GOI and other donors to develop an interim strategy, by the end of 1987, to finance district road maintenance nationwide. It is anticipated the strategy will increase the total amount of funds for maintenance and redress the imbalance of maintenance funds between Java/Bali and the Outer Islands. AID funds for road rehabilitation will not be committed until an acceptable strategy has been adopted. Finally, the Special Studies component of the project will assess the potential to transfer responsibility for financing maintenance to local governments. Pilot revenue mobilization or revenue sharing efforts for local government will be initiated in selected districts prior to beginning Phase II of the RRMS project.

*6. Integration with Food for Work (FFW) Programs and Community Involvement: Mission should explore the possibility of integrating some aspects of the project with an FFW program. Such integration would be particularly appropriate if communities are to be involved in district roads maintenance. Although PID is silent on community involvement, many successful road maintenance programs all over the world are based on such involvement and Mission is encouraged to explore this approach and treat it in the PP.*

The project will begin maintenance programs by using force account (government) crews to assure that district public works staff learn maintenance administration and work methods before non-force account approaches are tried. The Special Studies program will review the scattered experience with other approaches in Indonesia: contractors for selected maintenance tasks, the roadman system (assigning local citizens selected tasks on selected stretches of road), and community initiative (including a reported success with the latter in one project district in NTT). Both the roadman system and community initiative can incorporate varying degrees of community involvement. Although the self-help ethic (gotong royong) is not as strong in the Outer Islands as it is on Java, the potential that these approaches offer to reduce the financial burden of maintenance is attractive to the GOI. Trials of alternative approaches will begin prior to Phase II of the project.

Community involvement may be a significant factor in long-term solutions for the very low-volume roads which do not, on economic grounds, justify either conventional rehabilitation or conventional maintenance. Determining what to do with these roads is another task of the Special Studies program. Many of these roads were created by the labor-intensive (Padat Karya) program of the Ministry of Manpower. They are below district standard but are incorporated into district networks.

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Padat Karya regulations prevent the program from treating the same road more than once. Allowing Padat Karya forces to return periodically to Padat Karya roads would have significant employment benefits, would reduce the maintenance burden of the district public works office, and would involve significant levels of community participation.

Food For Work is not a part of the project. To the extent that FFW would depend on donor food contributions, it cannot be considered a sustainable element of a sustainable road maintenance and management plan. The Mission has taken the position that sustainability also requires that maintenance be totally GOI-supported. Food contributions would work against this goal. Finally, the administrative burden to district public works offices of managing grain stocks would be considerable. The burden to USAID to assure proper handling and accountability would further complicate an already management-intensive project. The Mission has nonetheless encouraged Catholic Relief Services to consider a Title II road maintenance effort on the island of Flores in NTT. This is close to RRMS project districts in NTT and if undertaken will be monitored for lessons applicable to RRMS.

*7. Environmental Assessment: It is doubtful that project would require an environmental assessment under AID guidelines, as proposed in the PID. Instead, PP should build into project design environmental criteria and protection measures as appropriate; such criteria and measures to become an integral part of the maintenance system to be implemented on a continuous basis by the implementing institutions. ANE/PD/ENV has pouched to Mission Environmental Officer (Des O'Riordan), a memo in this regard, and will provide TDY assistance in March-April as tentatively planned.*

See Annex L and Summary of Environmental Analysis in Section 4.6 of Project Paper.

*8. Section 611 Concerns: It was noted that the requirements of section 611 of the FAA (that there be adequate plans and estimates) may be met through establishing purpose as institutional and meeting 611 on a subproject basis. PP should outline how the requirements of this section are to be met.*

See Section 4.1.8 of Project Paper for 611(a) and Annex F for 611(e). All the requirements of the statutes will have been met in the project design, upon the Assistant Administrator's taking into consideration the Director's 611(e) certification.

*9. Donor Coordination: The PP should describe activities of other donors in the road sector in Indonesia, particularly maintenance at all levels (national, provincial, and district). Of particular interest are donor-planned activities during the life of the project and beyond, the extent of other donor involvement in maintenance, and how such projected involvement will affect the replicability of the project.*

The activities of other donors are summarized in Section 1.1.4 of the Project Paper. As discussed in Sections 1.1.4., 1.2.2, and 1.2.5, the initiation of Phase II of the RRMS project is timed to coincide with the beginning of a third generation of much larger district road projects financed by the World Bank, Asian Development Bank, and the OECF. Resolution of Phase I issues under the RRMS project will provide answers for chronic problems encountered in the projects of other donors. An informal dialogue has already been established between USAID and these larger donors. The RRMS Special Studies program will be the primary vehicle for continuing the dialogue. Other donors' experience will be reviewed as appropriate under each Study and the participation of other donor representatives in the annual review of Special Study findings by the GOI's Highway Steering Committee will be encouraged.

*10. Implementing Agency: The PID implies that the institutional arrangements for the project have not yet been sorted out, and that there is a likelihood that two ministries, public works and local government, will be equally involved. PP should include a detailed institutional analysis which outlines the capabilities and roles of all organizations to take part in the project at all levels and how these organizations and their respective divisions will relate to each other. The technical assistance package for the project should address any deficiencies in the skills or capabilities of these organizations, particularly at the district level.*

A reform of GOI arrangements for administering district road programs nationwide was effected in late May, 1987. A detailed analysis of the underlying institutional strengths and weaknesses is provided in Annex J and is summarized in Section 4.4 of the body of the Project Paper. Administrative arrangements for implementation of the RRMS project, reflecting the May reform, are described in Annex K and summarized in Section 4.5 of the Project Paper. The configuration of the large TA component (see Annex O for draft scopes of work) is designed to target the primary weaknesses of the institutions concerned.

*11. Selection Criteria and Economic Analysis: PP should include the details of the selection criteria to be used for setting priorities among road segments to be restored and maintained under the project. The different elements of the criteria should be described and the method for their aggregation and quantification should be outlined. A key criterion should be the projected economic return of each segment to be restored/maintained, but criteria may also include technical, social, community involvement, accessibility, and other elements. In addition, the economic analysis of the project should include illustrative economic analyses of typical candidate road segments using with/without approach. Such illustrative examples are not intended to replace the overall economic analysis of the project, which should demonstrate that the intended investment will yield economic returns competitive with other investments.*

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See Annex H and Section 4.2 of the Project Paper. Note that a concern for financial sustainability has meant that the selection criteria for roads to be rehabilitated with AID funds are extremely rigorous and do not incorporate proxy measurements of producer surplus or broader social concerns for road access.

*12. Private Sector Involvement: The project appears an ideal vehicle for private sector involvement in the rural areas of Indonesia, particularly for small construction firms to undertake road restoration. PP should include a thorough discussion of the potential for private sector involvement, what the constraints are for not utilizing such potential, and what could reasonably be done under the project to relieve these constraints. PP should also explore possibilities for training and for providing assistance for private sector firms in order to improve their capability, taking into consideration lessons learned from private sector involvement in road construction and maintenance schemes in Indonesia in the past.*

The performance of private contractors under other donor district road projects in Indonesia has been inferior to that of force account crews. The reasons, discussed in more detail in Sections 4.2 and 4.3 of Annex G, include poor supervision, contracts and payment procedures that do not adequately hold the contractor to design specifications, and a system of restricting district road contract awards to the smallest of contractors who lack the equipment and skills to perform to standard. The potential for improvement is considerable but lies more in establishing an administrative framework with adequate incentives for performance than it does in providing training to contractor staff. Other donors have supported contractor training projects in Indonesia with indifferent results. RRMS will not attempt to train contractors.

The RRMS approach will be to tender almost all rehabilitation work financed by the project and increasing amounts of selected maintenance tasks to private contractors. To assure performance, different contract formats and payment schedules will be used than are normally used for district road work. Project consultants will pay special attention to developing supervision procedures and providing on-the-job training in supervision techniques to district counterparts. Eligible contractors will be limited to larger firms registered in the provinces. For the longer-term, the Special Studies program will look in detail at similar improvements for the permanent system of contracting used for district roads.

*13. Project Budget: The budgetary implication of the [illegible] resolution and the Gramm-Rudman bill are unclear at this point, except that it appears that all funding levels in all accounts will be reduced and that country levels may be reduced by 10 percent or more. The impact on Indonesia levels will become more clear in the next few weeks. The impact on this project (its authorized funding level and periodic obligations) should be addressed in the PP, particularly within the context of the demands of other USAID projects and the projected heavy obligations in FY's 86, 87, and 88.*

The $55 million RRMS project spans 6 years, averaging less than $7 million per year. With an OYB of $40 to $45 million over the upcoming CDSS period, the Mission does not anticipate any problems in funding this activity. With the exception of the Agricultural and Rural Sector Support Program, there are no other new ARDN activities scheduled for FY 87 or FY 88, since the majority of the ARD portfolio is established and being implemented. While it does add to the Mission's mortgage, this same mortgage allows the Mission some flexibility and timing to consider other directions which the portfolio might take as a result of the new CDSS and to plan these activities in a rational manner without being driven by obligation worries.

# ANNEX E

## GOI REQUEST FOR ASSISTANCE

REPUBLIC OF INDONESIA
NATIONAL DEVELOPMENT PLANNING AGENCY
JAKARTA, INDONESIA

No. : 2004/K/6/1987.

Jakarta, June 10, 1987

Mr. William P. Fuller
Director
USAID Mission
c/o American Embassy
Jakarta

Re : Rural Roads Maintenance Systems Project

Dear Mr. Fuller,

Having discussed the Rural Roads Maintenance Systems Project with the Ministry of Home Affairs and the Ministry of Public Works, we herewith request a loan of up to 38.3 million United States Dollars (US$ 38.3 million) and a grant of up to 16.7 million United States Dollar (US$ 16.7 million). The Government of Indonesia will provide the Rupiah equivalent of US$ 18.75 million in cash and US$ 4.1 million in kind to support this project over its eight-year life.

The purposes of the project are as follows :

A. To establish effective and sustainable systems of road maintenance and management at the district level.

B. To improve systems for District Public Works Offices to determine work priorities for road rehabilitation and maintenance.

C. To develop systems for District government to balance road budget resources with road network needs.

D. To strengthen procedures and staff skills for District Public Works Offices to implement road work effectively.

E. To improve District Public Works organization and organizational incentives for implementing road work effectively.

We are pleased, in addition, to offer assurances to USAID on several aspects of the project which have been discussed over the past few months. First, as part of the Government of Indonesia's contribution, we will provide the US$ 6.5 million required over the life of the project to maintain the roads rehabilitated with project funds. Second, we agree with the principle that the maintenance of district roads should ultimately be the financial responsibility of

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local government. We support the proposal to develop local revenue pilot efforts for maintenance and will facilitate the development of such pilot experiments once the Rural Roads Maintenance Systems Project begins. Finally, we confirm our intention to develop a maintenance strategy by the end of 1987.

The project will be implemented by the Ministry of Home Affairs.

We look forward to your favourable consideration.

Sincerely yours,

J.B. Sumarlin
Minister of National Development Planning
Chairman of Bappenas

ANNEX F

SECTION 611(E) CERTIFICATION

## Section 611(e) Certification
## Rural Roads Maintenance Systems Project

The project will loan finance twenty-five (25) million and six (6) hundred thousand dollars representing approximately eighty (80) percent of the cost of rehabilitating 1600 kilometers of district roads in eleven pilot districts; ninety (90) percent of the cost of upgrading nine existing workshops and the design and construction of two new workshops ($0.45 million); and seventy-two (72) percent of the cost of new road rehabilitation and maintenance equipment ($6.9 million). The project will also grant finance technical assistance, training, and special studies. The purpose of the project is to assist the GOI to develop effective, sustainable systems of road maintenance and management at the district level.

I, William P. Fuller, Principal Officer of the Agency for International Development in Indonesia, do hereby certify that in my judgment the Government of Indonesia has the financial capacity and the resources to carry out, maintain and utilize this project effectively. This judgment is based upon the analyses contained in the Project Paper, as well as upon the successful maintenance and utilization of projects in Indonesia previously financed or assisted by the United States.

William P. Fuller
Director
USAID/Indonesia

# ANNEX G

# TECHNICAL ANALYSIS

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# 1. INTRODUCTION

## 1.1 NATURE OF INDONESIA'S ROAD NETWORK

Over 200,000 kilometers of roads are registered with the Bureau of Statistics (BPS) in Indonesia. Table 1 shows the distribution of these roads between the government authorities responsible for road administration. Annex M reviews the growth of the networks and government policy towards their further development.

TABLE 1

THE ROAD NETWORK

| | Length (km) | Share of Total |
|---|---|---|
| National Roads | 12,986 | 6% |
| Provincial Roads | 39,207 | 18% |
| District Roads | 141,600 | 65% |
| Other | | |
| - Municipal | 10,800 | 5% |
| - Transmigration | 9,200 | 4% |
| - Nucleus Estates | 3,800 | 2% |
| Total | 217,593 | 100% |

Source: Amphico Consortium, Indonesia, in association with Hoff & Overgaard A/S Denmark, Project Preparation Document for IBRD Rural Roads Development Project, Phase II, September 1986.

District roads comprise 141,600 kilometers, or about 70%, of the total network but are the least well defined. The Ministry of Public Works' Sub-Directorate of Rural Roads (SDRR), for example, in contrast to BPS, recorded a total of only 106,000 km of district roads at the end of 1985. The difference may be partly explained by BPS' inclusion of town roads and some earth links not yet registered with SDRR.

Other difficulties in defining the district network stem from inconsistent application of condition ratings and very broad definitions of surface type. Although every district records its road inventory by numbered link and surface type, and rates the condition of each link, definitions of surface type are too broad for many management purposes (Telford and engineered gravel, for example, are both classified as gravel roads). Although standard condition rating categories exist, their application is subjective, not uniform among districts, and is made across entire links rather than to individual features or segments of features. Comparison of road condition among districts and generalizations across districts are therefore difficult.

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Several broad generalizations can be made, however. First, the condition of district roads is poor. The SDRR carried out a partial inventory of 67,000 km in 1979/80 using uniform definitions of condition and found out that 60% were damaged or heavily damaged. By 1983, comparable findings on 82,000 km found that 63% fell into these categories.

Second, as shown in Table 2, there are dramatic differences between the networks of district roads on the Inner Islands of Java and Bali and those on the Outer Islands. The differences are due largely to the relatively early economic development and high population density of the Inner Islands. Most of Java's network was developed before Independence at a time when macadam building techniques were popular. The Inner Island district network is therefore dense (269 km per thousand square kilometers of land) and over half of it is paved, largely with macadam. Outer Island district roads developed much later and, without the Inner Islands' abundant labor, have not applied labor-intensive macadam techniques widely. The Outer Island network is therefore sparse (39 km per thousand square kilometers of land) and only 13% is paved, with over half of the total comprised of earth roads. Due to the relative density of population on the Inner Islands, however, there are an average of over 2,700 people per km of district road on Java/Bali, but only 885 in the Outer Islands.

TABLE 2

SUMMARY OF DISTRICT ROAD NETWORK LENGTH BY TYPE AND REGION (SDRR DATA), 1985

| | Java/ Bali | Outer Islands | Indonesia | USAID Provinces (NTT & South Sulawesi) |
|---|---|---|---|---|
| Total ('000 km) | 37.0 | 69.8 | 106.8 | 14.8 |
| Population (million) | 103.2 | 61.9 | 165.2 | 9.6 |
| Land Area ('000 sq.km) | 138 | 1,782 | 1,919 | 120 |
| Proportion by surface type | | | | |
| - Asphalt (%) | 51.6 | 13.1 | 26.5 | 6.6 |
| - Gravel (%) | 25.6 | 33.1 | 30.5 | 37.8 |
| - Earth (%) | 22.3 | 53.8 | 45.7 | 55.6 |
| Kilometers/'000 people | | | | |
| - Total road | 0.3[illegible] | 1.13 | 0.65 | 1.54 |
| - Sealed road | 0.19 | 1.48 | 0.17 | 0.10 |
| Kilometers/'000 sq.km | | | | |
| - Total road | 269 | 39 | 56 | 123 |
| - Sealed road | 139 | 5 | 15 | 8 |

* Includes registered district roads only, but population figures include major cities, transmigrants, etc.

Source: Sub-Directorate of Rural Roads, 1985, as cited in Amphico Consortium, Indonesia, in association with Hoff & Overgaard A/S Denmark. Project Preparation Document for IBRD Rural Roads Development Project, Phase II, September 1986.

The two provinces assisted by the RRMS project include about 15% of Indonesia's total length of district roads. As in the rest of the Outer Islands, earth and gravel are the dominant surface types.

## 1.2 CLASSIFICATION AND ASSESSMENT OF THE EXISTING NETWORK FOR MAINTENANCE PURPOSES

All district roads are classified by the GOI according to three different systems: 1) Primary (rural) or Secondary (urban); 2) Function and 3) Administrative or Political. The function classification separates roads into arterial, collector or feeder categories. (Most district roads are feeders or collectors.) The administrative or political classification designates roads as either national, provincial or district. This classification is primarily used to designate responsibility for construction and maintenance. The political classification is the more important for the RRMS Project; only district roads are involved.

The district roads for the 11 project districts total more than 7,400 km (see Table 3). Detailed data on bridges are available in only a few districts, but district officials estimate that there are as many as 5 km per bridge for all roads.

Four condition categories are used: good, fair, damaged, and heavily damaged. Although definitions of these conditions exist, they are difficult to apply and are inconsistently applied among districts. Visual inspection by consultants indicates the actual condition is generally lower than the reported condition.

TABLE 3

BREAKDOWN OF ROAD NETWORKS

| South Sulawesi | | NTT* | | | |
|---|---|---|---|---|---|
| District | District Roads (km) | District | District Roads (km) | Nat/Prov. Roads (km) | Total (km) |
| Pinrang | 389 | Kupang | 756 | 374 | 1130 |
| Sidrap | 638 | T.T.S. | 1430 | 162 | 1592 |
| Sinjai | 348 | Belu | 494 | 177 | 671 |
| Bone | 1099 | T.T.U. | 666 | 161 | 827 |
| Bulukumba | 786 | | | | |
| Jeneponto | 594 | | | | |
| Takalar | 214 | | | | |
| Total | 4068 | Total | 3346 | 874 | 4220 |

* Additional information on national/provincial road network kilometers is provided for NTT because road construction and maintenance units there (DPUP Cabang Dinas) execute work on national and provincial as well as on district networks.

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According to the project districts' own surveys, the overall condition of their networks is poor (see Table 4). Only 574 km (8%) are reported to be in good condition and 3149 km (43%) are listed as being in moderate condition. NTT project districts report almost 600 km more roads in moderate condition than South Sulawesi although field observations indicate the reverse is more likely. Consultants' field visits indicate that many of the road links in so-called moderate condition are passable, but at speeds well below the normal design speed for the type of terrain. Until detailed condition surveys are carried out, it is difficult to determine whether links reported to be in moderate condition require rehabilitation for the full length of the link or simply scattered portions.

TABLE 4

SUMMARY OF REPORTED CONDITIONS IN PROJECT DISTRICTS (KM)

| Province | Good | Moderate | Damaged | Heavily Damaged | Total |
|---|---|---|---|---|---|
| S Sulawesi | 495<br>12% | 1285<br>32% | 1454<br>36% | 834<br>20% | 4068 |
| NTT | 79<br>2% | 1864<br>56% | 503<br>15% | 900<br>27% | 3346 |
| Totals | 574<br>8% | 3149<br>42% | 1957<br>26% | 1734<br>24% | 7414 |

Damaged and heavily damaged roads represent 50% of the total network (3691 km) and can be assumed to be in need of rehabilitation, if it is economically justified.

Table 5 summarizes the classification of project district roads by type of construction. The categories of asphalt, gravel and earth are the terms typically used by districts to inventory their road networks. An asphalt road can be either paved or sealed; a gravel road can be well-graded crushed aggregate (engineered gravel) that is sometimes surfaced with local pit-run or river-run gravel, but commonly either a Telford or very rough macadam.

It is assumed that paved (asphalt) and engineered gravel roads in good condition and 20% of the same class of roads in moderate condition should begin receiving regular maintenance as soon as possible to keep them from falling into the lower categories.

It should be noted that there is some ambiquity on what is inventoried as a gravel road. Many of the roads classified as gravel actually have a Telford or very coarse macadam surface rather than a graduated engineered gravel surface. This type of construction provides a roadway that is normally passable in bad weather; however, it is very rough and vehicle speeds are very low, about 20-25 km/hr maximum. The riding surface of Telford and macadam roads cannot be maintained with equipment, nor can motor graders be used to reshape their parallel ditches. All maintenance work must thus be labor intensive. For the riding surface, manual labor can replace missing stones or fix small depressions. But this is a very slow process and the road surface would still be very rough. For engineering and inventory purposes, a Telford or macadam surface should be considered an unfinished gravel road. These roads will require investigation by project TA to determine whether a gravel (well-graded crushed aggregate or select material) layer should be added as a riding surface. A gravel surface can be maintained easily and vehicle speeds and riding comfort will increase while lowering vehicle operating costs. It is not the project's intent to maintain Telford roads until they are resurfaced.

TABLE 5

SUMMARY OF ROADS IN PROJECT DISTRICTS BY TYPE OF CONSTRUCTION (KM)

| Province | Asphalt | Gravel | Earth | Total |
|---|---|---|---|---|
| S Sulawesi | 957<br>23% | 1615<br>40% | 1496<br>37% | 4068 |
| NTT | 129<br>4% | 1040<br>31% | 2177<br>65% | 3346 |
| Totals | 1086<br>15% | 2655<br>36% | 3673<br>49% | 7414 |

## 2. TRAFFIC VOLUME AND COMPOSITION

Traffic counts are not conducted on district roads. Decisions on road geometry, pavement type, and pavement thickness for roads are therefore not based on traffic data. They may be based on district planners' intuitive assessments of traffic patterns but are equally likely to represent an attempt to cover the maximum length of road with a limited budget. Furthermore, the selection of roads to be improved is not based on traffic volume. The relationship between traffic and road class is not considered, resulting in a large number of either underbuilt or overbuilt roads.

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Donors have initiated traffic surveys for decision making in district road planning and construction. A traffic survey method established by World Bank consultants and Bina Marga requires that pedestrians, non-motorized vehicles, and motorized vehicles of different types be counted. In addition, observed numbers of people travelling in passenger vehicles and major types of freight being moved must be recorded.

The method incorporates adjustments to completed traffic counts to obtain a non-biased base-year average annual daily traffic count (AADT). The adjustments allow for: 1) conversion to a 24 hour basis; 2) daily traffic variation (e.g., market day traffic vs. non-market day); 3) seasonal variation caused, for example, by weather and associated road conditions, harvest peak, etc.; and 4) effects of inappropriate survey site selection.

Tables 6 and 7 show samples of traffic volume and transport mode distribution in four districts in the RRMS provinces (data were taken from traffic counts conducted under an OECF feasibility study in 1985).

TABLE 6

SAMPLE TRAFFIC VOLUMES ON DISTRICT ROADS IN THE PROJECT AREA

| District | No. of Links | Vehicles per Day 200-500 No. | 200-500 % | 50-200 No. | 50-200 % | 50 No. | 50 % |
|---|---|---|---|---|---|---|---|
| NTT | | | | | | | |
| Sumba Barat | 35 | 0 | 0 | 4 | 11 | 31 | 89 |
| Ngada | 50 | 0 | 0 | 13 | 26 | 37 | 74 |
| South Sulawesi | | | | | | | |
| Wajo | 92 | 17 | 18 | 42 | 46 | 33 | 36 |
| Gowa | 60 | 18 | 30 | 25 | 42 | 17 | 28 |

TABLE 7

SAMPLE TRANSPORT MODE DISTRIBUTION ON DISTRICT ROADS IN THE PROJECT AREA
(Total Daily Traffic Volume by Type of Vehicle on All Links)

| District | Car | Bus | Truck | Mtr.Cycle | Bicycle | Oxcart | Trishaw |
|---|---|---|---|---|---|---|---|
| Sumba Barat | 175 | 16 | 376 | 644 | 28 | 0 | 0 |
| Ngada | 498 | 145 | 160 | 513 | 52 | 50 | 0 |
| Wajo | 2589 | 479 | 1930 | 3915 | 784 | 950 | 0 |
| Gowa | 1733 | 490 | 1704 | 3293 | 3950 | 130 | 400 |

During the first year of the RRMS project detailed traffic surveys will be conducted on the networks covered by the project. The methodology now used by province public works offices as well as a recently introduced World Bank traffic survey methodology are adequate for this purpose. To assure a valid baseline count, the first year survey will be carried out by a contractor. Subsequent traffic surveys will be conducted periodically by district staff after they receive appropriate training. Spot checks by project TA will be required to assure the integrity of the counts. Initially, a traffic counting coordinator, assigned from the Sub-Directorate of Local Roads, Bina Marga, will be responsible for planning, supervising and documenting each traffic survey. Sub-Directorate of Local Roads staff in Jakarta will analyze the traffic count data. These responsibilities will be gradually transferred to provincial authorities. In conjunction with the traffic surveys, road condition surveys will also be conducted. The frequency of the survey will be determined by project TA and Bina Marga staff.

## 3. CURRENT ROAD DESIGN CONSRUCTION AND MAINTENANCE STANDARDS

### 3.1 DEFINITIONS

The vast majority of roads registered in district networks were constructed either before adequate standards were established or under road programs (Padat Karya, Transmigration, etc.) which use standards below those established for district purposes. The latter roads, once constructed, may be incorporated into the district network.

Road standards have been established and improved over the past five years. However, they have been only selectively applied, usually under donor-funded projects, and districts that do not receive donor assistance do not use them.

In the road standards established for donor projects, the construction of district roads is considered a time-staged process, related to expected Average Daily Traffic (ADT). This creates a classification system which recognizes these classes for district roads:

District Road Classes

| | Sealed | | | Unsealed |
|---|---|---|---|---|
| | IIIA | IIIB | | IIIC |
| | Asphalt | Sealed | Gravel | Gravel/Earth |
| ADT (undifferentiated) | 500-3000 | 200-500 | 50-200 | <50 |

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At the first classification stage, a simple grading of the natural earth provides the running surface for class IIIC light traffic. The term "gravel" is used locally to include Telford cobble and All Weather Compacted Aggregate Subgrade (AWCAS).* Thus, gravel roads classed as IIIB or IIIC may be surfaced with gravel, Telford, or AWCAS.

Under this definition, gravel, Telford, or AWCAS provides the running surface. However, for IIIB roads classified as "sealed roads," some are also treated with a spray sealcoat of asphalt or used motor oil, which may then be coated with gravel chips. This sealing is intended to stabilize the running surface and make it impermeable to water.

For class IIIB roads, therefore, important design changes may be in order. The seal for gravel may be used as ADT approaches 100, and the more advanced sealcoat as ADT approaches 200. Because the purpose of each sealing method is to stabilize the road, provide a smoother running surface, and to protect it against water infiltration, work must be done to the subgrade and the existing base. This mainly consists of a layered treatment:

Surface : wear-out, protective
Base : gravel and sand, 15 cm
Subbase : aggregate or macadam (usually only select material), 10-45 cm
Subgrade : stabilized soil (lime/cement) or stone, compacted

For this work, design specifications may provide lower or higher standards, given design speeds, limiting gradients, paved width, shoulder width, camber or slope of crown for surface and shoulders, bridge width (with or without sidewalks), etc. At this point, the terminology becomes confusing. It becomes even more confusing if the subbase/subgrade work is omitted at this stage of road building, and must be undertaken at the later stage (ADT 500) of an asphalt overlay.

Any of the following terms may be used to describe the transition from a IIIC road to a IIIB sealed gravel or sealed road: improvement, upgrade, betterment, support work, renovation, rehabilitation, and reconstruction. While the latter three terms suggest re-working to an original design standard, in practice, no definitive design standards exist regarding an earth or cobble road. Moreover, it is common practice

*This Indonesian definition of AWCAS differs from that used outside of Indonesia. The standard definition is all weather crushed aggregate surface.

the world over to incorporate "improvements" (i.e., to "upgrade" to a higher standard) at this state of road-building, to take advantage of the economies of scale inherent in the very large costs associated with re-working the road, virtually from the ground up: the subgrade, subbase, base, and surface treatment and pavement.

The running surface associated with each of the four major road conditions, i.e, asphalt, sealed, sealed gravel, gravel/earth, does not describe well the different kinds of surfacing which may be applied to meet the needs of wear and stability. The Indonesian Roads Department defines ten kinds of surface treatment or pavement construction above the level of the IIIC gravel/earth road. In descending order of their relative cost and durability, they are:

| Running Surface | Function | Indonesian Term |
|---|---|---|
| Asphalt concrete: | overlay, 4 cm, structural | LASTON |
| Two-layer asphalt (DBST): | overlay, 35 mm, non-structural | BURDA |
| One-layer asphalt (SBST): | overlay 20 mm, non-structural | BURTU |
| Aggregate buton asphalt : | overlay 3-5 cm, structural | LASBUTAG |
| Thin concrete asphalt: | overlay, sealcoat, 3 cm, non-struc. | LATASTON |
| Macadam penetration: | Pavement or base, 5 cm, structural | LAPEN |
| Thin sand & asphalt: | sealcoat, reseal, 3 cm, non-struc. | LATASIR |
| Asphalt spread: | sealcoat, reseal, non-structural | BURAS |
| Thin pure buton asphalt: | seal, overlay, non structural | LASTABUM |
| All weather crushed aggreg: | seal, overlay, non structural | JAPAT |

It can be seen from this list that some surfacing has structural properties, normally associated with overlay treatments (but not always), while others are surface dressings of seal or spray coats without structural value, and some are alternatively used for overlay or simple seal. Relative structural value also indicates longer wearability and gives a presumptive indication of the expected life of the wear surface, which is important to forecasts of the time lapse between the rehabilitation needs of a road. The type of surface above, which is applied to the general class IIIA or IIIB, therefore has significance to the costs associated with routine and periodic maintenance of the specific road surface being maintaine

Because the use of any alternative surface treatment may depend upon local materials availability, relative cost in the region, and familiarity with its application, differences may exist among regions in the kind of surface coat, cost, rate of wear, and service life, which are not readily identifiable by the loose classification of "asphalt" or "seal." Reports from the districts do not now make the needed distinctions. This was seen previously in the class IIIB roads, classified as sealed, but for which both a seal and a gravel condition may exist, and, for the gravel classification, where a thin surface dressing may or may not have been applied.

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## 3.2 STANDARDS AND GUIDELINES

Although they are unevenly applied, most technical standards and guidelines for road construction and data collection for district roads are already written and are adequate or are in various stages of development. Standards for geometrics and pavement are complete and acceptable. They are shown in Figure 1 at the end of this Annex. Those for drainage and bridge/culvert design are in draft and will need to be approved by USAID. Several standards and guidelines for maintenance are not yet available or are inadequate.

The Sub-Directorate of Local Roads is responsible for preparing technical standards and guidelines for district road works. At present, most of its attention has been focused on construction, but new donor projects increasingly emphasize maintenance. The Sub-Directorate should retain responsibility for the preparation of all standards and guidelines for districts, but donor project consultants should assist the Sub-Directorate to improve them if necessary. Table 8 gives a comprehensive list of all the standards and guidelines that will be used for the project. Selected standards and guidelines are discussed below.

TABLE 8

TECHNICAL STANDARDS AND GUIDELINES FOR DISTRICT ROADS TO BE USED IN THE RRMS PROJECT

| Title | Purpose | Availability |
|---|---|---|
| **Construction Standards and Guidelines** | | |
| 1. Design Standards for District Roads | Describe the basic road and bridge road design parameters, type of pavement, width, grade, etc., for different levels of traffic. | Yes |
| 2. Technical Design Standards and Guidelines | Describe the approved practices or guidelines (construction) for designing all of the road features (geometry, pavement, drainage, bridges, etc.). | Yes |
| 3. Materials and Construction Specifications | Describe the use of materials and construction work that are acceptable to the government. | Draft |
| 4. Construction Supervision Guidelines | Provide guidance to construction supervisors (inspectors) on how to check that a contractor is performing the work according to accepted practice. | No |

| Title | Purpose | Availability |
|---|---|---|
| 5. Construction Work Methods | Basically a how-to-do-it field guide covering the most frequent and important construction operations. | Partially |
| 6. Construction Unit Costs | A breakdown of the cost per day or unit cost for each resource for each construction activity. | Yes |
| **Maintenance Standards and Guidelines** | | |
| 1. Maintenance Quality Standards | Describe the level of condition in which the various road elements or features should be maintained. | No |
| 2. Maintenance Frequency Standards | Describe the number of times per year that a particular maintenance activity must normally be performed in order to maintain the quality standard for each of the features. | No |
| 3. Maintenance Performance Standards | Describe the purpose, composition of resources, approved work method and the average daily production for each activity. | No |
| 4. Maintenance Unit Costs | A breakdown of the daily cost and unit cost of measurement for each activity according to the maintenance performance standard. | Partially |
| 5. Maintenance Work Methods | A how-to-do-it field guide covering the most frequent and important maintenance activities. | Partially |
| **Data Collection Guidelines** | | |
| 1. Traffic Counts | Determines the average daily traffic (ADT) on a particular road link. | Draft |
| 2. Maintenance Feature Inventory | Counts all of the maintainable road features according to preselected units of measurement. | Partial Draft |

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| Title | Purpose | Availability |
|---|---|---|
| 3. Road/Bridge Condition Survey | The inspection of each of the major road features which results in a quantitative evaluation of the condition of each of the features and overall condition of the road. | Partial Draft |
| **Materials and Quality Control Standards and Guidelines** | | |
| 1. Materials Production Standards | Similar to maintenance standards. | Work Cost Analysis Forms Only |
| 2. Materials Production Work Methods | Similar to construction and maintenance work methods. | No |
| 3. Materials Quality Control Guidelines | Describes the approved work methods for field inspection for all construction and maintenance materials. | No |
| 4. Materials Standard Testing Procedures | Prescribes the standardized procedures for sampling and testing all construction and maintenance materials. | Yes, for Bina Marga |

### 3.2.1 Traffic Counts, Road Inventory, and Road/Bridge Condition Survey

These guidelines have been developed primarily for construction purposes and have been applied, apparently with success, to the data collection efforts of other donor projects. It appears that the traffic counting guidelines are adequate. The origin/destination survey sheet used during the data collection recently financed by the OECF would be of value to the RRMS project because it asks for vehicle cargo and weight, which may be an ancillary activity in the rehabilitation selection process.

The road inventory and road/bridge condition survey guidelines will require modification to be more useful for maintenance; e.g., each road/bridge element that requires a specific maintenance activity will have to be counted in the units that are associated with that activity (e.g., pavements can be measured in lane-kilometers, $m^2$, km, etc.) These modifications are necessary for the maintenance management system and developing them should be a task for technical assistance under the project. Later in the project, an improved method of determining overall road condition using weighted ratings should be tested.

### 3.2.2 Construction and Maintenance Unit Costs

The Sub-Directorate has prepared and distributed to all donor-funded districts, a set of Work Cost Analysis (WCA) standards which are calculated using local labor rates, materials units prices, and equipment rental rates for each district. They adequately cover construction, but some standards could still be added and improved for maintenance.

There is some doubt as to whether or not the Work Cost Analysis standards agree totally with the Construction and Maintenance Work Methods (e.g., WCA No. K 342, New AWCAS Construction, lists a different spread of equipment and thickness than does its corresponding work method, Execution Guide: All Weather Compacted Aggregate Road (JAPAT), No. 07/PT/B/1983). Project technical assistance should check both for consistency.

### 3.2.3 Construction and Maintenance Work Methods

A set of fourteen booklets covering many of the operations for pavement work was developed in 1983 for Bina Marga. All the booklets are for construction and a few are applicable to periodic maintenance as well. The series should be expanded to cover more of the most common operations for both kinds of work, such as how to cut ditches, how to smooth a road with a motorgrader, etc.

During the same period, a Highway Maintenance Manual was prepared, consisting of eight volumes covering maintenance, rehabilitation, support work, and replacement of roads and bridges. Only volume IA has been reviewed. It contains twelve of the booklets mentioned above. Many of the figures appear to be taken from the series of technical handbooks by the Asphalt Institute on the maintenance of asphalt pavements. These books should also be reviewed by project TA and, if applicable to the districts, reprinted and distributed.

### 3.2.4 Materials Standard Testing Procedures

Although not specifically developed for districts, a materials testing manual is found at Bina Marga and should be adopted as the standard for the proposed district Materials Units. The sampling and testing procedures are based on those of the American Association of State Highway and Transportation Officials (AASHTO) and the American Society for Testing Materials (ASTM). They appear to be acceptable for use under the project.

### 3.2.5 Materials Production Standards and Materials Production Work Methods

The only guidance concerning materials production consists of Work Cost Analysis forms. They do not fully describe the steps of production. A set of production work method guides should be formulated for aggregated production and perhaps other materials such as concrete pipe and cold-mix.

## 3.3 REHABILITATION AND MAINTENANCE UNIT COSTS

This section recommends unit prices for rehabilitation and maintenance under the project. Current unit prices for labor and some materials were collected from each district by PT Hasfarm. Equipment rental rates for force account equipment costs were borrowed from GOI Work Cost Analysis (Analisa Biaya Pekerjaan) forms. These equipment costs/hour are the same as those calculated by ENEX consultants and the Sub-Directorate of Local Roads in Rural Road Study Report for 5 Yr. Road Programs, 1984-1989, Kupang, NTT, January 1984.

### 3.3.1 Maintenance Unit Costs

Unit costs for routine and periodic maintenance (shown in Table 9) were estimated using the above unit prices and hourly equipment rental rates. Periodic maintenance crew composition and production were based on the standard Work Cost Analysis forms and the Bina Marga Highway Maintenance Manual (Manual Pemeliharaan Jalan) work guides. Routine maintenance crew composition and production were estimated from consultants' experience with maintenance activities in other developing countries. An effort was made to simplify and standardize the activity resources for the purpose of calculating resource requirements later on. The materials rates (qty per $m^2$, km, etc.) specified in the Bina Marga work guides were followed, but production figures were modified to permit a reduced pace so that on-the-job training and close supervision by the consultants and Public Works' staffs can introduce new techniques and sound work methods.

The unit cost estimates derived here include full equipment depreciation and all labor, management and overhead expenses. They are therefore most appropriate to work let to contractors and are high for force account work since government road work budgets do not account for depreciation and much of the labor, management and overhead expense is absorbed by routine budgets rather than development budgets for maintenance. The RRMS project will use both force account and contractors for maintenance. For estimating the overall project budget, the higher contract unit cost should be used. However, project TA should estimate the anticipated lower force account costs for later application as the project proceeds.

TABLE 9

SUMMARY OF ESTIMATED MAINTENANCE UNIT COSTS

| Type of Maintenance | Sealed Roads km/yr/ Crew | Sealed Roads $/km | Gravel Roads km/yr/ Crew | Gravel Roads $/km | Earth Roads km/yr/ Crew | Earth Roads $/km |
|---|---|---|---|---|---|---|
| - ROUTINE - Routine | 60 | 370 | 100 | 260 | 125 | 108 |
| - Smoothing | - | | 400 | 55 | 400 | 55 |
| Subtotal Routine Cost/km (incl. an allowance for emergency work) | | 370 | | 315 | | 163 |
| - PERIODIC - Resealing | 350 | 500 | - | - | - | - |
| - Regraveling | - | - | 450 | 585 | - | - |
| - Reshaping | - | - | 200 | 200 | 200 | 200 |
| Subtotal Periodic Cost | | 500 | | 785 | | 200 |
| - TOTAL MAINT. COST Routine + periodic | | 870 | | 1,100 | | 363 |

Average Cost of Resealing:

| | |
|---|---|
| 50% Chip Seal (using # 4 stone) | $350/km |
| 50% DBST (using 3/8" # 4 stone) | $650/km |
| Average Unit Cost | $500/km |

Average Production for Resealing:

| | |
|---|---|
| 50% Chip Seal | 100 km/yr per 400 km/inventory |
| 50% DBST | 60 km/yr per 300 km inventory |
| Average production | 80 km/yr per 350 km inventory |

Exchange Rate: $1.00 = Rp. 1,624 (1/21/87)

### 3.3.2 Rehabilitation Unit Costs

The RRMS feasibility study did not independently investigate actual production rates (km/day) and crew compositions for rehabilitation work. The Bina Marga Work Cost Analysis forms specify crew compositions and a production rate, but some of these rates are not practical; for example, activity K342, All Weather Compacted Aggregated Subgrade (AWCAS), calls for a gravel layer of 4 cm (loose). This is not a sufficient thickness to produce a lasting riding surface. Therefore, the actual production rate may be somewhat less than if 15 cm were used.

Instead, other donors' recent unit costs calculations have been adopted. Both the Asian Development Bank and the World Bank have engaged large teams of consultants to prepare staff appraisals for the Eighth Road Project (ADB Rural Roads II) and the Highway Maintenance and Betterment Project (IBRD 6066-IND). Because both projects follow up on previous projects, it is assumed that their unit costs for construction type activities adequately account for locally-appropriate work methods. The rehabilitation unit costs shown in Table 10 are estimated from the Banks' costs, adding an inflation factor to account for the time between when they were prepared (1984) and the beginning of work projected for the RRMS project (1988) as well as adjustments for the 1986 devaluation.

TABLE 10

SUMMARY OF ESTIMATED REHABILITATION UNIT COSTS

| Type of Work | $/km |
|---|---|
| **Rehabilitation** | |
| - Rebuild paved road | 25,725 |
| - Rebuild sealed road | 18,375 |
| - Rebuild gravel road | |
| - on existing granular surface | 12,340 |
| - on existing Telford or macadam surface | 14,705 |
| - Rebuild earth road | 7,150 |
| **Upgrading** | |
| - Upgrade existing gravel road to sealed road | 21,210 |
| - Upgrade existing earth road to gravel road | 15,970 |

Exchange Rate: $1.00 = Rp. 1,624 (1/21/87)

## 3.4 DESIGN PRACTICES

The experience of other donors indicates that the most serious design shortcomings are inadequate provision for drainage, poor vertical alignment design and inadequate recognition of pavement structure. Road improvements are frequently undertaken without modification of either horizontal or vertical alignment. There is a pronounced tendency to focus on the running surface to the exclusion of substructure, shoulders, ditches and other drainage features. Road construction is frequently undermined by the lack of subsoil drainage through natural shoulders.

Finally, design is rarely adjusted to account for variations along the length of the road. Standard pavement types and thicknesses are designed regardless of local physical conditions or terrain; pavements are therefore frequently underdesigned thus considerably reducing the road's life expectancy. There is a particular disregard for the importance of embankments in areas subject to flooding.

## 3.5 CONSTRUCTION PRACTICES

Although the experience with the construction practices of force account and contractor crews differs (see Section 4.2), in either case traditional construction practices are seriously deficient. The experience of the World Bank-financed Rural Roads project in 25 districts is typical of problems encountered nationwide and is summarized below (drawn from Amphico, Hoff and Overgaard, 1986).

First, there is little recognition of the importance of shaping and compaction in construction of subgrades. Water is rarely used to improve the compactability of dry subgrades, and as a result new pavements frequently break up in the first wet season after construction.

Second, even if pavement designs specify layered pavement construction, field crews are unlikely to follow the specification and structural failure of the riding surface is common. Telford construction, requiring labor-intensive hand-laying techniques, can be an effective base if done properly, but because wedge-shaped stones are frequently placed with the sharp end of the stone facing downwards directly on the subgrade, road failure is common. In instances where a crushed stone layer is provided as a base, the lack of vibrating compactors prevents proper compaction.

Third, pavement seals and reseals are usually done using the penetration macadam method because so many roads deform and thus require surface treatment. Poor results are assured by the uncontrolled heating of bitumen over open fires, the primitive method of bitumen application and insufficient quantity of bitumen to fill the roadway pores.

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Finally, despite abundant natural gravels, gravel roads are not popular nor are gravel construction techniques well developed. Gravel requires grading if it is to be used as a riding course, and this is not generally done. Most gravel roads are either lacking in fines or contain too many boulders. Specifications are rarely observed when they relate to the use of screened materials.

### 3.6 MAINTENANCE PRACTICES

Prior to 1984, little if any routine or regular periodic maintenance was performed on district roads. Beginning in 1984/85, the Ministry of Home Affairs earmarked, for road maintenance, 25% of every district's Inpres District (Inpres Kabupaten) allocation.

With the introduction of the 25% Inpres earmark, maintenance programs began. However, many districts divert maintenance funds to road upgrading or rehabilitation. Districts which attempt to use the funds properly do not know how to prioritize or organize the work. Work methods are poorly developed. There are scattered reports of maintenance being implemented successfully by the roadman system and, in one location at least, by local communities. (The roadman system delegates responsibility for certain aspects of road maintenane to individual residents along the road. Forms of compensation vary.) These have not been verified. Successful maintenance will require starting from scratch, including assessing reported successes in other parts of the country. Project TA will assist in the development of guidelines for maintenance.

## 4. IMPLEMENTATION OF CURRENT ROAD CONSTRUCTION AND MAINTENANCE PROGRAMS

### 4.1 ROADS MAINTAINED

Since the Inpres earmark for maintenance was introduced, there have been conflicting guidelines as to how the funds should be used. One set of GOI guidelines restricts maintenance work to "stable" roads. This is not acceptable. In practice, "stable" is understood to include asphalt (paved or sealed or both) or gravel roads in reasonably good condition. Earth roads are eliminated from consideration, even immediately after they are constructed. This situation results from the application of maintenance definitions used for national and provincial networks (which include few earth roads) to the district networks. Another set of guidelines, now corrected, prohibited the application of maintenance funds to roads less than two years old.

Public Works staff have indicated that the exclusion of earth roads from maintenance may have been an oversight and that they would not be excluded from maintenance programs under the AID project.

## 4.2 FORCE ACCOUNT VS. COMMERCIAL CONTRACT WORK

All maintenance and a small amount of construction work in Indonesia are executed by force account. Most construction is done by commercial lump-sum contract. Contracted projects are considerably larger than force account projects, but are still relatively small in value. For example, for the period 1983-86, project districts in South Sulawesi averaged 12 commercial contracts per year per district, with an average value of only $32,000 per contract.

Using commercial contractors rather than force account is in keeping with GOI policy at all levels. However, contrary to experience in many other countries, force account construction in Indonesia has proved to be more dependable than contractors. Other donors have found that, given training, it yields higher quality work that is completed in a more timely fashion. There are several reasons for the poor performance of contractors in district road work.

First, Inpres-funded contracts for work on district roads are usually reserved for small local contractors. These are very small firms with neither a well-trained or permanent labor force nor basic equipment. They usually recruit unskilled labor for each project. The equipment requirements to register as a C1, C2 or C3 contractor (defined in Section 4.5) are well below the minimum required to construct maintainable roads or to do the quality of work proposed for the RRMS project.

Because of the unskilled labor, the lack of equipment and a lack of technical knowledge, contract construction work methods follow traditional methods and are usually labor intensive. The kind of work that can be done with manual labor alone is limited to building earth or gravel roads. For earth roads, simple rough pioneering is all that is usually done. For gravel roads, the construction method is a hand-placed Telford or coarse macadam without a gravel surface layer. Engineered gravel cannot be done by hand. For all road types, drainage construction is rarely adequate. These construction methods are generally so below standard that even if maintenance activities were performed, they would not be effective.

Because most Class C contractors do not have construction equipment, contracts are sometimes modified to allow rental of the district's equipment (usually at a below economic rate or sometimes without charge). The practice of renting out district equipment does not work well, because the contractor rarely has the skills to use the equipment effectively, and has little incentive to utilize it efficiently or to maintain it. Frequently, it sits idle while under the control of the contractor and is unavailable for use elsewhere.

A second reason for the poor performance of contractors is inadequate supervision of contractor work by district public works offices. A third is the inappropriateness of the contracts themselves. These are discussed below.

## 4.3 CONSTRUCTION INSPECTION/CERTIFICATION

The present practice of construction inspection, called "construction supervision," is weak. First, inspectors typically visit a site only once a week and, due to transport shortages, sometimes only if the contractor provides a vehicle. That visit is usually for the purpose of noting completed progress for authorizing progress payments. The inspection is further hampered by inexperienced construction inspectors and a lack of authority to stop construction for non-compliance with specifications. This authority remains with the Bupati (district head).

Second, materials quality control is rarely carried out, other than visual checks of materials or their sources. There are no laboratory facilities or field testing equipment in the districts. Pit-run or river-run surfacing material receives only a visual approval. This material should receive a gradation analysis to determine if the blend of large and small sizes is within the allowable ranges permitted in the specifications.

Finally, supervision shortcomings in Indonesia are also related to problems of contract format. Contracts provide for lump sum project payments. Lump sum contracts, although easy for administration, are not a good method for close control or workmanship of materials quality. If a specific part of the job is defective, it is difficult to reject.

Present district practices for certifying and paying for completed work are inadequate to assure quality work and are not acceptable for RRMS purposes. The inadequacies are related to the weaknesses in contractor supervision and contract format cited above. The basis for progress payment is a vague "percentage of completion" rather than the rate of material inputs. Since designs are rarely complete or explicit, the contractor cannot otherwise be held to task. Although a percentage of the final payment is withheld for a specified period of time against failure of completed work, the amount is not large enough to assure quality performance.

## 4.4 MODEL FORCE ACCOUNT CREWS

It is the GOI's current policy to contract for most construction but to use force account (swakelola) for all maintenance work. As discussed in Section 4.2, contrary to experience elsewhere, in Indonesia force account usually yields a better product than contractor labor.

RRMS does not recommend a shift from the current GOI strategy involving the contractor/force account mix. Further, the GOI is reluctant to assign more work to its staff for fear of overburdening an already overextended staff.

RRMS recommends that each district establish a model force account crew for maintenance. The crew will serve as the focus for consultant inputs to improve the quality and efficiency of maintenance practices. All aspects of maintenance work will be addressed from the perspective of the field crew, including scheduling of equipment, use of materials and labor and technical adequacy of the maintenance work itself.

The model crew will be drawn from existing district staff, supplemented by additional labor only if required.

In addition to the district model force account crews for maintenance, RRMS recommends the use of a model crew for rehabilitation. As the skills and equipment required for rehabilitation are more complex than for maintenance, and the project intends to support the commercial contracting of rehabilitation work, it is recommended that only one model force account crew per province be established for this type of work. The model crew will be drawn from district staffs throughout the province to serve for a specified time. At the completion of this period, the staff member will be returned to the district where the individual's training will serve to train others. As in the case with the maintenance force account crews, the model rehabilitation crew will benefit from the relatively intense technical assistance provided by the consultant. Of particular importance is the training of crew members to supervise the wide range of rehabilitation work under their responsibility. This will also include participation in supervision of contractor rehabilitation work.

## 4.5 TENDER PROCEDURES

Contractor prequalification and selection procedures are explicitly defined by law and are adequate for RRMS purposes. Prequalification of contractors is conducted every five years by the province public works department which issues a list of contractors eligible to bid on projects within the province, including district road projects. All contractors are classified by three criteria:

- by field of competence, e.g., irrigation, buildings, bridge foundations, roads, etc.;
- by size of project for which they are qualified, i.e., specified levels of prior experience, capital and equipment for various project sizes; and
- by location of domicile and operations.

For road and bridge contractors, the following classifications apply:

| Contractor Class | Size of Contract |
|---|---|
| A | above Rp. 500 million |
| B1 | Rp. 200 - 500 million |
| B2 | Rp. 100 - 200 million |
| C1 | Rp. 50 - 100 million |
| C2 | Rp. 20 - 50 million |
| C3 | Rp. 5 - 20 million |

Tendering to prequalified contractors is done according to project size and the registered location of contractors' operations. Bids for a Rp. 70 million district road project, for example, are solicited from C1 road contractors registered in the district tendering the work. If none are available, bids are solicited from B2 contractors registered in the district. If this is not successful, solicitation is made to C1 contractors in adjacent districts, then to B2 contractors in adjacent districts. In the event neither succeeds, bids are opened to all C1 contractors registered in the province, then to all B2 contractors in the province. An exception is made for certain C1 contractors defined as "economically weak" - such firms are granted a 10% preference when bids for projects within the C1 class are evaluated.

## 4.6 ROLE OF PARASTATALS

In provinces located on Java and certain of the more developed islands, there are large private firms technically and financially capable of undertaking the road rehabilitation work proposed in the RRMS project. In contrast, in South Sulawesi and NTT, private sector construction capability is still limited to smaller, less technical work using labor intensive technology. Under GOI procurement regulations, there are provincial prequalification steps for contractor eligibility based on the estimated cost of work to be tendered. In project districts in NTT, for example, there are seven firms, of which two are private sector, that are eligible to bid on road construction in excess of $500,000. In South Sulawesi, there are no private firms which are eligible to bid on road construction in excess of $500,000.

The Mission's previous efforts, in Project Luwu in South Sulawesi, to encourage smaller private contractors as a by-product of a larger construction project were not successful. The Project Luwu road component suffered significant delays and quality control problems because the small firms went bankrupt and a parastatal had to complete a major portion of the 178 km road.

As a result of the Mission's analysis and experience, it is proposed to proceed with competitive procurement among the provinces' pre-qualified contractors which include parastatal firms. When GOI procurement regulations require soliciting tenders from outside that province to ensure that the requisite ten firms bid, the Mission will require that those additional firms include private sector companies. The Mission Director has the authority to grant a waiver for the use of government-owned businesses with host country contracting.

## 4.7 RECOMMENDATIONS FOR MAINTENANCE

A simple maintenance management system should be introduced to each DPUK and be used as the basis for planning, budgeting and controlling work in the field.

Initially, all maintenance should be performed by force account to give DPUK staff first-hand experience in work methods, and in crew and equipment management. Crew output will improve until the marginal improvement becomes very small and work methods will be close to optimum. This process may take several years.

It will then be time to experiment with alternative approaches to maintenance. First, by contracting some less critical maintenance activities to small local contractors, production standards will have been established by force account experience, and should become the standard for maintenance contracts. Experienced force account foremen can be reassigned to supervise these smaller contractors. Technical assistance may be needed to draw up appropriate formats for maintenance contracts. Second, pending the results of Special Studies, both the roadman system and efforts to enlist local communities to maintain their own roads should be tried on a pilot basis and expanded into other project districts as appropriate.

With some maintenance being performed by contract, roadmen, or local communities, the personnel and equipment required for force account maintenance will not have to grow to match the growth in the number of maintainable kilometers from the project rehabilitation program. Some maintenance work of all types should still be performed by force account in order to keep a check on the production rate and unit cost of each maintenance activity.

## 4.8 RECOMMENDATIONS FOR REHABILITATION

Rehabilitation of roads to a maintainable standard, acceptable for the RRMS project, will require a significant increase in the standard of work now conducted in the project districts. GOI policy to promote contractors rather than force account for major road work is sound but neither the capabilities of the small firms normally selected for this purpose nor the supervision systems normally applied by the DPUKs are adequate to yield quality performance.

Several steps are recommended. First, only contractors with sufficient in-house expertise and equipment should be permitted to bid on RRMS-financed rehabilitation work. This will require restricting work to Class B1 and A firms. Project rehabilitation will need to be tendered in packages of at least Rp. 200 million ($122,000) each and province governments will be required, before tendering begins, to revise contract

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regulations accordingly. Alternatives such as tendering multi-year contracts to smaller contractors (Class B2 and C) should be investigated during the project to see whether a guarantee of sufficient work over time would encourage smaller contractors to invest in skilled staff and equipment.

Second, concerted attention should be paid to improving DPUK skills and procedures for supervising contractors. Initially, project consultants stationed in the districts and DPUP staff will have to bear much of the supervision burden themselves alongside DPUK counterparts. Formal short-term training in supervision techniques (see Section 8) should complement this on-the-job approach. The project must provide adequate transport to assure mobility for inspections in the field. The project, through Special Studies, should also investigate ways in which DPUK supervisors can be delegated increased authority to stop work or otherwise control unsatisfactory performance in the field. One aspect of this, sufficiently important for a distinct Special Study, is adjusting contracts from lump-sum to a schedule of rates format (World Bank consultants are presently assisting the GOI to revise contract formats. USAID should review this work for application to the RRMS project and a standard contract format should be approved before any commitment of funds for road work, including procedures for correcting unsatisfactory work.) Finally, it is recommended that one Model Force Account Crew be formed per province to implement rehabilitation work in a selected district. The purpose of the Model Crew will be twofold: to provide an example of techniques and work methods required to rehabilitate roads to standard and to serve as a training ground, under the supervision of long-term TA, for staff from all project districts. In particular, the Model Force Account Crew should be viewed as the training ground for contract supervisors.

Third, for maintenance as well as rehabilitation work, a small Materials Unit should be formed, staffed and equipped in each district so that the control of materials can become a routine DPUK responsibility. This facility should have at least a set of sieves and scales for checking aggregate and soil gradation. It should also have field density equipment, such as a sand cone set or similar device for checking compaction density. Proctor equipment and a stove or oven should be provided to determine optimum soil density and moisture content. Concrete slump test equipment and cylinder molds should also be provided. Assistance for more sophisticated testing, such as Atterberg Limits and concrete cylinder breaking, should be requested from the DPUP (Provincial Public Works Service) Soils Laboratory as needed. Existing training courses for materials testing offered by the Diklat Bina Marga (see Section 8) are considered adequate for use by district-level personnel.

For the certification of completed work, the RRMS project must assure that AID requirements are met but must also explore long-term alternatives to the present district system which can be left in place once AID involvement is over. Long-term alternatives should be addressed by the Special Studies program in tandem with the assessment of alternative contract formats. For AID-specific purposes and until alternative contract formats are devised, it is recommended that each road design be approved by a consultant engineer, that the contract explicitly hold the contractor to all design specifications, and that certification be made on the basis of adherence to design and be made jointly by a direct AID contractor, and representatives of the DPUK and the DPUP. The ground rules for certification should be understood by all parties in the district. The stringency of certification standards should be increased gradually and proper advance notice should be given to contractors and force account crews who will perform the work. That notice should begin with the preparation of project designs and specifications, and contract documents.

## 5. ORGANIZATIONAL STRUCTURE AND STAFFING

### 5.1 RESPONSIBILITIES

Districts in South Sulawesi, as in most of Indonesia, have a DPUK which answers to the district chief (Bupati). This creates a distinct separation of responsibility for national/provincial roads (DPUP Cabang Dinas) and district roads (DPUK). Within the DPUK, personnel are sometimes rotated between road, irrigation or urban development projects.

The districts in NTT differ from the norm in that there is no DPUK. Rather, the local branch office of the DPUP Cabang Dinas carries out district road work. It also handles the rehabilitation of provincial roads and the maintenance of both national and provincial roads in addition to attending to district, provincial, and national interests in water resources and urban development. The Chief of the DPUP Cabang Dinas thus answers to two distinct officials and interests: the Chief of the DPUP and the Bupati.

### 5.2 SOUTH SULAWESI

The organizational structure of DPUKs in South Sulawesi differ among districts because each Bupati has some organizational discretion. Only five districts (Bone, Takalar, Sinjai, Pinrang & Jeneponto) have a Road Section. The other two (Sidrap & Bulukumba) have no structural unit for road work. A Road Design section will have to be established in these districts.

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The education levels of DPUK staff in South Sulawesi are shown in Table 11. (Definitions of educational terms are given in Table 12.) Staffing levels for technicians in the five districts with a Road Section are slightly lower than in NTT, with an average of 10 each. About 50% of staff in these sections are STM (technical high school) graduates. The Road Section staff in Jeneponto are all SMP (first-level secondary school graduates).

The educational levels of DPUK Chiefs in South Sulawesi are relatively high, with most holding post-secondary degrees. A fairly large number, however, do not have technical training: one is an Ir. and three are Drs., two are BA and one is an STM. Only one of the five Chiefs of a Road Section is a BA (Takalar), two are an STM (Jeneponto and Sinjai) and the other two are non-technical SMA.

## 5.3 NTT

The organizational structures of the Cabang Dinas in NTT are uniform. They include a Road Section with Subsections for Engineering Design, Maintenance, and Construction. There is a separate Planning Section with Subsections for Programming, Program Control, and Transmigration. Each section and subsection has a Chief, but the technical staffs in each section may be treated as a pool without permanent responsibilities and are frequently rotated from one project to the next, especially in construction supervision.

Staffing levels for technicians average 13 in the Road Sections for three of the districts.* Kupang reports having only two technicians in its Road Section. Approximately 80% of the Road Section technicians in the other two districts are permanent staff; the ratio of permanent to non-permanent staff is about 4 to 1. Table 12 summarizes the distribution of personnel by educational level and employment status (permanent or non-permanent) vs. job position.

## 5.4 PROPOSED ORGANIZATIONAL STRUCTURE

A uniform DPUK organizational structure is not necessary for the RRMS project. Specific arrangements may vary depending upon the specific needs and capacities of the locality. However, in general, the organizational structure should reflect the different tasks and skill areas specified below. One minimum requirement is that each DPUK have a distinct section with clear responsibility for the district's road development and management program. A second requirement is that it include a subsection with full-time staff responsible for road maintenance. For those districts which do not yet have a distinct workshop unit, one will be required. Figure 2 illustrates a configuration encompassing the various skill areas described below.

TABLE 11

EDUCATIONAL BREAKDOWN OF PERSONNEL,
SOUTH SULAWESI

| Position | Higher Education* | | | | Secondary | | | |
|---|---|---|---|---|---|---|---|---|
| | 5 Year Program | | 3-4 Year Program | | Upper Level | | | Lower Level |
| | Ir | Drs. | BE | BA | STM | SMA/ SLA | ST | SMP |
| Chief of DPUK | 1 | 3 | | 2 | 1 | | | |
| Road Section, Chief (1) | | | | 1 | 2 | 2 | | |
| Road Section, Staff | | | | | 24 | 17 | | 6 |
| Plan./Pgm. Sect., Chief (2) | 1 | | 2 | | | | | |
| Plan./Pgm. Sect., Staff | | | | | 17 | | | |
| Tech. Section, Chief (3) | | | | | | | 1 | |
| Tech. Section, Staff | | | | | 2 (4) | | 1 | |
| Total Permanent | 2 | 3 | 2 | 3 | 46 | 19 | 2 | 6 |
| Total Nonpermanent | | | | | (4) | | | |

Note (1) Road Section in Bone, Sinjai, Takalar, Pinrang, Jeneponto
Note (2) Planning Program Section in Bone, Pinrang, Bulukumba, Jeneponto
Note (3) Technical Section in Sidrap

*For definitions of educational terms, see Table 12.

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TABLE 12

EDUCATIONAL BREAKDOWN OF PERSONNEL, NTT

| Position | Higher Education | | | | Secondary Education | | | | Other |
|---|---|---|---|---|---|---|---|---|---|
| | 5 Year Program | | 3-4 Year Program | | Upper Level | | | Lower Level | |
| | Ir | Drs. | BE | BA | STM | SMA/ SLA | ST | SMP | |
| Chief of DPUP Cabang Dinas | 1 | | 1 | | | | 1 | | |
| Road Section, Chief | | | 1 | | 1 | | | | 1 |
| Road Section, Staff | | | | | 31 ( 8) | | | | |
| Planning Section, Chief | 1 | | | | 1 | | 1 | | |
| Planning Section, Staff | | | | | 13 (1) | | | | |
| Total Permanent | 2 | - | 2 | - | 46 | - | 2 | - | 1 |
| Total Nonpermanent | | | | | ( 9) | | | | |

* The analysis is only for 3 districts: Kupang, TTS, and Belu.

Definitions of educational terms
Ir. : Insinyur - A graduate of a 5-year engineering curriculum
Drs.: Doctorandus - A graduate of a 5-year non-engineering curriculum
BE : Engineering Associate Degree
BA : Liberal Arts Associate Degree
STM : Technical Secondary School (High School)
SMA/SLTA: General Secondary School
ST : Middle School
SMP : Primary School

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The field staff in both provinces are primarily temporary employees, for whom the rate of turnover is high. Most of these jobs do not require skilled workers. A maintenance management system, however, will require more skilled workers in the maintenance and construction crews.

It is recommended that the following should be permanent staff for each DPUK:

| Title | No. Required |
|---|---|
| 1. Chief Road Section | 1 |
| 2. Chief Engineering Subsection | 1 |
| 3. Engineering Subsection Technicians | 4 |
| 4. Chief Maintenance Subsection | 1 |
| 5. Maintenance Supervisor | 1 |
| 6. Chief Rehabilitation Subsection | 1 |
| 7. Foreman Rehabilitation Crew (in Model districts) | 1 |
| 8. Construction Supervisors | 2 |

Other staff such as foremen and equipment operators for road maintenance activities should also have a permanent status. The number of foremen and equipment operators depends on the number of maintenance crews assigned to each district. This is discussed further in Section 5.4.3 dealing with maintenance.

### 5.4.1 DPUK Roads Section, Engineering and Planning Subsection

One specifically identified group should have responsibility for developing the district's road management and maintenance plan, including proposals for rehabilitation of deteriorated roads, and routine maintenance of those roads in good condition. This will require staff capacities to plan and carry out traffic counts, road feature condition inventories, field investigations and implementation monitoring. It is also essential that there be a capacity to use this "raw" information in the development of long-term and short-term road management plans, including allocating and scheduling the use of DPUK financial, human and equipment resources.

It is preferred that this group be led by an associate degree graduate in civil engineering (sarjana muda) or, at a minimum, a graduate of a secondary technical school. He should supervise a group of four or five technicians in carrying out the various field investigations and surveys.

* Data from TTU were received too late to be incorporated here. These figures apply to Kupang, TTS and Belu only.

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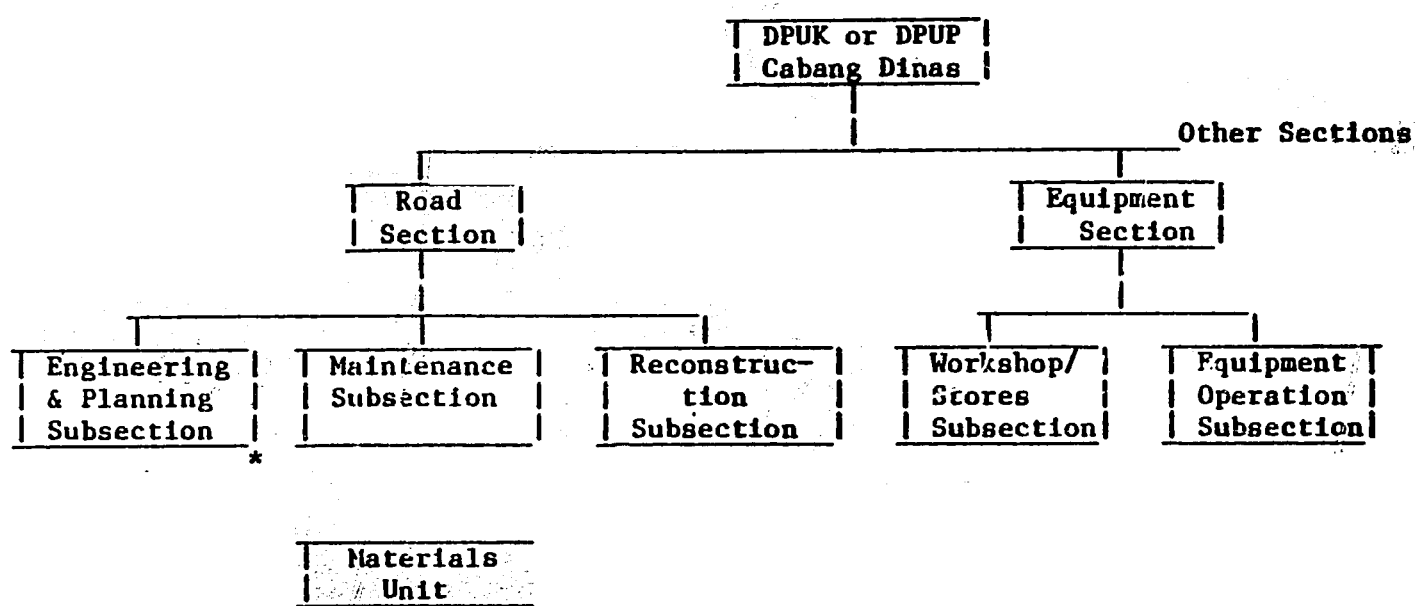
FIGURE 2

MODEL ORGANIZATION




* Possible location for Materials Unit

### 5.4.2 Reconstruction Subsection (Rehabilitation and Betterment)

This section should be responsible for overseeing and supervising road construction and rehabilitation work carried out by contractors. This will require a capacity to understand and interpret technical requirements, conduct field investigations, and undertake spot checks of construction and rehabilitation work. For the districts with a Model Force Account Crew, this section should supervise its operations.

The Chief of this subsection should be at least a graduate of a secondary technical school (STM), although a graduate of a general secondary school (SMA) may be acceptable with additional technical training and experience. A supervisor will also be required to oversee the work of the Model Force Account Crew. For this position, considerable experience at the field level is probably more important than formal academic qualifications, although the foreman should be fully capable of reading and understanding technical guidelines, plans and drawings. This supervisor will require between two and five assistants with responsibility for specific tasks such as surveying, equipment management, road works, bridge and culvert rehabilitation. The size of the force account field crew (see Table 13) will in part depend on the size of the district and the extensiveness of its road system. However, the crew should be large enough to undertake all aspects of road rehabilitation work, and therefore should include approximately six equipment operators. All the above staff should be permanently appointed civil servants. Few of the eleven project districts meet this requirement at present.

In addition, the Model Force Account Crew will require non-permanent staff including foremen (mandors), drivers and skilled or semi-skilled laborers, along with 180 manual laborers to carry out rehabilitation and betterment work. This category of staff need not be permanent civil servants and could be contracted on an annual, monthly or daily basis.

Finally, this section will require two technicians to assist with the planning, oversight and assessment of the use of materials in road construction and rehabilitation. These staff members should be graduates of a secondary technical school (STM), with field experience and additional technical training.

### 5.4.3 Maintenance Subsection

The project will require the creation of a separate unit explicitly charged with the implementation of the district's maintenance program. This will involve both force account work crews and, potentially, the use of private contractors, roadmen and, possibly, community groups in carrying out routine and periodic maintenance tasks.

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TABLE 13

RECOMMENDED PERSONNEL LEVEL FOR
MODEL FORCE ACCOUNT CREW

A. REHABILITATION AND BETTERMENT

Permanent Staff :

| | |
|---|---|
| Section Head | 1 |
| Supervisor | 1 |
| Assistant Supervisors | 2 - 5 |
| Operators * | 6 |
| Sub Total | 10-13 |

Non-permanent Staff

| | |
|---|---|
| Mandors | 10 |
| Drivers * | 6 |
| Skilled laborers | 10 |
| Semi-skill laborers | 10 |
| Manual laborers | 180 |
| Sub Total | 216 |

Total Staff Requirement

B. MAINTENANCE (MINIMUM CREW SIZE)

| | |
|---|---|
| Foreman | 1 |
| Operators | 3 |
| Drivers | 5 |
| Skilled laborers | 2 |
| Semi-skilled laborers | 2 |
| Workers | 10 |

Total Staff Requirement 23

* Number of staff required is based on equipment specified in Table 28.

This subsection should be supervised by a Chief who is preferably an STM or SMA graduate who has at least 10 years field experience and some additional technical training. The Chief should be assisted by one supervisor responsible for the work of each force account crew. The supervisor will need two to five assistants to help oversee, supervise and monitor the work of both force account crews and contractors. For this work practical experience is of greater importance than formal academic requirements. The chief and the supervisor should be permanent employees.

The force account crew for maintenance will depend upon the size of the district and the extensiveness of the road network. Tables 14 and 15 provide specific proposals for each of the project districts in South Sulawesi and NTT.

### 5.4.4 Materials Unit

A key element of quality control and field construction supervision is the ability to test construction materials and completed construction. Slump tests, compaction rates, gravel analysis, etc. require specialized tests to see if they are within specifications. The individual in charge of the materials unit should be a permanent employee and hold an STM, at a minimum. The unit's main responsibilities are to perform the necessary field tests on maintenance and rehabilitation work, to collect samples, prepare test reports, and notify the individual in charge in case of a deficiency.

### 5.4.5 DPUK Equipment Section, Workshop/Stores Subsection

The management of DPUK equipment is an essential part of the overall road management and maintenance program. The equipment staff are responsible for ensuring that road construction and maintenance equipment are kept in good working order, routinely checked and maintained, and that the minimum amount possible of down time occurs for any given piece of equipment. This will require skills in the areas of small component repairs, tire repair, lubrication, large equipment maintenance and repair, welding and soldering, stock management and machine shop management.

To carry out these responsibilities, the equipment section will require a Chief with a bachelors degree in equipment engineering. Recommended staff for this subsection include 10 positions that require a total of 18 persons to perform tasks in each DPUK Workshop. The recommended personnel consist of:

| Office | Quantity |
|---|---|
| 1. Equipment Section Chief | 1 (P) |
| 2. Workshop/Store Subsection Chief | 1 (P) |
| 3. Equipment/Operational Subsection Chief | 1 (P) |
| 4. Administrative Subsection Chief | 1 (P) |

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TABLE 14

MAINTENANCE CREW PERSONNEL REQUIRED FOR
SOUTH SULAWESI, 1ST AND 7TH YEARS OF OPERATION

| Maintenance Crews Calculated and Assigned | | Year | 1st Calc. | 1st Assign | 7th Calc. | 7th Assign |
|---|---|---|---|---|---|---|
| Pinrang | Routine | Routine | 1.1 | 1 | 0.9 | 1 |
| | | Smoothing | 0.1 | - | 0.2 | - |
| | Periodic | Resealing | 0.1 | - | 0.1 | - |
| | | Regraveling | 0.1 | 1 | 0.1 | 1 |
| | | Reshaping | 0.1 | - | 0.3 | - |
| Sidrap | Routine | Routine | 1.3 | 1 | 1.8 | 2 |
| | | Smoothing | - | - | 0.1 | - |
| | Periodic | Resealing | 0.2 | 1 | 0.2 | - |
| | | Regraveling | - | - | 0.1 | 1 |
| | | Reshaping | - | - | 0.3 | - |
| Sinjai | Routine | Routine | 0.2 | 1 | 0.7 | 1 |
| | | Smoothing | - | - | 0.2 | - |
| | Periodic | Resealing | - | - | - | - |
| | | Regraveling | - | - | 0.1 | - |
| | | Reshaping | - | - | 0.4 | 1 |
| Bone | Routine | Routine | 0.8 | 1 | 2.2 | 2 |
| | | Smoothing | 0.1 | - | 0.5 | - |
| | Periodic | Resealing | 0.1 | - | 0.1 | - |
| | | Regraveling | - | - | 0.2 | 1 |
| | | Reshaping | 0.3 | 1 | 0.9 | 1 |
| Bulukumba | Routine | Routine | 0.2 | 1 | 1.5 | 2 |
| | | Smoothing | - | - | 0.3 | - |
| | Periodic | Resealing | - | - | - | - |
| | | Regraveling | - | - | 0.1 | 1 |
| | | Reshaping | - | - | 0.8 | 1 |
| Jeneponto | Routine | Routine | 1.1 | 1 | 1.3 | 1 |
| | | Smoothing | 0.2 | - | 0.3 | - |
| | Periodic | Resealing | 0.1 | - | - | - |
| | | Regraveling | 0.1 | - | 0.2 | 1 |
| | | Reshaping | 0.3 | 1 | 0.6 | 1 |
| Takalar | Routine | Routine | 0.9 | 1 | 0.5 | 1 |
| | | Smoothing | - | - | - | - |
| | Periodic | Resealing | 0.2 | - | 0.1 | - |
| | | Regraveling | - | - | - | - |
| | | Reshaping | - | - | 0.1 | 1 |
| Province Totals | Routine | Routine | | 7 | | 8 |
| | | Smoothing | | - | | - |
| | Periodic | Resealing | | 1 | | - |
| | | Regraveling | | 1 | | 5 |
| | | Reshaping | | 2 | | 5 |

| Resource Calculations | | No. of Kilometers/Crew/Year Type of Road - Inventory | | |
|---|---|---|---|---|
| District Road MTCE Work | | Sealed | Gravel | Earth |
| Routine | Routine | 60 | 100 | 125 |
| | Smoothing | - | 400 | 400 |
| Periodic | Resealing | 350 | - | - |
| | Regraveling | - | 450 | |
| | Reshaping | - | 200 | 200 |

TABLE 15

MAINTENANCE CREW PERSONNEL REQUIRED FOR
NTT, 1ST AND 7TH YEARS OF OPERATION

| Maintenance Crews Calculated and Assigned | | Year | 1st Calc. | 1st Assign | 7th Calc. | 7th Assign |
|---|---|---|---|---|---|---|
| Kupang | Routine | Routine | 0.5 | 1 | 1.5 | 2 |
| | | Smoothing | 0.1 | - | 0.4 | - |
| | Periodic | Resealing | - | - | - | - |
| | | Regraveling | 0.1 | 1 | 0.2 | 1 |
| | | Reshaping | 0.1 | - | 0.7 | 1 |
| TTS | Routine | Routine | 0.3 | 1 | 2.4 | 3 |
| | | Smoothing | 0.1 | - | 0.7 | - |
| | Periodic | Resealing | - | - | - | - |
| | | Regraveling | - | - | 0.1 | 1 |
| | | Reshaping | 0.2 | - | 1.4 | 1 |
| Belu | Routine | Routine | 0.1 | - | 0.9 | 1 |
| | | Smoothing | - | - | 0.2 | - |
| | Periodic | Resealing | - | - | - | - |
| | | Regraveling | - | - | 0.1 | 1 |
| | | Reshaping | 0.1 | - | 0.5 | - |
| TTU | Routine | Routine | 0.3 | 1 | 1.3 | 2 |
| | | Smoothing | - | - | 0.3 | - |
| | Periodic | Resealing | 0.1 | - | 0.1 | - |
| | | Regraveling | - | - | - | - |
| | | Reshaping | - | - | 0.5 | 1 |
| Province Totals | Routine | Routine | | 2 | | 8 |
| | | Smoothing | | - | | - |
| | Periodic | Resealing | | - | | - |
| | | Regraveling | | 1 | | 3 |
| | | Reshaping | | - | | 3 |

| Resource Calculations | | No. of Kilometers/Crew/Year Type of Road - Inventory | | |
|---|---|---|---|---|
| District | Road MTCE Work | Sealed | Gravel | Earth |
| Routine | Routine | 60 | 100 | 125 |
| | Smoothing | - | 400 | 400 |
| Periodic | Resealing | 350 | - | - |
| | Regraveling | - | 450 | - |
| | Reshaping | - | 200 | 200 |

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Workshop-Warehouse

| | |
|---|---|
| 5. Mechanics/Servicemen/Electrician | 4 (P) |
| 6. Welder | 1 (NP) |
| 7. Storeman | 1 (P) |
| 8. Dispatcher | 1 (P) |
| 9. Helpers | 6 (NP) |
| 10. Typist/File Clerk | 1 (NP) |
| | 18 |

Note : P = Permanent Staff
NP = Non Permanent Staff

### 5.4.6 Equipment Operation Subsection

The Equipment Operation Subsection runs the fleet of heavy equipment required for maintenance and rehabilitation. It monitors the condition of all equipment and alerts the other sections as to when a piece of equipment is due for service or repair. Table 16 shows the number of staff required to support a major function of this subsection in the two districts which have model force account crews for rehabilitation. (Total staffing needs for each section/subsection are shown in Tables 17 and 18.)

## 5.5 STAFFING REQUIREMENTS

Data are available in USAID/Indonesia files listing the number of people employed in each DPUK, by discipline. It is not always clear however, in what capacity the individuals serve, or if individual staff members are responsible for more than one area of expertise. For example, drivers, equipment operators and servicemen are frequently interchangeable. Engineers and planners are equally flexible in their assignments. Tables 17 and 18 provide an approximate indication of existing and proposed staffing needs in the 11 project districts. Based on the Mission's recent experience in determining provincial staff needs, it should be noted that the two tables should serve only as a guide to the number and type of skills required. The goal is to make the most effective use of existing staff and not to hire new staff.

## 5.6 RELATION WITH DPUP

The personnel required at the district level will be supplemented by personnel at the provincial level with specified responsibility for monitoring and supporting the work of the DPUK. The monitoring function is to ensure that the policy directives formulated at the national level are properly understood and implemented, and the support function is to assist the DPUK in meeting project objectives by providing technical information, guidance and assistance where required.

TABLE 16

EQUIPMENT OPERATOR REQUIREMENTS:
REHABILITATION EQUIPMENT FOR MODEL FORCE ACCOUNT DISTRICTS

| Type of Equipment | Number of Units | Number of Operators | Number of Drivers |
|---|---|---|---|
| - Bulldozer w/Ripper 100 HP, 12 ton | 1 | 1 | — |
| - Motor Grader 100 HP, 9 ton | 1 | 1 | — |
| - Wheel Loader 80 HP, 8 ton, 1.2 $m^3$ | 1 | 1 | — |
| - Vibrator Roller 65 HP, 6 ton self proppelled | 1 | 1 | — |
| - Asphalt Sprayer w/ spray bar, 800 l, one burner towed | 1 | 1 | — |
| - Dump Truck, 130 HP, 5 ton load | 4 | — | 4 |
| - Water Tank Truck 130 HP, 4000 ltr | 1 | — | 1 |
| - Flat Bed Truck 45 HP, 3.5 ton | 1 | — | 1 |
| - Rock Crusher w/Screens 30 TPH | 1 | 1 | — |
| TOTAL | 12 | 6 | 6 |

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TABLE 17

SUMMARY OF EXISTING AND PROPOSED STAFFING NEEDS,
SOUTH SULAWESI

| Position | Staff Requirement | | Availability of Existing Staff | | Ex. Non-Permanent Staff Assigned as Permanent Staff | Net New Staff Needed | |
|---|---|---|---|---|---|---|---|
| | Permanent | Non-Permanent | Permanent | Non-Permanent | | Permanent | Non-Permanent |
| Road Section | | | | | | | |
| -Chief | 7 | 0 | 7 | 0 | 0 | 0 | 0 |
| Engineering and Planning Subsection | | | | | | | |
| -Chief | 7 | 0 | 6 | 0 | 0 | 1 | 0 |
| -Technical Staff | 28 | 0 | 16 | 0 | 0 | 12 | 0 |
| Maintenance Subsection | | | | | | | |
| -Chief | 7 | 0 | 5 | 0 | 0 | 2 | 0 |
| -Supervisor (Maint. Foreman) | 7 | 0 | 3 | 0 | 0 | 4 | 0 |
| -Assistant Supervisor | 14 | 0 | 6 | 0 | 0 | 8 | 0 |
| Materials Unit | | | | | | | |
| -Chief | 7 | 0 | 4 | 0 | 0 | 3 | 0 |
| -Technician | 0 | 14 | 0 | 9 | 0 | 0 | 8 |
| Reconstruction Subsection | | | | | | | |
| -Chief | 7 | 0 | 4 | 0 | 0 | 3 | 0 |
| -Contractor Supervisor | 7 | 0 | 4 | 0 | 0 | 3 | 0 |
| -Assistant Supervisor | 2 | 0 | 0 | 0 | 0 | 2 | 0 |
| Workshop/Store Subsection | | | | | | | |
| -Chief | 7 | 0 | 4 | 0 | 0 | 3 | 0 |
| -Mechanics/Electrician | 28 | 0 | 19 | 6 | 5 | 10 | 0 |
| -Operators | 41 | 0 | 13 | 33 | 23 | 5 | 0 |
| -Dispatcher | 7 | 0 | 5 | 0 | 0 | 2 | 0 |
| Equipment Operation Subsection | | | | | | | |
| -Equipment Foreman | 7 | 0 | 3 | 1 | 1 | 3 | 0 |
| Administrative Subsection | | | | | | | |
| -Administrator | 7 | 0 | 6 | 0 | 0 | 1 | 0 |
| -Clerks/Typist | 0 | 21 | 16 | 3 | 0 | 0 | 11 |
| Total | 190 | 35 | 121 | 52 | 29 | 62 | 19 |

Note:
1. This calculation is made for 7 project districts: Pinrang, Bone, Sidrap, Sinjai, Bulukumba, Jeneponto, and Takalar.
2. From the 7 project districts, only Jeneponto has a force acount crew for road rehabilitation work.
3. Numbers may not add or subtract correctly reading across or down the table since the table is compiled from district-by-district calculations and thus assumes existing staff are not reallocated between districts.

TABLE 18

SUMMARY OF EXISTING AND PROPOSED STAFFING NEEDS,
NTT

| Position | Staff Requirement | | Availability of Existing Staff | | Ex. Non-Permanent Staff Assigned as Permanent Staff | Net New Staff Needed | |
|---|---|---|---|---|---|---|---|
| | Permanent | Non-Permanent | Permanent | Non-Permanent | | Permanent | Non-Permanent |
| Road Section | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| Engineering and Planning Subsection | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Technical Staff | 12 | 0 | 15 | 0 | 0 | 0 | 0 |
| Maintenance Subsection | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Supervisor (Maint. Foreman) | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Assistant Supervisor | 6 | 0 | 6 | 0 | 0 | 0 | 0 |
| Materials Unit | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Technician | 0 | 6 | 0 | 6 | 0 | 0 | 0 |
| Reconstruction Subsection | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Contractor Supervisor | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Assistant Supervisor | 2 | 0 | 2 | 0 | 0 | 0 | 0 |
| Workshop/Store Subsection | | | | | | | |
| -Chief | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| -Mechanics/Electrician | 12 | 0 | 20 | 0 | 0 | 0 | 0 |
| -Operators | 21 | 0 | 23 | 0 | 0 | 4 | 0 |
| -Dispatcher | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| Equipment Operation Subsection | | | | | | | |
| -Equipment Foreman | 3 | 0 | 3 | 0 | 0 | 0 | 0 |
| Administrative Subsection | | | | | | | |
| -Administrator | 3 | 0 | 3 | 0 | 0 | 1 | 0 |
| -Clerks/Typist | 0 | 9 | 20 | 0 | 0 | 0 | 9 |
| Total | 85 | 15 | 119 | 6 | 0 | 4 | 9 |

1. The calculation is only made for 3 project districts: Kupang, TTS, and Belu.
2. Data on personnel from the district of TTU are not available.
3. From the 3 districts, only the district of Kupang has a force acount crew for road rehabilitation work.
4. Numbers may not add or subtract correctly reading across or down the table since the table is compiled from district-by-district calculations and thus assumes existing staff are not reallocated between districts.

To fulfill these two functions, additional provincial staff will be required to assist the districts. These individuals must have both sufficiently high professional and technical qualifications, and extensive experience in road construction, management and maintenance. They must be able to assist the DPUK in road management planning, management of equipment, materials and manpower, oversight and supervision of design and implementation, monitoring standards, and reviewing budgets. To meet these requirements, these support staff must have full technical qualifications as engineers, considerable experience with the implementation of road rehabilitation and maintenance projects, an understanding of the local government administrative system, and an ability to assist without appearing to dominate or direct the DPUK staff.

In addition to the assistance of the above DPUP professional staff, Bina Marga will second one recent graduate engineer to each district. This young engineer will work in the design office together with the TA team member to further upgrade and reinforce DPUK in-house capabilities.

## 6. EQUIPMENT MANAGEMENT

### 6.1 SOURCES OF EQUIPMENT

There is no equipment procurement policy for DPUKs. Although districts may use their own Inpres Roads and Inpres District funds for equipment purchases without unusual restrictions on amount, type, manufacturer or origin, and although these funds may be used to purchase spare parts for any type of equipment, in practice Inpres funds are almost entirely used for road work.

Instead, districts depend on external sources for equipment, and the diversity of external sources leads to a collection of equipment not necessarily appropriate to the districts' needs. Some equipment is left to districts after a national construction project has been completed in the area. Other equipment has been given by Bangda as grants in-kind to complement the Inpres Dati II program (districts were not consulted as to whether they could use the equipment or whether a different type of equipment would be more appropriate. This aid by Bangda, however, has been discontinued since FY 84/85 and it is unlikely that it will be given again in the future). Districts which have received donor assistance for district roads from the World Bank, ADB or OECF continue to utilize project-supplied equipment until it is deadlined.

A final source is equipment owned and pooled by provincial or national public works offices. At the provincial level, an equipment and supplies center (ALKAL) manages equipment repairs and material stocks for work on national and provincial projects within the province. For nationally-owned equipment, Bina Marga operates depots. Each depot stores equipment that is available to surrounding provinces. When available, equipment from ALKALs or Bina Marga depots may be borrowed for short-term needs upon request. There is no charge for the use of the equipment itself. However, if a DPUP operator is sent with the unit, his transportation and per diem costs are borne by the DPUK, as well as the transport cost from the pool to the site (for a Lo-Boy, for example, Bina Marga's Depot in Ujung Pandang charges for fuel and Rp. 17,000/day for the driver).

Although private equipment rental dealers are developing, especially on Java, districts rarely, if ever, use this as a source for meeting equipment needs.

In the RRMS project districts, the equipment now on hand has come from three sources:

OECF: Dump trucks, graders, loaders, dozers, tire rollers, crushers.
BANGDA: Steel wheel rollers, hand compactors, crushers.
DPUP and Bina Marga: Dump trucks, graders, loaders, dozers, asphalt sprayers.

With the exception of compaction equipment (steel wheel rollers and hand compactors), most of the equipment in operating condition is four years old and was provided by the former OECF project. Formally, this OECF equipment belongs to the Ministry of Public Works, although it is assigned to the DPUKs for their use. Of the eleven project districts, five out of seven in South Sulawesi were provided with OECF equipment (Pinrang, Takalar, Sidrap, Bone and Jeneponto) while only one (Belu) in NTT was so provided. OECF equipment now represents 57% of all operating equipment in South Sulawesi and 30% in NTT.

Generally, ALKAL or depot equipment is not a reliable source for district use. Table 19 shows the present fleet of operating road equipment based at the provincial (ALKAL) facilities in Kupang (NTT) and Ujung Pandang (South Sulawesi) as well as in the Bina Marga depot in Ujung Pandang. The fleet based at ALKAL in Kupang consists mostly of old equipment, purchased in the early 1970s with a World Bank loan. Few of these units could be considered of real value to the districts, except for such short specific tasks as the usage of a 3-ton crane truck to help remove the engine of a damaged piece of district equipment in the field. In South Sulawesi, the equipment listed under Depot Bina Marga includes units distributed among the six provinces under Depot VII's jurisdiction. Again, some of these units may be available for such brief specific tasks as using a truck-trailer from the depot to move a piece of heavy equipment to/from a district to/from the workshop in Ujung Pandang.

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## 6.2 EQUIPMENT REQUIREMENTS

### 6.2.1 Maintenance

The first step in identifying equipment requirements was to determine the equipment needed for a crew to perform road maintenance activities. Table 20 indicates the types and quantities of equipment for the following activities:

1) Routine Activities
   1 Dump Truck (3.5 ton)
   1 Hand Compactor

2) Smoothing
   1 Motorgrader (100 HP)

3) Resealing*
   1 Asphalt Sprayer, 800 liter, towed
   2 Dump Trucks (3.5 ton)
   1 Vibrator Roller, self-propelled, 6 ton
   1 Flat Bed Truck (3.5 ton)

4) Regraveling
   1 Motorgrader (100 HP)
   1 Wheel Loader (1.2 $M^3$)
   1 Vibratory Roller, self-propelled, 6 ton
   4 Dump Trucks (3.5 ton)
   1 Water Tank Truck, 4000 l

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* Resealing is a periodic maintenance activity. It will be performed by a contractor until such time as there is enough work every year to occupy a complete resealing crew.

TABLE 19

AVAILABILITY OF PROVINCIAL AND BINA MARGA EQUIPMENT

| Item No. | Type of Equipment | Manu-facturer | Model | Year* | NTT DPUP/ALKAL | | South Sulawesi DPUP/ALKAL | | Depot** (Bina Marga) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Good | NMR | Good | NMR | Good | NMR |
| 1 | Bulldozer on track | KOMATSU/ | D.60A | 1971 | 1 | - | 7 | 0 | 57 | 12 |
| | | FIAT ALLIS/ | 16B | 1978 | 1 | - | | | | |
| | | HALLA | | | | | | | | |
| | | KOMATSU | D-155 | 1982 | - | 1 | | | | |
| 2 | Motor Grader | KOMATSU | GD.36-5H | 1971 | - | 1 | 19 | 2 | 81 | 18 |
| | | KOMASU | GD.31RC | 1980 | 1 | - | | | | |
| 3 | Stone Crusher | JAQUES | JM2014-14 | 1972 | - | 1 | 10 | 2 | 26 | 8 |
| 4 | Loader on wheel | KIMCO HOUGH | JH-60 | 1971 | 1 | - | 18 | 6 | 46 | 16 |
| | | MASSEY FER- | MF-50 | 1974 | - | 1 | | | | |
| | | GUSON | | | | | | | | |
| 5 | Three wheel roller | BARATA | MV-6P | 1969 | 5 | 1 | 5 | 26 | 77 | 54 |
| | | | | 1974 | 6 | - | | | | |
| | | | | 1980 | - | 1 | | | | |
| 6 | Pneumatic roller | SAKAI | TS-7409 | 1980 | 3 | - | 24 | 0 | 74 | 10 |
| 7 | Vibrating roller | BARATA | MGD-1000 | 1983 | 2 | - | 2 | 0 | 10 | 1 |
| | | TAYKIOKU | TR-850 | 1980 | 3 | - | | | | |
| | | | | 1979 | 1 | - | | | | |
| 8 | Grass Cutter | SINAMORE | S20-113 | 1980 | - | 1 | - | - | - | - |
| 9 | Winch Manual | TIRFOR | T35S | 1971 | - | 1 | - | - | - | - |
| 10 | Asphalt Sprayer | LINHOFF- | - | 1971 | - | 1 | 3 | 2 | 10 | 7 |
| | | AUTOMAIN | | | | | | | | |
| | Asph.Sprayer Truck | ISUZU | TXD20 | 1971 | - | 1 | | | | |
| 11 | Fuel Tank Truck | ISUZU | TXD20 | 1971 | - | 1 | 0 | 1 | 4 | 5 |
| 12 | Water Tank Truck | TOYOTA | DA.110 | 1979 | 2 | - | 0 | 5 | 16 | 11 |
| | | ISUZU | TLD-54 | 1980 | 1 | - | | | | |
| 13 | Trailer towed | INTERNATIONAL | SI.T20-I.29 | 1962 | - | 1 | 1 | 1 | 6 | 3 |
| 14 | Dump Truck | ISUZU | TXD20 | 1971 | 2 | - | 192 | 53 | 463 | 152 |
| | | ISUZU | TLD 54S | 1980 | 4 | - | | | | |
| | | IH-1850 | Loadstar | 1976 | 2 | - | | | | |
| | | TOYOTA DYNA | BU-30 | 1980 | 3 | 1 | | | | |

Notes: NMR = Needs minor repairs

* Year applies to NTT only. Age for South Sulawesi equipment could not be obtained.

** Most depot equipment is presently spread and being used in the six provinces under Depot VII's jurisdiction.

Table X

TABLE 20

RESOURCES PER CREW, ROUTINE MAINTENANCE

- Routine Activities - Sealed, gravel and earth surfaces; frequency depends on type of road

| Labor | Equipment | Materials (Max Annual) |
|---|---|---|
| (1) Foreman | (1) 3.5 T dump truck | (120) $m^3$ cold mix |
| (1) Driver | (1) Hand operated compactor | (1440) l asphalt prime sealed road |
| (10) Workers | | (315) $m^3$ gravel - gravel roads |

- Grader Smoothing - Gravel and earth surfaces; 2 x /yr; 800 km work/year per 400 km inventory

| Labor | Equipment | Materials |
|---|---|---|
| (1) Operator | (1) Motorgrader 100 HP | None |

Periodic Maintenance

- Resealing - Sealed surfaces; 80 km work/year; 1 x ea 4.4 years avg. per 350 km inventory

| Labor | Equipment | Materials (Max Annual) |
|---|---|---|
| (1) Foreman | (1) Tractor (farm type) | (1,100) $m^3$ 1st Coarse stone |
| (2) Operators | (1) Broom attachment (optional) | (95,700) l 1st Coarse asphalt |
| (3) Drivers | (1) Asphalt sprayer 800 l | (1,100) $m^3$ 2nd coarse stone)-DBST |
| (2) Skilled | (2) 3.5 T dump truck | (99,000) l 2nd coarse asphalt |
| (2) Semi-skilled | (1) Asphalt tank (optional) | |
| (10) Workers | (1) Flat bed truck 3.5 T | |

- Regraveling - Gravel surfaces; 150 km work/yr; 1 x ea 3 yrs per 450 km inventory

| | | |
|---|---|---|
| (1) Foreman | (1) Motorgrader 100 HP | (33,000) $m^3$ crushed aggregate (well-graded or select material) |
| (3) Operators | (1) Loader 1.2 $m^3$ | |
| (4) Drivers | (1) Vibratory roller | |
| (1) Driver | (4) 3.5 T dump truck | |
| (4) Workers | (1) Water tank truck | |

- Reshaping - Gravel & earth surfaces 200 km work/yr 1 x per yr per 200 km inv.

| Labor | Equipment | Materials |
|---|---|---|
| (1) Foreman | (1) Motorgrader 100 HP | None |
| (2) Operators | (1) Vibratory roller | |
| (1) Driver* | (1) Water truck* | |
| (2) Workers | | |

*Not needed if the work is performed when the surface is moist.

Other Maintenance

| Labor | Equipment | Materials |
|---|---|---|
| As required | (1) Flat bed truck, 3.5 T | As required |
| | (1) Concrete mixer 0.1 $m^3$ | |

5) Reshaping
1 Motorgrader (100 HP)
1 Vibratory Roller, self-propelled, 6 ton
1 Water Tank Truck, 4000 l.

6) Other Maintenance

1 Flat Bed Truck (3.5 ton)
1 Concrete Mixer (0.10 $m^3$)

At the beginning of the first year of operations, all districts should have equipment for routine activities, smoothing and reshaping. This includes one each of the following: motorgrader, dump truck, vibratory roller, water tank truck, and hand compactor.

The next step is to obtain the number of crews required for each of the maintenance activities. The calculated number of crews is derived from Tables 21 and 23 for South Sulawesi, and Tables 22 and 24 for NTT. The calculated number of crews are given in fractions. A conservative approach was taken to combine the fractional amount of work required for equipment of the same type. For example: smoothing, reshaping and regraveling all require a motorgrader. The sum of the fractions of motorgrader needed for each activity gives the total number of required motorgraders. If the sum is above a full number, for example 1.1 or 2.1, then an additional unit is added. Tables 25 and 26 are samples of the calculations done for one district. They summarize the calculated and assigned quantities of equipment required in the 1st and 7th year of operations in Pinrang District, South Sulawesi. A complete set of tables for all districts is available in USAID/Indonesia files.

Hand compactors are used for pot-hole patching of asphalt-paved surfaces. Because this activity is not done all the time, the quantity of hand compactors needed is estimated in the tables as a fraction (50%) of the number of routine activity crews. Flat bed trucks and concrete mixers are needed for other types of maintenance work such as repairs to bridge and drainage structures, sign maintenance, etc. One unit per district was estimated. A wheel loader is needed for regraveling operations. Whenever this operation is performed on a scale requiring a regraveling crew, one wheel loader will be added to the list of required equipment. A regraveling crew is either formed at the beginning of the first or at the beginning of the fourth year of operations, depending on the requirements of the work program. If the crew is only formed in the fourth year, at that time, a wheel loader and four dump trucks should be added.

### 6.2.2 Rehabilitation

Rehabilitation equipment will only be required in the two districts with Model Force Account Crews. The following criteria were considered for selecting the types and sizes of rehabilitation equipment:

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TABLE 21
ROAD INVENTORY: SOUTH SULAWESI

| | | Asphalt | | | | | Gravel | | | | | Earth | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G | MOD | D | HD | TOT | G | MOD | D | HD | TOT | G | MOD | D | HD | TOT | |
| Pinrang | Km | 32 | 45 | 14 | - | 92 | 108 | 45 | 27 | - | 180 | - | 94 | 24 | - | 118 | 390 |
| Sidenreng Rappang | Km | 9 | 356 | 60 | - | 425 | - | 79 | 35 | 45 | 159 | - | - | - | 63 | 63 | 647 |
| Sinjai | Km | 6 | 13 | 5 | 0 | 24 | 11 | 69 | 81 | 0 | 161 | - | 5 | 158 | - | 163 | 348 |
| Bone | Km | 14 | 40 | 90 | 26 | 170 | 35 | 99 | 220 | 65 | 419 | 43 | 121 | 268 | 79 | 511 | 1100 |
| Bulukumba | Km | - | 40 | 37 | - | 77 | - | 26 | 172 | 58 | 256 | - | 98 | 133 | 222 | 453 | 786 |
| Jeneponto | Km | 34 | 15 | 10 | 20 | 79 | 85 | 27 | 35 | 204 | 351 | 82 | 13 | 17 | 52 | 164 | 594 |
| Takalar | Km | 46 | 43 | 11 | - | 100 | 0 | 47 | 43 | - | 90 | - | 10 | 14 | 0 | 24 | 214 |
| Province Total | | 141 | 552 | 227 | 46 | 966<br>24% | 239 | 392 | 613 | 372 | 1616<br>40% | 125 | 341 | 614 | 416 | 1496<br>36% | 4078 |

G = Good MOD = Moderate D = Damaged HD = Heavily Damaged

TABLE 22

ROAD INVENTORY: NTT

| | | Aaphalt | | | | | Gravel | | | | | Earth | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G | MOD | D | HD | TOT | G | MOD | D | HD | TOT | G | MOD | D | HD | TOT | Total |
| Kupang | Km | 15 | 7 | - | - | 22 | 69 | 111 | 199 | 49 | 428 | - | - | 90 | 216 | 306 | 756 |
| TTS | Km | - | 8 | - | - | 8 | - | 291 | - | - | 291 | - | 1131 | - | - | 1131 | 1430 |
| Belu | Km | - | 1 | - | - | 1 | - | 209 | 82 | - | 291 | - | - | 202 | - | 202 | 494 |
| TTU | Km | - | 96 | 0 | 2 | 98 | 10 | 10 | 10 | - | 30 | 0 | 0 | 0 | 538 | 538 | 666 |
| Province Total | | 15 | 112 | 0 | 2 | 129<br>4% | 79 | 621 | 291 | 49 | 1040<br>31% | 0 | 1131 | 292 | 754 | 2177<br>65% | 3346 |

G = Good MOD = Moderate D = Damaged HD = Heavily Damaged



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TABLE 23

MAINTENANCE PROGRAM:
SOUTH SULAWESI

(number of kilometers that can be maintained in years one and seven)

| Year / Type of Road | 1st S | 1st G | 1st E | 7th S | 7th G | 7th E |
|---|---|---|---|---|---|---|
| Pinrang<br>Total Km<br>Existing Network = 390 Km | 41 | 29 | 10 | 18 | 36 | 24 |
| Sidenreng Rappang<br>Total Km<br>Existing Network = 638 Km | 80 | 4 | 0 | 85 | 32 | 13 |
| Sinjai<br>Total Km<br>Existing Network = 348 Km | 9 | 7 | 0 | 5 | 32 | 33 |
| Bone<br>Total Km<br>Existing Network = 1099 Km | 22 | 14 | 34 | 34 | 84 | 102 |
| Bulukumba<br>Total Km<br>Existing Network = 786 Km | 8 | 0 | 10 | 15 | 51 | 91 |
| Jeneponto<br>Total Km<br>Existing network = 594 Km | 37 | 23 | 42 | 16 | 70 | 33 |
| Takalar<br>Total Km<br>Existing network = 214 Km | 55 | 3 | 0 | 20 | 18 | 5 |
| Provincial Maintenance Total Km | 252 | 80 | 96 | 193 | 323 | 301 |

S = Sealed G = Gravel E = Earth

Note: USAID files contain computer printouts showing the kilometers of district road per district that will be maintained each year.

TABLE 24

MAINTENANCE PROGRAM:
NTT

(number of kilometers that can be maintained in years one and seven)

| Year / Type of Road | 1st S | 1st G | 1st E | 7th S | 7th G | 7th E |
|---|---|---|---|---|---|---|
| Kupang<br>Total Km<br>Existing Network = 756 Km | 16 | 23 | 0 | 4 | 86 | 61 |
| TTS<br>Existing Network = 1430 Km | 2 | 5 | 38 | 2 | 58 | 223 |
| Belu<br>Total Km<br>Existing Network = 494 Km | 0 | 10 | 0 | 0 | 58 | 40 |
| TTU<br>Total Km<br>Existing Network = 666 Km | 19 | 3 | 0 | 20 | 6 | 108 |
| Provincial Maintenance Total Km | 37 | 41 | 38 | 26 | 208 | 435 |

S = Sealed G = Gravel E = Earth

Note: USAID files contain computer printouts showing the kilometers of district road per district that will be maintained each year.

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TABLE 25

EQUIPMENT NEEDS FOR ANNUAL ROAD MAINTENANCE PROGRAM: 1ST YEAR, PINRANG KABUPATEN, SOUTH SULAWESI

| Item | Maintenance Activity | Number of Crews | Dump Truck | Motor Grader | Wheel Loader | Vibrat. Roller | Water Truck | Flat Bed Truck | Hand Compact. | Concrete Mixer |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Routine Activities | 1.1 | 1.1 | - | - | - | - | - | 1.1 | 1.1 |
| 2 | Smoothing | 0.1 | - | 0.1 | - | - | - | - | - | - |
| 3 | Reshaping | 0.1 | - | 0.1 | - | 0.1 | 0.1* | - | - | - |
| 4 | Regraveling | 0.1 | 4** | 0.1 | 0.1 | 0.1 | 0.1 | - | - | - |
| 5 | Other | 1.0 | - | - | - | - | - | 1.0 | - | 1 |
| | Total Calculated | | 5.1 | 0.3 | 0.1 | 0.2 | 0.2 | 1.0 | 1.1 | 2.1 |
| | Total Assigned | | 6 | 1 | 1 | 1 | 1 | 1 | 1*** | 2 |

NOTE: Total calculated quantities of equipment per crew reflect the equipment needed in the first year of maintenance operations.
Total assigned quantities of equipment per crew reflect the equipment needed through the third year but delivered at the beginning of the first year of maintenance operations.

* Water tank truck is not needed for reshaping activity when the surface is moist.
** Dump trucks are needed for regraveling as a complete group of four units.
*** Hand compactors are needed as approximately one-half of number of crews for routine activities.

TABLE 26

EQUIPMENT NEEDS FOR ANNUAL ROAD MAINTENANCE PROGRAM: 7TH YEAR, PINRANG DISTRICT, SOUTH SULAWESI

| Item | Maintenance Activity | Number of Crews | Dump Truck | Motor Grader | Wheel Loader | Vibrat. Roller | Water Truck | Flat Bed Truck | Hand Compact. | Concrete Mixer |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Routine Activities | 0.9 | 0.9 | - | - | - | - | - | 0.9 | - |
| 2 | Smoothing | 0.2 | - | 0.2 | - | - | - | - | - | - |
| 3 | Reshaping | 0.3 | - | 0.3 | - | 0.3 | 0.3* | - | - | - |
| 4 | Regraveling | 0.1 | 4** | 0.1 | 0.1 | 0.1 | 0.1 | - | - | - |
| 5 | Other | 1.0 | 1.0 | 1.0 | - | - | - | 1.0 | - | 1.0 |
| | Total Calculated | | 5.9 | 1.6 | 0.1 | 0.4 | 0.4 | 1.0 | 0.9 | 1.0 |
| | Total Assigned | | 6 | 2 | 1 | 1 | 1 | 1 | 1*** | 1 |

NOTE: Total calculated quantities of equipment per crew reflect the equipment needed in the seventh year of maintenance operations.
Total assigned quantities of equipment per crew reflect the equipment needed through the seventh year but delivered at the beginning of the fourth year of maintenance operations.

* Water tank truck is not needed for reshaping activity when the surface is moist.
** Dump trucks are needed for regraveling as a complete group of four units.
*** Hand compactors are needed as approximately one-half of number of crews for routine activities.

- The estimated type and kilometers of rehabilitation work are shown in Section 9.3. Approximately two-thirds of the work will be on gravel and earth roads.
- Large-sized equipment was avoided due to the narrowness of district roads.
- Uniformity with existing types of equipment is preferred to facilitate repairs and operations.
- Complex equipment was omitted.
- The capacity of the equipment is a function of the volume of reconstruction work.
- With the exception of crawler-type bulldozers, all the equipment should move on wheels.

The types and quantities of equipment required for a basic district fleet are shown in Table 27, and are discussed below. The bulldozer should come equipped with a ripper. It will be used in the quarries and to assist in the road work. The size and type of motorgrader should be the same as for road maintenance, to simplify service and repair as well as logistics. The same reasoning applies to the selection of wheel loaders, vibratory rollers, water tank trucks and flat bed trucks. The asphalt sprayer should come equipped with a spraybar for sealing and resealing of roads. The capacity is dimensioned to the volume of work expected to be performed. Dump trucks for the rehabilitation group should be larger than the ones used for road maintenance. The recommended type has a more powerful engine of approximately 130 HP and a GVW (gross vehicle weight) of at least 8.5 ton. The dump body should be of heavy duty construction and with a minimum struck capacity of 3 $m^3$. A rock crusher/screening plant should be provided to districts that do not have access to a commercial source of crushed aggregate. It should be portable to accompany the rehabilitation group.

Maintenance and rehabilitation equipment needs for the first year are summarized in Tables 28 and 29, for South Sulawesi and NTT, respectively.

## 6.3 AVAILABILITY OF EQUIPMENT

The types and quantities of equipment now operational and available in the project districts are summarized in Tables 30 and 31. Only equipment suited to road maintenance and rehabilitation and only equipment in good or fair condition have been included. Common and abundant types of equipment in the districts, such as three-wheel rollers, are left out.

TABLE 27

EQUIPMENT REQUIREMENTS:
REHABILITATION EQUIPMENT

(for Model Force Account Districts)

| Item No. | Type of Equipment | Main Characteristics | Quantity Required at Beginning of 1st year |
|---|---|---|---|
| 1. | Bulldozer/w Ripper | 100 HP, 12 ton | One |
| 2. | Motorgrader | 100 HP, 9 ton | One |
| 3. | Wheel Loader | 80 HP, 8 ton articulated, 1.2 m3 | One |
| 4. | Roller, Vibratory | 65 HP, 6 ton self-propelled | One |
| 5. | Asphalt Sprayer w/Sprayer Bar | 800 l, one-burner, towed | One |
| 7. | Dump Truck | 130 HP, 5 ton load capacity | Four |
| 8. | Water Tank Truck w/Spray Bar | 130 HP, 4,000 l, tank water pump driven by PTO | One |
| 9. | Flat Bed Truck | 45 HP, 3.5 ton capacity | One |
| 10. | Rock Crusher/ Screens | 30 TPH, portable, electric generator set | One |

SUMMARY OF EQUIPMENT NEEDS IN 1ST YEAR - MAINTENANCE, SOUTH SULAWESI

| Type of Equipment | Pinrang | Sidrap | Sinjai | Bone | Takalar | Jeneponto | | Bulukumba | Total |
|---|---|---|---|---|---|---|---|---|---|
| | MTCE | MTCE | MTCE | MTCE | MTCE | MTCE | REC | MTCE | |
| BullDozer 100 HP, 12 ton | - | - | - | - | - | - | 1 | - | 1 |
| Motorgrader 100 HP | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 9 |
| Wheel Loader 1.2 m3 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| Roller, Vibratory 6 tons | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Asphalt Sprayer, 800 ltr | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 7 |
| Dump Truck, 5 tons | - | - | - | - | - | - | 4 | - | 4 |
| Water Tank Truck 4000 ltr | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Flat Bed Truck, 3.5 ton | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Rock Crusher, 30 TPH | - | - | - | - | - | - | 1 | - | 1 |
| Dump Truck, 3.5 ton | 6 | 3 | 2 | 3 | 2 | 7 | - | 2 | 25 |
| Hand Compactor | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 7 |
| Pick-Up Utility | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Pick-Up 1 Ton | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| SSB Radio | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 21 |
| Motor Cycle 100 cc | 4 | 4 | 3 | 4 | 3 | 5 | - | 3 | 26 |
| Multipurpose Tractor w/a | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 7 |
| Gasoline Engine Jack Hammer | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 7 |
| Jeep Towed Trailer, 2 tons | 2 | 2 | 2 | 2 | 2 | 2 | - | 2 | 14 |
| Mini Vibro Roller, 1 ton | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 7 |
| Concrete Mixer, 0.1 m3 | 2 | 2 | 2 | 2 | 2 | 2 | - | 2 | 14 |
| Concrete Vibrator | 2 | 2 | 2 | 2 | 2 | 2 | - | 2 | 14 |
| Sheep Foot Roller - Towed | - | - | - | - | - | - | 1 | - | 1 |

TABLE 29

SUMMARY OF EQUIPMENT NEEDS IN 1ST YEAR - MAINTENANCE, NTT

| Type of Equipment | Kupang | | TTS* | TTU* | Belu | |
|---|---|---|---|---|---|---|
| | MTCE | REC | MTCE | MTCE | MTCE | Total |
| Bulldozer 100 HP, 12 ton | - | 1 | - | - | - | 1 |
| Motorgrader 100 HP | 1 | 1 | - | - | 1 | 3 |
| Wheel Loader 1.2 m3 | 1 | 1 | - | - | - | 2 |
| Roller, Vibratory 6 tons | 1 | 1 | - | - | 1 | 3 |
| Asphalt Sprayer, 800 ltr | 1 | - | - | - | 1 | 2 |
| Dump Truck, 5 tons | - | 4 | - | - | - | 4 |
| Water Tank Truck 4000 ltr | 1 | 1 | - | - | 1 | 3 |
| Flat Bed Truck, 3.5 ton | 1 | 1 | - | - | 1 | 3 |
| Rock Crusher, 30 TPH | - | 1 | - | - | - | 1 |
| Dump Truck, 3.5 ton | 6 | - | - | - | 1 | 7 |
| Hand Compactor | 1 | - | - | - | 1 | 2 |
| Pick-Up Utility | 1 | 1 | - | - | 1 | 3 |
| Pick-Up 1 Ton | 1 | 1 | - | - | 1 | 3 |
| SSB Radio | 3 | - | - | - | 3 | 6 |
| Motor Cycle 100 cc | 4 | - | - | - | 2 | 6 |
| Multipurpose Tractor w/a | 1 | - | - | - | 1 | 2 |
| Gasoline Engine Jack Hammer | 1 | - | - | - | 1 | 2 |
| Jeep Towed Trailer 2 tons | 2 | - | - | - | 2 | 4 |
| Mini Vibro Roller, 1 ton | 1 | - | - | - | 1 | 2 |
| Concrete Mixer, 0.1 m3 | 2 | - | - | - | 2 | 4 |
| Concrete Vibrator | 2 | - | - | - | 2 | 4 |
| Sheep Foot Roller - Towed | - | 1 | - | - | - | 1 |

* Activities in TTS and TTU are postponed until 4th year of project operation.

TABLE 30

AVAILABILITY OF OPERATING EQUIPMENT, SOUTH SULAWESI

| Type of Equipment | Pinrang | Sidrap | Sinjai | Bone | Takalar | Jeneponto | Bulu-kumba | Total |
|---|---|---|---|---|---|---|---|---|
| Bulldozer 100 HP, 12 ton | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 5 |
| Motorgrader 100 HP | 2 | 2 | 0 | 2 | 1 | 1 | 0 | 8 |
| Wheel Loader 1.2 m3 | 2 | 3 | 0 | 2 | 1 | 2 | 0 | 10 |
| Roller, Vibratory 6 ton | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 9 |
| Roller, Rubber Tired | 2 | 2 | 0 | 2 | 1 | 1 | 0 | 8 |
| Asphalt Sprayer, 800 l | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Dump Truck, 5 ton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water Tank Truck, 4000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flat Bed Truck, 3.5 ton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rock Crusher | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 5 |
| Dump Truck, 3.5 ton | 12 | 14 | 1 | 14 | 5 | 15 | 0 | 61 |
| Hand Compactor | 2 | 4 | 4 | 3 | 4 | 0 | 4 | 21 |
| Concrete Mixer | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 4 |
| Total | 25 | 29 | 8 | 26 | 15 | 23 | 6 | 132 |

TABLE 31

AVAILABILITY OF OPERATING EQUIPMENT, NTT

| Type of Equipment | Kupang | TTS | Belu | TTU* | Total |
|---|---|---|---|---|---|
| Bulldozer 100 HP, 12 ton | 0 | 0 | 3 | 0 | 3 |
| Motorgrader 100 HP | 1 | 0 | 2 | 0 | 3 |
| Wheel Loader 1.2 m3 | 1 | 0 | 2 | 0 | 3 |
| Roller, Vibratory 6 ton | 3 | 2 | 1 | 3 | 9 |
| Roller, Rubber Tired | 1 | 0 | 0 | 0 | 1 |
| Asphalt Sprayer, 800 l | 0 | 0 | 0 | 0 | 0 |
| Dump Truck, 5 ton | 0 | 1 | 0 | 0 | 1 |
| Tailgate Chip Spreader | 0 | 0 | 0 | 0 | 0 |
| Water Tank Truck, 4000 l | 0 | 0 | 0 | 0 | 0 |
| Flat Bed Truck, 3.5 ton | 0 | 0 | 1 | 0 | 1 |
| Rock Crusher | 2 | 0 | 3 | 0 | 5 |
| Dump Truck, 3.5 ton | 5 | 5 | 22 | 7 | 39 |
| Hand Compactor | 4 | 0 | 7 | 0 | 11 |
| Paddlewheel Mixer | 0 | 0 | 0 | 0 | 0 |
| Concrete Mixer | 0 | 0 | 2 | 3 | 5 |
| Total | 17 | 8 | 43 | 13 | 81 |

*Source: Subdirectorate of Rural Roads, January 1984.

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## 6.4 DISPOSITION OF OECF EQUIPMENT

Many of the project districts have equipment which had been procured under OECF projects. It is recommended that this equipment be used as fully as possible and this assumption is incorporated in all existing equipment use calculations and all proposed equipment procurements. Although it is possible that underutilized equipment in good repair, upon inspection by an AID contractor may be assigned for use in an adjoining district, this has not been factored into the calculations of this section.

## 6.5 EQUIPMENT PROCUREMENT REQUIREMENTS

To estimate the total equipment procurement requirements for the duration of the project, it is necessary to add:

- Equipment needed at the beginning of the fourth year of operations (as the rehabilitation program advances, additional kilometers or road will be in need of maintenance);
- Equipment needed for replacements; and
- Support equipment.

A tabulation of the required total amount of road maintenance equipment at the beginning of the fourth year of operations is available in USAID/Indonesia files. The increase in numbers represents the additional equipment that will be required to maintain the rehabilitated sections of road. Except for replacement units, it is estimated that no new rehabilitation equipment will be needed in the fourth year for the Model Force Account districts because the rehabilitation spreads are basically formed by new units acquired at the beginning of the project.

## 6.6 EQUIPMENT NEEDED FOR REPLACEMENT

A replacement program for existing equipment should be considered for the beginning of the fourth year of operations, estimated to occur in 1991. The primary need will be for trucks. The present fleet has 91 dump trucks (3.5 tons each). At the beginning of the project it is estimated that 40 units, reserved strictly for maintenance work, will be needed. Thus, most districts will start the project with twice as many light dump trucks as necessary. Because of their sparse utilization, it is possible that many of these units will be available for continuing light maintenance work in 1991. However, considering that these units will be about nine years old in 1991, it is prudent to assume that 40 new 3.5 ton dump trucks should be added as replacements at the beginning of the fourth year of operations.

The total number of hours of operation for the existing heavy equipment is not accurately known, but a rough estimate can be made from the Hasfarm reports and from a few units observed in the field. An average of 600 hours of operation per year is assumed. On this basis, the OECF heavy equipment currently available averages four years of age, or an estimated 2400 hours of operation. Therefore, they should also be considered for replacement in the mid-life of the project. These units are identified in Table 32.

## 6.7 SUPPORT EQUIPMENT

The requirement for support equipment was estimated taking the following into consideration:

- Each DPUK should receive one pick-up utility truck and one pick-up truck (1 ton) to assist the Road Section and the Equipment Section, respectively, in carrying out inspection and administrative duties. Also, one pick-up truck (1 ton) should be assigned to each rehabilitation group.

- Maintenance crew foremen should be equipped with motorcycles as a means of transportation. The quantity of motorcycles required is in direct proportion to the number of maintenance crews formed for routine activities, reshaping and regraveling work.

- SSB radio equipment should be installed in the DPUK workshops and in the maintenance group pick-ups (mobile units).

A distribution of the support equipment is shown in Table 33.

## 6.8 EQUIPMENT PROCUREMENT COST ESTIMATE

Table 34 lists the equipment to be procured in the first and fourth years of the project. The initial procurement cost will be primarily comprised of heavy equipment necessary to perform road rehabilitation work. Basically, eleven spreads of equipment would be grouped in the early stages of the project in order to bring the districts' highly-trafficked links of road network to maintainable condition.

All support equipment should be available at the same time to ensure that inspectors and foremen can travel to work sites. These vehicles should be assigned exclusively to the project. For this purpose, existing available vehicles in the districts were considered as additional support equipment and were not subtracted from the total to be procured.

TABLE 32

ESTIMATE OF EQUIPMENT REPLACEMENT

| Type of Equipment | Manufacturer | Model | To be Replaced in 1991 |
|---|---|---|---|
| Wheel Loader | KIMCO | JH600 | 1 unit |
| | Fiat Allis | 54SB | 1 unit |
| Stone Crusher | Barata | DDVI | 4 units |
| Dump Truck, 3.5 ton | Toyota Dyna | BU-30 | 40 units |
| Motorgrader | Komatsu | GD-31 | 3 units |
| | Caterpillar | 120 | 1 unit |
| Bulldozer | Caterpillar | D6C | 1 unit |
| | Caterpillar | D7G | 1 unit |

TABLE 33

SUPPORT EQUIPMENT

| Type of Equipment | Total Quantity | Distributed to | Observation |
|---|---|---|---|
| Pick-Up Utility | 11 | 11 DPUK | One unit for each DPUK Road Section |
| Pick-up (1 ton) | 11 | 11 DPUK | One unit for each DPUK Road Section |
| SSB Radio, Base and Mobile Units | 33 | 22 Mobil Units | One each, mobile units<br>One each, DPUK Workshops |
| | | 11 DPUK Workshops | One each at:<br>ALKAL in Kupang<br>ALKAL in Waingapu<br>ALKAL in Ende<br>ALKAL in Ujung Pandang |
| Motorcycles | 38 | 26 Maintenance Crews in S. Sulawesi | One for each Maintenance Crew Foreman at:<br>Pinrang - 4<br>Sidrap - 4<br>Sinjai - 3<br>Bone - 4<br>Takalar - 3<br>Jeneponto - 5<br>Bulukumba - 3 |
| | | 12 Maintenance Crews in NTT | Kupang - 4<br>TTS - 3<br>Belu - 2<br>TTU - 3 |

# TABLE 34

## COST ESTIMATE OF REHABILITATION AND MAINTENANCE EQUIPMENT

| ITEM | TOTAL NUMBER | UNIT COST* | TOTAL COST** | YEAR 1 PROCUREMENT NUMBER | YEAR 1 TOTAL COST | YEAR 1 FUNDING SOURCE LOAN | YEAR 1 FUNDING SOURCE PL 480 *** | YEAR 2 PROCUREMENT NUMBER | YEAR 2 TOTAL COST | YEAR 2 FUNDING SOURCE LOAN | YEAR 2 FUNDING SOURCE PL 480 | YEAR 4 PROCUREMENT NUMBER | YEAR 4 TOTAL COST | YEAR 4 FUNDING SOURCE LOAN | YEAR 4 FUNDING SOURCE PL 480 | ANTICIPATED SOURCE/ORIGIN (FOR LOAN-FUNDED YEAR ONE PROCUREMENT ONLY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINTENANCE & REHABILITATION EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Bulldozer 90 HP,12 tons,w/ripper | 1 | 110,500 | 133,100 | 1 | 133,100 | 133,100 | | 0 | | | | 0 | 0 | 0 | | 941 |
| 2. Motorgrader,100HP | 19 | 70,000 | 1,609,300 | 5 | 423,500 | | 465,850 | 0 | | | | 14 | 11,239,700 | 11,239,700 | | |
| 3. Wheelloader,1.2 m3 | 11 | 70,000 | 931,700 | 3 | 254,100 | 254,100 | | 0 | | | | 8 | 708,400 | 708,400 | | 941 |
| 4. Roller,Vibratory 6 tons | 15 | 60,000 | 1,089,000 | 1 | 72,600 | | 79,860 | 0 | | | | 14 | 11,062,600 | 11,062,600 | | |
| 5. Asphalt Sprayer,800 ltr | 10 | 8,500 | 102,850 | 8 | 82,280 | 82,200 | | 0 | | | | 2 | 21,505 | 21,505 | | 941 |
| 6. Dump Truck, 5 tons | 8 | 25,000 | 242,000 | 8 | 242,000 | | 266,200 | 0 | | | | 0 | 0 | 0 | | |
| 7. Water Tank Truck, 4000 ltr | 15 | 25,000 | 453,750 | 11 | 332,750 | | 366,025 | 0 | | | | 4 | 126,500 | 126,500 | | |
| 8. Flatbed Truck, 3.5 Tons | 11 | 19,900 | 264,869 | 10 | 240,790 | | 264,869 | 0 | | | | 1 | 25,174 | 25,174 | | |
| 9. Dump Truck, 3.5 ton | 71 | 20,000 | 1,718,200 | 4 | 96,800 | | 106,480 | 0 | | | | 67 | 1,695,100 | 1,695,100 | | |
| 10. Hand Compactor | 14 | 1,200 | 20,328 | 1 | 1,452 | | 1,597 | 0 | | | | 13 | 19,734 | 19,734 | | |
| 11. Multipurpose Tractor w/Attach. | 20 | 39,000 | 943,600 | 9 | 424,710 | 351,000 | | 0 | | | | 11 | 542,685 | 542,685 | | 941 |
| 12. Gasoline Engine Jack Hammer | 20 | 3,000 | 72,600 | 9 | 32,670 | 32,670 | | 0 | | | | 11 | 41,745 | 41,745 | | 941 |
| 13. Jeep Towed Trailer, 2 ton | 40 | 1,500 | 72,600 | 18 | 32,670 | | 35,937 | 0 | | | | 22 | 41,745 | 41,745 | | |
| 14. Mini Vibro Roller, 1 ton | 20 | 10,000 | 242,000 | 9 | 108,900 | 108,900 | | 0 | | | | 11 | 139,150 | 139,150 | | 941 |
| 15. Concrete Mixer, 0.1 m3 | 40 | 900 | 43,560 | 18 | 19,602 | | 21,562 | 0 | | | | 22 | 25,047 | 25,047 | | |
| 16. Concrete Vibrator | 40 | 550 | 26,620 | 18 | 11,979 | 11,979 | | 0 | | | | 22 | 15,307 | 15,307 | | |
| 17. Sheep Foot Roller-Towed | 2 | 3,000 | 7,260 | 2 | 7,260 | 7,260 | | 0 | | | | 0 | 0 | 0 | | |
| Sub-total | 357 | | 7,973,537 | 135 | 2,517,163 | 981,217 | 1,608,380 | 0 | 0 | 0 | 0 | 222 | 15,704,391 | 15,704,391 | 0 | |
| SUPPORT EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Pick-up Utility | 24 | 15,000 | 455,400 | 11 | 199,650 | 0 | 219,615 | 0 | | | | 13 | 246,675 | 246,675 | | |
| 2. Pick-up 1 ton | 24 | 10,000 | 303,600 | 11 | 133,100 | 0 | 146,410 | 0 | | | | 13 | 164,450 | 164,450 | | |
| 3. SSB Radio | 27 | 2,900 | 99,630 | 27 | 99,743 | 0 | 109,217 | 0 | | | | 0 | 0 | 0 | | |
| 4. Motor Cycle 100 cc | 70 | 1,200 | 106,260 | 32 | 46,464 | 0 | 51,110 | 0 | | | | 38 | 57,684 | 57,684 | | |
| Sub-total | 145 | | 964,310 | 81 | 473,957 | 0 | 521,353 | 0 | 0 | 0 | 0 | 64 | 468,809 | 468,809 | 0 | |
| WORKSHOP EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. New Workshop | 2 | 100,000 | 200,000 | 2 | 220,000 | 0 | 242,000 | | | | | 0 | 0 | 0 | | |
| 2. Existing Workshop | 9 | 40,000 | 360,000 | 7 | 308,000 | 0 | 338,800 | | | | | 2 | 88,000 | 88,000 | | |
| Sub-total | 11 | | 560,000 | 9 | 528,000 | 0 | 580,800 | 0 | 0 | 0 | 0 | 2 | 88,000 | 88,000 | 0 | |
| MISCELLANEOUS OFFICE/FIELD TOOLS | | | | | | | | | | | | | | | | |
| Average estimated cost of package per district | 11 | 2,000 | 22,000 | | | | | 11 | 22,000 | | | | | 0 | | |
| Actual need determined by Year one Survey | | | | | | | | | | | | | | 0 | | |
| Sub-total | 11 | | 22,000 | 0 | 0 | 0 | 0 | 11 | 22,000 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Grand-total | 524 | | 9,519,847 | 225 | 3,519,120 | 981,217 | 2,710,533 | 11 | 22,000 | 0 | 0 | 288 | 16,261,200 | 16,261,200 | 0 | |

*CIF Jakarta, no spareparts included **CIF Ujung Pandang and Kupang, also includes an additional 10% of CIF Jakarta price for spare parts *** Includes Tax (PPn) 10%

Note : Figures do not add because tax is included in the cost for equipment procured with PL 480 proceeds

The total cost of US$ 9,519,847.00 represents the estimated maximum amount that would be spent on road equipment throughout the project. This is based on current available prices of equipment of Code 941 or Indonesian origin. It is recommended that Bina Marga be responsible for arranging competitive bidding for all of the road equipment.

It is recommended that an equipment engineer be engaged before the the project begins to make a comprehensive condition inventory of the existing equipment in all project districts, as well as any other equipment that could be made available by Bina Marga (a case in point are four new stone crushers (Golden Star) seen by consultants in the yard at the ALKAL workshop in Kupang). The equipment engineer could then select specific units to be transferred to the chosen districts before the start of the project. It is possible that a few units of used heavy equipment in good condition can be found in the yards in Kupang and Ujung Pandang. However, the project should not depend on obtaining much of its required equipment from this source. The USAID project is a long-term one that will use up most of the life of even new equipment; it is thus not advisable to start with old, unreliable equipment. The spread of equipment has to be kept as a complete operating group and the inclusion of an unreliable wheel loader, for example, would disrupt the whole operation.

## 6.9 OWNERSHIP OF PROJECT EQUIPMENT

Initially, Bina Marga should own the project equipment. This will ensure Bina Marga's interest in facilitating repair work from the ALKAL workshops. The equipment should be permanently assigned to the DPUKs (and be identified by code) for exclusive use in force account work. It should not be rented out to contractors.

The issue of ultimately transferring ownership to the districts should be considered only in the context of a broader investigation, under Special Studies, into district equipment policy. This investigation should consider district rental policies, and the capability of the districts to finance and conduct equipment maintenance.

## 6.10 EQUIPMENT STANDARDIZATION

During bid evaluation, care should be taken to standardize, as much as possible, to existing types and makes of equipment. Non-standardization will require increased stocks of spare parts, additional training for mechanics and operators, additional special tools for major repairs, etc. The large amount of Japanese equipment funded by OECF in the two provinces has effectively standardized the fleet, as shown by the following current configuration of operating units in project districts:

| | | |
|---|---|---|
| Motorgrader (Komatsu GD 31) | : 11 out of 11 units | (100%) |
| Bulldozer (Komatsu D50E) | : 4 out of 4 units | (100%) |
| Wheel Loader (Kobelco LK300) | : 12 out of 13 units | ( 92%) |
| Dump Truck (3.5 ton) (Toyota Dyna BJ-30) | : 56 out of 57 | ( 98%) |

Although it is unlikely that large amounts of AID funds can be made available for Japanese equipment, with the exception of trucks for which there are few alternatives with a parts and service capability in-country, it is recommended that standardization be carefully considered in the disposition of GOI contributions to the equipment budget.

## 6.11 RENTING EQUIPMENT TO CONTRACTORS

It has been a common practice for DPUKs to rent out some of their equipment to small contractors for road works. Most of the equipment being rented out is road rollers, as these are the most common type of equipment in the district Public Works fleets. In general, however, there is much confusion in the districts as to what type of equipment can be rented. This depends partly on who owns the equipment (the central government, the province or DPUK) and partly on what type of work the equipment is assigned to do (maintenance or construction). As a rule, in South Sulawesi, all equipment owned by the DPUK as well as OECF equipment designated for road maintenance can be rented to contractors. In Pinrang and Sidrap districts, for example, OECF-financed stone crushers and dump trucks are identified as maintenance equipment and are being rented out. OECF reconstruction equipment, however, may not be rented out. Rental regulations for equipment owned by DPUK are made by the district governments themselves. Terms and rates vary radically from district to district.

The Government of Indonesia is taking tentative steps to phase out equipment rentals to contractors and to encourage contractors to obtain their own equipment. This policy is now in force for Public Works offices at the national and provincial levels but will, apparently, take longer to be effective at the district level because 1) most of the small contractors eligible for district work do not own or have access to equipment other than that provided by the DPUK, and 2) the regulations on the disposition or use of equipment owned by the districts are under the authority of individual Bupatis, not the Ministry of Public Works.

Present rental policies should be examined further under the project. There are indications that subsidized rentals of DPUK-owned equipment act as a disincentive for contractors to purchase their own equipment. They also distort, at least in theory, the choice of equipment/labor combinations. Other alternatives to encourage contractors to purchase the equipment required for quality work should be investigated. The gradual shift to a system in which DPUK equipment is not rented out could be facilitated, for example, by offering a

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continuity of work to local contractors through multi-year contracts; this would attract medium-sized contractors who most probably already own some equipment. Multi-year contracts would also help contractors to obtain equipment financing from local banks, or to make leasing or rental arrangements with equipment suppliers or equipment hire firms.

A small but potentially significant alternative is leasing. Three such firms were contacted for information:

P.T. Amarta Karya (Jakarta),
P.T. United Tractors (Jakarta), and
P.T. Adi Jaya Lima Pradana (Ujung Pandang).

Some are partly owned by the government (Amarta Karya); others are branches of large equipment agents (United Tractors) or are small privately-owned and operated firms (Adi Jaya). In all cases, rental agreements are very flexible. Equipment can be rented with or without operational costs (fuel, oil, parts, repairs), the transportation to the work site is negotiable, and the form of payment is variable. In general, they provide their own operators and mechanics and prefer to have all-inclusive rates for fuel, oil, maintenance, parts, all repairs and mobilization (if within reasonable distances).

## 6.12 THE PROPOSED EQUIPMENT MANAGEMENT SYSTEM

With some exceptions, districts do not have the information or procedures to manage equipment effectively. Procedures for this purpose are already developed and used, however, for Public Works equipment at the provincial and national levels. These should be adapted for use by RRMS project districts.

The objective of an equipment management system is to obtain maximum productivity from the equipment and the people who support it. The four basic elements of equipment management are discussed below.

### 6.12.1 Equipment Control

This consists of maintaining an up-to-date inventory of the equipment fleet. The inventory identifies all units of equipment, the present location of each, and who is responsible for each. It provides information on the utilization of each unit, its condition, and the availability of equipment for reassignment to other work.

### 6.12.2 Servicing and Repair Management

Formal procedures are needed for planning, scheduling and control of equipment maintenance and repair operations. A system of preventive equipment maintenance must be defined and integrated with the scheduling

of other work and control processes. The purpose is to ensure regular attention to routine service so as to prevent excess wear which may lead to breakdowns and more costly repairs.

To maintain control of repair operations, an equipment workshop job order should be used. The form serves several purposes, including:

- documentation of the problems with the unit and the work that is required;
- formal authorization for performing the work; and
- documentation of the actual labor hours, spare parts and materials used in the performance of the work.

The workshop job order becomes the principal source document for cost data related to servicing and repair for individual equipment units.

### 6.12.3 Parts Management

Parts management determines optimum stocks of parts and supplies. It includes procedures for purchasing, warehousing, stock control and issuing of parts. A key element of parts management involves maintaining parts in stock at levels that are effective for equipment servicing and repair and are also affordable. In setting these levels, the storemen must consider such factors as the value of the items, their rate of usage, and local conditions which may influence the ease of procurement from local sources. The management of inventories of parts and supplies requires control of the issuance and receipt of parts so that records reflect current quantities of each.

### 6.12.4 Equipment Costs

Analyses of the effectiveness of equipment use require detailed records of the direct costs of operating and maintaining the equipment. Cost data are also used for developing equipment unit cost rates (imputed rental rates). In addition, equipment rental rates provide a means by which the actual costs of road maintenance or rehabilitation work can be identified. When rental rates include consideration of all equipment-related costs and when the amount of time of equipment usage on maintainance or rehabilitation work is reported (utilization), actual costs of work can be determined for future planning and budgeting.

Rental rates provide a convenient and reliable means for preparing performance-based road maintenance budgets in ways that permit comparison of the cost-effectiveness of different approaches. There are several criteria and procedures commonly employed for measuring equipment usage as a basis for determining the rental rate: cost per kilometer, cost per hour, cost per day, or cost per month. It is suggested that in the RRMS project, equipment unit cost rates for the districts be based on cost per

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day of actual usage. This is the simplest approach for preparing annual work programs and performance budgets. It also provides the easiest way of reporting actual equipment usage. For calculating these unit costs, there are three general cost elements: direct costs (parts, repairs, fuel, oil), indirect costs (overhead items), and depreciation. The categories to be included in the equipment unit cost rate calculation depend on the purpose. If rental rates are to be used for budgeting and control, the indirect costs and/or the depreciation costs may be excluded.

It is recommended that the project adopt equipment unit cost rates (rental rates), reflecting direct costs only, for preparing annual maintenance programs and budgets. This will simplify budgeting and provide adequate funds for fuel, oil, parts, supplies and repairs. Thus, the road work budget should not include these items. Existing procedures at the provincial and national levels are generally adequate for this purpose and should be adopted as the basis for developing an equipment management system in each project district. The following existing Bina Marga forms (which are also found in USAID/Indonesia files) should be used:

- for equipment control:
  - Buku Harian Peralatan
  - Laporan Pemakaian Peralatan (form LLP5)
  - Laporan Bulanan Pemakaian Peralatan (form LBPP);
- for servicing and repair management:
  - Kartu Servis
  - Perintah Kerja Perbaikan Peralatan;
- for parts management:
  - Kartu Persediaan
  - Kartu Rak
  - Bukti Pengeluaran Barang.

Data provided by the system should be compiled in a simplified format (to be developed by Public Works aided by the technical assistance team) as the basis for establishing an average equipment unit cost rate for each type of equipment.

## 7. WORKSHOPS

### 7.1 CURRENT SITUATION

In the Outer Islands, equipment workshops exist only in districts that have received donor assistance. OECF I, World Bank Rural Roads I and ADB Rural Roads I projects have funded these workshops in the past; ADB Rural Roads II and World Bank Rural Roads II are now funding new ones. In the RRMS project, USAID will construct two workshops and will upgrade nine already existing workshops.

The experience with workshops in donor projects has been disappointing: there is no concept of inventory at the district level; there are no master mechanics; there are few tools for repairing equipment; there are missing or incomplete repair manuals; and there are inadequate budgets for equipment maintenance and repair.

The effectiveness of RRMS workshops will require several measures:

- clear responsibilities;
- upgraded capability of mechanics through training programs or new trained mechanics;
- systems for spare parts procurement and parts management;
- systems for maintenance and inventory control of the equipment assigned to each district;
- provision of manuals for maintenance and repair; and
- adequate budget allocations for workshop operation.

## 7.2 DESIGN, CONSTRUCTION AND OUTFITTING

Of the eleven districts, seven already have workshops (two more are now constructing workshops with Australian assistance) but they require improvements in order to function effectively. The exact requirements will be determined by a detailed survey of each in the first year of the project. The types of work anticipated are listed below:

- install piping for an air compressor, 3-phase electrical supply, water supply and sanitary facilities
- add a washing ramp, loading ramp and a guard shelter
- erect permanent fences
- provide paved equipment storage
- build an access road within each compound and from the workshop to the public road
- provide desks and chairs, book shelves, display board for tools, counters for toolroom and warehouse, workbenches, racks for spare parts, and a rack for tires
- for some workshops, particularly ex-OECF ones, additional space for tool and supplies storage and workbench area may be required. Location and space for simple soil/materials tests must also be considered.

The estimated cost of improvements per workshop is $32,000.

New workshops should be located near the DPUK, preferably on the outskirts of town where there is access to easy communication with the DPUK office, and where electricity, telephone and water hook-ups are available.

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Although the workshops that have been constructed by OECF, ADB and the World Bank differ in size, their design layout is generally the same and is adequate. New workshops will have to be built in two districts: Bulukumba and Sinjai in South Sulawesi. USAID will adopt the design used for the ADB II project with some modifications:

- Floor thickness of the repair bays should be a minimum of 15 cm.
- The workshop should have washing, loading, and service ramps.
- A 3-phase electric generator set of 15 KVA should be installed.
- A well and a water tower should be provided for each workshop.
- Much greater attention should be paid to properly completing the external facilities on the workshop site, e.g., access road, parking areas, equipment storage area, drainage system, and fencing.
- Workshop outfitting such as piping for an air compressor, and for electrical, water and sanitary installations needs similar attention.

The estimated cost per new workshop is $82,000.

## 7.3 WORKSHOP OPERATION AND TRAINING

In view of the poor previous experience with DPUK workshop operation and management, a comprehensive training program for workshop operation should cover the following areas:

- New equipment familiarization,
- Field equipment operations,
- Equipment maintenance and repairs,
- Spare parts identification, ordering and control, and
- Equipment management.

The following specific recommendations are made for equipment management:

- Control: It will be necessary to use a code number for project equipment (new and old) when implementing the maintenance management system. It is recommended that the Bina Marga code be adopted and include the letter "K" (for example, 44/001/K01). The first two numbers identify the province in which the equipment is assigned, the second three numbers identify the type of equipment, and the last alpha-numerical code denotes that the equipment is specifically assigned for district road works.

- Inventory: Not all districts use Bina Marga's K.I.B. form (Inventory Card) for maintaining an inventory control of the equipment assigned to them from Bina Marga or the province. No district-owned equipment is now registered in an inventory format. It is recommended that K.I.B. forms be provided to all districts by Bina Marga so that all equipment (irrespective of source) can be properly identified and registered.

- Status (condition): Up-to-date records on the condition of equipment are not being kept by most districts. In the past, some DPUKs used the Bina Marga form "Buku Harian Peralatan," which is adequate to capture reliable information on the status of the equipment as it is provided directly by the operator. This practice should be required and all such Bina Marga forms adopted by the districts should be accompanied by instruction booklets on how to use them. The project TA team should assist in this area to ensure that the forms are properly completed and used.

- Utilization: Again, there is no consistent record keeping system for the use of equipment. The Bina Marga form LBPP (Laporan Bulanan Pemakaian Peralatan) and form LIP5, which are monthly reports summarizing the condition, utilization and fuel/oil consumption of the equipment, should be adopted for the project.

- Fuel Control: There is no established district procedure for controlling fuel allocation. Each district uses its own system, mostly entries in a simple notebook (many times not identifying the unit in the field) and the date. In one district fuel coupons are used for dispensing fuel to vehicles, but for heavier equipment (rollers), the staff simply trust the operators. It would be useful to apply a similar coupon system in other project districts.

- Maintenance, Servicing and Repairs: In all districts visited, including the ones with OECF workshops, there was no evidence of any control of labor or parts for equipment maintenance and repair. Forms such as work orders for preventive maintenance programs and schedules are not being used at all; there is no established system for managing the work. Existing Bina Marga forms such as Perintah Kerja Perbaikan Peralatan and Kartu Service, which are now used at the provincial level, should be adopted and implemented in the workshops.

- Parts Management: Systems for controlling or stocking spare parts are non-existent at the district level. At the most a storeman keeps a book with entries of parts and supplies acquired. The existing parts management system used in the ALKAL warehouse in Ujung Pandang is adequate for adaptation to district needs.

- Parts and Fuel Purchase: Most districts procure parts on their own. Although funds from Inpres Penunjangan Jalan and Inpres Dati II can be used to acquire spare parts for any type of equipment with no restrictions, this is rarely done apparently because of political pressures on the DPUK to use as much of the budget as possible for road work. Instead, most districts include funds in roadwork budgets for the direct costs of operating equipment. This is acceptable but means that the cost

should be included in the rental rates used to estimate the budget for road work and the amount allowed for parts should be clearly identified when receiving the funds. An equipment cost accounting system would provide this information. A separate budget for indirect, overhead or emergency costs, not otherwise provided, will be required each year.

## 7.4 WORKSHOP EQUIPMENT AND TOOLS

The district workshops should be provided with tools and equipment for washing, lubricating, changing filters, repairing tires, changing batteries, replacing small parts, repairing minor components such as alternators, starters, and water pumps, and for welding and soldering.

The estimated cost of the workshop equipment required for each district is:

| | |
|---|---|
| 1. Lubrication Service Equipment | US$ 17,000 |
| 2. Tire Service Equipment | 17,000 |
| 3. Battery and Electric Section Equipment | 5,000 |
| 4. Diesel Injection and Hydraulic Section Equipment | 3,000 |
| 5. Repair Section Equipment | 15,000 |
| 6. Welding, Body and Paint Section Equipment | 35,000 |
| 7. Machine Shop Section Equipment | 7,000 |
| 8. Miscellaneous | 1,000 |
| | US$ 100,000 |

For the two new and nine existing workshops, the total cost will be approximately U.S. $668,800. A detailed final list of workshop equipment and tools should be prepared by a project consultant early in the project so that equipment can be procured while the new workshops are being built.

## 7.5 RESPONSIBILITIES AND RELATIONSHIP TO ALKAL

Bina Marga classifies the type of work done in workshops in five levels:

Level I : Maintenance work done by operators and drivers before and after they operate equipment.

Level II : Preventive maintenance work done by mechanics and serviceman in the workshop area.

**Level III** : Adjustments and minor repairs done by mechanics in the workshop.

**Level IV** : Major repairs done by master mechanics in fully-equippe workshops. This includes overhauling engines, tranmissions, and changing clutches in heavy equipment.

**Level V** : Repairs that require the fabrication of parts and major rehabilitation of equipment in very damaged condition.

Work to be done at DPUK workshops should be limited to levels II and III. Workshops should restrict their attention to equipment and should not be responsible, as some have in the past, for materials testing. Repairs that necessitate dismantling and assembling units that need setting or adjustments using special tools, equipment or facilities should be done at ALKAL workshops. These are tasks defined under levels IV and V. For transporting district equipment in need of level IV or V repair, ALKAL workshops in Kupang and Ujung Pandang should be required to use their existing Lo-Bed truck-trailers. These units are now under ALKAL control and upon request can be assigned to provide support to DPUK's workshops, as per directives from Bina Marga, provided that funds for the direct costs are available in DPUK budgets.

When repairs that are beyond the districts' capability can be performed in the field without transporting equipment to the ALKAL, the RRMS project should consider utilizing the procedures previously established under the OECF project in South Sulawesi. Under these procedures, the ALKAL periodically sends a mobile workshop based in Ujung Pandang to each project workshop to check the equipment's condition. Each mobile workshop team consists of a mechanic, a logistics person, and an equipment/spare parts specialist. The team spends an average of five days in each district, during which the mechanic examines in detail every piece of equipment. The spare parts specialist helps DPUK equipment personnel to prepare a list of spare parts necessary for any equipment in need of repair. The list is then approved and signed by the Chief of the DPUK. Upon returning to ALKAL the list is submitted to the equipment coordinator who reviews it and his office prepares a "Request for Repair" (Permintaan Perbaikan). This is submitted to the repair section at the ALKAL which issues a work order complete with a request list of spare parts, and sends it to the storeroom. The storeman evaluates and checks the list against the inventory of parts acquired by the project and stored at ALKAL. Spare parts are released from the storeroom and given to the mobile workshop mechanic. Upon returning to the district, the mechanic repairs the equipment. A report is made and the work order is closed, signed by both the mechanic and the Chief of the DPUK.

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The ALKAL in Ujung Pandang has three mobile workshop teams attending seven districts with OECF equipment. Adding two more AID-funded districts (Sinjai and Bulukumba) might necessitate the addition of at least one more mobile workshop (this is not included in the recommended list of equipment to be procured but should be considered later in the project).

The current practices for purchasing spare parts for OECF equipment in South Sulawesi should also be considered for the RRMS project. These procedures are as follows. Periodically (usually once a year), each DPUK makes a list of spare parts needed for maintaining OECF equipment. The list is submitted and reviewed by ALKAL, which then purchases in bulk. When spare parts (filters, etc.) requested are not available at the ALKAL, the ALKAL can directly purchase parts if the total cost per district for the year does not exceed Rp. 1 million. If the total cost exceeds Rp. 1 million, a competitive procurement is held. Parts are received and stored at ALKAL's warehouse and distributed to each DPUK according to its needs. These spare parts are kept in stock for future maintenance use.

## 8. TRAINING

### 8.1 ASSESSMENT OF TRAINING IN THE MINISTRY OF PUBLIC WORKS

The Ministry of Public Works (MPW) employs a staff of about 110,800 including 12,200 permanent staff at the central level, 70,300 permanent staff in the DPUPs, and 28,300 staff in temporary positions for specific project assignments. Staff of district Public Works offices are not included in these figures; as employees of the district government, they are technically staff of the Ministry of Home Affairs.

The MPW began to provide regular in-service training for its staff during the mid-1970s. By the mid-1980s, training in local universities (degree and non-degree) accounted for about half the training time and 60% of the APBN budget provided. Short courses accounted for the remaining 40%. Figures have not been available for the amount of additional money provided out of district and provincial budgets for these activities.

The management structure for MPW staff training is headed by a central Training Department, the Pusdiklat, which reports to the Secretary General of the MPW. The Pusdiklat is responsible for coordinating training programs in the MPW and for providing short courses in cross-sectoral subjects for central, project and provincial staff. Three subunits (Bidang Diklats), corresponding with the three Directorate Generals of Pengairan, Bina Marga and Cipta Karya (water resources, highways and urban development), are responsible for arranging training related directly to their respective technical subsectors.

Pusdiklat is theoretically supposed to oversee and coordinate training of the three Bidang Diklats and to oversee general training (e.g., Ministry procedures). In fact, the Bidang Diklats get most of their funds through the Directorate Generals and not through Pusdiklat because training is tied to projects, and most projects are budgeted through the Directorate Generals. Thus, Bidang Diklats are more responsive to their Directorate General than Pusdiklat, and Pusdiklat is really peripheral to the central tasks and activities of the Directorate General.

For departmental employees in Jakarta, training, including administrative costs, is financed mainly through development budgets (DIPs) allocated to the Pusdiklat and the Bidang Diklats of the Directorate Generals. The DPUPs and DPUKs also contribute to the financing of training for their provincial and district staff, but it is unclear how much they provide or what budget priority they give to training.

Short courses are delivered mainly at five Regional Training Centers (RTCs) owned or rented by the Pusdiklat and located in Bandung, Surabaya, Yogyakarta, Medan and Ujung Pandang; several other training facilities, owned or leased and operated by the three Directorate Generals, also exist. The bulk of their activities are part of larger projects, most commonly involving APBN funds channeled through one of the three Directorate Generals.

As a result of the RTCs' reliance on other agencies for training programs and funds, they largely respond to demands from other agencies rather than attempting to initiate their own programs. Even for training programs funded through their own DIPs, the RTCs exercise little or no control over the content of training or the selection of participants. For training funded by other divisions of the Public Works organization, the RTCs also have no control over the appointment of teaching staff, most of whom are from outside the RTC. The head of the RTC and his staff, then, are largely administrators of training facilities, with only occasional actual teaching responsibilities or substantive involvement in the development of training programs.

Despite the importance placed on manpower upgrading by the MPW, the effectiveness of the training provided is limited by: 1) poor coordination and inefficiences in planning and management of courses for staff, 2) insufficient facilities to provide for the volume of training required by staff, 3) inadequate experience with the provision of training for smaller contractors and mandors, 4) a theoretical rather than practical orientation, 5) limited use of professional trainers, and 6) lack of continuity in presentation materials and the details of curricula.

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Bina Marga training also tends to be too theoretical with little emphasis on practical skills and with institutional disincentives similar to these encountered in other programs. These include:

- trainers have a strong incentive to produce new materials (earn overtime) rather than rely upon previously-developed modules;
- trainees have a strong incentive simply to attend training without giving attention to its utility in their work.

While exact figures are not available, in the aggregate, training for DPUP staff lags behind that for central and project staff. Only 7% of the total APBN cost of short-term training is spent on DPUP staff.

The policy toward training for DPUK staff is somewhat ambiguous due to the structural cleavage between the Ministry of Public Works and the Ministry of Home Affairs. Although the MPW has a general mandate to provide technical training for DPUK employees, there is no direct authority to identify and take steps to address DPUK needs. One mechanism that has developed recently is the allocation of a small amount of Inpres Penunjangan Jalan to central Bina Marga authorities to prepare courses exclusively for DPUK staff. Eleven standard courses have been developed, largely for training employees from DPUKs where donor-funded projects are active. These courses include most of the common skill areas required for DPUK work: project management, mechanics and advanced mechanics, construction supervision, quality control, laboratory skills, workshop management, field gang skills, surveying, and equipment operation. The courses have been given both at RTCs and at selected DPUP sites. Although these courses are well administered, they are nonetheless insufficiently field-oriented and instructors are not skilled as trainers.

A chronic constraint to training for DPUK staff has been the financing of travel, room and board for trainees. This is typically the responsibility of the DPUK, yet there is rarely a clearly identifiable source of funds to tap for this purpose. Finally, the DPUK rarely participates in determining the content of courses, the timing of training, or the number of training positions open. This at times results in the inappropriate selection of trainees.

Experimental efforts using private equipment supplier training courses for operators and mechanics are reported to be quite successful.

These observations suggest that training for DPUK staff be physically and theoretically as close to the field as possible. The new structure of DPUP-DPUK relations allows an enhanced role for the DPUPs in facilitating training for DPUK staff. The RRMS project should not focus on Pusdiklat, but should utilize the Bina Marga Bidang Diklat in tandem with DPUP staff to provide training either at the DPUP or, ultimately, in the districts themselves.

## 8.2 TRAINING NEEDS

The greatest need for training is in maintenance and rehabilitation planning skills, including selecting standards for roads, identifying the work needed to meet standards, and managing resources to organize and control the work. Maintenance requires more sophisticated management than construction -- district offices must distinguish between critical and routine needs and must be able to respond flexibly, fitting routine maintenance activities in between emergency repairs. At the same time, there is a continuing need for training in the technical aspects of implementing maintenance work, teaching field staff how to fill in pot holes, etc. With this perspective in mind, the following training program is recommended.

### 8.2.1 Short-Term Training for Planning

The planning procedures adopted by the project will introduce new tasks to district staff. Under the project, DPUK and perhaps Bappeda II (district regional planning board) staff will be required to measure traffic periodically in order to select links for project-financed reconstruction work. They will need to monitor road feature conditions routinely for maintenance decisions. Key skills now lacking in the DPUK are techniques for conducting road/bridge inventory and condition surveys, and traffic counts. DPUPs and the Sub-Directorate for Local Roads have the skills and procedures to conduct these tasks and should assist in introducing them to the districts. This should be done through short-term courses at the DPUP or in the district with assistance from the TA team.

A second category of planning skills that the districts will need to acquire is maintenance planning. These are the procedures required for a maintenance management system and include tasks such as estimating and setting standards for work crew performance, setting priorities for tasks, etc. The target group for these skills should be DPUK administrators at the Section Chief level and above. On-the-job training by project TA over a period of years rather than formal coursework, is proposed in this case although seminars will be required to introduce the logic and procedures of maintenance management.

### 8.2.2 Short-Term Technical Training

Short-term technical training should be primarily targeted to force account foremen, staff who supervise contractors, and materials control personnel. Short-term technical training should be carried out primarily during the rainy season when road work is stopped. It should be conducted through short courses, whose topics would include the following:

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- For Foremen
  maintenance work methods
  crew organization
  recording and reporting procedures
  materials handling
  others, as identified during project implementation

- For Contractor Supervisors
  grading designs and specifications
  supervision techniques
  others, as identified during project implementation

- For Materials Control Staff
  testing equipment
  sampling techniques
  others, as identified during project implementation.

In addition to the need for training in construction-related fields, road design skills also require upgrading. Bina Marga has not yet developed a course in road design. It is recommended that with the publication of Bina Marga's new Technical Guidelines for District Roadworks, a training program be introduced to implement the new guidelines.

Short courses should be kept to a week or less whenever possible. It is suggested that they be held initially at existing training centers (DPUP and RTC) but, beginning in the second and third years, they should be gradually moved to the districts themselves. For planning purposes, it should be assumed that 10 to 15 man-days per year of short-term training in these topics would be adequate for each DPUK employee in these positions.

Practical and applied techniques should be stressed. For this reason, Public Works staff with long field experience should be utilized as much as possible to assist in preparing and delivering short courses. However, professional trainers from the TA team and/or the Bina Marga Bidang Diklat should assist in organizing the presentations. Holding courses in the districts will help to promote a practical, as opposed to a theoretical, tone. On-site field work, including follow-up visits over time, should be incorporated into the training program.

A complete inventory and review of all potentially useful existing materials and courses should be conducted early in the project in order to develop a core set to be used under the project. Prior to the development of a detailed RRMS training plan, the existing eleven DPUK courses should be reviewed for their use in or adoption for the project. Training materials not available from that source are likely available from the extensive collection of course outlines, slides, films, etc. now scattered about at various training centers.

Financing may be required for minor improvements to existing course materials, but most short course training can begin before any improvements are made. (It should be noted that field visits indicated many of the pre-packaged teaching aids were not being used; further, there are built-in disincentives to using pre-packaged materials. TA consultants will have to weigh these concerns as part of the review of existing materials.)

Although foremen, contractor supervisors, and materials control staff should be the primary target of this short-term training, deficiencies of other DPUK staff in specific technical skills important to the project (topographical surveying, drafting, etc.) may become apparent as the project is implemented. Funds should be held in reserve for such purposes and existing facilities or courses utilized to address them as the need arises. One training mechanism suggested by DPUP staff was short internships of DPUK personnel on DPUP projects. This should be considered further.

During the first year of the project, while the review of training is taking place, it is recommended that a small number of DPUK staff participate in selected courses from the eleven standard courses now offered in order to provide an opportunity to assess the courses' utility and to get a start on skills that will be in demand early in the project.

8.2.3 Long-Term Training

Long-term training should not be the primary focus of the project training program. However, the project will provide for long-term in-country undergraduate civil engineering training for up to two persons per district in districts with a relative shortage of staff trained to this level. These persons should be only from the Section Chief level or above. The benefit would be a general improvement in the district's quality of design and implementation.

Care should be taken to assure that the absence of staff who are in long-term training does not impede project implementation. The eight-year life of the project allows for a measured pace for long-term training, but consideration should be given to secondment of DPUP staff to DPUK positions left vacant during the training period.

It is also recommended that up to eight master's degrees be funded. RRMS will require considerable input from both DPUP and Ministry (especially Sub-Directorate of Local Roads) staff. The newly-defined role for DPUPs means DPUP staff must provide leadership in the areas of maintenance planning, construction supervision and pavement management. A new IBRD-funded master's degree program was recently introduced at the Institute of Technology Bandung. It is recommended that once the project is well underway, up to six DPUP candidates be selected for this program. The RRMS' focus on long-term district road policy and planning

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will focus primarily on the Sub-Directorate of Local Roads in the Ministry of Public Works. Sub-Directorate staff are civil engineers without specialized training in the planning or economic issues they face. Up to two master's degrees will be financed in related fields.

## 8.3 TRAINING OF CONTRACTORS

The bulk of rehabilitation and a growing share of maintenance work conducted under the project will be performed by contractors. Historically, problems of low quality of contracted work in Indonesia stem from many factors including inadequate supervision, unrealistically low contract budgets, and contractors' lack of knowledge of construction techniques and equipment. Contractor training cannot by itself solve all these problems. It has, moreover, proved difficult to administer and evaluate in other countries. Consequently, it is suggested that a formal program of courses for contractors not be undertaken in the AID project. Instead, improved supervision and realistic contract budgets should be combined with a program in which contractors eligible to bid on project contracts must observe the techniques applied by the district model force account teams which, in turn, will be under the supervision of project consultants.

## 8.4 TRAINING FOR EQUIPMENT-RELATED PERSONNEL

Equipment training should be provided to both existing and any new equipment-related staff. It should combine formal courses and follow-up on-the-job training covering: familiarization with new equipment; field equipment operations for operators/drivers and equipment maintenance/repairs for mechanics; spare parts identification, ordering and control; and equipment management. Equipment training should maximize the resources available from equipment suppliers and the skills in place at the provincial-level ALKALs.

### 8.4.1 New Equipment Familiarization

In-country equipment suppliers should be utilized for this purpose. This activity can be included in contracts for procuring new equipment and the courses should be given when the equipment is delivered. All equipment suppliers offer this training at their headquarters, and in several instances, on site. USAID/Indonesia has a complete list of supplier training programs.

Orientation courses should be given to all operators and servicemen (mechanics) of DPUKs and ALKALs for each type of equipment delivered. They should include:

- Equipment characteristics;
- Techniques of operation (operator manuals usage);
- Preventive maintenance services (lube manuals usage);
- Usage of special tools for repair/maintenance; and
- Instruction for repairs (workshop manuals usage).

A consultant training specialist should review equipment orientation courses before they are given and should coordinate the details of their presentation with equipment suppliers.

### 8.4.2 Field Equipment Operation and Maintenance

#### 8.4.2.1 Operators/Drivers

Following the orientation courses, DPUK operators should be trained by experienced instructors from the ALKALs in Ujung Pandang and Kupang (pending results of the first-year training review, the existing Bina Marga operators' course could substitute for or complement this approach). These field training programs should be conducted at the districts, and should include one-on-one practical sessions that demonstrate: checking the equipment before starting the engine, correct procedures for starting the engine, safe and correct operation of the equipment, work techniques, and the correct manner of shutting down the engine and parking the equipment. Preventive maintenance tasks for which the operators are responsible should also be reviewed.

A consultant training coordinator should arrange for existing video-cassettes and slide-tape courses on equipment operation to be presented as part of this field training. These materials are available at Diklat offices in Surabaya and Ujung Pandang. Costs for the training will involve transportation and per diem for the instructors from each ALKAL. An estimated five days will be required in each district for a team of three ALKAL instructors.

#### 8.4.2.2 Mechanics/Servicemen

Following the orientation courses, DPUK mechanics/servicemen should also receive follow-up training from experienced instructors from ALKAL (again, the existing courses may substitute or complement). The training should be conducted in the ALKAL facilities in Ujung Pandang and Kupang upon receiving the new equipment and before distributing it to the districts. Training for mechanics/servicemen should be limited to the type of work defined in the Pedoman Pemeliharaan Peralatan as levels II and III (equipment maintenance and minor repairs).

It is estimated that four trainees (mechanics/servicemen) from each district should receive this training (helpers should be trained later on-the-job by their trained supervisors). An estimated two weeks should be planned for this training. The main topics should include trouble shooting fuel systems, cooling systems, electrical systems, brake systems, hydraulic systems, and servicing and testing of components. No major repairs or overhauls should be included. The consultant training coordinator should help to plan, organize and administer the training program. He should arrange for existing video-cassettes and slide-tape courses on equipment maintenance and minor repairs to be presented as a complement to the "hands-on" training.

### 8.4.3 Spare Parts Identification, Ordering and Control Courses

DPUK storemen should be trained at ALKAL warehouses for two weeks. Training should be "on-the-job," demonstrating daily routine duties. Each trainee should also be fully familiar with the following Bina Marga manuals: Pedoman Penyimpanan dan Penyaluran Barang and Pembukuan Barang Gudang di Lingkungan.

Practice during training should assure that each storeman can manage the forms used in a parts management system, such as:

- Requisition/issue slips,
- Requisition/issue slip registers,
- Requisition and issue vouchers, and
- Requisition and issue voucher registers;

and the forms used for inventory/stock control, such as:

- Bukti Pengeluaran Barang,
- Kartu Persediaan, and
- Kartu Rak.

Effective training for storage bin numbering and spare parts maintenance can easily be done during the same two-week period by simply observing and copying existing ALKAL procedures.

### 8.4.4 Equipment Management

Training in equipment management should be provided to the Chiefs of Equipment Sections on a one-on-one and on-the-job basis by the project consultants. This should be preceded by the adaptation of existing Bina Marga procedures for the districts' use in a district equipment management system. Training should cover the various elements of equipment management such as: equipment control, servicing and repair management, and parts management. Special attention to the development of and training in an equipment cost system should be provided by the project consultant equipment engineer.

## 8.5 TRAINEE SELECTION

Clear criteria for trainee seletion should be established early in the project to assure that training is appropriately targetted.

## 8.6 FINANCING OF TRAINING

Districts have no training funds of their own. Inpres Penunjangan Jalan is the sole source of funds specifically earmarked to provide training for district staff. These funds, however, are not given to the district but are controlled by national or provincal authorities. They, in turn, allocate training slots among districts. This system often results in training being provided to persons whose job does not require the skill taught. A recommended alternative is to provide a portion of the Inpres Penunjangan training fund to each DPUK annually with which the DPUK would fund the travel and per diem costs of participants in short courses of its own choosing.

# 9. WORK PROGRAMS AND BUDGETS - REHABILITATION AND MAINTENANCE

## 9.1 PROCEDURE FOLLOWED

The project will utilize annual traffic-based screening procedures to determine which links are eligible for rehabilitation financing. Complete traffic data were not available for estimation purposes before completion of this Project Paper -- a complete traffic counting exercise is required in the first (i.e., preparatory) year of the project and periodically thereafter. Instead, traffic data from two sample districts in each province were used and extrapolated to the networks of the project districts.

The following calculations are thus illustrative only. Once more reliable data on traffic road inventory and conditions are obtained, the programs will be verified.

Work programs and budgets for rehabilitation and maintenance were developed based on the inventory and road condition data collected from each DPUK/Cabang Dinas. The provincial summaries were tabulated according to the existing practice of classifying roads into only three types: "asphalt," "gravel" and "earth" and according to the reported road condition: good, moderate, damaged and heavily damaged. The total kms for all roads in the 11 districts is 7,425 km. The breakdown is shown in Table 35.

To determine what work is needed it was necessary to distribute the inventory kms among the different types of road that are actually found in the networks. From that distribution it is easier to visualize what work has to be done. The following assumptions were made:

(1) All good asphalt roads and 20% of fair asphalt roads can be maintained.
(2) 75% of the reported gravel roads are Telford roads, and therefore "unmaintainable." Using the same formula as above, this means only 25% of the reported good gravel roads and 5% of the reported fair roads can be maintained.

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TABLE 35

EXISTING KILOMETERS AND CONDITION OF ROAD
SOUTH SULAWESI AND NTT

| District | Asphalt | | | | | Gravel | | | | | Earth | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | G | M | D | HD | ToT | G | M | D | HD | ToT | G | M | D | HD | ToT | |
| South Sulawesi | | | | | | | | | | | | | | | | |
| 1. Pinrang | 32 | 46 | 14 | 0 | 92 | 108 | 45 | 27 | 0 | 180 | 0 | 94 | 24 | 0 | 118 | 390 |
| 2. Jeneponto | 34 | 15 | 10 | 20 | 79 | 85 | 27 | 35 | 204 | 351 | 82 | 13 | 17 | 52 | 164 | 394 |
| 3. Bulukumba | 0 | 40 | 37 | 0 | 77 | 0 | 26 | 172 | 58 | 256 | 0 | 98 | 133 | 222 | 453 | 786 |
| 4. Takalar | 46 | 43 | 11 | 0 | 100 | 0 | 47 | 43 | 0 | 90 | 0 | 10 | 14 | 0 | 24 | 214 |
| 5. Sidrap | 9 | 356 | 60 | 0 | 425 | 0 | 79 | 35 | 45 | 159 | 0 | 0 | 0 | 63 | 63 | 647 |
| 6. Sinjai | 6 | 13 | 5 | 0 | 24 | 11 | 69 | 81 | 0 | 161 | 0 | 5 | 158 | 0 | 163 | 348 |
| 7. Bone | 14 | 40 | 90 | 26 | 170 | 35 | 99 | 220 | 65 | 419 | 43 | 121 | 268 | 79 | 511 | 1,100 |
| Total | 141 | 553 | 227 | 46 | 967 | 239 | 392 | 613 | 372 | 1,616 | 125 | 341 | 614 | 416 | 1,496 | 4,079 |
| NTT | | | | | | | | | | | | | | | | |
| 1. Kupang | 15 | 7 | 0 | 0 | 22 | 69 | 111 | 199 | 49 | 428 | 0 | 0 | 90 | 216 | 306 | 756 |
| 2. Belu | 0 | 1 | 0 | 0 | 1 | 0 | 209 | 82 | 0 | 291 | 0 | 0 | 202 | 0 | 202 | 494 |
| 3. TTS | 0 | 8 | 0 | 0 | 8 | 0 | 97 | 97 | 97 | 291 | 0 | 377 | 377 | 377 | 1,131 | 1,430 |
| 4. TTU* | 0 | 96 | 0 | 2 | 98 | 0 | 10 | 10 | 0 | 30 | 0 | 0 | 0 | 538 | 538 | 666 |
| *Data from Subdit Rural Roads - PU | | | | | | | | | | | | | | | | |
| Total | 15 | 112 | 0 | 2 | 129 | 79 | 427 | 388 | 146 | 1,040 | 0 | 377 | 669 | 1,131 | 2,177 | 3,346 |

(3) 50% of all earth roads are unmaintainable, so that 50% of the good earth roads and 10% of the fair roads can be maintained.

The remainder of the roads were considered unacceptable for maintenance and therefore in need of rehabilitation, if the traffic counts justify.

Finally, GOI annual funding allocations allow only for rehabilitation of about 20-25% of the entire network. There is also a significant number of existing gravel and earth roads which do not carry enough traffic to justify even their current type of construction. Therefore, due to expected low traffic and insufficient funds to rehabilitate all the kms in bad condition, most of the unacceptable gravel and earth classification were dropped from consideration.

The remaining kms were earmarked for either rehabilitation or betterment. Data did not exist to permit detailed calculation of the rehabilitation program for each of the 11 project districts. Reliable traffic flow data were available for only a few districts in South Sulawesi and NTT, none of which was included in the project districts. An attempt was made to select two representative districts in each province and the data from these districts were extrapolated to the four NTT and seven South Sulawesi districts.

In virtually all cases, the data tended to underestimate the extent of the maintenance and rehabilitation programs:

- Traffic counts are from 1985 while subsequent GOI projections provide for a 15% nationwide (outside Jakarta) growth in traffic.
- NTT traffic data are taken from districts off Timor Island which appear to have less traffic than Timor Island.
- Vehicle operating costs are based on costs on Java, where vehicle operations are less expensive than in the project districts. The higher operating costs in the Outer Islands tend to support maintenance and rehabilitation at a lower level of traffic than is shown here.
- Non-motorized traffic data are not included in the traffic counts, yet this represents a considerable pattern in project districts. Similarly, there has been no allowance for non-motorized traffic switching to motorized vehicles with the provision of easier/better access.

For these reasons, the proposed maintenace and rehabilitation programs must be considered approximations which will be corrected by actual traffic counts and adjustments to the Simplified Selection Table. The final work program was increased by 25% to allow for this "softness" of data.

## 9.2 MAINTENANCE PROGRAM

Tables 36 and 37 show the estimated maintenance kilometers distributed to each of the districts in each year of the project. The three assumptions noted in Section 9.1 serve as the basis for determining the number of kms of road eligible for maintenance. The budget for the maintenance program was prepared using a representative sample of districts (identified as [1] and [])) for which reasonably detailed data enabled the calculation of units costs. The representative sample and unit costs are generated separately for NTT and South Sulawesi and are shown in Table 38. Multiplying the unit costs by the estimated kilometers for each year gave the total base maintenance budget. A 4% inflation factor was added to each year's calculated costs.

The total kilometers to be reconstructed for each type of road were added to the first year kilometers for the estimate of the maintenance program in the year following the last year of rehabilitation, labeled the 7th Year. As in the rehabilitation program, bridge maintenance costs were estimated directly using 10% of the total maintenance programs.

It is assumed that the maintenance program will be funded by the GOI. The unit costs were calculated as direct cost only; therefore, a percentage for overhead and administration (35%) was assumed to arrive at a total budget cost.

## 9.3 REHABILITATION PROGRAM

The distribution of the rehabilitation work was assumed to be best if it would start at a reduced level, gradually increase, and finally taper off so as not to be too great a load or a sudden end of work for the construction industry. The percentages were distributed as follows:

| Year: | 1st | 2nd | 3rd | 4th | 5th | 6th | |
|---|---|---|---|---|---|---|---|
| Percentage: | 10 | 15 | 20 | 20 | 20 | 15 | = 100 |

The selection of roads for rehabilitation for the purpose of this project paper is based on an analysis of the two model districts per province referred to earlier in this section. The analysis of the two sample districts in each province enabled a closer approximation of the following variables:

(1) the number and type of links which might warrant rehabilitation based on traffic flow;
(2) the mix of type of work applicable to each type of link, i.e., rehabilitation of a paved road, upgrading of an earth road, etc.
(3) the applicable unit costs.

TABLE 36

TOTAL ROAD MAINTENANCE PROGRAM
SOUTH SULAWESI

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total | Total ($) | Totals Calculated from Uninflated Maintenance Cost in Dollars |
|---|---|---|---|---|---|---|---|---|---|---|
| Old Stock | 428 | 357 | 285 | 214 | 143 | 71 | 0 | 1,498 | | |
| from 1st year rehab. | 0 | 80 | 80 | 80 | 80 | 80 | 80 | 480 | | |
| from 2nd year rehab. | 0 | 0 | 120 | 120 | 120 | 120 | 120 | 600 | | |
| from 3rd year rehab. | 0 | 0 | 0 | 160 | 160 | 160 | 160 | 640 | | |
| from 4th year rehab. | 0 | 0 | 0 | 0 | 160 | 160 | 160 | 480 | | |
| from 5th year rehab. | 0 | 0 | 0 | 0 | 0 | 160 | 160 | 320 | | |
| from 6th year rehab. | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 120 | | |
| Total kilometers maintained | - 428 | 437 | 485 | 574 | 663 | 751 | 800 | 4,138 | | |
| Total maintenance cost | 1,021,878 | 970,991 | 1,020,094 | 1,173,462 | 1,327,353 | 1,489,531 | 1,589,381 | 8,592,689 | 5,207,690 | 5,207,690 |
| (Inflated @ 4% p.a.) | 1,021,878 | 1,009,830 | 1,103,333 | 1,319,985 | 1,552,815 | 1,812,242 | 2,011,073 | 9,831,158 | 5,958,277 | |
| GOI funds (25% Impr.Kab.) | 379,870 | 387,467 | 395,217 | 403,121 | 411,183 | 419,407 | 427,795 | 2,624,060 | 1,711,552 | 1,711,552 |
| GOI Surplus (Deficit) | (642,008) | (622,363) | (708,116) | (916,864) | (1,141,632) | (1,392,835) | (1,583,278) | (7,007,098) | (4,246,726) | (3,496,139) |
| Net GOI Surplus (Deficit) | 843,666 | 617,480 | 264,652 | 53,284 | (175,040) | (157,630) | 664,475 | 2,110,886 | 1,279,325 | 2,404,300 |
| GOI Surplus (Deficit) in $ | (389,096) | (377,190) | (464,525) | (555,675) | (691,898) | (844,143) | (959,563) | (4,246,726) | | |
| Net GOI Surplus (Def.) in $ | 511,313 | 374,230 | 160,395 | 32,293 | (106,085) | (95,533) | 402,712 | 1,279,325 | | |



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TABLE 37

TOTAL ROAD MAINTENANCE PROGRAM
NTT

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total | Total ($) | Totals Calculated from Uninflated Maintenance Cost in Dollars |
|---|---|---|---|---|---|---|---|---|---|---|
| Old Stock | 116 | 97 | 77 | 58 | 39 | 19 | 0 | 406 | | |
| from 1st year rehab. | 0 | 48 | 48 | 48 | 48 | 48 | 48 | 288 | | |
| from 2nd year rehab. | 0 | 0 | 71 | 71 | 71 | 71 | 71 | 355 | | |
| from 3rd year rehab. | 0 | 0 | 0 | 95 | 95 | 95 | 95 | 380 | | |
| from 4th year rehab. | 0 | 0 | 0 | 0 | 95 | 95 | 95 | 285 | | |
| from 5th year rehab. | 0 | 0 | 0 | 0 | 0 | 95 | 95 | 190 | | |
| from 6th year rehab. | 0 | 0 | 0 | 0 | 0 | 0 | 71 | 71 | | |
| Total kilometers maintained | 116 | 145 | 196 | 272 | 348 | 423 | 475 | 1,975 | | |
| Total maintenance cost | 269,947 | 286,651 | 330,017 | 415,207 | 492,882 | 574,170 | 644,426 | 3,013,299 | 1,826,242 | 1,826,242 |
| (Inflated @ 4% p.a.) | 269,947 | 298,117 | 356,945 | 467,051 | 576.602 | 698,565 | 815,404 | 3,482,633 | 2,110,687 | |
| GOI funds (25% Impr.Kab.) | 379,870 | 387,467 | 395,217 | 403,121 | 411,183 | 419,407 | 427,795 | 2,824,060 | 1,711,552 | 1,711,552 |
| GOI Surplus (Deficit) | 109,924 | 89,350 | 38,271 | (63,930) | (165,419) | (279,158) | (387,609) | (658,573) | (399,135) | (144,690) |
| Net GOI Surplus (Deficit) | 803,141 | 678,459 | 514,198 | 412,063 | 310,264 | 328,717 | 639,099 | 3,685,941 | 2,233,904 | 2,668,976 |
| GOI Surplus (Deficit) in $ | 66,620 | 54,152 | 23,194 | (38,746) | (100,254) | (169,187) | (234,915) | (399,135) | | |
| Net GOI Surplus (Def.) in $ | 486,752 | 411,187 | 311,635 | 249,735 | 188,039 | 199,222 | 387,333 | 2,233,904 | | |

TABLE 38

MAINTENANCE COSTS IN MODEL DISTRICTS IN SOUTH SULAWESI AND NTT

| South Sulawesi | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total |
|---|---|---|---|---|---|---|---|---|
| Kilometers maintained of District (1) + (2) | 53 | 70 | 101 | 145 | 190 | 236 | 277 | 1,072 |
| Total maintenance cost | 126,541 | 155,655 | 212,286 | 296,432 | 380,579 | 467,874 | 530,323 | 2,189,690 |
| Average Unit Cost | 2,388 | 2,224 | 2,102 | 2,044 | 2,003 | 1,983 | 1,987 | |
| N T T | | | | | | | | |
| Kilometers maintained of District (1) + (2) | 48 | 59 | 81 | 111 | 143 | 176 | 207 | 825 |
| Total maintenance cost | 111,702 | 116,906 | 136,153 | 169,441 | 202,729 | 238,710 | 280,834 | 1,256,475 |
| Average Unit Cost | 2,327 | 1,981 | 1,681 | 1,526 | 1,418 | 1,356 | 1,357 | |



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In addition, it should be noted that none of the existing "asphalt" roads were considered for betterment because an upgrade from a sealed road would be asphalt concrete pavement. That type of road would require a very high average daily traffic (ADT) and is not likely to be a design class for district roads.

The budget for the rehabilitation program was then prepared using the weighted distribution and the activity unit costs shown in Table 39.

Tables 40 and 41 show a distribution of the eligible kms in each province over the years of the project during which civil works occur.

The proposed rehabilitation program will not be too great a burden on district staffs. A review of past experience shows that DPUKs have been tendering up to five or more road work contracts per year and implementing a combined force account and contract value of Rp. 430 million in road work per district per year. The ability of a DPUK to take on the work will depend on factors such as the quality of contractors, the amount of paperwork required, and the district's ability to effectively supervise their contractors.

It must be emphasized again that the calculated program is illustrative, and that the actual distribution of works during the project will be made based on annual screening, which will be based in turn on measures of traffic volume, not extrapolated traffic data.

For gravel road reconstruction, the AWCAS method of construction by stages using well-graded crushed aggregate is preferred because it provides a durable surface appropriate for that volume of traffic as specified in the District Road Design Standard.

Because no data were available in the inventory for bridges or for calculating unit costs, bridges were estimated to add 10% to the cost of the rehabilitation program.

TABLE 39

MODEL DISTRICTS IN SOUTH SULAWESI AND NTT FOR REHABILITATION

| Type of Work | Total Kilometer Model Districts (1) + (2) | Weighted Distribution | Unit Cost Rp.000 | Total Cost Roads only Rp.000 | Total Cost + Bridges @ 10% Rp.000 |
|---|---|---|---|---|---|
| South Sulawesi | | | | | |
| Rehab: Paved or Sealed | 33 | 12% | 48,600 | 1,603,800 | 1,764,180 |
| Rehab: Gravel | 99 | 35% | 29,700 | 2,940,300 | 3,234,330 |
| Rehab: Earth | 75 | 27% | 15,500 | 1,162,500 | 1,278,750 |
| Upgrade: Gravel to seal | 56 | 20% | 46,500 | 2,604,000 | 2,864,400 |
| Upgrade: Earth to gravel | 16 | 6% | 35,000 | 560,000 | 616,000 |
| Total | 279 | 100% | | 8,870,600 | 9,757,660 |
| | | Average Unit Cost | | 31,794 | 34,974 |
| NTT | | | | | |
| Rehab: Paved or Sealed | 28 | 13% | 48,600 | 1,360,800 | 1,496,880 |
| Rehab: Gravel | 20 | 10% | 29,700 | 594,000 | 653,400 |
| Rehab: Earth | 142 | 27% | 15,500 | 2,201,000 | 2,421,100 |
| Upgrade: Gravel to seal | 0 | 0% | 46,500 | 0 | 0 |
| Upgrade: Earth to gravel | 18 | 9% | 35,000 | 630,000 | 693,000 |
| Total | 208 | 100% | | 4,785,800 | 5,264,380 |
| | | Average Unit Cost | | 23,009 | 25,310 |

TABLE 40

TOTAL ROAD REHABILITATION PROGRAM
SOUTH SULAWESI

FUNDS FLOW
(Rp.000 or Km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total | Total ($) | Totals Calculated from Uninflated Rehabilitation Cost in Dollars |
|---|---|---|---|---|---|---|---|---|---|---|
| Rehabilitation | | | | | | | | | | |
| % Distribution | 10% | 15% | 20% | 20% | 20% | 15% | | | | |
| Kilometers Rehabilitated | 80 | 120 | 160 | 160 | 160 | 120 | 0 | 802 | | |
| -Rehab.Paved or Sealed (12%) | 10 | 14 | 19 | 19 | 19 | 14 | 0 | 96 | | |
| -Rehab.Gravel (35%) | 28 | 42 | 56 | 56 | 56 | 42 | 0 | 281 | | |
| -Rehab.Earth (7%) | 22 | 32 | 43 | 43 | 43 | 32 | 0 | 217 | | |
| -Upgrade Gravel to Seal (20%) | 16 | 24 | 32 | 32 | 32 | 24 | 0 | 160 | | |
| -Upgrade Earth to Gravel (6%) | 5 | 7 | 10 | 10 | 10 | 7 | 0 | 48 | | |
| Rehabilitation Cost: | | | | | | | | | | |
| -Rehab.Paved or Sealed (12%) | 467,728 | 701,591 | 935,455 | 935,455 | 935,455 | 701,591 | 0 | 4,677,276 | | |
| -Rehab.Gravel (35%) | 833,681 | 1,250,522 | 1,667,362 | 1,667,362 | 1,667,362 | 1,250,522 | 0 | 8,336,812 | | |
| -Rehab.Earth (27%) | 335,638 | 503,457 | 671,276 | 671,276 | 671,276 | 503,457 | 0 | 3,356,379 | | |
| -Upgrade Gravel to Seal(20%) | 745,862 | 1,118,793 | 1,491,724 | 1,491,724 | 1,491,724 | 1,118,793 | 0 | 7,458,620 | | |
| -Upgrade Earth to Gravel(6%) | 168,420 | 252,631 | 336,841 | 336,841 | 336,841 | 252,631 | 0 | 1,684,204 | | |
| Total Rehabilitation Cost | 2,551,329 | 3,826,994 | 5,102,658 | 5,102,658 | 5,102,658 | 3,826,994 | 0 | 25,513,291 | 15,462,601 | |
| (inflated @ 4% p.a.) | 2,551,329 | 3,980,073 | 5,519,035 | 5,739,797 | 5,969,388 | 4,842,368 | 0 | 28,601,991 | 17,334,540 | |
| AID Share (80%) | 2,041,063 | 3,184,059 | 4,415,228 | 4,591,837 | 4,775,511 | 3,873,894 | 0 | 22,881,593 | 13,867,632 | 12,370,081 |
| GOI Share (20%) | 510,266 | 796,015 | 1,103,807 | 1,147,959 | 1,193,878 | 968,474 | 0 | 5,720,398 | 3,466,908 | 3,092,520 |
| GOI Funds (60% Inpr.Kab.) | 1,995,940 | 2,035,858 | 2,076,575 | 2,118,107 | 2,160,470 | 2,203,679 | 2,247,753 | 14,838,382 | 8,992,959 | 8,992,959 |
| GOI Surplus (Deficit) | 1,485,674 | 1,239,843 | 972,768 | 970,148 | 966,592 | 1,235,205 | 2,247,753 | 9,117,984 | 5,526,051 | 5,900,439 |

TABLE 41

TOTAL ROAD REHABILITATION PROGRAM
NTT

FUNDS FLOW
(Rp.000 or Km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total | Total ($) | Totals Calculated from Uninflated Rehabilitation Cost in Dollars |
|---|---|---|---|---|---|---|---|---|---|---|
| REHABILITATION | | | | | | | | | | |
| % Distribution | 10% | 15% | 20% | 20% | 20% | 15% | | | | |
| Kilometers Rehabilitated | 48 | 71 | 95 | 95 | 95 | 71 | 0 | 475 | | |
| -Rehab.Paved or Sealed (13%) | 6 | 9 | 12 | 12 | 12 | 9 | 0 | 62 | | |
| -Rehab.Gravel (10%) | 5 | 7 | 10 | 10 | 10 | 7 | 0 | 48 | | |
| -Rehab.Earth (68%) | 32 | 48 | 65 | 65 | 65 | 48 | 0 | 323 | | |
| -Upgrade Gravel to Seal (0%) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| -Upgrade Earth to Gravel (9%) | 4 | 6 | 9 | 9 | 9 | 6 | 0 | 43 | | |
| Rehabilitation Cost: | | | | | | | | | | |
| -Rehab.Paved or Sealed (13%) | 300,350 | 450,525 | 600,700 | 600,700 | 600,700 | 450,525 | 0 | 3,003,501 | | |
| -Rehab.Gravel (10%) | 141,190 | 211,785 | 282,380 | 282,380 | 282,380 | 211,785 | 0 | 1,411,902 | | |
| -Rehab.Earth (68%) | 501,059 | 751,588 | 1,002,118 | 1,002,118 | 1,002,118 | 751,588 | 0 | 5,010,589 | | |
| -Upgrade Gravel to Seal (0%) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| -Upgrade Earth to Gravel (0%) | 149,747 | 224,621 | 299,494 | 299,494 | 299,494 | 224,621 | 0 | 1,497,472 | | |
| Total Rehabilitation Cost | 1,092,346 | 1,638,520 | 2,184,693 | 2,184,693 | 2,184,693 | 1,638,520 | 0 | 10,923,465 | 6,620,282 | |
| (Inflated @ 4% p.a.) | 1,092,346 | 1,704,061 | 2,362,964 | 2,457,482 | 2,555,782 | 1,993,510 | 0 | 12,166,145 | 7,373,421 | |
| AID Share (80%) | 873,877 | 1,363,248 | 1,890,371 | 1,965,986 | 2,044,625 | 1,594,808 | 0 | 9,732,916 | 5,898,737 | 5,296,225 |
| GOI Share (20%) | 218,469 | 340,812 | 472,593 | 491,496 | 511,156 | 398,702 | 0 | 2,433,229 | 1,474,684 | 1,324,056 |
| GOI Funds (60% Impr.Kab.) | 911,687 | 929,921 | 948,520 | 967,490 | 986,840 | 1,006,577 | 1,026,708 | 6,777,743 | 4,107,723 | 4,107,723 |
| GOI Surplus (Deficit) | 693,218 | 589,109 | 475,927 | 475,994 | 475,684 | 607,875 | 1,026,708 | 4,344,514 | 2,633,039 | 2,783,667 |



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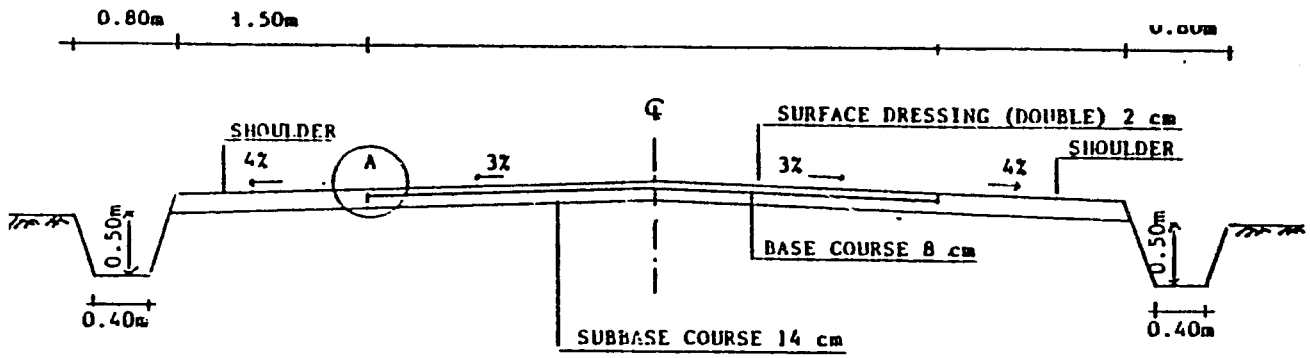
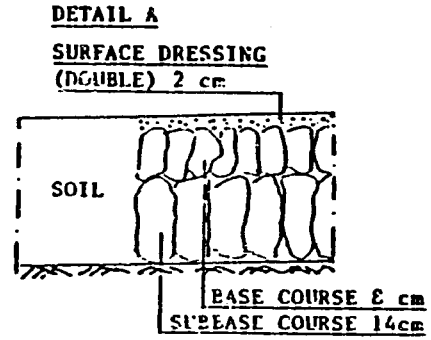
FIGURE 1

TYPICAL ROAD CROSS SECTION

TYPICAL ROAD CROSS SECTION
CLASS III A

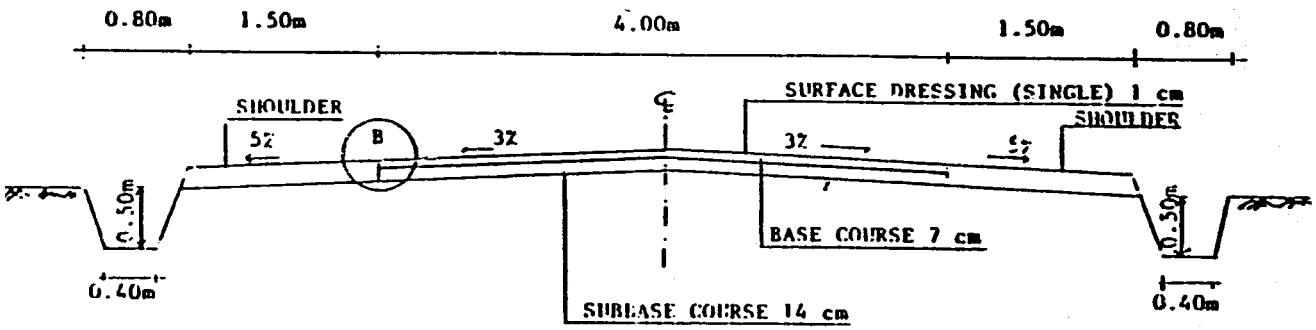


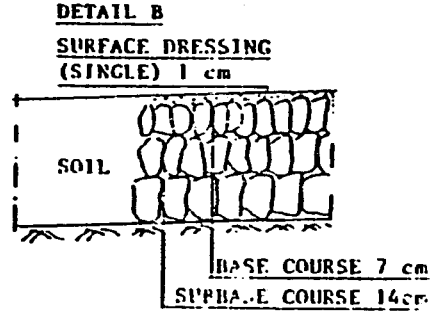




Cut slope depends on material. From 2:1 in normal material to 5:1 in rockcut

Thickness of pavement depends on the subgrade CBR.

TYPICAL ROAD CROSS SECTION
CLASS III B (ASPHALT SEAL)

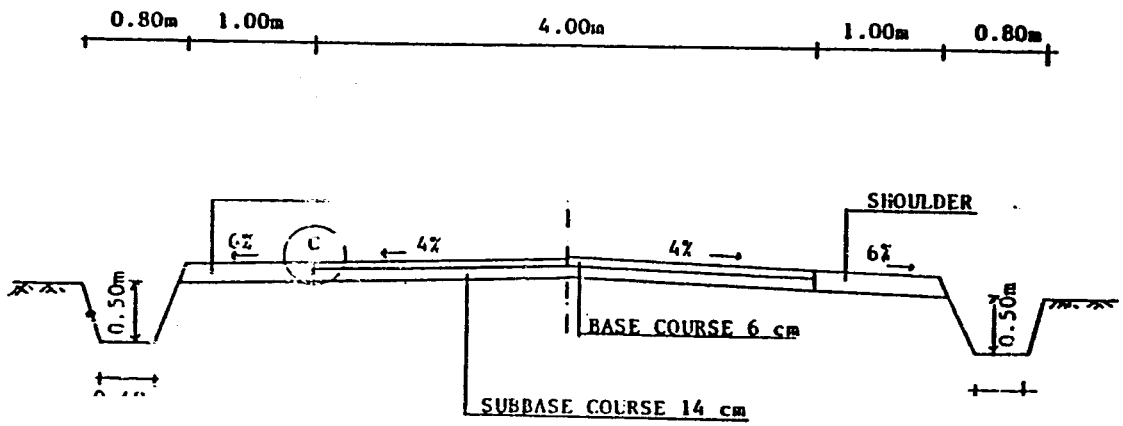


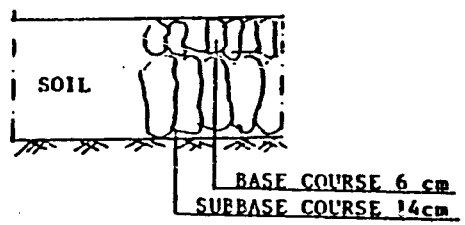

SCALE: AS SHOWN

FIGURE 1 (CONTINUED)

TYPICAL ROAD CROSS SECTION
CLASS 111B (GRAVEL)



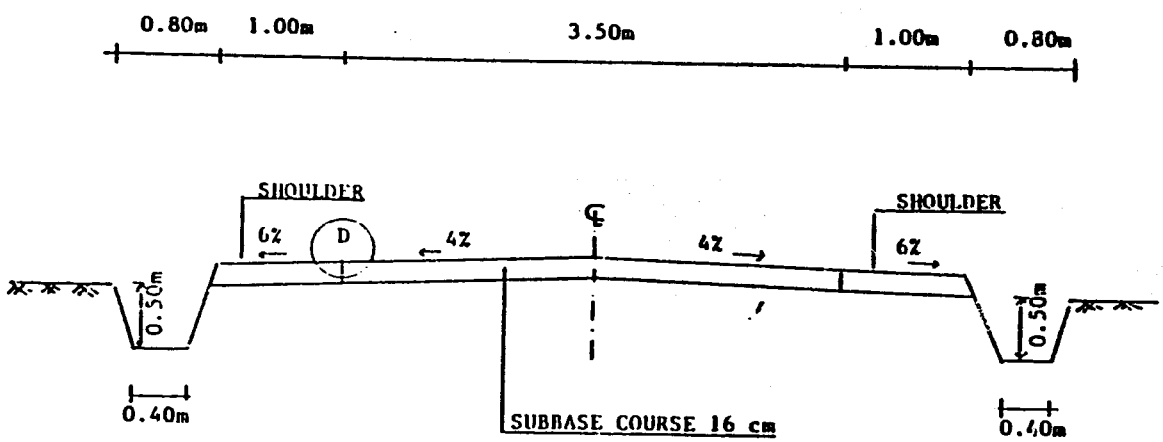

DETAIL C



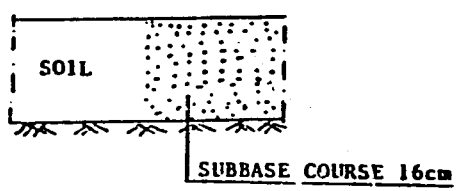

Cut slope depends on material. From 2:1 in normal material to 5:1 in rock cut

Thickness of pavement depends on the subgrade CBR

TYPICAL ROAD CROSS SECTION
CLASS 111C




DETAIL D




SCALE: AS SHOWN



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FIGURE 1 (CONTINUED)

DGH DESIGN STANDARDS FOR LOCAL ROADS

| ROAD CLASSIFICATION | | | CLASS III A | | | CLASS III B | | | | | | CLASS III C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SURFACE TYPE | | | ASPHALT SURFACE | | | ASPHALT SEAL | | | GRAVEL *) | | | GRAVEL/AWCAS *) | | |
| TRAFFIC VOLUME: ADT (FOUR WHEEL VEHICLE) | | | 1000 - 500 | | | 500 - 200 | | | 200 - 50 | | | < 50 | | |
| TERRAIN | | | FLAT | ROLLING | MOUNTAINOUS | FLAT | ROLLING | MOUNTAINOUS | FLAT | ROLLING | MOUNTAINOUS | FLAT | ROLLING | MOUNTAINOUS |
| TRAFFIC LANES | | | 2 | 2 | 2 | 1+ | 1+ | 1+ | 1+ | 1+ | 1+ | 1 | 1 | 1 |
| DESIGN SPEED (Km/hr) | | DESIRABLE | 70 | 60 | 40 | 60 | 40 | 30 | 60 | 40 | 30 | 50 | 30 | 30 |
| | | MINIMUM | 50 | 40 | 30 | 40 | 30 | 30 | 40 | 30 | 30 | 30 | 30 | 30 |
| GRADIENT (%) | | MAXIMUM | 6 | 8 | 10 | 6 | 8 | 10 | 6 | 8 | 12 | 8 | 12 | 16 |
| PAVEMENT WIDTH (m) | | MAXIMUM | 6.0 | 6.0 | 6.0 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 3.5 | 3.5 | 3.5 |
| | | MINIMUM | 4.5 | 4.5 | 4.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.0 | 3.0 | 3.0 |
| SHOULDER WIDTH (m) | | MAXIMUM | 2.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.0 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 0.75 |
| | | MINIMUM | 1.5 | 1.0 | 0.75 | 1.0 | 1.0 | 0.75 | 1.0 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| ROAD BED WIDTH (m) | | MAXIMUM | 10.0 | 9.0 | 9.0 | 8.0 | 7.5 | 6.5 | 7.5 | 6.5 | 6.5 | 5.5 | 5.5 | 5.0 |
| | | MINIMUM | 7.5 | 6.5 | 6.0 | 5.5 | 5.5 | 5.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 |
| MINIMUM CURVE RADIUS e MAX = 10% | | DESIRABLE | 160 | 115 | 50 | 115 | 50 | 30 | 115 | 50 | 30 | 80 | 30 | 30 |
| | | MINIMUM | 80 | 50 | 30 | 50 | 30 | 30 | 50 | 30 | 30 | 30 | 30 | 30 |
| RIGHT OF WAY (ROW) | | DESIRABLE | 16 M | | | 12 M | | | 12 M | | | 12 M | | |
| | | MINIMUM | 12 M | | | 10 M | | | 10 M | | | 8 M | | |
| ROAD CAMBER (NORMAL) | | PAVEMENT | 3% | | | 3% | | | 4% - 6% | | | 4% - 6% | | |
| | | SHOULDER | 4% - 6% | | | 5% - 6% | | | 6% - 7% | | | 6% - 7% | | |
| BRIDGE WIDTH | SPAN < 6 M | DESIRABLE OVERALL WIDTH | 7.0 M | | | 7.0 M | | | 7.0 M | | | 4.5 M | | |
| | | WITHOUT SIDEWALK (MIN) | 4.5 M | | | 4.5 M | | | 4.5 M | | | 4.5 M | | |
| | 6-30 M | DESIRABLE OVERALL WIDTH | 7.0 M | | | 7.0 M | | | 4.5 M | | | 4.5 M | | |
| | | WITHOUT SIDE WALK (MIN) | 4.5 M | | | 4.5 M | | | 4.5 M | | | 4.5 M | | |
| | > 30 M | DESIRABLE OVERALL WIDTH | 7.0 M | | | 4.5 M | | | 4.5 M | | | 4.5 M | | |
| | | WITHOUT SIDEWALK (MIN) | 4.5 M | | | 4.5 M | | | 4.5 M | | | 4.5 M | | |
| | TEMPORARY BRIDGE (MINIMUM) | | 3.0 M | | | 3.0 M | | | 3.0 M | | | 3.0 M | | |
| BRIDGE DESIGN LOADING | | | 70 % BM | | | 70 % BM | | | 50 % BM | | | 50 % BM | | |

* DESIRABLE IF SURFACE IS COATED WITH ASPHALT

SOURCE: DIRECTORATE GENERAL OF HIGHWAYS, SUBDIRECTORATE OF LOCAL ROADS, AUGUST 1986.

# ANNEX H

# ECONOMIC ANALYSIS

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# 1. MACRO ECONOMIC CONSIDERATIONS

## 1.1 PURPOSE

The purpose of this paper is to consider (1) the size and nature of the economic adjustment problem facing Indonesia, (2) the sufficiency of additional financing being arranged with donors and banks, and (3) the significance and meaning of past policy reform and the outlook for future reform.

## 1.2 NATURE OF ADJUSTMENT PROBLEM

Indonesia has two fundamentally related but substantively different adjustment problems. The first relates to relatively short- to medium-term macro stabilization, with restoration of balance in the external and budgetary accounts and resumption of reasonable levels of growth the principal focus of policy considerations. The second relates to longer-term restructuring of the economy away from its present inward-looking, oil dependent status to a faster growing, more outward-looking economic structure that features greater roles for labor-intensive manufacturing and non-oil exports.

The two adjustment problems substantively differ in that policies designed to achieve one set of adjustment objectives (e.g., stabilization) will not necessarily be sufficient by themselves to achieve the other set of adjustment objectives (e.g., restructuring), at least within an appropriate time frame. Although there is almost unanimous agreement among analysts on the ultimate necessity of longer-term restructuring policy reforms, it is not true that short- to medium-term macro stabilization cannot be achieved in their absence.

The current sense of urgency on restructuring reforms relates far more to assumptions about the political timing requirements of this type of policy reform (and the present perceived window of opportunity) than its absolute necessity for achievement of short- to medium-term balance in external payments or budgetary accounts. There is nothing inherent in the present balance of payments situation that demands that all key elements of longer-term restructuring reform be completed within some immediate time frame.

The need for external finance will not materially change over the short to medium term, even if we assume corrective restructuring steps

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* See Indonesian Economic Adjustment and Reform, USAID/Jakarta, March 25, 1987 for the body of report for which this executive summary was originally prepared. Portions of this report also appear as part of the economic annexes submitted with the Indonesia Policy Support Program project paper on April 10, 1987.

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are taken to the maximum extent possible. A perception on the part of the GOI that imminent external financing requirements are overwhelming is more likely to be met by short-term measures, including repressive policy responses, than by corrective restructuring responses that require considerable time to take effect.

1.3 SIZE OF ADJUSTMENT PROBLEM

Indonesia is at the beginning of what will probably be a very difficult 3-4 year adjustment period. It is in the midst of an economic recession that has substantially worsened with the decline in average oil prices from $25/BBL in 1985 to $12/BBL in 1986. Because Indonesian export earnings and budgetary revenues are highly dependent on oil and LNG earnings (70%+ in 1984/5), the drastic decline in oil prices poses significant adjustment burdens on balance of payments, government budgets, growth, incomes and employment. This adjustment burden is expected to be prolonged because of the relatively unfavorable and highly uncertain medium-term outlook for oil prices and the relatively long lead time for structural adjustment policy measures to have substantial impact.

The IBRD projects that real GDP growth will average less than 2.5% during the period 1986-90 and that real per capita income will decline by an average 0.7% per year. On the basis of these projections and historical employment-output elasticities, less that 40% of the 10 million new entrants to the labor force during the period 1986-90 will find employment. This follows upon an already worsening employment and incomes situation in the preceding 5 years (1981-85) when GDP growth averaged 2.5% as well.

Symptomatic of the pessimistic outlook for oil prices and the current economic recession, real budgetary expenditures, excluding debt service, may fall by as much as 40%, compared to their 1985/6 levels, during the period 1987/8-1990/1. Real development expenditures will probably fall by more than 50%. The current account deficit is expected to substantially worsen, rising from $1.8 billion in 1985/6 to an estimated $4.8 billion in 1986/7 before falling to a projected $2.9 billion in 1987/8 and $1.2 billion in 1988/9. External financing requirements will double to almost $7 billion by 1986/7, ease slightly to $6 billion by 1987/8, and probably stabilize between $4-5 billion 1988/9-1990/1. The growing debt service burden is a major factor in the continuing need for large amounts of external financing.

In sum, over the next 3-4 years the government faces significant increases in external financing requirements, major decreases in real non-debt budgetary expenditures, a decline in average real GDP growth to one-third of the level in the 1970s, falling real per capita incomes, and significant increases in employment pressures.

1.4 OIL AS THE "X" FACTOR

All potential adjustment scenarios over the next several years depend critically upon the price and production trend assumptions for oil and LNG. Even as recently as FY 1984/5 oil and LNG accounted for 71% of

domestic budgetary revenues and 72% of commodity export revenues. Since then oil prices have fallen by about 60%.

Because of the extreme sensitivity to relatively small changes in production and the existence of substantial excess production capacity, world oil prices can easily swing by several dollars in either direction depending on the market's perception of OPEC discipline -- real or imagined -- or other extraordinary factors affecting oil supply such as the Iraq-Iran war.

This means that future oil price levels and trends are highly uncertain and potentially subject to considerable volatility until world-wide excess production capacity disappears, presumably sometime in the early 1990s. The potential range in oil prices during the interim could easily be from about $8/barrel to the $27/barrel that existed in 1985. Oil prices could be almost anywhere within this range (and beyond) depending on OPEC production levels, worldwide stock levels, unanticipated supply disruptions, growth in world demand, and market expectations.

Although the new OPEC agreements look hopeful at first glance, low oil prices and smaller production volumes are not consistent with long-term stability in oil-dependent economies around the world and are, therefore, likely to be more unstable than the old agreements with higher prices. If the poorer nations couldn't afford to abide by larger quotas at $27/barrel, they will be less likely to be able to do so with smaller quotas at $18/barrel. It is clear that each OPEC member will still be worse off in 1987 than in 1985 and only marginally better off than in a very tough 1986. The poorer countries with large populations tend to export proportionately less of their production and are, therefore, hurt relatively more by proportionately shared production cuts that at the margin must come from their exports.

1.5 SUFFICIENCY OF FINANCE

The GOI strategy is to maximize program or local currency lending that will provide both immediate balance of payments support as well as local currency financing for the budget. Because of the seriously deteriorated public debt service ratio and current uncertainties related to oil prices, the GOI must look first to the donor community for its financial support.

The GOI strongly wishes to avoid any type of IMF standby or other type of financing arrangement which is accompanied by conditionality. Similarly, the GOI strongly prefers to raise new finance rather than go through the process of an official debt rescheduling which would probably have to be accomplished by some form of an IMF arrangement with conditionality. The GOI is interested in an IMF Commodity Financing Facility, however, because it is not accompanied by conditionality and some believe it would represent an IMF stamp of approval in the eyes of the international banking community.

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Approximately $2.2 billion in donor program or local cost financing assistance, two-thirds expected to be disbursed in 1987/8, is currently under negotiation, approaching final agreement, or has been signed. The Japanese are the most important player in terms of total resources ($1.2 billion), although the IBRD is highly significant both in amount ($0.8 billion) and in terms of the moral leadership being exercised in the general endeavor to mobilize program-type assistance. Among the smaller donors the USG is considering a $75 million policy support loan which could be negotiated by early summer 1987 and disbursed over a two year period.

Approximately one-half of the estimated $2.2 billion of additional donor balance of payments support had been signed as of early March, 1987. Most of the additional financing is likely to be negotiated and signed within the next 1-4 months. Almost all of the $2.2 billion in assistance is expected to be disbursed within 12-24 months of signing. It is likely that additional loans of similar nature will be requested by the GOI for disbursement beginning in 1988/9. This might easily total another $0.5-$1.0 billion beyond what is already under negotiation.

On the basis of our analyses, we believe that Indonesia has taken the necessary steps for short-term adjustment and will be able to successfully finance its balance of payments over the next two years without drawing down official reserves much below the $4.5 billion level. This outcome is critically dependent, however, upon the GOI being able to successfully negotiate donor assistance now under review in timely fashion, on Indonesian oil prices averaging $13.50/barrel in 1987/8 and $15.00/barrel in 1988/9, and on the absence of prolonged capital flight. Given that the timing of financial flows is critical and that the uncertainty and potential volatility of future oil prices makes it impossible to guarantee any particular outcome, it is obvious that Indonesian economic adjustment during the next 3-4 years remains uncertain.

## 1.6 SIGNIFICANCE OF STEPS TAKEN 1983-86

The Government of Indonesia has undertaken one of the more comprehensive and far reaching set of economic policy reforms of any country in the world over the four year period 1983-86. During this period Indonesia has essentially set its factor prices right, set in motion substantial public and private resource mobilization measures, controlled inflation at single digit levels despite two devaluations, maintained the real effective exchange set by the devaluations, exercised consistent budgetary austerity (including a generally ruthless approach to budgetary subsidies), exercised significant restraint on new state enterprise investment, and, in general, taken several measures which have moved toward significant liberalization of the market.

Some evidence is already available on the immediate impact of some of these policy measures, although it is important to realize that for

many of the changes most of the potential gain is still to come and will take place over the very long term. Examples of policy impact in the first three years of the four year reform period (1982/3 - 1986/7) include: (1) non-oil exports increased 59% from $3.9 billion to $6.2 billion, (2) imports fell 31% from $20.6 billion to $14.2 billion, (3) total official reserves increased 67% from $4.3 billion to $7.2 billion, (4) net foreign assets of the banking system increased 60% from $7.5 billion to $12.0 billion, (5) government non-oil taxes and revenues increased 93% from Rp. 4.2 trillion to Rp. 8.1 trillion, (6) petroleum subsidies fell 69% from Rp. 1.0 trillion to Rp. 0.3 trillion, (7) banking system time deposits increased 279% from Rp. 2.4 trillion to Rp. 9.1 trillion, (8) state bank time deposit rates increased from an average 8-9% to an average 15-17%, (9) the real effective exchange rate depreciated by 6%, (10) consumer prices increased an average 7.3% per year, (11) the GDP deflator increased an average 8.5% per year, (12) import licensing restrictions were abolished or relaxed for 44% of the value of imports previously restricted, (13) over 70% of total imports by value enter Indonesia at 0-5% tariff, and (14) cost of shipping has been reduced 20-40% and processing time on customs procedures has been reduced by several weeks.

The breadth and consistency, as well as the significance, of the policy measures taken since 1983 are not an accident. They show both direction and intent. They represent a very conscious movement toward a greater role for the market economy and movement away from direct government control.

## 1.7 STRATEGIC ISSUES AHEAD

While the recent policy measures of 1983-86 are highly impressive much still remains to be done on several reform fronts. Indonesia faces several strategic issues over the next 10 years from the perspective of addressing and containing the incomes-employment problem, including: (1) trade, investment, and industrial deregulation, (2) agricultural diversification, (3) resource mobilization and distribution, (4) containment and management of urban growth, (5) increasing the private sector's share of resource allocation, and (6) human resource development.

It is important to understand that although deregulation of trade, investment, and industry constitutes one of the key issue areas facing Indonesia, it is not the only important issue. It is also important to understand that the need for deregulation is not simply confined to those factors affecting the external economy or to the question of import monopolies. In examining claims on the overriding importance of a given policy issue it is important to place it in the perspective of the full range of problems facing Indonesia.

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## 1.8 GOI REFORM STRATEGY

The consistent direction of policy reform and economic decision making during the period 1983-6 points to a strong market-oriented philosophy. This is demonstrated repeatedly in the examination of individual reforms, the range of reforms taken as a whole, and the strong supporting economic management of the economy.

The strategy towards policy reform seems to be: (1) marshal the facts, commission analyses, and establish technical credibility of a proposed measure both within and outside government; (2) prepare public opinion by open debate and by supportive statements over an extended time period; (3) attack less controversial issues first but build toward a more open market economy by taking continuous steps in that direction; and (4) address the more politically difficult issues on the basis of long-term national good during periods of economic pressure/crisis.

Beyond the broader generalization that the reform strategy is focused on market liberalization, the specifics of the strategy have included: (1) correction of factor prices including capital, foreign exchange and energy, (2) virtual elimination of direct budgetary subsidies, (3) reduced interference in commodity input and output pricing, (4) reduction of commercial and industrial regulatory and licensing barriers, (5) reduction of protective barriers to external competition including non-tariff barriers and rationalization and lowering of nominal tariff levels, (6) mobilization of resources for both public and private sector use, (7) reduction of interference in credit allocation, (8) containment and reduction of the role of state enterprises, and (9) official support for promotion of private sector expansion.

In sum, the broad outline of GOI reform strategy seems amply clear. The past track record is good and seems likely to continue. Although likely to improve, economic pressures on the economy will not subside over the next 3 to 4 years and will continue to act as a backdrop for arguing the necessity of timely reforms. The ever-growing employment problem will continue to loom larger and will weigh even more heavily in the argumentation for reform. (The employment problem will not simply disappear because the GOI manages to finance its medium-term adjustment problem.) For all of these reasons there are grounds for optimism that the reform momentum will continue. As long as reform maintains its credibility, its direction is relatively clear and the chances that it will continue to occur relatively good.

## TABLE 1

### REVISED BALANCE OF PAYMENT PROJECTIONS, 1986/87 - 1990/91
($ billion)

| | Actual 1985/6 | Projected 1986/7 | 1987/8 | 1988/9 | 1989/0 | 1990/1 |
|---|---|---|---|---|---|---|
| Gross Exports | 18.6 | 13.4 | 14.5 | 16.2 | 18.3 | 19.8 |
| Oil and LNG 1/ | 12.4 | 6.4 | 6.5 | 7.4 | 8.9 | 9.8 |
| Non-Oil 2/ | 6.2 | 7.0 | 8.0 | 8.8 | 9.4 | 10.0 |
| Gross Imports | 12.5 | 12.4 | 11.8 | 11.4 | 12.0 | 12.6 |
| Oil and LNG 3/ | 2.5 | 3.4 | 3.3 | 3.4 | 3.5 | 3.6 |
| Non-Oil 4/ | 10.0 | 9.0 | 8.5 | 8.0 | 8.5 | 9.0 |
| Net Services | 7.9 | 5.8 | 5.6 | 6.0 | 6.5 | 7.2 |
| Oil and LNG 3/ | 3.8 | 1.5 | 1.3 | 1.5 | 1.8 | 2.3 |
| Non-Oil 5/ | 4.1 | 4.3 | 4.3 | 4.5 | 4.7 | 4.9 |
| Current Account | 1.8 | 4.8 | - 2.9 | - 1.2 | - 0.2 | 0.0 |
| Official Capital | 3.4 | 5.2 | 5.8 | 4.3 | 4.0 | 4.0 |
| Donor AID 6/ | 2.8 | 3.2 | 4.4 | 3.7 | 3.0 | 3.0 |
| Non-Donor 6/ | 0.6 | 2.0 | 1.4 | 0.6 | 1.0 | 1.0 |
| Other Capital 7/ | 0.6 | 0.8 | 0.2 | 0.2 | 0.2 | 0.2 |
| Debt Repayment 8/ | 1.6 | 2.1 | 3.0 | 3.4 | 3.8 | 3.9 |
| Net Errors & Omissions | 0.5 | | | | | |
| Change in Reserves (- = increase) | - | 0.9 | - 0.1 | 0.1 | - 0.2 | - 0.3 |
| Memorandum | | | | | | |
| Official Reserves | 5.8 | 4.9 | 5.0 | 4.9 | 5.1 | 5.4 |
| Public Debt Service 9/ | 4.3 | 4.4 | 5.0 | 5.4 | 5.8 | 5.6 |
| Public Debt Service Ratio 10/ | 21.4 | 29.5 | 31.3 | 30.5 | 29.3 | 26.3 |
| Assumed Oil Price ($/BBL) | 25.0 | 12.3 | 13.5 | 15.0 | 18.0 | 20.0 |

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**Notes:**

1/ Assumes oil production (including .140MBD condensate) at 1.405 MBD (1986/7), 1.300 MBD (1987/8), and 1.330 MBD thereafter. LNG production assumed at 793 MMBTU. LNG revenues will tend to be understated during later years of the projection period as production levels and exports increase. Assumes average prices ($/BBL) as follows:

| | Oil | LNG |
|---|---|---|
| 1986/86 | 12.3 | 15 |
| 1987/88 | 13.5 | 15 |
| 1988/89 | 15 | 17 |
| 1989/90 | 18 | 20 |
| 1990/91 | 20 | 22 |

2/ Assumes favorable initial impact from devaluation on non-oil exports during last 4 months of FY 86/87, through 1987/88, tailing off by 1988/89. Numbers roughly parallel impact of 1983 devaluation adjusted for timing. Long-term impact could be substantially greater than suggested here. Non-oil exports in 1986/7 would have been about $6.5 billion in the absence of devaluation, based on performance of first six months. World economy assumed to continue 1986/87 performance.

3/ Produced by embassy oil/LNG model. Consistent with export assumptions on production levels and price. Projections not strictly comparable with either imports or services of oil/LNG in 1985/86 because of difference in GOI accounting treatment. The aggregation of oil/LNG imports and services are comparable, however.

4/ Assumes that non-oil imports are only affected during last quarter of FY 86/87 because of orders in pipeline. The decreases in projected imports in following periods roughly parallel the 1983 devaluation and are considered conservatively plausible. Projected decreases are somewhat less optimistic than experienced following 1983 devaluation because imports have already been squeezed, massive rescheduling of state enterprise projects are no longer a major alternative, and there are no significant food commodity imports in the import bill as there were prior to the 1983 devaluation. The 1986/7 import projection appears reasonable based on estimated actual imports of $4.6 billion during the first six months of the fiscal year.

5/ Net non-oil services are assumed constant except for the increase in estimated debt service interest payments. This appears conservative since the devaluation should actually depress service imports and stimulate exports, resulting in a net decline in non-interest non-oil services. However, the increase in interest payments may be somewhat underestimated. (Note: freight on imports is treated under services rather than imports in these projections. This lowers imports and raises services by roughly $1.0 billion.)

6/ See Tables 2 and 3 for the source of estimates. The non-donor assistance in 1986/87, 1987/8 and part of 1988/9 represents drawdown of existing commercially syndicated standby credits.

7/ Other capital represents net direct foreign investment and net private borrowing, except in 1985/6 and 1986/7 when net state enterprise capital flows are included. Appreciation on currency revaluation, estimated at $400-$500 million, is included in FY 1986/7. Appreciation on currency revaluation in FY 1985/6 is assumed to be included in both "other capital" and errors and omissions. See 5/86 IMF report.

8/ Debt amortization of principal based on IBRD 12/31/85 estimates for GOI direct debt plus state enterprises, except for treatment of state enterprises in 1985/6 and 1986/7. See footnote #7. A nominal increase of $200 million to $300 million was added to years subsequent to FY 86/87. The amortization for FY 87/88 and beyond may be progressively understated as repayments become due on debt incurred after December 1985. However, this is probably not a serious understatement until possibly late in the projection period, because donor borrowings generally have a 5 to 10 year grace period. It is assumed that commercial credit drawdowns have a 3 year grace period.

9/ Combined interest and principal payments on direct government debt plus state enterprise debt. Includes LNG expansion. Source is IBRD's 5/86 estimate adjusted for estimated additional payments on new commercial drawndowns subsequent to 12/31/85.

10/ Direct government debt plus state enterprise debt as a percentage of gross exports of goods and services. Exports of services assumed at $1.5 billion throughout projection period.

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TABLE 2
REVISED BUDGETARY PROJECTIONS, 1986/87 - 1990/91 1/
(Rp. Trillion)

| | Actual | Projected | | | | |
|---|---|---|---|---|---|---|
| | 1985/6 | 1986/7 | 1987/8 | 1988/9 | 1989/0 | 1990/1 |
| **Revenues 2/** | | | | | | |
| Oil/LNG | 11.1 | 4.6 | 5.6 | 6.9 | 9.2 | 10.7 |
| Oil | 9.4 | 3.8 | 4.5 | 5.7 | 7.6 | 8.8 |
| LNG | 1.7 | 0.8 | 1.1 | 1.2 | 1.6 | 1.9 |
| Non-Oil/LNG 3/ | 8.1 | 10.1 | 10.1 | 10.9 | 11.8 | 12.8 |
| Income Tax | 2.3 | 2.8 | 3.1 | 3.4 | 3.7 | 4.1 |
| VAT | 2.3 | 3.2 | 3.5 | 3.9 | 4.3 | 4.7 |
| Other | 3.5 | 4.1 | 3.5 | 3.6 | 3.8 | 4.0 |
| Total Domestic | 19.2 | 14.7 | 15.7 | 17.8 | 21.0 | 23.5 |
| External AID/Credit 4/ | 3.6 | 7.0 | 8.7 | 6.3 | 5.8 | 5.8 |
| Total Revenues | 22.8 | 21.7 | 24.4 | 24.1 | 26.8 | 29.3 |
| **Expenditures** | | | | | | |
| Routine | 11.9 | 13.4 | 15.8 | 16.8 | 18.1 | 19.4 |
| Debt service 5/ | 3.3 | 5.3 | 7.3 | 7.9 | 8.7 | 8.6 |
| Non-debt service 6/ | 8.6 | 8.1 | 8.5 | 8.9 | 9.4 | 9.8 |
| Development 7/ | 10.9 | 8.3 | 8.6 | 7.3 | 8.7 | 10.9 |
| Total Expenditures | 22.8 | 21.7 | 24.4 | 24.1 | 26.8 | 29.3 |
| Non-debt | 19.5 | 16.4 | 17.0 | 16.2 | 18.1 | 20.7 |
| (% of total) | (85.5) | (75.6) | (70.0) | (67.2) | (67.5) | (70.6) |
| Memorandum: | | | | | | |
| Deflated Expenditures 8/ | 22.8 | 19.3 | 18.9 | 17.8 | 18.9 | 19.7 |
| Non-debt | 19.5 | 14.6 | 13.2 | 12.0 | 12.7 | 13.9 |
| Development | 10.9 | 7.4 | 6.6 | 5.4 | 6.1 | 7.3 |
| Oil Price Assumption ($/BBL) | 25.0 | 12.3 | 13.5 | 15.0 | 18.0 | 20.0 |

**Notes:**

1/ Projections are post-September 12th devaluation. Average exchange rate 1986/87 assumed at Rp. 1,420. Thereafter, assumed at Rp. 1,650.

2/ Based on some oil price and volume assumptions as Balance of Payments, Table 1.

3/ Revenues for 1986/7 are estimated actual on the basis of performance during first six months and the past relationship between 1st semester receipts and receipts for the entire fiscal year. VAT and income tax assumed to grow at 10 percent 1987/88-1990/91. Other revenues assumed to grow at 5 percent 1987/88-1990/91. Other revenues drop in 1987/8 because of a major decline in fuel sales. These revenues decline as international oil prices rise.

4/ Assumes 44 percent of donor assistance disbursed prior to devaluation at Rp. 1,125 per dollar. Assumes syndicated commercial borrowing effectively 100 percent drawn prior to the devaluation because of fungibility effect (i.e., swap facilities will be replaced). Assumes no proceeds from anticipated reserve drawn down will be used for budgetary support other than stated. Assumes that all official capital in balance of payments 1987/88-1990/91 used for budgetary support, except $0.5 billion each year for state enterprises. This means that for 1986/87 that project aid was converted at an average rate of Rp. 1,420 = $1, that non-donor AID was all converted during 1st six months @ Rp. 1,125 = $1, and that a small portion of reserve drawdown counterpart funds (Rp. 200 billion) was used to finance the budget. Approximately Rp. 1.3 trillion counterpart funds from an estimated $0.9 billion reserve drawn down are left over and not drawn elsewhere in this projection.

5/ Debt service is based on IBRD 5/86 projections with modest increases for estimated interest and amortization on drawdown of commercial standby credits subsequent to 12/31/85. Debt service for state enterprises is not included in this projection. There is an indication that in reality, however, at least some portion of state enterprise debt may be serviced through this line item. Annex II Table 1.

6/ Assumes personnel, commodities, and subsidies to regions to essentially remain constant in aggregate in real terms. Assumes no routine budget subsides. Assumes increase of 5% per annum in nominal terms beginning in 1987/88. This implies that domestic fuel oil prices would need to be raised in 1989/90 (Rp. 0.5 billion) and again in 1990/91 (Rp. 0.5 billion), representing a total 10% increase.

7/ Development expenditures are taken as a residual for projected period. Residual shares of GOI development expenditures, after making allowance for assumed donor disbursements, are not necessarily consistent with likely requirements for non-project expenditures.

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Expenditures were deflated for inflation and the estimated September '86 devaluation effect. Expenditures were deflated by 12.5% (1986/7), 28.7% (1987/8), and for an additional 5% compounded annually thereafter on the 1987/8 base deflater. Inflation was assumed 5.5% (1986/7), 9.0% (1987/8), and 5% per year (1988/9-1990/91). Real non-debt expenditures and development expenditures are assumed proportional to their share in nominal expenditures. Because foreign exchange is not distributed equally between debt and non-debt and between development and non-debt expenditures, real expenditures will not vary proportionately to nominal shares. Real non-debt service may be somewhat overstated in earlier periods and understated in later periods. Development expenditure is unprobably overstated throughout.

TABLE 3

COMPARISON OF BUDGETED EXPENDITURES, 1982/83 - 1987/88
(Percentage Share)

| | 1982/3 | 1985/6 | 1986/7 | 1987/8 |
|---|---|---|---|---|
| Routine Expenditures | 44.9 | 53.8 | 61.3 | 66.0 |
| Civil Service | 16.0 | 17.9 | 19.7 | 18.9 |
| Goods Procurement | 6.8 | 6.6 | 6.4 | 5.2 |
| Subsidies to Regions | 8.4 | 11.2 | 12.3 | 11.6 |
| Debt Service | 6.3 | 15.5 | 19.7 | 29.9 |
| Food Stock Financing | - | - | 1.9 | - |
| Other | 7.4 | 2.6 | 1.2 | 0.4 |
| Development Expenditures | 55.1 | 46.2 | 38.7 | 34.0 |
| Rupiah Financing (GOI) | 43.4 | 27.6 | 22.3 | 10.2 |
| Departments | 20.0 | 14.1 | 8.3 | 2.6 |
| Defense | 3.6 | 1.6 | 1.4 | 0.6 |
| Regional Development | 0.7 | 0.7 | 1.2 | 1.1 |
| INPRES | 9.0 | 6.4 | 6.1 | 4.1 |
| East Timor | - | - | - | - |
| Fertilizer | 3.0 | [illegible].4 | 3.1 | 0.9 |
| Equity Investment | 3.5 | 1.1 | 1.0 | 0.4 |
| Other | 3.6 | 1.1 | 1.2 | 0.5 |
| Project Aid (donors) | 11.7 | 18.6 | 16.4 | 23.8 |
| Total Budget | 100.0 | 100.0 | 100.0 | 100.0 |
| Total Budget (Rp. Billion) | 15,607 | 23,046 | 21,422 | 22,783 |
| Percent Domestically Financed | 88.3 | 81.4 | 83.6 | 76.2 |
| Nominal % Change | 1/ | + 47.7 | - 7.0 | + 6.4 |
| Real % Change 2/ | 1/ | + 16.3 | -12.3 | -12.8 |

1/ Using FY 1982/3 as the base year.

2/ After deflating for 3/83 and 9/86 devaluations and consumer price increases. Deflationary factors were: 1985/6(27%), 1986/7(6%), 1987/8(22%).

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# 2. MICRO ECONOMIC ANALYSIS

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## 2.1 SUMMARY

### 2.1.. Selection of Rehabilitation Priorities

Districts do not, at present, use formal or consistent procedures to assign priority to road links for rehabilitation. Formal pre-screening methods have been developed to evaluate and rank road projects at the district level under donor-funded projects. They have been, however, an invention of donors and have required outside consultants to apply them.

These methods have attempted to incorporate measures of producer surplus as a complement to the conventional consumer surplus (vehicle operating cost savings) screening indices but have proved very complex, have produced inconclusive results, and in the end have always necessitated resorting to traffic counts and vehicle cost savings as the basis for selection.

A simple rural roads screening method developed by the IBRD is recommended for use under the AID project. This is a single table based on vehicle cost savings only, extended by interpolations to now include the expected road work costs (Rp. 9 to 39 million/km) in the project area. In matrix form, it identifies the level of traffic at alternative reconstruction cost levels which would produce various internal rates of return between 6% and 15%. Both the cost and the traffic level (average daily traffic) correspond to study area conditions and the table is simple enough to be applied, with supervision, by the kabupatens themselves. The assembly of these observed and probable variations into one screening table was based on sample data and estimated road work costs. Because the sample data were not comprehensive and because the variable parameters (e.g., vehicle composition) may be discovered during project implementation to vary geographically and/or over time, the table will need to be refined periodically as the project proceeds.

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* This analysis was prepared before the September 1986 devaluation of the Rupiah. Numerical values of the calculations here have not been changed to reflect the new exchange rate. These values, however, have been adjusted on the version of the simplified table (Required Levels of ADT to Justify Major Road Treatment Costs) presented in the body of the Project Paper. The conclusions of this analysis are not substantially affected by the devaluation.

A monitoring/evaluation survey is also suggested as an option to measure project effects upon non-vehicle activity such as cash-crop production and transport price changes if considered necessary during the project life. This survey would serve as a device to estimate benefits beyond vehicle savings for those roads which are improved, and as a check upon low-volume roads in regions which may be emerging as development areas.

### 2.1.2 Selection of Maintenance Priorities

It is recommended that, initially, road links and bridges in "good" condition and perhaps the best 20% or so in "moderate" condition begin receiving regular maintenance as soon as possible (based on current data, this means that until rehabilitation work gets underway, the opportunity to begin a full-scale maintenance program exists in only a limited number of kabupatens). A task of the project should be to refine maintenance procedures for assigning priority through planning tools that are included in the proposed maintenance management system.

## 2.2 STANDARDS AND DEFINITIONS USED IN ROAD DESIGN AND MAINTENANCE

### 2.1.1 Assessment

The road building industry worldwide uses a variety of terms to describe different road treatments. This section identifies both the local terminology that should be discarded and the more suitable terms that clearly delineate a function, and therefore provide the basis for proper cost estimates.

The construction of kabupaten roads can be considered a time-staged process, related to expected average daily traffic (ADT). This expectation is also used to create a classification of roads. The Indonesian Roads Department (Bina Marga, Jakarta) recognizes these road classes for kabupaten roads:

KABUPATEN ROAD CLASSES

| | IIIA Sealed Asphalt | IIIB Sealed | IIIB Gravel | IIIC Unsealed Gravel/Earth |
|---|---|---|---|---|
| ADT (undifferentiated): | 500-3000 | 200-500 | 50-200 | <50 |

At the first stage, a simple grading of the natural earth provides the running surface for class IIIC light traffic. The term "gravel" is used

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locally to include Telford cobble and all weather compacted aggregate subgrade (AWCAS).* Thus, gravel roads classed as IIIB or IIIC may be surfaced with Telford, engineered gravel, or AWCAS. The difference among these classifications is that Telford is large boulders and rocks; true (engineered) gravel is crushed, sized and graded for specific layered uses; and AWCAS is lesser in quality.

Under this definition, gravel/Telford/AWCAS provides the running surface. However, for IIIB roads which are classified as "sealed roads," some of these gravel-surfaced roads are also treated with a spray sealcoat of asphalt or used motor oil, which may then be coated with gravel chips. This sealing is intended to stabilize the running surface and make it impermeable to water.

For class IIIB roads, therefore, important design changes may be in order. The seal for gravel may be used as ADT approaches 100, and the more advanced sealcoat as ADT approaches 200. Because the purpose of each sealing method is to stabilize the road, provide a smoother running surface, and to protect it against water infiltration, work must be done to the subgrade and the existing base. This mainly consists of a layered treatment:

| | |
|---|---|
| Surface : | wear-out, protective |
| Base : | gravel and sand, 15 cm |
| Subbase : | aggregate or Macadam (usually only select material), 10-45 cm |
| Subgrade: | stabilized soil (lime/cement) or stone, compacted |

For this work, design specifications may provide lower or higher standards, given design speeds, limiting gradients, paved width, shoulder width, camber or slope of crown for surface and shoulders, bridge width (with or without sidewalks), etc. It is at this point that the terminology becomes confusing. It becomes even more coufusing if the subbase/subgrade work is omitted at this stage of road building, and must be undertaken at the later stage (ADT 500) of an asphalt overlay.

Any of the following terms can be used to describe the transition from a IIIC road to a IIIB sealed gravel or sealed road: improvement, upgrade, betterment, support work, renovation, rehabilitation, or reconstruction. While the latter three terms suggest re-working to an original design standard, in practice, no definitive design standards exist regarding an earth or cobble road. Moreover, it is common practice the world over to incorporate "improvements" and "rehabilitations" (i.e., to "upgrade" to a higher standard) at this stage of road-building, to take advantage of the economies of scale inherent in the very large costs associated with re-working the road, virtually from the ground up: the subgrade, subbase, base, and surface treatment and pavement.

This Indonesian definition of AWCAS differs from that used outside of Indonesia. The standard definition is all weather crushed aggregate surface.

The running surface associated with each of the four major road types, asphalt, sealed, sealed gravel, and gravel/earth, does not describe well the different kinds of surfacing which may be applied to meet the needs of wear and stability. The Indonesian Roads Department defines ten kinds of surface treatment or pavement construction above the level of the IIIC gravel/earth road. In the general descending order of their relative cost and durability, they are:

| Running Surface | Function | Indonesian Term |
|---|---|---|
| Asphalt concrete | overlay, 4 cm, structural | LASTON |
| Two-layer asphalt* (DBST) | overlay, 35 mm, non-structural | BURDA |
| One-layer asphalt* (SBST) | overlay, 20 mm, non-structural | BURTU |
| Aggregate buton asphalt | overlay, 3 cm, structural | LASBUTAG |
| Thin concrete asphalt | overlay, sealcoat, 3 cm, non-structural | LATASTON |
| Macadam penetration | pavement or base, 5 cm, structural | LAPEN |
| Thin sand & asphalt | sealcoat, reseal, 2 cm, non-structural | LATASIR |
| Asphalt spread | sealcoat, reseal, non-structural | BURAS |
| Thin pure buton asphalt | seal, overlay, non-structural | LASTABUM |
| All weather crushed aggregate. | wear coat | JAPAT |

It can be seen from this list that some surfacing types have structural properties normally associated with overlay treatments (but not always), while others are surface dressings of seal or spray coats without structural value, and some are alternatively used for overlay or simple seal. Relative structural value also indicates longer wearability and gives a presumptive indication of the expected life of the wear surface, which is important to forecasts of the time lapse between the rehabilitation needs of a road. The type of surface above, which is applied to the general class IIIA or IIIB, therefore has significance to both cost estimates and to service life. It has further significance to the costs associated with routine and periodic maintenance of the specific road surface being maintained.

Because the use of any alternative surface treatment may depend upon local materials availability, relative cost in the region, and familiarity with its application, differences may exist among regions in the kind of surface coat, cost, rate of wear, and service life, which are not readily identifiable by the loose classifications of "asphalt" or "seal." Reports from the districts do not now make the needed distinctions. This was seen previously in the class IIIB roads, which were classified as sealed, but for which both a seal and a gravel condition may exist, and, for the gravel classification, where a thin surface dressing may or may not have been applied.

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* 1 stone seal.

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### 2.2.2 District Definitions of Road Work

To supplement its road classification system, the Indonesian Roads Department has proposed the following definitions of road work.*

New Road Construction: completely new road over existing track with or without new foundation or new surface.

Upgrading: increase of serviceability and reliability, i.e., to upgrade from gravel to asphalt.

Rehabilitation: of reliable roads (all seasons), to return a road to its original state of service, e.g., asphalt overlay.

Support Work: restoration of a deteriorated (non-reliable) road to its original standard, i.e., resealing, recoating, etc.

Road and Bridge Maintenance: patch potholes; repair ruts, drainage, signs; fill depressions, etc.

These definitions are simple and clear. But they do not say how or to what extent these activities will be conducted. This is left to the detailed design standards, which define alternative minimum and desirable specifications. New road construction may be of a bulldozed earth, cobble-laid, gravel, seal, or asphalt type, appropriate to its purpose. Upgrading is defined in the conventional sense. Rehabilitation is reserved for all-weather roads, open 350 days per year, or not closed more than 5 days consecutively due to poor drainage, flooding, or poor alignment contributing to both. This definition protects against the rehabilitation "to its original state of service" of an unreliable road, which would revert to a poor state seasonally.

Support work in Indonesia employs the standard definition given to periodic maintenance by U.S. engineers, although periodic maintenance (but not support work) is presumed to be accompanied by regular routine maintenance. The definition above of road and bridge maintenance is a fair description, but fails to state that this is a regular, repetitive item of work done annually over the expected life of the road. The U.S. definition errs on the side of oversimplicity as well, commonly stated as "that level of work which maintains the road to its original design standard." Both routine and periodic maintenance combine to achieve this result, in theory, under both local and foreign standards.

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* See Bina Marga (Highway Department) draft: Methods Manual for Kabupaten Road Programs, 1986.

Both standards are correct as far as they go. But these are static definitions applied to a dynamic condition; the original design standards become obsolete as the "design ADT" is surpassed by actual ADT, as normal weathering takes its toll of even a well-maintained road, or as heavier vehicles enter the traffic flow. Vehicle repetitions and axle-loadings, terrain, weather, and actual design or actual construction, as compared to the standard for design, may all vary from forecasted levels. The periodic resealing or overlays undertaken by support work/periodic maintenance may therefore, in practice, be overlapped by rehabilitation or upgrading.

### 2.2.3 District Definitions of Maintenance Practices

The proposed Methods Manual for kabupaten roads authorities, in draft form at Bina Marga, attempts to define the nature of maintenance and to specify manpower and the level of work to be undertaken. Maintenance means "a routine job in which the degree of damage in gravel roads is no more than 7 percent while in asphalted roads no more than 5 percent. In other words, maintenance only handles small jobs such as filling in holes, grading, and operations on gravel roads." In addition, the manual states: "Periodic work such as overlaying is categorized as construction work. Emergency work (natural disasters, etc.) is handled separately."

These are unsatisfactory definitions, at variance with what is already understood. The 7% and 5% damage estimates are supposed to refer to potholing, but make no reference to width or depth, surface cracking (asphalt) or loss of surface (gravel), and seem to imply that beyond these very uncertain parameters, maintenance is to be replaced by some form of periodic surface treatment. However, periodic work such as overlaying is construction work.

These efforts to advise field staff on the degree of wear that should be attended by repair are cited here because they move in the right direction, but somehow miss imparting a clear and functional guideline. That they are also incomplete appears to result from generally slack maintenance performance in the past, and a preoccupation with road building and rehabilitation efforts, for which foreign projects and years of experience have best equipped the engineering staff at all jurisdictional levels.

Serious thought has obviously been given in the draft Methods Manual to instruction on maintenance work. Table 4 and Figure 1 (an excerpt from the manual) on the following pages clarify the types of work included in maintenance work and specifications.

The same problems exist with the instructions given in Table 4. The percentages vary from those given above, other forms of surface wear such as cracking and surface loss are not mentioned, the percentages are impractical in field use, and they imply limits on either side of which the proper kind of maintenance is unclear. The specific numbers of manpower and the frequency of their work may be an average, a maximum, or a minimum, but in practice, must vary with traffic, local conditions, and different weather patterns between different regions.

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TABLE 4
DRAFT METHODS INSTRUCTIONS ON MAINTENANCE WORK

| PEKERJAAN PEMELIHARAAN (MAINTENANCE) | | |
|---|---|---|
| | MACAM PEKERJAAN (Type of Work) | PERSYARATAN MAKSIMUM (Maximum Requirement) |
| PERKERASAN (Pavement) | - Perbaikan permukaan jalanan yang berlubang: (Pothole repair on:) | |
| | - Jalan aspal (Asphalt road) | Kerusakan 3% total luas jalan (Damage not to exceed 3% of road surface) |
| | - Jalan kerikil (Gravel road) | Kerusakan 5% total luas jalan (Damage not to exceed 5% of road surface) |
| | - Perbaikan penurunan: (Rut repair on:) | |
| | - Jalan aspal (Asphalt) | Kerusakan 2% (Damaged 2%) |
| | - Jalan Kerikil (Gravel) | Kerusakan 2% (Damaged 2%) |
| | - Perataan kembali pada jalan kerikil (Blading on gravel road) | 2 x dalam 1 tahun (2 times/year) |
| DRAINASE (Drainage) | - Perbaikan saluran samping (Side ditch repair) | 2 orang/Km - 2 x 1 tahun (2 person/Km - 2 times/year) |
| | - Pembersihan saluran samping (Side ditch cleaning) | 3 orang/Km - 2 x 1 tahun (3 person/Km - 2 times/year) |
| | - Pembersihan gorong-gorong (Culvert cleaning) | 1/2 orang/Km -2 x 1 tahun (0.5 person/Km-2 times/year) |
| SISI SAMPING JALAN (Road side) | - Membersihkan semak pada damiya (Bush clearing) | 4 orang/Km (4 persons/year) |
| | - Pemotongan Rumput (Grass cutting) | 6 orang/Km -2 x 1 tahun (6 persons/Km -2 times/year) |
| | - Perataan bahu jalan kiri + kanan (Road shoulder repair) | Tergantung jumlah kerusakan (Depends on the level of deterioration) |
| JEMBATAN (Bridge) | - Pembersihan dan pengecatan jembatan (Bridge cleaning and painting) | 3 orang/jembatan dan 2 Km ada 1 jembatan (3 persons/bridge and assured there is one bridge for every 2 Km) |
| LAIN-LAIN (Others) | - Pemeliharaan lalu lintas (Traffic sign repair) | 2 orang/5 Km (2 persons/5 Km) |
| | - Alat bantu + alat-alat lain (Hand tools etc.) | 12 set alat bantu/Km (12 unit/Km) |

Note: English translation supplied.

FIGURE 1

EXCERPT FROM DRAFT METHODS MANUAL

Road Maintenance

a. General

Maintenance means a routine job in which the degree of damage in gravel roads is no more than 7% while in asphalted roads no more than 5%. In other words, maintenance only handles small jobs such as filling in holes, grading and operations on gravel roads.

Periodic work such as overlaying is categorized as construction work. Emergency work (natural disasters etc.) is handled separately.

b. Types of maintenance work and the specifications

In order to clarify the types of work included in maintenance work and their specifications, can be seen in the following table.

Source: Guide to the Planning and Construction of Kabupaten Roads/Bridges, Designs, Construction, Budgeting and Documentation.

## 2.2.4 Conclusions

Rehabilitation efforts may expect to confront ill-defined and overlapping road conditions in the field. Road treatment guidelines incorporate a wide range of surfacing types and different costs under the deceptively simple classification of "sealed roads." Narrowly interpreted, rehabilitation therefore means returning to the original standard. Attendant maintenance costs will therefore vary according to the different wear rates of the different surface treatments. A demonstration project intended to enlist institutional support, chiefly for maintenance practices, must thus likely be prepared to rehabilitate roads to a standard which has a consistent maintenance program and cost, is associated with dependable (and fewer) surfacing types, and is consistent with ADT volume and local weather patterns. Too strict a distinction between upgrading and rehabilitation would operate against meeting this goal.

A general lack of experience in maintenance, both routine and periodic, is evident in the guidelines and in the operations of staff at the district level and above. Clear guidelines relevant to surface types need to be formulated at several levels of authority. These guidelines must also provide for effective monitoring in the field.

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## 2.3 SELECTION OF ROAD PROJECT PRIORITIES

### 2.3.1 Current Practice

A simple pre-screening index has been adopted by the Roads Department and Ministry of Home Affairs for use under donor-funded road programs.* This index is based on Zone of Influence criteria which define two elements, the cost per kilometer per capita and the cost per kilometer per hectare. Apparently developed by ENEX of New Zealand under an IBRD-financed Rural Road Study Project in 1981, the method attempts to select, through preliminary screening, those roads for which costs/km/capita are at a minimum (a large population is served), and costs/km/hectare of cultivated land are at a minimum (a large freight demand).

Originating at the district level, using forms approved and issued by the Roads Department, the following steps are incorporated in a complete proposal submission to donors:

1. List of all road links: name, number, km, surface, surface condition, surface width, previous recent expenditures on link.

2. Classification of links: reliable, unreliable (seasonal closures of two weeks or more), and important network links.

3. Mapping: by jurisdiction (national, provincial, etc.), by function (feeder, market, collector), surface, reliability.

4. Infrastructure: river, rail, airports, ports (alternative modes), shown on map, including populations in each town or village and names of each town or village.

5. Markets: names of market towns and market days in the district and in neighboring districts.

6. Development proposals: if any, details of proposal, to include scope, location, land area, population, required infrastructure, an indication of in or near district, and whether planned or under construction.

7. Additional mapping: topographical (terrain) within the district and in neighboring districts. Land use and/or soil maps showing crop patterns and noncultivatable area, within and in neighboring districts.

8. Planning map: existing district plans for road improvements.

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* In the case where no donor is involved, kabupatens do not use formal screening methods or selection criteria for determining the allocation of road funds.

9. Proposal: the district Public Works Department (DPUK) and district Regional Planning Board (BAPPEDA II) jointly prepare road improvement proposals: DPUK is responsible for design and cost estimates on roads selected by BAPPEDA II, or selected by DPUK on the basis of engineering/maintenance requirements.

10. Pre-screening: to accompany each proposal.
    a. Short links less than 2 km eliminated unless serving major population area. Urban roads eliminated (submit under separate program and evaluation procedure).
    b. Development roads separated for more complete evaluation within a coordinated development program. Not suited to pre-screening method, but submittal accepted for review.
    c. Rival routes or modes within a 3 km distance which are not collector roads will not be screened until collector roads are improved and maintainable.
    d. Maintained roads screened out of program; routine maintenance not part of program; place in routine program.

11. Sorting: arrangement of road projects for pre-screening analysis.
    a. Application of cost index:
        Cost/km/capita, over 5-year population forecast period.
        Cost/km/hectare, over 5-year cultivation period.
    b. Design year is 6th year, i.e., based on expected level of population and area cultivated in 5th year.
    c. Ranking: for each road link list proposed projects by order in which they attain least cost for both indexes, in columnar format to show both indexes side by side.

12. Program proposal: this is an annual document submittal, showing for each year of a five-year program:
    a. Annual budgets over a five-year period, related to b) below.
    b. Priority ranking of projects, starting with the topmost in the first year and in descending order annually thereafter. Technical and economic data from steps 1-10 accompany submittal.
    c. Budgetary adjustments: conform annual budget total to individual project proposals (eliminate errors).

13. Technical survey submittal: provide survey, equipment inventory, traffic counts, volume and cost estimates, and relevant supporting information.

14. Screening: by Roads Department (Jakarta). Based on a sample survey of the program data, certain project proposals are selected for testing against economic criteria. Traffic composition and vehicle operating costs are used to identify a weighted average vehicle for forecasts of comparative costs on existing surface/condition against proposed surface/condition, to obtain preliminary justification by benefit-cost ratio after 12% discount. The screening test identifies the general level of reliability of proposals for the year, extent of need for further data/analysis, and monitors the effective use of the pre-screen procedural steps.

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### 2.3.2 Comments on Current Practice

The procedural steps listed in points 1 through 9 above appear to be largely administrative, as no practical use is made of them in arriving at the key index method, which must be considered the focal point by both the district and Jakarta. This is indicated by the screening undertaken by Jakarta, which shifts the base of analysis to "economic criteria," an almost exclusive concern with vehicle operating costs. The procedural steps therefore provide data annually which might instead be submitted once, and be followed by changes in the data as they occur to keep the informational base current. Since the real data base consists of cost estimates, aggregate populations and cultivated hectares within the zone of influence, and traffic, the time spent in filling out forms and drawing up maps might be better spent on these four areas alone.

For example, the collection and reporting of all road links by name, number, etc. and the names of towns, villages, and numbers of population in each, is of little value if proposed road projects are for other road links and other villages and populations. Since the zone of influence is the determinant, only road links and populations within the zone are relevant.

Likewise, in classifying links as reliable or unreliable and reporting the names of market towns and number of market days, an unreliable link is automatically screened out of the proposal, even if it is a market road or bears a relatively heavy proportion of traffic (these factors are not correlated). Market towns and market days are not followed by a disclosure of activity levels which relate to goods traffic or the economic values which they suggest for roads with low vehicle traffic. Because of the importance later given to traffic (and the reported low reliability of the cost/km/hectare index), a simple survey of farmers to collect data on volume marketed locally and frequency of marketing at these markets could produce data on actual goods flow annually, by named type of transport -- bicycle, cart, etc. Alternatively, market-day counts of goods arriving and mode of arrival (perhaps to include both buyers and sellers by mode) could provide real numbers for what is now left to supposition, i.e., that hectares somehow equate with production, and that all production means traffic flow (there are no subsistence farmers, or, all production is a cash crop).

It is noted that the screening process conducted in Jakarta does include an extensive analysis of roads with high-ranked agricultural potential but low-ranked vehicle traffic. No equivalent evaluation exists at the district level, beyond the cost/km/hectare index. Moreover, traffic survey forms for ADT counts at the district level do include counts of pedestrians, bicycles, carts, etc., but not of loads indicative of market days and non-market days.

### 2.2.3 Reported Experience with the Methods Used for Donor Projects

After five years of operation, the methods instituted for donor projects at the kabupaten level still appear to be awkward to implement and

uncertain in terms of identifying suitable projects for rehabilitation. The most recent experience, reported in March 1985 in the Main Report of the Local Roads Component (for 20 kabupatens) by Hoff & Overgaard, Kampsax, relates to feasibility studies undertaken precedent to the ADB 8th Loan. The projects were located in Central Java, Nusa Tenggara Barat, and Bali.

At the time of the study, the Methods Manual, which is summarily described above, had been distributed to the districts, and the program for annual program submittals had been in operation for perhaps two years. In actual practice, the main problems were reported as follows.

First, the index ranking methods do not correlate well with the more conventional screening employed at the national level. As proxies for traffic volume and vehicle cost savings, there was "no significant correlation identified between IRR (resulting from project evaluation) and the area index." For the population index, "a relatively weak statistical relationship ... in the range of $r^2 = 0.5$ to 0.7 and more typically in the range of $r^2 = 0.2\%$ to 0.4" was found.* That is, the coefficients of determination (goodness of fit) may be only 20% to 40% in predictive value.

Second, the index ranking is accepted as indicative, which is its main purpose. But sampling by advanced feasibility studies must determine project priorities. The addition of more detail to the index method would reduce its simplicity and "the time and resources required might more usefully be directed to more extensive traffic surveys and direct project evaluation."

Third, index ranking becomes progressively unrepresentative as the road network becomes more complex. Both population and land area estimates at the district level are subject to subjective interpretation and contain errors resulting from overlapping zones of influence not correctly apportioned among road links.

Fourth, "The Kabupaten generally undertook the necessary work promptly and many put much effort into mapping and presentation. However, the quality of data relating to road costing and zone of influence analysis left much to be desired. Aside from traffic surveys (for which there was specific funding allocation), supplementary field surveys requiring work outside the office were rarely completed satisfactorily. There was evidently limited understanding of the purpose of and connection between different parts of the manual procedures or of their relevance to road programme proposals. Kabupaten planning tended to remain locked on immediate needs over the next year or so, rather than addressing the longer term needs and development of the road network."

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* Discrepancy not explained.

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### 2.3.4 Conclusions

The Methods Manual and national screening procedures for donor projects are part of the institutional structure now in place. Notwithstanding the apparent simplicity of the manual on first glance, it is not simple. Some of its complexity relates to its format, which provides a wealth of detail but fails to address the salient features which later come under intensive study (by means of sample project evaluations in Jakarta). Some problems also arise from calculation errors and interpretations of zonal boundaries. But if the population and cost indexes themselves, even when accurate, fail to produce acceptable measures of relative feasibility, improvement of the indexes would seem to be of higher priority than refinements provided by "more extensive traffic surveys and direct project evaluation" imposed later at the national level.

A reduced informational format would provide the time to obtain field survey data on market volumes of goods by type of conveyance. In addition, cost/km/ton of freight is more nearly equivalent to cost/km/capita than is cost/km/hectare, and also permits estimates of average market price per ton by type of freight. Such estimates lead directly to the producers surplus form of analysis that is applicable to predominantly agricultural areas lacking important vehicle traffic flows. This analytic style is used at the national level for these cases, and seeks to evaluate transport price changes translated into changes in farm-gate prices, and farmers' savings which generate value added by further production — all expressed as prices and costs per ton. (This is a complicated form of analysis not suited, beyond the level indicated, for application at the district level. It is firmly in place at the national level as the alternate methodology to the conventional vehicle cost savings methodology.)

The introduction of a market-oriented goods volume survey at the district level with supplemental market price information (value estimates) probably will not reduce the incidence of errors associated with existing formats. However, as an extension of the present area index, and used jointly with it, it could well provide the volume and value of estimates that much of the present format seems intended to produce largely by inference.

The reported problems of overlapping zonal jurisdictions in the annual program submission (apparently repeated thereafter for the five-year period) appear to result from (1) a format that identifies all roads, with each road having an equal probability of sharing pro-rata in a zone of influence occupied by another road, and (2) the use of a method of analysis more suited to a sparse network than to the more dense road system found in Central Java, NTB, and Bali.

The suggestion that in such a dense network all the road links need to be named and numbered, etc., may well be a valid concern for overlaps, but only in an exceptional circumstance, e.g., the districts inaccurately reported the priorities, priorities were bunched in a single year, and funds for rehabilitation were unlimited. If the five-year program truly represents priority rankings and their relative time-staging, the overlap of

zonal road boundaries could be of concern only if bunched in a one-year or two-year period. If such bunching occurs, the selection process will likely err in over-selection (i.e., too many roads are being selected) because of a large budget each year or because of a concentration of the network in the areas of highest traffic volume. If concentrated, a probability exists that roads are overbuilt: a later analysis of road links in NTT and South Sulawesi shows that for 364 links, 7% report no traffic; fully 38% report traffic levels between one and ten vehicles daily, including motorcycles, which average 46% of that total.

This result should dispel the notion that overlapping zones of influence carries meaning by itself, unless accompanied by ADT traffic counts. Even though both traffic volume and rates of deterioration must be roughly equal to warrant bunching in the program. This should be unlikely under the pre-screening process, which requires that rival routes or modes within a 3 km distance that are not collector roads will not be screened until collector roads are improved and maintainable. Given the narrow 3 km limit, overlaps could occur only if roads were within 6 km of each other, or both were collector roads. Either event could suggest overbuilding (a single collector could serve, with a feeder road structure). If a mountain range or similar barrier divides these roads and thus accounts for their proximity, it also indicates separate zones of influence imposed by terrain rather than by 3 km limits. This possibility is supposedly already presented by the mapping supplements, and could explain roughly equal traffic levels and road conditions for two areas with the same travel patterns. What cannot be explained is how so many of these roads can be assembled in a budget-limited and time-staged program, yet with so many overlapping problems that the districts have difficulty in calculating populations and hectares for each. Because these very calculations enter into the index methods designed to support selection and ranking, there should be little wonder that the methods correlate poorly with later project evaluations.

Generally, inasmuch as the focus of attention at the national level is on vehicle activity and/or tonnage-based value-added analysis, the introduction of a tonnage-based survey report would fill a present void in the analysis. A first-year report of the informational items, rather than consecutive annual re-confirmations, might free some time for improved traffic surveys and tonnage reports. These might include more frequent seasonal counts, reflecting vehicle load (number of passengers and estimated kilograms of produce), market price sampling, and some form of check upon forecasted growth rates. (The latter is mentioned because of the tendency to forecast traffic at significantly higher growth rates than the observed and forecasted population and farm produce rates, which could occur only if income growth and income elasticity were unnaturally high.)

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## 2.4 EVALUATION OF SHADOW PRICING, LABOR INTENSITY AND EMPLOYMENT IMPACT

### 2.4.1 Shadow Pricing

In road projects shadow pricing is attempted when clear evidence exists that market prices or policy distortions create an uneconomic allocation of resources. Such cases would arise from: 1) a controlled foreign exchange rate which understates the real values of imported capital and consumable items (road equipment, vehicles, fuel, tires, etc.); 2) controlled interest rates that do not reflect true capital scarcities that may be observed in the "black" market for money; 3) labor wages paid on current road work which are well above alternative potential earnings levels in other economic sectors; and 4) major unemployment of the labor force in the region of the proposed project from which labor will be drawn, in which case "true" economic costs are less than financial outlay.

In the first case, foreign exchange nationally is at open market exchange rates, traded freely according to supply and demand by commercial banks to private citizens, and appears to present no need for shadow pricing.

The cost of domestic borrowing is fairly high, which may affect the ability of private contractors to establish qualifications according to equipment available, but only for equipment relatively idle and not productive in commercial road-building activity. As the main thrust of government policy is to employ contractors rather than force account for both rehabilitation and maintenance, the interest costs should be assumable during the course of this project, which aims to expend added funds for such purposes. Such higher interest costs enter into a further economic consideration of the IRR, which may be sought from road investment costs within the project. The IRR is expected to exceed commercial loan rates by an element acceptable for risk-taking, i.e., several percentage points more than the commercial rate, and roughly equal in total to the best return available in the economy from alternative investments. The best return is usually not known, but the implication of high money market rates is that some sectors must be producing such a return -- or rates would be lower. Rates soften as demand declines. On the other hand, a government project, having other aims than profitability expressed in financial terms, is not compelled to exact an economic rate of return which reflects national alternatives in the private sector if it is engaged in selective investments in regional sub-sectors which do not enjoy those alternatives. A road project in low-income regions designed for rural areas is not generally the place to look for such a return; the moreso if institution-building and demonstration effects are its goals. This frame of reference will condition the rate of return actually sought, but still demands that such returns be maximized to provide the greatest economic benefits that can be realized in the selective placement of funds within the subsector.

Labor wages paid by DPUKs for casual and permanent labor appear to be marginal, ranging throughout all kabupatens from Rp. 1500 to Rp. 4000 daily (US $1.35 to 3.57), for unskilled labor, equipment operators, and crew

foremen. This level of wage, according to kabupaten accounts, results in the loss of staff to other employments -- claimed usually to be private contractors. This would indicate that the opportunity costs of local labor are being perceived and acted upon; opportunity costs are being exercised, and labor is finding its best alternative employment. It then appears that labor wages are not excessive in the project area, provide mobility of labor, and, by implication, provide for a free movement of labor between its perceived opportunity cost levels in this subsector.

The question of area unemployment/underemployment cannot be fully known from available data beyond a presumption that it exists. It is probably greater in NTT than in South Sulawesi, if opportunities for commercial (paid) employment is meant. However, as these areas are dominantly rural, farm sector employment provides the main means of employment and income. This sector is not amenable to analysis of the kind applied to the commercial sector, and its paid employments and higher standards of living. What is known is that standards are low, and inheritances tend to reduce acreages passed on to descendents in the normal course of rural life. In its relation to the road-building sector, reports by kabupaten staff state that seasonal patterns exist, such that labor becomes scarce for road re-building during harvest periods. This suggests that labor wages for road work in the project areas are too low to be attractive, except seasonally (during underemployment) because alternative farm work affords a preferred level of return. This would indicate that in general, labor is neither scarce nor abundant, and is relatively balanced between seasons in its best choices about the way to maximize its opportunities. The conclusion cannot be drawn that the "true" labor wage rate is at an economic cost less than the financial outlay, but that labor is being paid its actual economic value.

### 2.4.2 Labor-Intensive Road Building

Under the conditions named above, a substitute road building practice intended to maximize labor input would seem to be more a theoretical choice than a real one for these project areas. As a technical choice, having alternative economic outcomes different from capital-intensive road building, a measure would have to be taken of the change in IRR (lower labor costs over a longer time period accompanied by certain losses in efficiency traded off for more labor employment and wider income distribution). These nominal measures do not undertake to evaluate other factors which are inherent in the trade-off: the desired build-up of private contractor capacity in giving efficient assistance to government agencies in charge of roads, or the relative effects upon quality and durability of the road itself (which means a trade-off to higher vehicle operating costs in the short run and earlier rehabilitation costs in the long run).

The evidence cited by the ADB 8th Loan pre-appraisal team is that labor-intensive work is inappropriate as a least-cost choice for paving and the major rebuilding of surface, base, and sub-base, in which machines are best utilized. Labor remains a complement to such work, but the addition of

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labor beyond the economic numbers required is uneconomic. For routine and periodic maintenance, labor finds its most economic and broadest employment: clearing roads and drainage ditches, pothole patching, smoothing depressions in spot repair, grass cutting, bridge deck repair and sign painting, etc.

Under present goals of the government, private contractors are being encouraged as a new industry. They have already been designated by the Bina Marga to perform most of the work on national and provincial roads, both rehabilitation and maintenance. Bina Marga's instruction to AID is to consider this factor in road work in kabupaten areas. The economic choice appears now to rest mainly, in the long-term, with the contractor, and with his least-cost considerations. So far, the contractors are alleged to be building up their skilled or semi-skilled staffs with ex-DPUK personnel, which suggests that labor application has not lost ground to capital-intensive procedures in ways which can yet be measured.

### 2.4.3 Employment Impacts

At the kabupaten level no reports exist of employment and income effects of their road-building programs beyond the employment records of DPUK staff (force account); private contractors are graded and ranked by equipment and financial resources. A monitoring system does not exist for secondary benefits which may be passed on to farmers and rural communities that result from reduced transport costs on improved roads. Such a monitoring system is being proposed as an option in this project paper, which will take account of changes in production volume, and transporters' prices per kilogram and per passenger, with and without road improvements.

Although the planning on donor projects which take place at provincial and district levels attempts to take account of populations, development areas, and road networks, this is not done in a systematic manner. The simple format seen in South Sulawesi, for example, is a series of map overlays, with estimated population by area overlain on a map of the road network; another map showing "development areas" indicates whatever degree of correspondence is clearly manifest, and decisions are made on this basis -- with the emphasis upon growth and development. This has resulted in building new roads into development areas when roads already exist which are not being used, because they are not being maintained. No account is taken of the time-stage of the "development" area: its original state was merely marked for development by a foreign consulting group which performed soils tests and earmarked different crops for potential development, or a planned development with a sponsor undertaking a planned scope of investment, or an investment now underway, or a mature "project" with measurable volumes of production.

Given this level of economic planning, employment impacts have not been formally considered. The monitoring which is suggested for this loan program is of sufficient detail to permit evaluation of the amount of transfer which may occur between transporters and rural communities, in the way of reduced transport prices. As transport price is reduced, a measure

is made of the reduction in vehicle operating costs achieved by road improvements (the price falling less than the cost decrease), and at the same time, the transfer of some portion of the cost reduction to the farmer and rural community. Volume monitoring of produce entering the market supplements these data, indicating how transport price changes induce further goods production, which is a measure of increase in regional income and apparent employment. The joint beneficiaries are the transporter and the farmer's family; the total benefit which is bestowed by the road improvement may be taken as the change in VOC forecasted for that road link, and the shares in that benefit are recorded in the amount retained by the transporter and released to the buyer of transport.

These proxy measures of employment, income, and well-being do not now exist in Indonesia. When installed, they are expected to produce the kind of detail which will then be used in planning at local levels, as a start toward more complete evaluation procedures.

## 2.5 EVALUATION OF ALTERNATIVE REHABILITATION AND MAINTENANCE SYSTEMS

### 2.5.1 A Forecast and Test of Simplified Methods

The Roads Department recognizes three classes of district-level roads. These are recounted here:

KABUPATEN ROAD CLASSES

| | IIIA Sealed | IIIB | | IIIC Unsealed |
|---|---|---|---|---|
| | Asphalt | Sealed | Gravel | Gravel/Earth |
| ADT: | 500-3000 | 200-500 | 50-200 | <50 |

The traffic levels daily which correspond to these classes and conditions imply that as traffic increases, an improved road condition may be considered. Section 2.3 reviewed the nature of this road improvement process.

The relationship between ADT volume and its composition (type of vehicle), and between composition and vehicle cost (cost/km varying with vehicle type) will be demonstrated in this section. The composition and the costs are those which correspond with expected traffic volumes to be found in Nusa Tenggara Timor and South Sulawesi. They are, however, abstracted from 210 traffic counts in 20 kabupatens intensively studied by Hoff and Overgaard in the Local Roads Component study of March 1985 preliminary to the ADB 8th Loan appraisal. These tend toward greater accuracy than current ADT estimates now available from the outer island project area, but represent a wider sample, and appear to reflect the same vehicle composition.

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A ten-year forecast will use current (Hoff and Overgaard, March 1985) cost estimates for rehabilitation (relative to surface type), and annual maintenance costs for sealed and unsealed roads which were derived in that study to correspond to both the ADT volume and the road surface. In this way, the current costs and traffic volumes which may be expected for project area roads can be tested in advance of project commitment, for four different kinds of rehabilitation activity, each carrying vehicle volumes appropriate to the design class of road. It will be seen whether these ADT levels and cost levels are consistent with the Roads Department vehicle volume standards: i.e., does a volume of 50-200 ADT justify an improvement to a gravel from a gravel/earth standard? Does a volume of 200-500 justify a movement from gravel to sealcoat? Are these the standards which should guide the AID project, or are there other considerations in addition to these?

In order to test the results, a simplified formulation prepared by IBRD will be used. This is borrowed from tables which may be suitable for use at the district level, showing the ADT level required to earn a specified rate of return over a ten-year period, given a particular traffic growth rate. This ADT level is correlated with the composite level of vehicle operating costs (weighted average), and the percentage of these costs saved in the transition from a lesser surface to an improved surface. The critical question of costs invested in the rehabilitation and annual maintenance is directly associated with ADT. It therefore becomes possible to identify a required level of ADT needed to perform the functions which will be specified here at expected cost levels:

| | |
|---|---|
| From poor seal to fair seal | From unsealed to fair seal |
| From gravel to fair seal | From unsealed to gravel |

These will be the typical rehabilitation efforts in the project study area.

It may be noted that the simplified method borrowed from the IBRD reference work is the simplest of eight increasingly complex methods suggested therein. As is the case with the district use of the index population and area methods, it may be seen that the application of this reference table to work in rural areas may strain the definition of "simple." For a review of this method and others, see Economic Appraisal of Rural Roads, World Bank Staff Working Paper, number 610, 1983.

The sample survey from 210 traffic counts related ADT volume to type of road surface. The road surface itself represented a specific road class (asphalt, seal, poor seal, fair seal, and unsealed), which corresponds to the ADT levels shown below. The percentages of vehicle composition are also indicated.

ROAD TYPE AND VEHICLE COMPOSITION (%)

| Road | ADT | 4-Wheel | Motor-cycle | Carts/ Bicycles | Pedestrians Shoulder-Burdens |
|---|---|---|---|---|---|
| Fair seal | 500 | 27 | 34 | 18 | 21 |
| Fair seal | 200 | 19 | 29 | 20 | 32 |
| Poor seal | | 18 | 24 | 32 | 26 |
| Fair seal | 200 | 7 | 22 | 27 | 44 |
| Unsealed | 50 | 7 | 16 | 16 | 61 |
| Average | | 16 | 25 | 23 | 37 |

The most striking quality of this table is the proportion of non-motorized traffic (60%) plus the high proportion of motorcycles in the remaining total. These same proportions are confirmed in the traffic counts of the study area.

Vehicle operating costs per kilometer have been used to weight the average vehicle cost, using the percentage distributions shown above. The vehicle costs are borrowed from the March 1985 reference study, which defined operating costs according to road type (asphalt, gravel, earth), and according to condition (good, fair, poor, bad). The resulting cost matrix produces an average cost composition of expected traffic on project area roads, and the average total cost per composite vehicle for four different road classes.

AVERAGE COST COMPOSITION OF TRAFFIC

| | 4-wheel Vehicle | | Motorcycles/Bikes/Carts | | Total | |
|---|---|---|---|---|---|---|
| | Rp/km | % | Rp/km | % | Rp/km | % |
| Fair seal | 103 | 23 | 9 | 50.5 | 112 | 73.5 |
| Poor seal | 135 | 18 | 10 | 56 | 145 | 75 |
| Fair gravel | 128 | 7 | 10 | 49 | 138 | 56 |
| Unsealed | 178 | 7 | 9 | 32 | 187 | 39 |

The proportion of total traffic which is accounted for in these figures is shown as a percent in the total column; the balance represents pedestrians and porters (pikulans). Full-scale project evaluations conducted by the reference study assigned costs to both pedestrians and porters, and further assumed for the "with rehabilitation" case that this traffic would adopt a conveyance mode (truck or bus). These costs and assumptions are not used here.

Rehabilitation costs per kilometer, which were prepared in the reference study for application as the average expected costs for 30 kabupaten, and expected average routine repair and maintenance costs per kilometer, may now be incorporated into a forecast of input costs as the

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final stage of the three-step analysis which leads to the use of the simplified IBRD table. From the table we can learn which level of ADT is consistent with an intended rehabilitation, at specified vehicle cost and savings rates, selected discount rate, and rate of traffic growth, for a ten-year forecast period.

Summarizing the four forecast tables which have been prepared, input costs for rehabilitation and maintenance are presented below as net present values after discounting at 15%.

REHABILITATION AND MAINTENANCE COSTS FOR FOUR ROAD TYPES

| Treatment | Implied ADT | Rehab. Cost | Maint. Cost/ year | Net Present Value |
|---|---|---|---|---|
| | | ..... | Rp. 000/km | ..... |
| Poor seal to fair seal | 200-500 | 22,400 | 559 | 25,068 |
| Fair gravel to fair seal | 200 | 27,600 | 528 | 30,119 |
| Regravel gravel | 50-200 | 15,000 | 406 | 16,937 |
| Unsealed to gravel | 200 | 20,000 | 606 | 22,892 |

It may be noted that the costs of applying a seal of asphalt overlay to gravel exceed the costs of resealing an already sealcoated road, just as the costs of initially applying gravel to an earth (unsealed) road are greater than the costs of regravelling. This is mainly due to the sub-surfacing costs necessary to provide a suitable subgrade, subbase and base, and widening associated with going to a higher standard.

The basis for entry into the IBRD table is U.S. dollars equivalent, which is intended to facilitate use by any country of the standard cost figures which are shown. The table itself could therefore be converted into Rupiah equivalents, if its use is found suitable for general employment on the project. It has been found necessary to interpolate, in actual use of the table, using six calculation steps to find two significant numbers: the net present value total and the ADT level. The final results of the full analysis are the following:

## IBRD SIMPLIFIED SCREENING METHOD RESULTS

(10-year period, 5% traffic growth, 15% discount)

| VOC $/km | VOC-S % | NPV: (Rp. | $15,125 16,937 | $20,450 22,892 | $22,400 25,068 | $26,900 30,119) |
|---|---|---|---|---|---|---|
| | | | Interpolated Value | | | |
| | | | ADT Level Required | | | |
| .167 | 40 | | 124 | | | |
| .167 | 26.2 | | | 247 | | |
| .13 | 23 | | | | 505 | |
| .123 | 19 | | | | | 768 |

(The designations VOC and VOC-S mean vehicle operating cost per kilometer and the savings in VOC expressed as a percentage of the prior road costs. NPV is the net present value over ten years of the combined rehabilitation and maintenance costs after discounting at 15%: the Rupiah equivalent —Rp. 1120 = $U.S. 1 — is shown in thousands.)

These final figures permit a comparison of existing kabupaten road design standards (and classes), which are based upon expected ADT levels, with the externally-given parameters that associate ADT levels with the ten-year cost structure of the rural road. The comparison is shown below.

### COMPARATIVE ADT DESIGN THRESHOLDS FOR 15% RETURN

| Treatment | Kabupaten Design ADT | Table ADT | Difference |
|---|---|---|---|
| Reseal sealed road | 500-3000 | 768 | 268 |
| Gravel to sealcoat | 200-500 | 505 | 305 |
| Regravel gravel | 50-200 | 124 | — |
| Earth to gravel | <50 | 247 | 197 |

The higher levels of ADT which the IBRD tables indicate are consistent with the decision parameters would suggest that kabupaten thresholds for upgrading to a higher design standard are below the levels needed to gain a 15% rate of return on the invested capital. It is not certain, however, that such a return is intended, as considerable emphasis is placed at the kabupaten level (and at the provincial planning level) upon road-building as a development tool in geographic areas considered strategic to growth of employment and income.

Other rates of return may therefore be considered, at 12% or 10%, if it can be accepted that this policy addresses longer-term issues than the sole

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criterion of reducing vehicle operating costs. It is only the savings in vehicle costs which are being measured by the table. The shift to a partial analysis of both vehicle costs and of value-added, in order to address both issues simultaneously, or to omit vehicle costs and go to an analytic base mainly concerned with measures of value-added, would add considerable complexity to a simplified screening method intended for kabupaten use. Such a shift encompasses an entirely different approach, consisting of with-and-without forecasts of: 1) production costs by type of crop, 2) farm-gate prices, 3) transport prices and transport costs by type of vehicle and route to market, 4) market prices by type of crop, and 5) estimates of production volumes and cultivable land area. Analysis of this kind is commonly conducted by consultants for large-scale development schemes, for which the input of associated infrastructure (utilities, specialized crops and technical specialties, financing sources and credit terms, etc.) are an important part of project evaluation.

The apparent differences in levels of ADT suggested by the table and now in use by the kabupatens as benchmarks for design can possibly also be explained by conceptual differences. The reported life of roads for each design class does not in actual experience attain a full ten years. Consulting firms reviewing kabupaten roads and provincial road networks for ADB, IBRD, OECF and JICA have reported generally a surprisingly short life of roads, even those built at higher design standards. The basis for this shortcoming appears to be associated in part with weather (heavy rainfall), choice of alignment over flood-prone ground, and improper construction in the use of selected and graded materials, combined with failure to adhere to the design standards regarding width, sub-surface working (compacting, water-binding, depth of and kind of material, etc.). The resulting early failure of such roads, as a matter of practical local experience, may lead to the establishment of lower ADT standards in an effort to 1) prolong the life of the road, if it is perceived that road life is associated with traffic level rather than with external factors, and/or 2) to provide some form of seal-coating to an all-weather standard at all levels of traffic as a response to the weathering factor as the main source of the problem.

In either case, the application of the IBRD table to the road classes and design standards of the kabupatens would be inappropriate to existing roads now affected by poor construction supervision. However, if effective construction supervision assured that construction methods met the design standards, it may be believed that the ADT levels associated with the ten-year lives of roads could induce a change in concept and in road standards to provide for rehabilitation and upgrading at higher levels of ADT.

There are some problems associated with use of the IBRD table. The first is a minimum traffic growth rate of 5%, which the "table" permits to rise to 8, 10, 12, and 15% via a series of similar tables, with discount rates from 10 to 18%, for all roads with a service life of ten-years. Succeeding tables are related to a 15-year service life, with the same order of growth prospects and discount rates. For the study area kabupaten roads, which are mainly lightly trafficked, a 5% growth rate may be too high in some cases (the tables do not require that a forecast be made over the ten-year period to arrive at a design-level ADT, but rather that the

existing ADT count in the present year assume some rate of growth) and that that rate of growth be either 5%, or 8, 10, 12, or 15%. The extrapolations from table to table which may result are as difficult as the interpolations within the existing tables.

Interpolations on the reference table are forced by the NPV of aggregated construction and maintenance costs, in intervals of: $10,000, $18,000, $20,000, $25,000, $35,000, etc., combined with VOC and VOC-S relationships which block out $.10/km costs and varying fixed levels of savings as a percentage of those costs, and then jump to $.25/km, and $.50/km, etc., with similar ratios of savings. It is unlikely that a line item for ADT will be found unless the horizontal NPV cost item is squarely related to the vertical columns of VOC and VOC-S. In our use of the table, five applications of the table found no such perfect fit, and six separate calculations were required to find one ADT number.

It is yet possible that this system can be made to yield the relatively small range of costs associated with kabupaten roads, and expanded to show the most frequently appearing costs, and therefore become a very usable guideline.

Table 5 on the following page for further interpolations of these data which produce ADT levels yielding a range of IRRs from 6% to 15% for seven levels of rehabilitation costs.

### 2.5.2 Evaluation of Rehabilitation, Routine and Periodic Maintenance Versus Current Non-maintenance Practice

This section will bring together assorted elements which are seen as the major economic variables influencing the choice of road treatment, and the selection procedures that can optimize each choice. The factors addressed are as follows:

- Sample survey of vehicle type and volume on project study roads.
- Composition of expected average vehicle costs and ADT volumes on each of the five kabupaten road classes.
- Reported and expected road life for each class under existing procedures and under forecasted controlled procedures.
- Comparative vehicle savings over ten years under routine, periodic, routine and periodic combined, and rehabilitation procedures, against a common base of non-maintenance, for each of the five classes of roads.
- Discounted present values of all cost flows compared.
- Discounted benefit/cost ratios of all cost flows.
- Comparative marginal costs and marginal revenues (savings) of each of the alternative procedures.
- The apparent influence of ADT level, rate of traffic growth, vehicle composition and its cost level, upon the choice of alternative road treatment procedures.
- The influence of timing of road treatment during road life upon the choice of treatment.

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TABLE 5

REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS

(Rp. 000/Km) Base Year Rehabilitation/Upgrading Costs:

| IRR % | 8960 | 11200 | 13440 | 15680 | 17920 | 20160 | 22400 | 25200 | 28000 | 30800 | 33600 | 36400 | 39200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base Year ADT Volume: | | | | | | | | | | | | |
| 6 | 46 | 58 | 70 | 82 | 94 | 105 | 110 | 128 | 146 | 160 | 173 | 186 | 199 |
| 7 | 49 | 62 | 75 | 87 | 99 | 111 | 118 | 137 | 155 | 170 | 184 | 198 | 212 |
| 8 | 52 | 65 | 79 | 92 | 105 | 118 | 126 | 145 | 164 | 180 | 195 | 210 | 225 |
| 9 | 55 | 69 | 83 | 97 | 111 | 124 | 134 | 154 | 173 | 190 | 206 | 222 | 238 |
| 10 | 58 | 72 | 87 | 102 | 116 | 131 | 145 | 164 | 182 | 200 | 217 | 234 | 251 |
| 11 | 60 | 76 | 92 | 107 | 122 | 137 | 151 | 171 | 191 | 210 | 228 | 246 | 265 |
| 12 | 63 | 80 | 96 | 112 | 128 | 143 | 155 | 177 | 199 | 219 | 239 | 259 | 279 |
| 13 | 66 | 83 | 100 | 117 | 134 | 150 | 167 | 188 | 208 | 229 | 250 | 271 | 291 |
| 14 | 69 | 87 | 105 | 122 | 139 | 156 | 175 | 196 | 217 | 239 | 261 | 283 | 304 |
| 15 | 72 | 90 | 109 | 127 | 145 | 163 | 185 | 206 | 226 | 249 | 272 | 295 | 317 |

* Motorized vehicles only.

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)

### 2.5.2.1 Survey of ADT on Project Roads

Traffic counts prepared under the OECF II Feasibility Study for three kabupatens in the study area during 1985 provide ADT counts for 145 road links distributed geographically as follows: Ngada (NTT) 50 links, Sumba Barat (NTT) 35 links and Gowa (South Sulawesi) 60 links.

A summary of these links according to daily volume shows the dispersal of traffic over low-volume and high-volume road links.

ADT VOLUME BY ADT CLASS

| | Road Links | 0 | 1-10 | 11-30 | 31-50 | 51-100 | 101-200 | 201-300 | 435 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sumba Barat | 35 | 1 | 6 | 17 | 7 | 2 | 1 | 1 | | | |
| Ngada | 50 | 11 | 15 | 8 | 6 | 6 | 2 | 0 | | | |
| Gowa | 60 | 4 | 5 | 4 | 3 | 18 | 17 | 6 | 1 | 1 | 1 |

The vehicle types composing the volumes shown above are: car/jeep, minibus, light truck or light pickup, and motorcycle. The relative proportion of motorcycles (%) for each ADT class is:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 48 | 54 | 53 | 45 | 48 | 60 | | | |
| 28 | 45 | 49 | 32 | 38 | | | | |
| 62 | 54 | 68 | 56 | 41 | 42 | 46 | 50 | 42 |

In their previous Feasibility Study Inventory Survey of March 1980, the OECF I consultants found for seven other kabupatens in the present AID project study area a more concentrated grouping of traffic in the 1-10 and 11-30 vehicles per day class. The kabupatens represented in that survey were Manggarai and Belu (NTT), and Takalar, Bone, Sidrap, Pinrang, and Jeneponto (South Sulawesi), which reported only one road with more than 100 ADT among 219 road links, and showed 10 links which had no traffic.

The 1985 volumes for NTT reflect a similar tendency toward grouping at lower-level ADTs, but Gowa shows 35 road links carrying traffic levels between 51 and 200 ADT. Among the 145 links counted in 1985, 16 links carry no traffic, or 11% of the total counted. This may indicate the inventorying of an abandoned road, over-building of the road network, or a road seriously overdue for repair.

A sampling of the 1985 counts, to provide, from each ADT volume class, an average volume and an average composition of vehicle types associated with that volume, furnishes a basis for forecasting vehicle operating costs for these volumes over different road classes. The sample provided the following characteristics:

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## ADT VOLUMES BY ROAD CLASS AND BY COMPOSITION

| ADT Class | 200-500 No. | 200-500 % | 50-200 No. | 50-200 % | <50 No. | <50 % |
|---|---|---|---|---|---|---|
| Car/Jeep | 101.4 | 28 | 35.4 | 28 | 7 | 24 |
| Minibus | 40 | 11 | 14.2 | 11 | .5 | 2 |
| Lt. truck | 65.7 | 18 | 30 | 24 | 4.5 | 16 |
| Motorcycle | 157.1 | 43 | 47.1 | 37 | 16.7 | 58 |
| Average Total | 364.2 | 100 | 126.7 | 100 | 28.7 | 100 |
| Number of cases: | 7 | | 12 | | 10 | |

For the two road cases reported in Gowa as having over 500 ADT, a fourth road class may be added (the asphalt case). The percentage composition of traffic for these roads, in the order as above, is: 23, 15, 16, and 46, with an average 550 ADT.

Application of the vehicle operating cost tables prepared in March 1985 for the Local Roads Component, Main Report (Hoff & Overgaard, Kampsax), specific to kabupaten roads in Central Java, NTB, and Bali, permits an analysis of the range of vehicle costs from "good" to "bad" conditions. For each of the above vehicle types, these designations will be used to infer that "good" exists in year 0 of the ten-year forecasts (a newly resurfaced or re-worked road to appropriate standard for its class -- and that this carries no cost through the forecast). In the years following, "bad" conditions and costs will be reached according to the field reports of the short lifetimes of these roads; these will vary in life by type of road. But because maintenance and rehabilitation efforts are supposed to extend these road lives beyond the levels observed with no maintenance, the forecast will indicate for the non-maintenance condition (the null hypothesis, or "do nothing case"), that from "bad" we can go to "worse." For this case alone, the rate of growth in costs annually will be forecasted at one-half the annual rate which arises for the years between good and bad cost levels (from good design standard to end of service life). In this way, a full ten years of forecast can be made, and this can provide for introducing maintenance and/or rehabilitation according to cost levels identified with the average for 30 kabupatens in the March 1985 study. This will permit a measure of comparative effects upon vehicle costs, and may indicate the proper timing of periodic works.

In summary form, the vehicle cost forecast for the composite vehicle on each road class is shown below.

| | Sealed Roads | | | Unsealed Roads | | |
|---|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Gravel | Earth |
| ADT: | 550 | 364 | 127 | 364 | 127 | 29 |
| Class: | 500 | 200-500 | 50-200 | 200-500 | 50-200 | 50 |
| Year | Rp/km Vehicle Operating Costs | | | | | |
| 1 | 58.0 | 71.6 | 77.7 | 72.8 | 77.7 | 97.8 |
| | Rp/km in Bad Condition or at End of Service Life | | | | | |
| 3 | | | | 148.5 | | 134.9 |
| 4 | | | | | 160.5 | |
| 5 | | 133.8 | 160.6 | | | |
| 8 | 127.6 | | | | | |
| | Rp/km in Final Year of Forecast | | | | | |
| 10 | 143.3 | 200.8 | 257.8 | 577.4 | 346.4 | 415.9 |

In this forecast, the overlapping of gravel road classes, which is part of the present kabupaten road classification system, will be subjected to a two-part analysis. This is designed to test the effects upon a gravel road of a high volume of traffic (364 ADT) on an unsealed road, a low volume (127 ADT) on an unsealed road, and a "nominal" volume (also 364 ADT) on a sealed road. In each of these cases, the volume falls within the designated road class, but for each road class, a different kind of potential surfacing may exist.

The cost forecasts for the selected ADT volumes will also assume a 1.7% traffic growth rate annually. This is the average population growth rate for NTT and South Sulawesi provinces in the period 1980-1983. The method of forecast is to add the 1.7% annually to inital ADT volumes, multiplied by Rp. cost/km, multiplied by 365 days.

Abstracting from the forecasts of average expected costs per kilometer in the March 1985 study of 30 kabupatens (for the ADB 8th Loan), the summary table following will show the amount of cost for routine, periodic, and rehabilitation work, by type of road.

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SUMMARY OF COST AND TIMING FOR INTERVENTION PRACTICES

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT: | 550 | 364 | 127 | 364 | 29 |
| Cost/km (Rp 000): | | | | | |
| Routine | 590 | 529 | 360 | 606 | 300 |
| Periodic | 2857 | 2223 | 2709 | 2709 | 1224 |
| Rehab. | 22400 | 17000 | 20000 | 15000 | 2709 |
| Year of Intervention: | | | | | |
| Routine | Annual | Annual | Annual | Annual | Annual |
| Periodic | 8 | 4 and 8 | 5 | 4, 7, 10 | 6 |
| Rehab. | 8 | 4 and 8 | 5 | 4, 7, 10 | 6 |

The selection of the timing for periodic or rehabilitative work does not follow the previous estimate of years of road life in most of these cases. The reason for this lies with the economic argument that the search for a correct timing must find that year-to-year period for which the rise in vehicle costs is greater than the amount of cost being introduced, so that the savings in vehicle costs are at least equal to the amount of input costs. That is, marginal revenue (savings) equals marginal costs, and timing is at an optimum. For low volume roads and for some higher volume roads with lesser annual rates of increase in vehicle costs, that particular year was either delayed beyond the so-called service life of the road, or was not found at all.

Another reason for delayed intervention is that in year 1 of the forecast, following a year 0 in which the road is brought to "good" cost levels, the vehicles enjoy the good, or minimum cost level, and not the higher costs associated with succeeding years. For this same reason, routine maintenance is not introduced until year 2 of the forecast (i.e., end of year 1).

### 2.5.2.2 Comparative Vehicle Savings

Each road treatment designed to intervene in the rise of vehicle operating costs on the unmaintained road base case must be assigned a cost-saving function. The accepted fact that both maintenance and rehabilitation perform cost-saving functions does not tell us how this function operates or how much will be saved. Models of maintenance savings, usually for gravel or earth roads, typically portray traffic of heavy

trucks (6-tons and tractor-trailer compositions), measure rutting and gravel losses on the roads per vehicle pass, and recommend interventions based on the joint rise in vehicle and resurfacing costs. Low volume roads in such cases produce high savings resulting from routine, periodic maintenance practices which consist of relatively low-cost blading, shaping, and surface gravel replacements.

The high levels of vehicle savings to large vehicles reported by such studies will not be duplicated on low-volume light vehicle roads which consist of about 50% motorcycles. Rather, other questions may be asked than the specific savings functions of each intervention: 1) What is the minimum or the maximum expected savings? 2) How does the function operate exactly? 3) What are the real choices between routine and periodic maintenance and rehabilitation, in cost, timing, and benefits?

The forecasts which follow will attempt to answer these questions. Certain variables in the forecast, which must remain fixed for the present analysis, should be tested later by computer modelling to arrive at better or more optimum answers. These variables are ADT level forecasted for each road type; composition of ADT and therefore vehicle cost per unit; rate of traffic growth; and comparative costs of routine, periodic and rehabilitation work per kilometer and therefore expected savings and cost levels and timing itself, which must vary as all the components of the forecast vary. For these reasons, the following assumptions enter the forecast:

Basic estimates of functions:

## Routine Maintenance

- Routine maintenance is introduced in year 2, as year 1 vehicle costs are "good" following year 0 optimum road conditions which carry no cost.
- Routine maintenance continues annually at a fixed level designated for each of the five forecasted road types.
- Savings in vehicle costs arise, year-to-year, out of the incremental rise in vehicle costs from one year to the next, as the residual difference between the amount of rise and the cost of routine maintenance. That is, after deducting routine maintenance costs, the entire balance of the rise in vehicle costs is claimed as a maximum savings level for the year.
- In the next year and all succeeding years, vehicle savings from the prior year are also deducted, along with current-year maintenance costs, to avoid cumulative effects not attributable to the effects of an annual program.

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- It is asserted in this model that the residual savings are maximum. They may not be. Some portion of the routine maintenance costs may accrue as savings to vehicles. In the forecast, a percentage rate of savings per year is therefore shown, relative to the alternative level of unmaintained road vehicle cost levels in that year.

Periodic Maintenance

- Periodic maintenance should be introduced in the year in which the incremental gain in savings is at least equal to the input cost. Failing that, the input should be in the year when savings and cost differences are at a minimum.

- The cost of routine maintenance is saved in the year of periodic maintenance. For one forecast format which compares total ten-year costs, the savings are taken as a credit; for another which examines benefits and costs, the full value of the periodic maintenance cost is reflected.

- When periodic maintenance occurs, the prior year's vehicle costs on the maintained road are used as the reference basis (rather than the forecast table of vehicle costs on the unmaintained road). The rise in vehicle costs permitted in this year is the rate of rise in annual traffic growth only (1.7%). This identifies the new level of vehicle costs given by the periodic maintenance. The level of savings is the difference between the forecasted level of vehicle costs — with routine maintenance — and the new level given by periodic maintenance.

- Because periodic maintenance involves overlays, re-sealing, and regravelling, this is not a complete return to "good" or minimum vehicle cost levels of year 0, as the road width and general configuration are not being changed as with rehabilitation/upgrading, although higher traffic levels now exist. Savings are therefore accounted as some intermediate level between minimum vehicle costs given by rehabilitation and that level given by routine maintenance. At present, this is a convention which assumes major work tasks for rehabilitation not encompassed in periodic maintenance: base, sub-base and sub-grade work may be re-worked for substantial improvement to vehicle operation.

- In the years following periodic maintenance, the annual rate of increase in vehicle costs is taken as one-half the rate shown by the forecast of vehicle costs on the unmaintained road, until another periodic maintenance year is selected. The calculation process then repeats as above.

Rehabilitation

- Rehabilitation is forecasted to occur in the same years as selected for periodic maintenance. These years approximate the reported life of the road types, and may correspond to the time at which rehabilitation is sought to restore these roads in actual practice.

- Consistent with present practice, no maintenance is given the road until it is rehabilitated, and no maintenance thereafter. Unmaintained road vehicle cost forecasts are used as the basis for analysis.

- With rehabilitation, "good" vehicle costs are resumed in the year of rehabilitation. Good vehicle costs per unit are applied to the total vehicle numbers forecasted in the rehabilitation year to obtain annual vehicle costs; rehabilitation therefore returns vehicle costs to their condition in year 0, multiplied by the forecasted vehicle volume in year X.

- In succeeding years, the rate of growth which obtains for vehicle costs on an unmaintained road will apply, as a rate, to the vehicle costs newly set in year X of the rehabilitation.

### 2.5.2.3 Discounted Present Values of All Alternative Cost Flows

The ten-year forecasts permit comparisons of the annual cost flows and their discounted net present value sums (at 12%) in two parts: vehicle costs annually and input costs of routine, or periodic, or rehabilitative interventions. As the base case, the unmaintained road forecast will show vehicle costs only, as no interventions occur. All alternative costs of treatment and their cost-reducing effects upon vehicle cost levels, will be compared with the base case to measure the total cost reduction achieved by each, relative to the base case. Savings over the base case are then compared for each alternative treatment. The results of this first stage evaluation are shown below.

COMPARATIVE NPV SUMS OF COSTS AND SAVINGS OVER TEN YEARS
(at 12% discount)

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT: | 550 | 364 | 127 | 364 | 29 |
| NPV (Rp. 000/km) Costs: | | | | | |
| Unmaintained | 103,755 | 93,793 | 39,108 | 174,138 | 11,751 |
| Rehabilitated | 99,030 | 86,147 | 41,760 | 103,994 | 9,753 |
| Routine | 100,416 | 89,613 | 29,549 | 147,602 | 9,685 |
| Rout./Periodic | 98,197 | 80,674 | 29,464 | 129,378 | 9,740 |
| NPV (Rp. 000/km) Savings: | | | | | |
| Rehabilitated | 4,725 | 7,646 | (2,652) | 70,144* | 1,998 |
| Routine | 3,339 | 4,180 | 9,559 | 26,536 | 2,066 |
| Rout./Periodic | 5,558* | 13,119* | 9,644* | 44,760 | 2,011 |

* Selected as preferred

It may be seen that the aggregate cost-reducing effects of any alternative treatment in most cases are not a large percentage of the total cost without any treatment at all. The maximum achieved appears to be 40% under unsealed gravel conditions for rehabilitation, which occurs three times in ten years in the forecast, and for a traffic volume on the distinctly high side for a gravel road. The important instruction given by the table above is that: 1) vehicle costs must be borne by the traffic flow under any condition of maintenance or lack of maintenance, 2) high levels of traffic which tend to approach levels consistent with a road transition to a higher design standard will benefit the most from road treatments, and 3) low volumes of traffic on any road class (design standard) which approach the lower limit of those staniards will benefit the least from road treatments.

The last statement is underscored by the response of the sealed gravel road carrying the low volume 127 ADT, for which rehabilitation costs, incurred only once midway in the forecast, actually produce higher total costs than the unmaintained alternative. In fact, for such a low-volume road, routine maintenance alone is almost as effective as the combination of routine and periodic maintenance combined.

For the earth road with light traffic and very moderate annual vehicle costs, one rehabilitation in the ten-year forecast is more expensive and produces less than one periodic maintenance in the same period, which is, in turn, less productive than simple routine maintenance throughout the

period. This again emphasizes the role of vehicle volume and the cost level for that volume (variable with road design standard) upon the savings generated by a given road treatment (and the cost of that treatment relative to vehicle costs).

In effect, the fixed parameters described above are all indeed variable. The forecast attempts to take what appears to be known from field data and to make it inform about broad conditions which occur most frequently. These assembled "facts" say that in some cases, depending upon input costs and other factors, rehabilitation can provide the correct answer, and in other cases the wrong answer (or, the worst answer). In any road treatment something is achieved. In four out of five cases, the combination of routine and periodic maintenance is the least-cost solution compared to routine maintenance alone; but in two cases rehabilitation both saves more than routine maintenance (asphalt and seal), and less than the combined effects of routine and periodic maintenance. The combined effects are again to be preferred for low volume gravel, but low volume earth responds best to routine only. In only one case is rehabilitation to be preferred to routine or combined routine and periodic maintenance: the test case of high volume traffic on a low volume road (gravel).

For this last case, the high volume (364 ADT) started out in year 1 in excess of the design capacity of the 50-200 ADT Class IIIB road, and therefore obtains its preferred status from failure of the year 0 design standard to accurately take account of the real level of ADT. This test case was visited upon the gravel standards, along with a narrowly acceptable level of 127 ADT for the same gravel standard, to compare the outcomes of higher and lower volumes of traffic on a road design which begins to accept gravel at only 50 vehicles a day, but for which the IBRD design standard requires 216 ADT (which would place IBRD ADT in the sealed road class of 200-500 ADT IIIB class).

Further conclusions on the functions of these variations in traffic level, input cost, timing, and savings levels must await a computerized version. With this model, other tests may find the optimum conditions for least-cost solutions to each of the five road types, using any of the road treatment tools as appropriate to different ranges of traffic volume.

### 2.5.2.4 Benefits, Costs, and Marginalities

The second stage analysis looks to the preferred solution, not in terms of least total costs and comparative total savings over the ten year period, but in terms of the net gains received for the cost effort expended. The same forecast yields annual cost data as inputs and measures annual savings as benefits. Their net present value sums (NPV) produce a benefit-cost analysis, a relative priority ranking profile based on the amplitude of the surplus of benefits over costs above the 1.00 value (for which the sum of benefits is equal to and no greater than the sum of the cost effort), and a clearer picture of the incremental benefits bestowed by the separate function of periodic maintenance.

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This is also important to the distributional aspect of the cost shares borne by the public and private sectors. The trade-off in costs undertaken by the road treatments (the public) to shoulder some of the vehicle costs (the private sector) by substituting road outlays for a reduction in vehicle costs will never succeed in producing equal cost shares. It was seen above that vehicle costs must be largely borne by the traffic such costs derive from. They can only be reduced marginally by road treatment alternatives. So the marginal trade-off rate becomes more important, and this will be examined.

The absolute relative cost shares which result from the forecasts above are identifiable from the forecasts. These show, for the different ADT volumes on different road types, how present volumes of traffic affect this distribution. With higher or lower ADT volumes, different cost shares would be represented.

RELATIVE COST SHARES AS PERCENT, PRIVATE AND PUBLIC

| | Sealed | | | | | | Unsealed | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Asphalt | | Seal | | Gravel | | Gravel | | Earth | |
| ADT: | 550 | | 364 | | 127 | | 364 | | 29 | |
| | priv. | publ. | priv. | publ. | priv. | publ. | priv. | publ. | priv. | publ. |
| Unmaintained | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 |
| Rehabilitated | 91 | 9 | 79 | 21 | 73 | 27 | 84 | 16 | 86 | 14 |
| Routine Maint. | 97 | 3 | 97 | 3 | 94 | 6 | 98 | 2 | 85 | 15 |
| Rout./Periodic | 96 | 4 | 94 | 6 | 89 | 11 | 95 | 5 | 79 | 21 |

It is seen that the high cost of rehabilitation usually undertakes a higher share of public costs than does routine or combined routine and periodic maintenance. However, as noted above, it may be misplaced spending, as with the gravel 127 ADT case, and may be less efficient than some alternatives which are suitable for the same timing and same level of traffic, accompanied by routine annual treatments at less cost.

The marginal costs and benefits of the same levels of spending as forecasted are reviewed below.

## COMPARATIVE BENEFITS AND COSTS OF ALTERNATIVES

(NPV at 12%; period, 10 years)

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT: | 550 | 364 | 127 | 364 | 29 |
| (Rp. 000/km) | | | | | |
| 1) Rehabilitation with no Maintenance | | | | | |
| Savings | 13,772 | 25,325 | 8,689 | 91,924 | 3,461 |
| Costs | 13,624 | 19,551 | 13,329 | 27,876 | 1,678 |
| Ratio | 1.01 | 1.29 | .65 | 3.27 | 2.06* |
| 2) Routine Maintenance without Periodic Maintenance | | | | | |
| Savings | 6,885 | 2,498 | 12,035 | 32,952 | 2,969 |
| Costs | 3,143 | 2,819 | 1,918 | 3,229 | 1,599 |
| Ratio | 2.19* | 2.66* | 6.27* | 10.20* | 1.85 |
| 3) Incremental Values of Periodic Maintenance | | | | | |
| Savings | 3,508 | 12,225 | 1,689 | 23,732 | 590 |
| Costs | 1,291 | 2,588 | 1,723 | 4,280 | 694 |
| Ratio | 2.72* | 4.72* | .98 | 5.54 | .85 |
| 4) Routine and Periodic Maintenance Combined | | | | | |
| Savings | 10,393 | 19,723 | 13,724 | 56,684 | 3,559 |
| Costs | 4,434 | 5,407 | 3,641 | 7,509 | 2,293 |
| Ratio | 2.34* | 3.64* | 3.76 | 7.54 | 1.55 |

* Selected as preferred

Note: Item 1) includes as costs the loss of vehicle cost savings afforded by routine maintenance up to the year of rehabilitation.

From this second-stage approach to comparative analysis, we learn that the marginal savings produced by present rehabilitation practices are generally less than the marginal savings produced by routine and/or routine-and-periodic maintenance. Only two exceptions exist, one of which was previously identified in the first-stage analysis: 1) the cost of rehabilitation for the 127 ADT gravel road increases the total cost stream over the ten-year period beyond cost levels for non-maintenance, and 2) the low-trafficked earth road case was previously seen to be better served by

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routine maintenance, but now appears to be better served by rehabilitation midway in the ten-year period. The comparative benefit-cost ratios for earth roads are:

| | |
|---|---|
| rehabilitation | 2.06 |
| routine maintenance | 1.85 |
| routine/periodic | 1.55 |

These ratios say that for the marginal cost involved in treatment, the marginal savings exceed a 12% rate of return by an amplitude over 1.00, as shown above. The selection of routine maintenance as the correct solution, on the basis of comparative total ten-year cost flows discounted, would have been incorrect. But in this case, only "marginally" incorrect: the total difference in total cost flows discounted over ten years is only Rp. 68,000. But it is still Rp. 68,000 per kilometer.

To better understand marginalities, compare the actual savings levels and cost levels forecasted for rehabilitation and for routine maintenance.* The difference between savings levels is Rp. 492,000, and between costs is Rp. 79,000; for the added expenditure by rehabilitation of Rp. 79,000, savings are increased 6.22 times over the level of that expenditure (another marginality). This is well worth the incremental cost. However, the attempt to implement a periodic maintenance program for this road must come in at a higher cost than Rp. 79,000 — the incremental cost will in fact be Rp. 694,000. But the gain in savings is only Rp. 590,000, or even less than the added cost, and gives a .85 benefit-cost ratio (less than 12%). The reason for this is explained by cost curves and the relative point on this U-shaped curve at which the cost input falls. The right-hand part of the curve indicates increasing costs, and the point at which the extra costs of periodic maintenance must be, because on that rise is also found decreasing marginal revenues. The lower-cost increment of rehabilitation must be on the decreasing cost side of the curve, at which increasing marginal revenues appear. In industrial terms, the scale of plant is too small to permit large incremental investments, and only moving to a larger scale of plant (higher ADT volumes) can the new investment be moved back to a lower cost/larger revenue part of the curve.

With these two exceptions noted, it is shown to be generally true that routine maintenance produces higher benefit-cost (B/C) ratios than rehabilitation as now practiced. Whereas rehabilitation of the low volume 127 ADT gravel road succeeds only in contributing more costs to a high cost case, routine maintenance provides a 6.27 B/C ratio. It is also seen for this 127 ADT gravel road case that the added expenditure for periodic maintenance does not pay its way, at a .98 ratio, and would only lower the total benefits of a combined routine and periodic maintenance program, to a B/C of 3.76. For this low-volume road, and for the low-volume earth road, periodic maintenance appears to be unwarranted for those present traffic levels.

* The same earth road case.

The incremental values shown for periodic maintenance provide a guide to the selection of this option: when B/C ratios are greater than those for routine maintenance alone, the periodic option should be selected, as it will raise the total combined B/C ratio. When the B/C ratios for periodic maintenance are lower than those for routine maintenance, the total combined B/C ratio will fall.

The second-stage benefit-cost ratio analysis gives a second reversal of an earlier selection based upon total costs/total savings: for the 127 ADT gravel road case, total savings of Rp. 9,644,000 produced by combined routine and periodic maintenance are greater than the total savings of Rp. 9,559,000 produced by routine maintenance only. The combined maintenance programs were therefore selected. But the marginal analysis shows clearly that the added periodic maintenance results in only a .98 ratio against a routine maintenance ratio of 6.27, and brings down the combined ratio to the level of 3.76. It is not an economic option. Routine maintenance alone is preferred.

It remains true that total savings are higher with this option than without it. The marginal influence, however, shows that the cost of obtaining the added savings is greater than the amount of the added savings, and brings down the "marginal efficiency of capital" — a rule that says every added cost should at least pay its own way. This is another way of talking about "decreasing returns," or the "law of diminishing marginal efficiency."

All of this has to do with the properties of the U-shaped total cost curve, and the relation of marginal cost curves and marginal revenue curves. The marginal cost curve rises from the lower left of the U curve, bisects it at its lowest point (a minimum cost point), and continues upward to the right on the inside of the U. This curve says that to the left of the intersection, added variable costs may be undertaken in the pursuit of optimum company profits (vehicle savings) and minimum company unit costs (composed of fixed and variable costs, which together give the U shape to the total cost curve). As marginal costs (variable costs) are undertaken, the roads budget is moving up the marginal cost line toward a minimum unit cost point of intersection with the U, and correspondingly, down the left-hand side of the U (total costs per unit are falling). But why expand costs marginally in this way? Where is the payoff? This is explained by the marginal revenue curve, which moves opposite to the marginal cost curve, and slopes downward to the right, bisecting the U also at the minimum cost point. Therefore, as marginal costs (added road expenditures) approach the point at which they may intersect, total costs are falling, marginal costs are rising, and marginal revenues added by each incremental variable cost are falling, but we are still proceeding toward an optimum: each added unitary cost brings in an added unitary revenue greater than its cost.

When the marginal cost curve intersects the marginal revenue curve, the maximum condition is reached. Total costs are at a minimum and the last added expenditure has produced the last and optimum level of added savings. Beyond this point, continued additions to cost are above the optimum level and total costs must begin to rise. At the same time, the revenue which is

brought in is falling. That is, adding periodic maintenance to routine maintenance now produces a .98 B/C ratio, whereas the former marginal cost of routine maintenance brought in a 6.27 B/C ratio. This relationship of total cost to marginal cost and marginal savings explains how total costs can be less and total savings more by selecting the periodic maintenance option, but how also its selection becomes sub-optimum in the marginal efficiency of its application.

In the real world, where costs per kilometer are fixed as bulk sums, you cannot glide smoothly up the marginal cost curve, but sometimes find among alternatives that the lumpy investment carries you beyond the desired goal. Each of the kabupaten road types has its own U-shaped cost curve and related marginalities. From the earth class to the asphalt class, they may be represented by a little industrial plant, then a bigger one, followed by a medium-size plant, and a large-scale plant.

The scales represented here carry the meaning that, for the earth road, built to the scale designed to handle up to 50 vehicles a day, routine and/or periodic expenditures (the marginal cost curves do not really care what the costs are called), are worthwhile so long as traffic is growing to the level of 50 vehicles per day. At 50, added expenditures only increase input costs and total costs. It may be time to consider a trade-off to a larger scale of plant, represented by the gravel road. If a trade-off is made, the whole cost structure is changed, a new plant is built with higher fixed costs (the new investment), but with potentially greater output and much lower unit costs. The greater vehicle volume which this plant can accommodate is 200 vehicles per day, and you only have 50 to 100 vehicles a day now. Therefore, you can expand routine or periodic variable costs as volume increases and achieve a reduction in total costs, which means more marginal revenues (vehicle savings). At some point in future operation, this scale of plant will be performing at its optimum level, at or near 200 vehicles per day, and consideration should again be given to shifting total cost curves by moving to a sealed road, which can carry from 200 to 500 vehicles a day.

### 2.5.2.5 Summary and Conclusions

A forecast of vehicle volumes and costs, reduced to net present values, may use either of two methods of analysis: reductions in total costs from a base case and the corresponding total savings, or a marginal analysis with a benefit-cost ratio. The marginal analysis is preferred, and is not more complicated. It has special value in the case of timing and amount of periodic maintenance, which along with rehabilitation, are the only variables that may exist as discretionary costs for any road. The comparative evaluation of given levels of traffic, each within the design parameters for that road class, and one well above the road's design capacity, has tested several main considerations which will confront the rural roads project.

First, the timing of interventions relates more to vehicle volume and rate of annual cost change than it does to reported years of service life of the road. It is possible that the lighter vehicles which comprise traffic on study area roads impart the lower unit costs which result in lower savings levels annually, longer apparent service life of the road (by which is meant that the cost of intervention is greater than the value of the savings for most roads having traffic levels which do not yet approach the design capacity of the road), and that the imputed traffic growth rate of 1.7% is a rate that does not produce sufficient year-to-year savings to warrant the incremental costs of even routine and/or periodic maintenance, in the case of earth roads carrying 29 ADT, but do warrant a one-time rehabilitation.

Second, routine maintenance in all cases except the earth road case produces better economic results than rehabilitation, at the forecasted levels of traffic. Periodic maintenance, at the timing stages shown, adds substantially to the marginal savings of vehicles in the case of asphalt and sealed roads, but tends to bring down the average savings rate for low-volume gravel, high-volume gravel road, and earth roads — at forecasted ADT levels. Periodic maintenance is nevertheless worthwhile for the high-volume gravel road, as its B/C ratio is still positive, though declining, and it is a better alternative than rehabilitation, which has a negative B/C ratio.

Third, too much importance should not be attached to outcomes of this kind which must "fix" ADT levels, growth rates, and traffic composition. Although they are drawn from the project study areas as a sample of the weighted average, they cannot reflect the range of conditions that are inherent in that average. To arrive at more definitive statements of the likely ADT level of any given road, in particular, a computer modelling of average compositions of traffic, and the average costs associated with these compositions, may lead to reasonable identification of that ADT level which is the threshold case for upgrading (earth to gravel, gravel to seal). If this level can be found, it will mark certain roads for rehabilitation/upgrading.

Fourth, the costs of intervention are derived from forecasted average expected costs for the ADB study of 30 kabupatens in March 1985, for other provinces. Costs may vary from these in future actual practice. Any further model-building must take account that all costs are variable costs, the more so in the long-run, and become fixed only by the management decisions which place them in the model. This fixes the outcomes, even though they remain to be found.

Fifth, the approach to the project must consider that the forecast basis of the above analysis assumed that in year 0 each road type had been brought to a level of design standard which produced a minimum or "good" vehicle cost for that level of ADT. It did not say who brought them to this condition. It is unlikely that most roads will be in this condition in the study area. But it was necessary to test interventions for this environment only, because of the nature of the test: service lives, timing, kind and amount of cost associated with alternatives, and present practices. The previous section explored the question of feasible levels of ADT for rehabilitation, using a simplified IBRD selection table. This section

exposes the question of how to deal with routine maintenance, which may be an alternative in the model, but is commonly a no-choice event following road improvement -- and the main focus of the institution-building and applied practices sought by the project. That is, routine maintenance is not commonly subjected to a selection or performance criterion. In normal practice, neither is periodic maintenance, but it has been shown that it should be, and is an important alternative to rehabilitation.

Sixth, if the project elects to rehabilitate a road, it will face costs and ADT levels which may be tested by a simple reference table as suggested by IBRD. That table may be converted to Rupiah relationships, and made more manageable by focusing on the narrower range of ADT levels, costs, savings, and growth rates, which will apply to the project area, avoiding the time-consuming effort of interpolations. However, once the "good" condition road is discovered in the field or selected for initial work, it is brought to a state which has presumably been justified by a given level of traffic. The presumption exists that the good state should be maintained, and that routine maintenance is the vehicle for this. In four cases out of five, it has been shown to be the earth road, 29 ADT case excepted. Even in that case, a positive benefit-cost ratio was identified (1.85), and represented no miserable failure alongside the 2.06 ratio given by the one-time rehabilitation. For this reason, and because of the direction of the project, routine maintenance should be seen as a normal follow-on to road restoration or upgrading, not subject to selection.

Seventh, it is possible to make a further case that salvage values of roads maintained produce further economic values at the end of year ten, whereas roads unmaintained do not. In all cases this would enhance the benefit-cost ratio, and is nice to see, but provides very little by way of selection criteria or comparative choice in intervention options.

Eighth, traffic levels and traffic savings dominate these selection options, as currently stated. The alternative value-added approach to low-volume roads is not treated.

## 2.6 RECOMMENDATIONS: REHABILITATION PRIORITY SELECTION PROCESS

### 2.6.1 Recommended Simplified Screening Method

A review of reference work on simplified methods for evaluating low-volume rural roads has produced no better method than the IBRD tabular format. This format shows the relationships between road investment costs, ADT volumes, and internal rates of return (IRR). This format is set out in the table on the next page. The problems of interpolation between tables of IRR and within each table, have been resolved here by simply completing all the interpolations which correspond to the ranges of vehicle operating costs (VOC) and vehicle operating cost savings (VOCS) to obtain the levels of detail needed for small changes in ADT (Appendix C explains how the interpolations were made). In the project area, these costs tend to be grouped at the lower end of the scale. This lower scale reflects the lower

TABLE 6
REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS*

(Rp. 000/Km) Base Year Rehabilitation/Upgrading costs:

| IRR % | 8960 | 11200 | 13440 | 15680 | 17920 | 20160 | 22400 | 25200 | 28000 | 30800 | 33600 | 36400 | 39200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base Year ADT Volume: | | | | | | | | | | | | |
| 6 | 46 | 58 | 70 | 82 | 94 | 105 | 110 | 128 | 146 | 160 | 173 | 186 | 199 |
| 7 | 49 | 62 | 75 | 87 | 99 | 111 | 118 | 137 | 155 | 170 | 184 | 198 | 212 |
| 8 | 52 | 65 | 79 | 92 | 105 | 118 | 126 | 145 | 164 | 180 | 195 | 210 | 225 |
| 9 | 55 | 69 | 83 | 97 | 111 | 124 | 134 | 154 | 173 | 190 | 206 | 222 | 238 |
| 10 | 58 | 72 | 87 | 102 | 116 | 131 | 145 | 164 | 182 | 200 | 217 | 234 | 251 |
| 11 | 60 | 76 | 92 | 107 | 122 | 137 | 151 | 171 | 191 | 210 | 228 | 246 | 265 |
| 12 | 63 | 80 | 96 | 112 | 128 | 143 | 155 | 177 | 199 | 219 | 239 | 259 | 279 |
| 13 | 66 | 83 | 100 | 117 | 134 | 150 | 167 | 188 | 208 | 229 | 250 | 271 | 291 |
| 14 | 69 | 87 | 105 | 122 | 139 | 156 | 175 | 196 | 217 | 239 | 261 | 283 | 304 |
| 15 | 72 | 90 | 109 | 127 | 145 | 163 | 185 | 206 | 226 | 249 | 272 | 295 | 317 |

* Motorized vehicles only.

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)



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unit costs of operating relatively light vehicles, which produce, in turn, a demand for higher levels of ADT to meet specified rates of return.

### 2.6.2 Use of the Screening Table*

The interpolations explained in Appendix C provide the basis for expanding the summary table which shows a matrix relating the ADT levels required to justify a range of invested costs between Rp. 000/km 8,960 and 39,200, in order to obtain a range of IRRs from 6% through 15%. This range of IRRs was stated to show 1) the relatively low IRRs yielded by certain lower levels of ADT, 2) the alternative use of the table for development areas which produce low current traffic levels, but may be acceptable for other reasons, and 3) an optional management tool for use according to policy decisions relating to level of expenditure selected (whether to regravel or newly seal a gravel road, for example, two separate costs which will place the IRR in a different class for a given level of traffic).

The invested cost levels are differentiated to provide intermediate cost steps, to take account of cost differences which may exist from one rural area to another, and the need to distinguish between the "minimum" and the "desirable" standard which is commonly employed in Indonesian road design practice.

Example of use: a field report shows an ADT of 72 for a specified road link. This ADT can be located at several places in the table: a 15% IRR can be obtained for this level of traffic if the invested costs of restoration/upgrading are estimated at Rp. 8,960,000/km; if these invested costs were placed at the level of Rp. 11,200,000/km, this level of traffic would produce a reduced IRR of 10%; if invested costs were still higher, at Rp. 13,440,000/km, the IRR would drop to midway between 6 and 7%.

A higher traffic count is reported at 198 ADT: for an invested cost of Rp. 25,200,000, the IRR is slightly above 14%; for Rp. 28,000,000/km the rate of return is just under 12%, and will fall for still higher levels of invested cost. But suppose the cost level is Rp. 15,680,000. At this lower cost level the table reports that an ADT of only 127 will yield a 15% IRR--and the 198 ADT level is off the chart. In this case, more than 15% is yielded; the exact yield can be readily plotted, if desired, by extrapolation.

A more awkward case: one link is reported to have an ADT of 58. It is in a development area, but no counts or surveys have been made of products coming out by road on bicycle or cart. It is a link in a kabupaten which has notably few roads qualifying for restoration because traffic levels are universally low. The aim of the project is to demonstrate, ultimately, the advantages of maintenance (but all roads here are unmaintained), and considerations of equity between kabupatens cannot be addressed by an ADT screening table. The screening table shows that a 10% return can be earned at an invested cost level of Rp. 8,960,000/km. But local costs will demand an expenditure of Rp. 11,200,000/km because of the long length of haul for

* See Mission note at the end of Section 2.6.4.

aggregates peculiar to this location. At that cost level, only 6% can be returned. This is a policy decision case which cannot be answered now for a six-year expenditure program.

Some specific local survey data, which are later recommended for road regions that are especially low-volume traffic generators, will assist in close judgments of this kind. Their use, both as monitoring devices following road restoration and maintenance investments, and as a data base needed for most roads before restoration, will supplement traffic counts and provide alternative measures of latent activity not reflected in traffic counts. Until such data become generally available, the grounds for clear decision-making, even if for recognizably marginal investments, will remain uncertain. With such data in hand, the marginal investment may be placed in contention with competing alternative road links of the same kind, and of the kind that assure high IRRs. The availability of funds, the existing levels of rivalry for those funds, and policy considerations will all remain the final determinants of decisions affecting these sub-optimum allocations of road funds.

### 2.6.3 Mechanics of the Screening Table

The ADT levels shown are a composite of the total sample survey of traffic counts, first assembled according to "apparent" road class (asphalt, seal, gravel, earth) to individuate the internal compositions that produce unique VOC structures, and the VOCS rate obtained by rehabilitation. These unique costs and savings were then averaged by group (asphalt class with seal road class, low-volume gravel road class with high-volume road class, and earth road volumes with estimated VOC and VOCS which would be expected in the differential between gravel and earth if they were not skewed by motorcycle traffic responding to deteriorated road conditions). Finally, all distributions, correlated with invested cost levels and IRR savings rates, were averaged to reflect the total composition of sampled traffic.

The ADT shown is for base year (reported, not forecasted) traffic. The table assumes a 5% traffic growth rate over a 10-year road life following restoration/upgrading. The table has distilled that forecast of rising VOC and VOCS into a single figure: ADT in the base year which yields the IRR shown. Actual growth rates on the project area roads are not known. There are no prior year counts available for comparison with present year counts. Five percent growth, however, is a nominal annual rate. Existing counts show that about 94% of all road links carry traffic volumes of less than 200 ADT. If they all carried as much as 200 ADT, it represents an annual increase in vehicle numbers of only 10 ADT. This seems a likely attainable growth rate.

The IRRs for different ADT levels show a sensitivity to small changes in VOC and VOCS, which in turn are due to traffic composition and to change in road condition from bad to good. Some of these effects shown by five sampled levels of traffic flow on different road classes have been merged by averaging. This has placed all roads in an initially "bad" condition, as a prerequisite to rehabilitation, to better reflect the change to "good," and

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to reduce the effects of variations in composition as volume varies. That is, unique compositions have been purposely merged to better reflect the overall sample rather than the special outcome of each of five tests. It may appear that the ADT requirements for the higher standard roads have been unduly increased by this merger because of the higher ADT levels found for earth roads. In fact, the objective of the table is better served in the generalized form, as earth and low-grade gravel roads comprise over 75% of the network and over 95% of the traffic now reported.

The ADT screening table is for traffic which includes motorized vehicles only. Appendix A reviews the ADT requirements which include bicycles and carts in the motorized traffic flow. That traffic flow, for a specified set of VOC and VOC savings, showed the need for higher levels of ADT to obtain selected rates of return than are required in the screening table. The former analysis specifically related the ADB 8th Loan road treatment costs to these traffic volumes: from earth to gravel, regravelling, from gravel to seal, and re-seal of seal. The present table does not do this. Instead, costs are not presumed to be known in advance, nor are they specific to the kind of road treatment or kind of original road surface type. Because such costs are now stated as variable costs, a wider range of cost change may be shown for intermediate levels within the probable cost range. This extends the application of the table, permitting flexibility in dealing with cost differences which may exist between road districts, or in engineering design variations which distinguish "minimum" from "desirable" standards. These distinctions may make the difference between feasibility and non-feasibility.

It should be emphasized that the ADT values in the screening table, while adequate for project start-up, will need to be adjusted over time and perhaps between geographic regions as well. The primary reason for this is that the table assumes uniform traffic composition and uniform traffic growth rates across all kabupatens. There is some evidence that these may vary significantly and that the ADT required to justify a given level of investment could be substantially higher or lower depending on location. Data to refine the table, however, will only emerge once kabupaten traffic counting begins during the first project year. Table refinements can be easily made particularly if one of the common microcomputer spreadsheet programs is utilized. Responsibility for updating or refining the screening table should be assigned to the appropriate GOI agency before the project begins.

### 2.6.4 Monitoring and Evaluation

The types of project monitoring suggested here are applicable to road links both before any road rehabilitation and maintenance takes place, and after a project has been approved by the screening test. Most of these have been mentioned in earlier sections which dealt with existing pre-screening practices.

1) A pre-screen traffic count, preferably by an independent local consulting firm not subject to local pressures, taken annually on road links in each kabupaten indicated to have more than 15 motorized vehicles a day.

Existing forms prepared by Bina Marga can be used to count both motorized and non-motorized traffic. The form provides for composition of traffic and total number of passes by type of traffic. The count program could start in 1987, to be repeated annually thereafter, perhaps by the DPUP or DPUK following the initial count by the independents.

2) Supplementary monitoring surveys, by DPUK/DPUP, also to start in 1987, for these same road links, would provide a basis if considered necessary for measuring other growth indicators than traffic. A single survey of three kinds of data would provide a year-by-year index of the changes occurring in non-traffic activity levels: volume of goods entering the cash market, value of cash-crop, and price of transport.

- Market price surveys at market or assembly stations, to note tons of cash crop entered per market day or assembly day, for non-motorized traffic only. Surveyor may check three times over a three-week period during the main harvest-market seasons, to produce an average tonnage per day and average season price per ton.

- On-Farm surveys of cash-crop volumes and reported market price, showing the form of non-motorized transport used during main harvest seasons.

- Transporters' price survey, of transporters of goods and passengers over rural roads, to obtain rates charged per ton and per passenger by distance travelled over road links having such motorized traffic.

The application of such surveys to pre-screening and post-approval, in simple one-page summary reports (see Figure 2), provides a basis for comparing the effects with-and-without road improvement, and an index of the relative changes occurring on both kinds of roads. This information is not provided by traffic counts alone, which will themselves measure the year-to-year impact of road treatments upon vehicle volume (does it increase or not, and by how much?). By surveying both the roads with road treatment and those without, a control is established by which the relative amount of change produced by road treatment can be measured against changes which may occur without road treatment. The net difference informs of the probable net influence of the road improvement on aggregate economic activity levels. In company with the transporters' prices, the index will show the relative rate of reduction that may be induced by improved roads, which theoretically is the basis for subsequent increases in farm production (as net income is seen to increase via the new distance between costs of producing-marketing and market price). A unit change in transport price is a direct "benefit"; a subsequent increase in production reflects a transfer of some of these benefits to the rural community in the form of income enhancement and gainful employment.

FIGURE 2

SURVEY SUMMARY

K bupaten: _____ Road Link Number: _____ Km of Link: _____

Main crops delivered to market: (average of 3 counts over 3 weeks)

| | Rice | Tree crops | Vegetables | Other |
|---|---|---|---|---|
| Kg: | | | | |
| Rp/Kg: (at market) | | | | |

Transported by:

| | | | |
|---|---|---|---|
| Bicycle | | | |
| Cart | | | |
| Porter | | | |
| Vehicle | | | |

Transport price asked by vehicle operators:

| | 1 km | 2 km | 3 km | 4 km | 5 km | 6 km | 10 km |
|---|---|---|---|---|---|---|---|
| 1 Passenger: | | | | | | | |
| 20 Kilograms: | | | | | | | |

Shown as a summary of all surveys for each road link above, the form itself is also the basic survey form to introduce individual survey data, house-to-house, or at each market serving the road link. As total tallies are completed, they need merely be added and averaged to produce the survey summary. Although somewhat spare in content, the form provides the essential data not now contained on alternative pre-screening forms previously used by other donors, and eliminates much of the detail those forms contained which add nothing to project evaluation. Annually, of course, the same farms and same markets should be revisited. This should likely be done by two-person teams, which may be permanent members of the DPUK/DPUP (district and provincial public works services) rather than students hired locally (who are not likely to be authority figures to farmers).

A perfect reporting system is not expected, and perfect reports will not be generated. The summary surveys are not themselves local evaluations and do not require local evaluation. But they are useful training instruments which lead to better awareness of the kinds of

measures that are appropriate to "developing" areas, and when combined with traffic counts made by DPUK/DPUP in succeeding years, will show the general basis for monitoring and evaluating their progress in road selection, and in measuring the effects of their maintenance and rehabilitation choices. Much like any control system, the intent is to test the influence of positive action against doing nothing.

Other potentially useful monitoring formats were considered and discarded. These were: 1) school enrollment—with and without road improvement, a premise that poor roads may inhibit normal social standards. However, local social factors such as harvest season employment and unknown legal requirements for obligatory attendance foreclosed this option; (2) average time to travel point-to-point along a road link (km per hour) might measure relative road condition for a standard 4-wheel vehicle. But jeeps and minibuses vary in their adaptation to different road conditions, and drivers' habits vary even more, making this an index of questionable value in comparing different road links; and 3) farmgate prices, to measure prices paid by transporters to pick up goods for market, and relative change in price with road improvement. Present evidence indicates that this is not current practice, and that a direct survey of transporters themselves at market would be simpler and more easily repeated on an annual survey basis.

Mission Note

The screening table's sensitivity to small variations in reported traffic volume raises the potential for the manipulation of traffic data. Safeguards will be provided under the RRMS project by using an independent contractor to conduct the first-year baseline count and by subsequent spot-checks performed by long-term project consultants. In the long-term, however, no screening procedure is viable unless the priorities it manifests are understood and accepted by its implementors. The long-term value of using the screening table is the awareness it instills of the engineering and economic significance of traffic levels in road work decisions. To the extent this awareness is institutionalized, traffic becomes the language in which even purposeful manipulation of screening procedures must be justified. The broad benefit exceeds the cost of manipulated uneconomic decisions on particular road links.

# APPENDIX A

## ECONOMIC TABLES

TABLE 1
VEHICLE OPERATING COST ESTIMATES

| Road Class and Condition | Car (Rupiah/km) | Pickup/ Minibus | Light Truck | Motor cycle | Cart | Bicycle |
|---|---|---|---|---|---|---|
| Asphalt | | | | | | |
| Good | 104.7 | 86.2 | 85.4 | 15.9 | 21.8 | 6.6 |
| Fair | 125.5 | 101.0 | 98.0 | 18.2 | 24.9 | 7.4 |
| Poor | 164.1 | 135.2 | 138.5 | 22.8 | 35.4 | 10.1 |
| Bad | 222.1 | 202.0 | 205.0 | 29.1 | 53.2 | 15.2 |
| Gravel | | | | | | |
| Good | 125.7 | 101.4 | 102.5 | 18.5 | 24.9 | 7.4 |
| Fair | 145.0 | 124.6 | 127.1 | 21.1 | 29.2 | 8.6 |
| Poor | 198.6 | 172.6 | 178.4 | 27.1 | 43.5 | 13.1 |
| Bad | 242.7 | 228.9 | 231.2 | 31.8 | 64.8 | 18.4 |
| Earth | | | | | | |
| Fair | 201.8 | 180.0 | 185.1 | 28.0 | 43.5 | 13.1 |
| Poor | 240.7 | 218.2 | 225.8 | 31.8 | 53.2 | 15.2 |
| Bad | 264.9 | 278.0 | 281.7 | 35.5 | 65.4 | 18.7 |

COMPARATIVE COSTS PER KILOMETER OF ALTERNATIVE ROAD TREATMENTS
(30 Kabupaten Average)

| Major Treatment | Road Class | Rupiah 000 per km | US$ Equivalent | ADT Implied |
|---|---|---|---|---|
| Seal (initial) | Gravel | 27,600 | 24,640 | 200 |
| Overlay Seal | Sealed | 22,400 | 20,000 | 200-500 |
| Gravel (initial) | Earth | 20,000 | 17.860 | 50-200 |
| Reseal | Sealed | 17,000 | 15,200 | 200-500 |
| Regravel | Gravel | 15,000 | 13,400 | 50-200 |
| Routine Repair and Maintenance | | | | |
| Unsealed Roads | | 298 | 266 | 50 |
| | | 406 | 363 | 50-200 |
| | | 606 | 541 | 200-500 |
| Sealed Roads | | 359 | 321 | 200 |
| | | 528 | 471 | 200-500 |
| | | 590 | 527 | 500 |

Source: Local Roads Component, Main Report, March 1985, Hoff, Overgaard and Kampsax (Central Java, NTB, Bali), for ADB 8th Loan.

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TABLE 2

REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS*

(Rp. 000/Km) Base Year Rehabilitation/Upgrading costs:

| IRR % | 8960 | 11200 | 13440 | 15680 | 17920 | 20160 | 22400 | 25200 | 28000 | 30800 | 33600 | 36400 | 39200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base Year ADT Volume: | | | | | | | | | | | | |
| 6 | 46 | 58 | 70 | 82 | 94 | 105 | 110 | 128 | 146 | 160 | 173 | 186 | 199 |
| 7 | 49 | 62 | 75 | 87 | 99 | 111 | 118 | 137 | 155 | 170 | 184 | 198 | 212 |
| 8 | 52 | 65 | 79 | 92 | 105 | 118 | 126 | 145 | 164 | 180 | 195 | 210 | 225 |
| 9 | 55 | 69 | 83 | 97 | 111 | 124 | 134 | 154 | 173 | 190 | 206 | 222 | 238 |
| 10 | 58 | 72 | 87 | 102 | 116 | 131 | 145 | 164 | 182 | 200 | 217 | 234 | 251 |
| 11 | 60 | 76 | 92 | 107 | 122 | 137 | 151 | 171 | 191 | 210 | 228 | 246 | 265 |
| 12 | 63 | 80 | 96 | 112 | 128 | 143 | 155 | 177 | 199 | 219 | 239 | 259 | 279 |
| 13 | 66 | 83 | 100 | 117 | 134 | 150 | 167 | 188 | 208 | 229 | 250 | 271 | 291 |
| 14 | 69 | 87 | 105 | 122 | 139 | 156 | 175 | 196 | 217 | 239 | 261 | 283 | 304 |
| 15 | 72 | 90 | 109 | 127 | 145 | 163 | 185 | 206 | 226 | 249 | 272 | 295 | 317 |

* Motorized vehicles only.

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)

TABLE 3
TRAFFIC VOLUMES (ADT) ON KABUPATEN ROADS IN PROJECT AREA

| Kabupaten | Number of Road Links | Number of Links in Different ADT Ranges: 0 | 1-10 | 11-30 | 31-50 | 51-100 | 101-200 | 201-300 | 435 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **South Sulawesi** | | | | | | | | | | | |
| Takalar | 43 | 1 | 31 | 11 | 0 | 0 | 0 | 0 | | | |
| Bone | 30 | 0 | 9 | 8 | 8 | 4 | 1 | 0 | | | |
| Sidrap | 38 | 3 | 16 | 19 | 0 | 0 | 0 | 0 | | | |
| Pinrang | 36 | 2 | 24 | 10 | 0 | 0 | 0 | 0 | | | |
| Jeneponto | 45 | 1 | 8 | 25 | 11 | 0 | 0 | 0 | | | |
| Gowa | 60 | 4 | 5 | 4 | 3 | 18 | 17 | 6 | 1 | 1 | 1 |
| Total: | 252 | 11 | 93 | 77 | 22 | 22 | 18 | 6 | 1 | 1 | 1 |
| % : | 100 | 4 | 37 | 31 | 9 | 9 | 7 | 2 | | | |
| **NTT** | | | | | | | | | | | |
| Manggarai | 8 | 0 | 7 | 1 | 0 | 0 | 0 | 0 | | | |
| Belu | 21 | 3 | 18 | 0 | 0 | 0 | 0 | 0 | | | |
| Sumba Barat | 35 | 1 | 6 | 17 | 7 | 2 | 1 | 1 | | | |
| Ngada | 50 | 11 | 15 | 8 | 6 | 6 | 2 | 0 | | | |
| Sikka | 3 | | | | | 2 | 1 | (High counts only) | | | |
| Kupang | 6 | | 1 | 3 | 1 | 1 | | (High counts only) | | | |
| Timor Tengah S. | 5 | | 4 | 1 | | | | (High counts only) | | | |
| Total: | 128 | 15 | 51 | 30 | 14 | 11 | 4 | 1 | | | |
| % : | 100 | 12 | 40 | 23 | 11 | 9 | 3 | 1 | | | |



+ 5h2

TABLE 4
TRAFFIC VOLUMES BY ROAD CLASS

| ADT Design Standard: | Earth 50 | Gravel 50-200 | Seal 200-500 | Asphalt 500 |
|---|---|---|---|---|
| Number Of Road Links Within Standard: | | | | |
| South Sulawesi: | 203 | 40 | 7 | 2 |
| NTT: | 110 | 15 | 1 | 0 |
| Total: | 313 | 55 | 8 | 2 |
| % : | 82 | 14 | 2 | 1 |

MINIMUM ADT LEVELS REQUIRED FOR ECONOMIC FEASIBILITY*

| (Rehabilitation): | From Earth to Gravel | Regravel of Gravel | From Gravel to Seal | Reseal of Seal |
|---|---|---|---|---|
| Costs (Rp. 000) | 20,000 | 15,000 | 27,600 | 22,400 |
| | Daily Traffic Level Minimum | | | |
| For 10% Return: | 203 | 100 | 569 | 406 |
| For 12% Return: | 222 | 109 | 623 | 444 |
| For 15% Return: | 247 | 124 | 768 | 505 |

* From Sec. 3 analysis of motorized and non-motorized traffic from 210 traffic counts in 20 kabupaten in Central Java, Bali, and NTB, for the ADB 8th Loan project evaluation.

TABLE 5
WEIGHTED AVERAGE COST PER COMPOSITE VEHICLE
ON PROJECT ROADS WITHOUT ROAD MAINTENANCE

| Ten-Year Forecast: (Rp/Km) | Sealed Roads | | | Unsealed Roads | | |
|---|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Gravel | Earth |
| ADT Standard | 500 | 200-500 | 50-200 | 200-500 | 50-200 | 50 |
| Actual: | 550 | 364 | 127 | 364 | 127 | 29 |
| 1. | 58.0 | 71.6 | 77.7 | 72.8 | 77.7 | 97.8 |
| 2. | 64.9 | 83.7 | 93.1 | 104.0 | 98.9 | 114.9 |
| 3. | 72.6 | 97.9 | 111.7 | 148.5 | 126.0 | 134.9 |
| 4. | 81.3 | 114.4 | 133.9 | 180.3 | 160.5 | 158.4 |
| 5. | 91.0 | 133.8 | 160.5 | 218.9 | 182.4 | 186.1 |
| 6. | 101.9 | 145.1 | 176.4 | 265.7 | 207.4 | 218.6 |
| 7. | 114.0 | 157.4 | 194.0 | 322.6 | 235.8 | 256.7 |
| 8. | 127.6 | 170.7 | 313.3 | 391.7 | 268.0 | 301.5 |
| 9. | 135.2 | 185.2 | 234.5 | 475.6 | 304.7 | 354.1 |
| 10. | 143.3 | 200.8 | 257.8 | 577.4 | 346.4 | 415.9 |
| Avg. Annual % | 17.14 | 21.72 | 26.64 | 51.99 | 35.52 | 18.96 |
| (Expected life of road is underlined) | | | | | | |
| Derived From: Rp/Km by Vehicle Type (unit cost weighted by % composition) | | | | | | |
| Good Condition | | | | | | |
| Car/Jeep | 24.1 | 35.1 | 35.2 | 35.2 | 35.2 | 48.4 |
| Minibus | 12.9 | 11.1 | 11.1 | 11.1 | 11.1 | 3.6 |
| Truck | 13.7 | 17.6 | 24.6 | 18.5 | 24.6 | 29.6 |
| Motorcycle | 7.3 | 7.8 | 6.8 | 8.0 | 6.8 | 16.2 |
| Total | 58.0 | 71.6 | 77.7 | 72.8 | 77.7 | 97.8 |
| Bad Condition | | | | | | |
| Car/jeep | 51.1 | 62.2 | 68.0 | 68.0 | 68.0 | 63.6 |
| Minibus | 30.3 | 22.2 | 25.2 | 25.2 | 25.2 | 5.6 |
| Truck | 32.8 | 36.9 | 55.5 | 41.6 | 55.5 | 45.1 |
| Motorcycle | 13.4 | 12.5 | 11.8 | 13.7 | 11.8 | 20.6 |
| Total | 127.6 | 133.8 | 160.5 | 148.5 | 160.5 | 134.9 |

1) This road case has been dropped from the evaluation.

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TABLE 6

UNMAINTAINED ROAD FORECAST OF VEHICLE OPERATING COSTS ANNUALLY
(Using Project Area Vehicle Compositions)

(Rp. 000/km)

| | Sealed Roads | | | Unsealed Roads | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT: | 550 | 364 | 127 | 364 | 29 |
| (Growth rate is 1.7% annually) | | | | | |
| 1 | 11,841 | 9,674 | 3.630 | 9,837 | 1,053 |
| 2 | 13.250 | 11.309 | 4.389 | 14.052 | 1.237 |
| 3 | 14.822 | 13.228 | 5.266 | 20.065 | 1,452 |
| 4 | 16,598 | 15,457 | 6,312 | 24,362 | 1,705 |
| 5 | 18,579 | 18,079 | 7,566 | 29,577 | 2,003 |
| 6 | 20,084 | 19,606 | 8,316 | 35,901 | 2,353 |
| 7 | 23,275 | 21,268 | 9,145 | 43,589 | 2,763 |
| 8 | 26,051 | 23,065 | 10,055 | 52,926 | 3,246 |
| 9 | 27,603 | 25,024 | 11,055 | 64,262 | 3,812 |
| 10 | 29,256 | 27,132 | 12,153 | 78,017 | 4,477 |

ANNUAL COSTS PER KILOMETER OF ROAD MAINTENANCE
(Average of 30 Kabupatens)
(Central Java, NTB, Bali)

(Rp. 000/Km)

| | SEALED ROADS | | | UNSEALED ROADS | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| ADT: | 500 | 200 | 200 | 200 | 50 |
| Routine Maintenance: | | | | | |
| | 589.5 | 528.1 | 359.1 | 606.1 | 298.5 |
| Periodic Maintenance (reshape and re-surface): | | | | | |
| | 2,857.0 | 2,223.0 | 2,709.0 | 2,709.0 | 1,224.0 |

TABLE 7
MAXIMUM SAVINGS LEVELS WITH ROUTINE AND PERIODIC MAINTENANCE, AND SUGGESTED MAINTENANCE INTERVALS (SEALED ROADS)

(Rp. 000/Km)

| Year | Asphalt (ADT 500) Routine = 590 | | | Periodic = 2857 | | Seal (ADT 364) Routine = 529 | | | | | Gravel (ADT 127) Routine = 360 | | | Periodic = 2709 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | % | VOC | S | VOC | S | % | VOC | S | VOC | S | % | VOC | S | VOC |
| 1 | - | - | 11841 | | | - | - | 9674 | | | - | - | 3630 | | |
| 2 | 819 | 6.2 | 12431 | | | 1106 | 9.8 | 10203 | | | 399 | 9.1 | 3990 | | |
| 3 | 982 | 6.6 | 13840 | (2857-590) | | 1390 | 10.5 | 11838 | (2223-529) | | 916 | 17.4 | 4350 | (2709-360) | |
| 4 | 1186 | 7.1 | 15412 | | | 1700 | 11.0 | 13757 | 24* | 12039 | 1602 | 25.4 | 4710 | | |
| 5 | 1391 | 7.5 | 17188 | | | 2093 | 11.6 | 15986 | 2984-529 | 13002 | 2496 | 33.0 | 5070 | (2068)* | 4790 |
| 6. | 1635 | 7.9 | 19169 | | | 998 | 5.1 | 18606 | 4564-529 | 14042 | 2886 | 34.7 | 5430 | 400-360 | 5030 |
| 7 | 1881 | 8.1 | 21394 | | | 1135 | 5.3 | 20133 | 4968-529 | 15165 | 3335 | 36.5 | 5810 | 528-360 | 5282 |
| 8 | 2186 | 8.4 | 23865 | (160)* | 21758 | 1268 | 5.5 | 21797 | 426+3002* | 18795 | 3885 | 38.6 | 6170 | 571-360 | 5599 |
| 9 | 962 | 3.5 | 26641 | 3795-590 | 22846 | 1430 | 5.7 | 23594 | 3295-529 | 20299 | 4525 | 40.9 | 6530 | 763-360 | 5767 |
| 10 | 1063 | 3.6 | 28193 | 2834-590 | 25359 | 1579 | 5.8 | 25553 | 3630-529 | 21923 | 5263 | 43.3 | 6869 | 967-360 | 5923 |

*Net balance after input of periodic maintenance, plus or minus savings generated by input.

| | | | |
|---|---|---|---|
| Net Periodic: | 2267 | 1694 | 2349 |
| Total Savings: | 2107 | 1718 | 280 |

In year 8: (1694)+426 surplus + 3002 generated

TABLE 8

MAXIMUM SAVINGS LEVELS WITH ROUTINE AND PERIODIC MAINTENANCE, AND SUGGESTED MAINTENANCE INTERVALS (UNSEALED ROADS)

(Rp. 000/Km)

| | Gravel (ADT 364) | | | | | Earth (ADT 29) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Routine = 606 | | | Periodic = 2709 | | Routine = 300 | | | Periodic = 1224 | |
| Year | S | % | VOC | S | VOC | S | % | VOC | S | VOC |
| 1 | - | - | 9837 | | | - | - | 1053 | | |
| 2 | 3609 | 25.7 | 10443 | | | (116) | (9.4) | 1145 | | |
| 3 | 5407 | 26.9 | 14658 | (2709-606) | | 7 | 0.5 | 1245 | | |
| 4 | 3691 | 15.1 | 20671 | 978* | 17590 | 160 | 9.4 | 1354 | | |
| 5 | 4609 | 15.6 | 24968 | 3869-606 | 21279 | 349 | 17.4 | 1472 | | |
| 6 | 5718 | 15.9 | 30183 | 4452-606 | 25731 | 581 | 24.7 | 1600 | (862)* | 1538 |
| 7 | 7082 | 16.2 | 36507 | 6100* | 28304 | 863 | 31.2 | 1739 | 201-300 | 1607 |
| 8 | 8731 | 16.5 | 44195 | 7945-606 | 36250 | 1207 | 37.2 | 1891 | 284-300 | 1679 |
| 9 | 10730 | 16.7 | 53532 | 8641-606 | 44891 | 1621 | 42.5 | 2055 | 376-300 | 1754 |
| 10 | 13149 | 16.8 | 64868 | 12936* | 49829 | 2122 | 47.4 | 2234 | 480-300 | 1833 |

*Net balance after input of periodic maintenance, plus or minus savings generated by input.

| | | | |
|---|---|---|---|
| Net Periodic: | | 2103 | 924 |
| Total Savings: | 1 | 3081 | 986 |
| | 2 | 8203 | |
| | 3 | 15093 | |



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# APPENDIX B

## UNIT COST CALCULATIONS

## SUMMARY

## ROAD MAINTENANCE UNIT COSTS: ROUTINE AND PERIODIC

**Calculate Possible Working Days per Year**

| Calender Days | - | Sundays and Holidays | - | Fridays .5 day | - | Lost Days | = | Annual Working Days |
|---|---|---|---|---|---|---|---|---|
| 365 | - | 65 | - | 26 | - | 54 | = | 220 |

### SUMMARY OF ESTIMATED MAINTENANCE UNIT COSTS

| Type of Maintenance | Sealed Roads km/Yr | Sealed Roads Rp(000)/km | Gravel Roads km/Yr | Gravel Roads Rp(000)/km | Earth Roads km/Yr | Earth Roads Rp(000)/km |
|---|---|---|---|---|---|---|
| ° ROUTINE - Routine | 60 | 510 | 100 | 360 | 125 | 150 |
| - Smoothing | - | | 400 | 70 | 400 | 70 |
| Subtotal Routine Cost (Incl. an allowance for emergency work) | | 510 | | 430 | | 220 |
| ° PERIODIC - Resealing | 350 | 680 | - | - | - | - |
| - Regraveling | - | - | 450 | 800 | - | - |
| - Reshaping | - | - | 200 | 255 | 200 | 255 |
| Subtotal Periodic Cost | | 680 | | 1055 | | 255 |
| ° TOTAL MAINT. COST Routine + Periodic | | 1,190 | | 1,485 | | 475 |

Average Cost of Resealing: 50% Chip Seal (using # 4 stone) Rp(000) 475/km
50% DBST (using 3/8" & #4 stone) Rp(000) 890/km

Average Unit Cost Rp (000)680/km

Average Production for Resealing:

50% Chip Seal 100 km/yr per 400 km inventory
50% DBST 60 km/yr per 300 km inventory

Average Production: 80 km/yr per 350 km inventory

## UNIT COST: ROUTINE MAINTENANCE - SEALED ROAD

(60 km/yr)

### Routine Activities

| Labor | Daily Rate | Daily Cost x Days | TOTAL COST Rp. 000 |
|---|---|---|---|
| (1) Foreman | 3,500 | Rp. 3,500 | |
| (1) Driver | 3,000 | = 3,000 | |
| (10) Workers @ 1,700 | 1,700 | = 17,000 | |
| SUBTOTAL LABOR: | | Rp. 23,500 x 365 = | 8,580 |

| Equipment | Daily Rate | Daily Cost | Days | |
|---|---|---|---|---|
| (1) 3.5 T Dump Truck | Rp. 33,440 | Rp. 33,440 | | |
| (1) Hand Opr. Comp. | | 10,856 | | |
| SUBTOTAL EQUIPMENT: | | Rp. 44,296 | x 220 = | 9,745 |

### Materials

| Pothole patching with cold mix | Qty | Unit Price | |
|---|---|---|---|
| - Cold mix: 1.5 $m^3$/day x 80 days = | 120 $m^3$/yr | @ Rp. 96,000/$m^3$ = | 11,520 |
| - Asphalt prime: 12 1/$m^3$ mix = | 1440 1/yr | @ 450/1 = | 650 |
| | | TOTAL ANNUAL COST: | Rp. 30,495 |
| | | UNIT COST: | Rp. 510/km |

### Cold Mix Calculation

Assume: Asphalt 7% weight

Stone = 100 lbs/$ft^3$ x 35.3 $ft^3$/$m^3$ = 3,530 lbs/$m^3$ mix

Asphalt = 0.07 x 3,530 lbs/$m^3$ mix = 247 lbs/$m^3$ mix

247 lbs/$m^3$ mix - 2.86 lbs/1 = 86,36 1/$m^3$ mix

| Cost: | | |
|---|---|---|
| Stone | 1/$m^3$ @ Rp. 19,000/$m^3$ | = 19,000 |
| Asphalt | 86 1/$m^3$ @ 450 1/$m^3$ | = 38,700 |
| Equipment | - estimate | = 30,000 |
| Labor | - estimate | = 8,300 |
| | Cost per $m^3$ | Rp. 96,000 |

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# WORKSHEET

## Routine Maintenance Crew - Routine Activities

| Inventory Qty. | Labor | Equipment |
|---|---|---|
| 60 km | (1) Foreman | (1) Stake body or 2.5 $m^3$ dump 3 ton |
| 20 Bridges (1 bridge/3 km) | (1) Driver | (1) Hand operator compactor |
| | (10) Workers | |

| | Kinds of Activities/Tasks | Production/day x | Days/yr = | Inventory/yr |
|---|---|---|---|---|
| | - Pavement (patching, depressions) | 0.75 km/day | 80 | 60 km |
| C | - Drainage (ditches, culverts, drains) | 0.75 km/day | 80 | 60 km |
| C | - Roadside | 2.0 km/day | 30 | 60 km |
| | - Miscellaneous | 6.0 km/day | 10 | 60 km |
| | - Bridges (cleaning, inspecting) | 1.0 Bridge/day* | 20 | 20 Bridges |
| | | | 220 | |

* Effective rate: production actually 2 bridges/day twice a year

Note: C indicates possible maintenance tasks for contract

## UNIT COST: PERIODIC MAINTENANCE - SEALED ROAD

(3.5 m wide = 0.5 km/day = 100 km/yr. on 400 km of inventory)

Chip Seal (using #4 (3/16" - 5 mm) stone)

| | Labor | Daily Rate | Daily Cost x Days = | TOTAL COST Rp. 000 |
|---|---|---|---|---|
| (1) | Foreman | Rp. 3,500 | Rp. 3,500 | |
| (2) | Operators | 3,900 | 7,800 | |
| (2) | Drivers | 3,000 | 6,000 | |
| (2) | Skilled | 2,500 | 5,000 | |
| (2) | Semi-skilled | 2,000 | 4,000 | |
| (10) | Workers | 1,700 | 17,000 | |
| | SUBTOTAL LABOR: | | Rp.43,300 x 365 = | 15,805 |

| | Equipment | Daily Rate | Daily Cost | Days |
|---|---|---|---|---|
| (1) | Tractor (farm)* | Rp. 41,427 | Rp. 41,427 | |
| (1) | Broom Attch.* | 15,240 | 15,240 | |
| (1) | Asphalt Sprayer | 16,230 | 16,230 | |
| (1) | 3.5 T Dump Trk. | 45,330 | 45,330 | |
| (2) | Tailgate Spreader | | 3,720 | |
| (1) | Pneu. Roller | 13,258 | 79,530 | |
| (1) | Asphalt Tank* | 10,000 | 10,000 | |
| (1) | Flatbed Truck | 31,650 | 31,650 | |

SUBTOTAL EQUIPMENT: Rp.243,127 x 220 = 53,490

(If the crew can produce more work a second dump truck is needed)

| Materials | Unit Price | Daily Cost | Days |
|---|---|---|---|
| (10) $m^3$ Chips (6 mm-#4; 0,005 $m^3/m^2$) | Rp. 19,000/$m^3$ | Rp. 190,000 | |
| (800) l Asphalt Binder (75%; 0.45 $l/m^2$) | Rp. 450/l | 360,000 | |

SUBTOTAL MATERIALS: Rp. 550,000 x 220 = 121,000

Annual Cost (ea 4 yrs)
Rp. 475,000/yr
100 km work
400 km inventory

TOTAL ANNUAL COST: Rp. 190,295

UNIT COST: Rp. 475/km

* Optional

755X

## UNIT COST: PERIODIC MAINTENANCE - SEALED ROAD

(3.5 m wide @ 0.5 km/day = 100 km/yr on 400 km inventory)

| Chip Seal (using 3/8" (9.5 mm) Stone) | | | TOTAL COST Rp. 000 |
|---|---|---|---|
| **Labor** | | | |
| Normal Spread Using #4 Stone | | | 15,805 |
| Add 1 Driver @ 3,000/day | x 365 | + | 1,095 |
| | SUBTOTAL LABOR: | | 16,900 |
| **Equipment** | | | |
| Normal Spread Using #4 Stone | | | 53,490 |
| Add 1 3.5T Dump Truck @ + Rp. 45,330/day x 220 | | + | 9,975 |
| | SUBTOTAL EQUIPMENT: | | 63,465 |

| Materials | Unit Price | Daily Cost | Days |
|---|---|---|---|
| (20) $m^3$ Chips (9 mm- 3/8"; .010 $m^3/m^2$) | Rp. 16,000/$m^3$ | Rp. 320,000 | |
| (1,600) 1 Asphalt Binder (75% - 0.90 $1/m^2$) | 450/1 | 720,000 | |

SUBTOTAL MATERIALS: Rp. 1,040,000 x 220 = 228,800

TOTAL ANNUAL COST: Rp. 309,165

Annual Cost (ea 4 yrs)
770/km too high!

UNIT COST: Rp. 770/km

# UNIT COST PERIODIC MAINTENANCE - SEALED ROAD

(3.5 wide = .275 km/day = 60 km/yr on 300 km inventory)

**DBST** (using 3/8" (9.5 mm) first course + #4 (3/16" - 5 mm) second course)

| Labor | Daily Rate | Daily Cost x | Days = | TOTAL COST Rp. 000 |
|---|---|---|---|---|
| (1) Foreman | | | | |
| (2) Operators | | | | |
| (3) Drivers | same as Chip Seal 3/8" stone | | | |
| (2) Skilled | | | | |
| (2) Semi-Skilled | | | | |
| (10) Workers | | | | |
| | | SUBTOTAL LABOR: | | 16,465 |

| Equipment | Daily Rate | Daily Cost | Days |
|---|---|---|---|
| (1) Tractor (farm)* | | | |
| (1) Broom attach.* | | | |
| (1) Asphalt Sprayer | | | |
| (2) 3.5 T Dump | | | |
| (2) Tailgate Spreader | | same as Chip Seal 3/8" stone | |
| (1) Pneu. Roller | | | |
| (1) Asphalt Tank* | | | |
| (1) Flatbed Truck | | | |
| | | SUBTOTAL EQUIPMENT: | Rp. 63,465 |

| Materials | Unit Price | Daily Cost | Days |
|---|---|---|---|
| (10) $m^3$ Stone 3/8" | Rp. 16,000/$m^3$ | Rp. 160,000 | |
| (870) l Asphalt | 450/l | 391,500 | |
| ( 5) $m^3$ Chips #4 | 19,000/$m^3$ | 95,000 | |
| (450) l Asphalt | 450/l | 202,500 | |
| | SUBTOTAL MATERIALS: | Rp. 849,000 x 220 | = 186,780 |

Annual Cost (ea 5 yrs)
Rp. 890/km
60 km work
300 km inventory

TOTAL ANNUAL COST: Rp. 266,710

UNIT COST: Rp. 890/km

* Optional

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## UNIT COST: ROUTINE MAINTENANCE - GRAVEL ROAD

Routine Activities: 3.5 m wide = 0.5 km/day = 100 km/yer on 400 km of Inventory

| | Labor | Daily Rate | Daily Cost | x | Days | = | TOTAL COST Rp. 000 |
|---|---|---|---|---|---|---|---|
| (1) | Foreman | Rp. 3,500 | Rp. 3,500 | | | | |
| (3) | Drivers | 3,000 | 3,000 | | | | |
| (10) | Workers | 1,700 | 17,000 | | | | |
| | SUBTOTAL LABOR: | | Rp.23,500 | x | 365 | = | 8,580 |

| | Equipment | Daily Rate | Daily Cost | Days | | |
|---|---|---|---|---|---|---|
| (1) | 3.5 T Dump | Rp. 33,440 | Rp. 33,440 | | | |
| (1) | Hand Opr. Comp. | 10,856 | 10,856 | | | |
| | SUBTOTAL EQUIPMENT | | Rp. 44,296 | x | 220 | = 9,745 |

| Materials | Unit Price | Daily Cost | Days | | |
|---|---|---|---|---|---|
| (4.2) $m^3$ Well-Graded Crushed Aggregate | Rp. 19,000 | Rp. 79,800 | | | |
| SUBTOTAL MATERIALS | | Rp. 79,800 | x | 220 | = 17,555 |

TOTAL ANNUAL COST: Rp. 35,880

UNIT COST: Rp. 360/km

Grader Smoothing 3.6 km/day = 800 km/yr (ea time) - 2 times per year = 400 km Inventory

| | | |
|---|---|---|
| Labor | (1) Operator @ Rp. 3,900 x 365 = | 1,425 |
| Equipment | (1) Grader @ Rp. 123,500 x 220 = | 27,170 |
| | TOTAL ANNUAL COST: | Rp. 28,595 |

Performed 2x/yr
Effective Prod. = 400 km/yr

UNIT COST: Rp. 70/km

WORKSHEET

Routine Maintenance Crew - (Routine Activities)

| Inventory Qty. | Labor | Equipment |
|---|---|---|
| 100 km Road<br>20 Bridges (1 bridge/5 km) | (1) Foreman<br>(10) Workers<br>(1) Driver | (1) Dump Truck 2.5 $m^3$<br>(1) Hand Operator Compactor |

| | Kinds of Activities/Tasks | Production/day x | Days/yr = | Inventory/yr |
|---|---|---|---|---|
| - | Roadway (patching, depressions) | 1.3 km/day | 75 | 100 km |
| C - | Drainage (ditches, culverts, drains) | 1.1 km/day | 90 | 100 km |
| C - | Roadside (vegetation, shoulders) | 4.0 km/day | 25 | 100 km |
| - | Miscellaneous | 10.0 km/day | 10 | 100 km |
| - | Bridges (cleaning, inspecting) | 1.0 Bridge/day* | 20 | 20 Bridges |
| | | | 220 | |

GRADER SMOOTHING CREW

| Inventory Qty | Labor | Equipment |
|---|---|---|
| 400 km | (1) Operator | (1) Grader |

| Kinds of Activities/Tasks | Production/day x | Days/yr = | Inventory/yr |
|---|---|---|---|
| - Blade the Loose Material from the Edges to the Center while Smoothing out the Small Irregularities<br>- Blade the Collected Material across Roadway Keeping the Crown | 3.6 km/day<br>2 x per year | 220 | 400 km |

Note: C indicates possible maintenance tasks for contract

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## UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

(0.7 km/day = 150 km/yr per 450 km inventory)

Regraveling: Use well graded crushed aggregate
assume: 3.5 m wide x .7 km/day &
replenish 6 cm = 150 $m^3$/km

| | Labor | Daily Rate | Daily Cost x | Days = | TOTAL COST Rp. 000 |
|---|---|---|---|---|---|
| (1) | Foreman | Rp. 3,500 | Rp. 3,500 | | |
| (3) | Operators | 3,900 | 11,700 | | |
| (4) | Drivers | 3,000 | 12,000 | | |
| (1) | Driver | 3,000 | 3,000 | | |
| (4) | Workers | 1,700 | 6,800 | | |
| | SUBTOTAL LABOR: | | Rp. 37,000 x | 365 = | 13,505 |

| | Equipment | Daily Rate | Daily Cost | Days | |
|---|---|---|---|---|---|
| (1) | Grader 100 hp | Rp. 123,500 | Rp. 123,500 | | |
| (1) | Loader 1.2 $m^3$ | 79,530 | 79,530 | | |
| (1) | Vib. Roller | 45,325 | 45,325 | | |
| (4) | 3.5 T Dump Trk | 31,650 | 126,600 | | |
| (1) | Water Truck | 35,160 | 35,160 | | |
| (6 hr/day) | SUBTOTAL EQUIPMENT | | Rp. 410,115 x | 220 = | 90,225 |

| Materials | Unit Price | Daily Cost | Days | |
|---|---|---|---|---|
| (150) $m^3$ Well-graded Crushed Aggregate | Rp. 19,000 | Rp.2,850,000 | | |
| SUBTOTAL MATERIALS | | Rp.2,850,000 x | 220 = | 627,000 |

TOTAL ANNUAL COST: Rp. 730,730

1x ea 3 yrs
Rp. 1,624,000 per 450 kms each year
Too expensive! Use select material.

UNIT COST: Rp.1,624/km

Assume: Gravel stockpiled ea 20 km, average haul dist = 5 km
3 trips/hr (including travel @ 15 min + load, spot, dump + posit. 5 min)
150 $m^3$ - 3 trips/hr - 6 hr/day - 2.1 $m^3$/trk = say 4 trucks

## UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

(0.7 km/day = 150 km/yr per 450 km Inventory)

**Regraveling: (Alternate)** Use select material, all other assumptions, labor cost and equipment cost remain the same as for the normal method using well-graded crushed aggregate

| | | TOTAL COST Rp. 000 |
|---|---|---|
| Labor | (same as normal method) | 13,505 |
| Equipment | (same as normal method) | 90,225 |

| Materials | Unit Price | Daily Cost | Days | |
|---|---|---|---|---|
| (150) $m^3$ selected material | Rp. 7,700 | Rp. 1,155,000 | 220 | 254,100 |

TOTAL ANNUAL COST: Rp. 357,830

1x ea 3 yrs

UNIT COST: Rp. 800/km

Rp. 800,000 x 450 km

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## UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

(0.9 km/day = 200 km/yr)

Reshaping: (No material required)

| | Labor | Daily Rate | Daily Cost x | Days = | TOTAL COST Rp. 000 |
|---|---|---|---|---|---|
| (.5) | Foreman | Rp. 3,500 | Rp. 1,750 | | |
| (2) | Operators | 3,900 | 7,800 | | |
| (1) | Driver | 3,000 | 3,000 | | |
| (2) | Workers | 1,700 | 3,400 | | |
| | SUBTOTAL LABOR: | | Rp. 15,950 x | 365 = | 5,821 |

| | Equipment | Daily Rate | Daily Cost | Days | |
|---|---|---|---|---|---|
| (1) | Grader 125 hp | Rp. 123,500 | Rp. 123,500 | | |
| (1) | Vib. Roller | 45,325 | 45,325 | | |
| (1) | Water Truck* | 35,160 | 35,160 | | |
| | SUBTOTAL EQUIPMENT | | Rp.203,985 x | 220 = | 44,877 |

Materials None

TOTAL ANNUAL COST: Rp. 50,700

UNIT COST: Rp. 255/km

* Not needed if the reshaping is performed when the surface material is moist.

## UNIT COST: PERIODIC MAINTENANCE - EARTH ROAD

(1.8 km/day = 125 km/yr)

**Routine Activities**

| | Labor | Daily Rate | Daily Cost x Days = | TOTAL COST Rp. 000 |
|---|---|---|---|---|
| (1) | Foreman | Rp. 3,500 | Rp. 1,750 | |
| (1) | Driver | 3,000 | 3,000 | |
| (10) | Workers | 1,700 | 17,000 | |
| | | SUBTOTAL LABOR: | Rp. 23,500 x 365 = | 8,580 |

| | Equipment | Daily Rate | Daily Cost | Days | |
|---|---|---|---|---|---|
| 1 | 3.5 T Dump | Rp. 33,440 | Rp. 33,440 | | |
| 1 | Hand Op. Comp. | 10,856 | 10,856 | | |
| | | SUBTOTAL EQUIPMENT | Rp. 44,296 x 220 = | | 9,745 |

**Materials** None

TOTAL ANNUAL COST: Rp. 18,325

UNIT COST: Rp. 146

**Grader Smoothing** 3.6 km/day = 800 km/yr per 400 km inv.

Labor: 1 Operator @ Rp. 3,900 x 365 days = 1,425

Equipment: 1 Grader @ Rp. 123,500 x 220 days = 27,170

TOTAL ANNUAL COST: Rp. 28,170

UNIT COST: Rp. 70/km

Performed 2x/yr
Effective Prod. = 400 km/yr

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WORKSHEET

Routine Maintenance Crew - Routine Activities

| Inventory Qty | Labor | Equipment |
|---|---|---|
| 125 km Earth Road | (1) Foreman | (1) Stake Body Truck |
| 12 Bridges (1 bridge/10 km) | (10) Workers | (1) Hand Operator Compactor |
| | (1) Driver | |

| | Kinds of Activities/Tasks | Production/day x | Days/yr = | Inventory/yr |
|---|---|---|---|---|
| | - Roadway Surface | 1.5 km/day | 85 | 125 km |
| C | - Drainage | 1.3 km/day | 95 | 125 km |
| C | - Roadside | 8.0 km/day | 15 | 125 km |
| | - Miscellaneous | (estimated) | 13 | 125 km |
| | - Bridges | 1.0 Bridge/day | 12 | 12 Bridges |
| | | | 220 | |

Grader Smoothing Crew

(same as for gravel roads)

Note: C indicates possible maintenance tasks for contract

## SUMMARY OF MATERIALS UNIT PRICES BY KABUPATEN

(Rp/unit)

| KABUPATEN | Select Mtrl. Pit-run ($m^3$) | Select Mtrl. River-run ($m^3$) | Crushed Rock 3/5 cm ($m^3$) | Crushed Rock 1/2 cm ($m^3$) | Crushed Rock 0.5/1 cm ($m^3$) | Sand, Found ($m^3$) | Cutback Asphalt ($m^3$) | Conc. Pipe @ 80 cm ($m^3$) |
|---|---|---|---|---|---|---|---|---|
| South Sulawesi | | | | | | | | |
| 1. Pinrang | 9,000 | 8,500 | - | - | - | 4,250 | 281 | - |
| 2. Sidenreng Rappang | 5,000 | 9,000 | 9,000 | 10,000 | 12,000 | 7,000 | 300 | 18,000 |
| 3. Wajo | 8,000 | 9,000 | - | - | - | 5,000 | - | - |
| 4. Bone | 6,000 | 6,500 | 8,000 | 10,000 | 11,000 | 6,000 | - | 2,500 |
| 5. Bulukumba | 7,000 | 8,000 | 13,000 | 14,000 | 15,000 | 7,500 | 300 | - |
| 6. Jeneponto | 4,000 | 5,000 | 3,000 | 2,000 | 4,500 | 4,000 | - | 17,500 |
| 7. Gowa | 4,250 | 4,500 | 6,500 | 8,000 | 10,000 | 3,000 | - | 30,000 |
| Average | 6,200 | 7,300 | 7,900 | 11,000 | 12,500 | 5,300 | 300 | 22,700 |
| NTT | | | | | | | | |
| 1. Belu | 1,500 | 7,500 | 10,000 | 15,000 | 15,000 | 5,000 | 450 | 75,000 |
| 2. TTS | 5,000 | 7,500 | 15,500 | 17,500 | 18,500 | 8,000 | 400 | 20,000 |
| 3. Kupang | 6,500 | 7,000 | 13,000 | 17,500 | 20,000 | 7,500 | - | 100,000 |
| 4. Sumba Barat | 1,500 | 1,500 | 12,500 | 12,500 | 25,000 | 8,000 | - | 30,000 |
| 5. Manggarai | 6,000 | 7,500 | 11,000 | 12,500 | 15,000 | 7,500 | - | 15,000 |
| 6. Ngada | 6,500 | 7,500 | 12,500 | - | - | 8,000 | - | - |
| 7. Sikka | 10,000 | 15,000 | 17,500 | 20,000 | 20,000 | 5,000 | 450 | 30,000 |
| Average | 5,300 | 7,700 | 13,200 | 15,900 | 19,000 | 7,000 | 450 | 45,000 |

Unit prices used for unit costs average indicated by ========

Source: P.T. Hasfarm reports data, provided by PU of each Kabupaten

SUMMARY OF DAILY LABOR RATES BY KABUPATEN

| Kabupaten | Foreman/ Mandor | Skilled Labor | Unskilled Labor | Carpenter | Operator | Mechanic |
|---|---|---|---|---|---|---|
| **South Sulawesi** | | | | | | |
| 1. Pinrang | 2,250 | 2,000 | 1,750 | 2,750 | 4,750 | 2,500 |
| 2. Sidenreng Rappang | 2,500 | 2,500 | 2,000 | 3,000 | 5,000 | 5,000 |
| 3. Wajo | 2,500 | 2,250 | 2,000 | 2,500 | 2,750 | 2,750 |
| 4. Bone | 2,500 | 2,000 | 1,400 | 3,000 | 4,000 | 3,500 |
| 5. Bulukumba | 2,250 | 1,750 | 1,500 | 2,500 | 2,500 | 2,500 |
| 6. Jeneponto | 2,000 | 2,500 | 1,250 | 3,000 | 3,500 | 2,500 |
| 7. Gowa | 2,250 | 2,000 | 1,750 | 2,500 | 3,000 | 2,500 |
| Average | 2,500 | 2,200 | 1,700 | 2,800 | 3,700 | 3,100 |
| **NTT** | | | | | | |
| 1. Belu | 6,000 | 2,500 | 1,500 | 2,500 | 7,500 | 3,000 |
| 2. TTS | 2,500 | 2,500 | 1,250 | 2,500 | 2,500 | 5,000 |
| 3. Kupang | 4,500 | 3,000 | 2,500 | 3,000 | 3,500 | 3,000 |
| 4. Sumba Barat | 2,500 | 1,750 | 1,500 | 2,500 | 3,000 | 3,000 |
| 5. Manggarai | 5,000 | 4,000 | 1,500 | 2,000 | 4,000 | 4,000 |
| 6. Ngada | 2,000 | 1,500 | 1,250 | 2,500 | 3,500 | 3,500 |
| 7. Sikka | 1,500 | 1,250 | 1,100 | 2,500 | 3,000 | 3,000 |
| Average | 3,500 | 2,400 | 1,600 | 2,500 | 3,900 | 3,500 |

Rates used for unit costs average indicated by ========

Source: Ibid.

SOURCE: Kupang, NTT

EQUIPMENT RENTAL RATES

Rural Road Study Report for
5 Yr. Road Programs 1984-1989
by Subdit Jalan-Lokal & ENEX Jan. 84

Daily Rate: use hourly rate x 6 hours

TABLE OF DERIVED HIRE CHARGES FOR EQUIPMENT EQUIPMENT 31.1.84

| PROVINCE / EVALUATION / DESCRIPTION OF INPUT RESOURCES: PLANT & HEAVY EQUIPMENT | CODE | US$ | COST Rp(000) | Total life in years | Total life in hours | Deprecl- allow. Rp/hour | Interest percent | Insurance percent | Consump. HORSE POWER | FUEL | LUBRIC | Running cost Rp per hour | Repairs spares | Operating total cost/hr | Total ownership cost/hr | Hire rate per hrs | Daily rate Rp/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (based on exchange rate: 1150Rp/US$). | | | .115 | | | | | | 31.71 | 50.15 | 80.50Rp/l/HP/h | | 80.01 | | | | |
| Bulldozer 120HP | E001 | 150,000 | 55,750 | 8.0 | 9,000 | 1115 | 1973 | 195 | 350 | 2828 | 1855 | 1977 | 3780 | 8751 | 10745 | 11,901 | 55,510 |
| Bulldozer 65HP | E003 | 110,000 | 23,850 | 6.0 | 9,000 | 2105 | 2165 | 517 | 65 | 2251 | 683 | 2112 | 2168 | 5110 | 6567 | 11,617 | 53,195 |
| Motor grader 125HP | E010 | 150,000 | 49,750 | 8.0 | 9,000 | 1175 | 1175 | 195 | 125 | 1315 | 1313 | 5658 | 3180 | 7838 | 10915 | 20,583 | 102,913 |
| Tractor.Rpdr,1.5m3 125HP | E020 | 159,000 | 49,750 | 8.0 | 9,000 | 1175 | 1175 | 995 | 175 | 1315 | 1313 | 5558 | 3100 | 9818 | 10745 | 20,583 | 102,913 |
| Crusher 10-50T/h,210HP | E031 | 1765,000 | 783,675 | 8.0 | 9,000 | 23338 | 26368 | 5271 | 210 | 7300 | 2205 | 1585 | 21016 | 30599 | 50009 | 85,667 | 115,036 |
| Crusher 15-20T/h, 40HP | E032 | 1118,000 | 101,150 | 8.0 | 9,000 | 10115 | 10115 | 2161 | 10 | 1110 | 178 | 1610 | 4756 | 36566 | 21021 | 31,665 | 151,212 |
| Crusher 10T/h, 25HP | E033 | 150,000 | 41,725 | 8.0 | 9,000 | 1175 | 1175 | 193 | 25 | 1121 | 763 | 1728 | 3780 | 5701 | 10115 | 16,811 | 55,218 |
| Screening plant 40HP | E040 | 111,000 | 11,780 | 8.0 | 9,000 | 1178 | 1178 | 876 | 60 | 1676 | 860 | 5518 | 3507 | 1010 | 3612 | 19,159 | 13,259 |
| Loader tracked 125HP | E051 | 150,000 | 41,750 | 8.0 | 9,000 | 1175 | 1175 | 175 | 175 | 1315 | 1313 | 5658 | 3180 | 9838 | 10115 | 20,583 | 102,913 |
| Loader wheeled 95HP | E052 | 110,000 | 21,830 | 6.0 | 9,000 | 2185 | 2185 | 517 | 95 | 3307 | 998 | 6100 | 2368 | 6608 | 6557 | 13,755 | 64,771 |
| Tractor wheeled 80HP | E053 | 111,000 | 10,115 | 6.0 | 9,000 | 1015 | 1015 | 217 | 80 | 2701 | 810 | 3673 | 916 | 1116 | 2609 | 6,701 | 31,537 |
| Roller,3-wheel 8-10T | E080 | 139,000 | 21,856 | 6.0 | 9,000 | 2165 | 2165 | 517 | 37 | 1786 | 307 | 1675 | 2186 | 1641 | 6567 | 10,616 | 53,116 |
| Roller,tandem 6-10T | E081 | 125,000 | 21,875 | 8.0 | 9,000 | 2128 | 2109 | 178 | 40 | 1318 | 120 | 1810 | 1119 | 3004 | 5173 | 1,723 | 16,363 |
| Roller,vibr.self-p 10T | E082 | 120,000 | 11,100 | 6.0 | 9,000 | 1110 | 1110 | 113 | 35 | 1717 | 368 | 1581 | 1517 | 3176 | 1178 | 7,558 | 33,771 |
| Roller,towed vibr 3-3T | E083 | 118,000 | 17,110 | 12.0 | 13,500 | 1171 | 2306 | 178 | 6 | 351 | 63 | 111 | 155 | 1363 | 3050 | 5,171 | 20,357 |
| Roller,pneumatic 8-15T | E084 | 110,000 | 21,850 | 6.0 | 9,000 | 2185 | 2185 | 517 | 95 | 3307 | 996 | 6100 | 2189 | 6608 | 6557 | 13,755 | 64,771 |
| Roller,vibr-ped 600kg | E087 | 15,000 | 1,175 | 6.0 | 9,000 | 118 | 118 | 160 | 7 | 213 | 71 | 317 | 398 | 715 | 1035 | 1,667 | 1,617 |
| Tamper,vibr. plate 4HP | E086 | 1100 | 517 | 6.0 | 9,000 | 60 | 60 | 12 | 1 | 731 | 47 | 716 | 66 | 321 | 131 | 455 | 2,275 |
| Concrete vibrator 4HP | E087 | 1400 | 517 | 6.0 | 9,000 | 60 | 60 | 12 | 1 | 731 | 12 | 716 | 60 | 376 | 131 | 455 | 2,275 |
| Chip spreader | E130 | 17,000 | 1,110 | 12.0 | 13,500 | 111 | 265 | 55 | 0 | 0 | 61 | 61 | 101 | 161 | 151 | 170 | 1,326 |
| Sprayer,self-prop.1000l | E152 | 116,000 | 15,770 | 12.0 | 13,500 | 3051 | 6103 | 1771 | 68 | 2361 | 711 | 3078 | 2911 | 5511 | 10375 | 15,811 | 53,100 |
| Asp.sprayer,towed 250l | E153 | 18,000 | 7,160 | 6.0 | 9,000 | 716 | 716 | 151 | 7 | 213 | 71 | 317 | 617 | 951 | 1751 | 2,705 | 13,521 |
| Asph.mixing plant 30T/h | E155 | 1185,000 | 181,075 | 12.0 | 13,500 | 12272 | 21513 | 4101 | 125 | 1315 | 1313 | 5658 | 1017 | 15175 | 11721 | 57,111 | 211,111 |
| Asph.mixing plant 10T/h | E156 | 115,000 | 11,775 | 12.0 | 13,500 | 7785 | 5170 | 6111 | 50 | 1710 | 575 | 7761 | 7199 | 1651 | 10111 | 61,090 | 55,590 |
| Asphalt finisher 1.87m | E157 | 130,000 | 71,850 | 12.0 | 13,500 | 1170 | 3980 | 716 | 30 | 1613 | 315 | 1338 | 7597 | 7750 | 6766 | 1,718 | 36,031 |
| Fuel tank truck 68HP | E172 | 114,000 | 17,110 | 6.0 | 9,000 | 1711 | 1711 | 355 | 68 | 2361 | 711 | 3078 | 1111 | 6510 | 3799 | 8,651 | 17,253 |
| Water tank truck 68HP | E182 | 117,000 | 16,115 | 12.0 | 13,500 | 1178 | 2755 | 151 | 68 | 2361 | 711 | 3078 | 907 | 3700 | 3236 | 7,011 | 23,387 |
| Trailer,towed 4T | E191 | 11,506 | 1,181 | 12.0 | 13,500 | 100 | 111 | 10 | 0 | 0 | 61 | 61 | 69 | 111 | 338 | 101 | 1,803 |
| Low loader+tractor 60HP | E197 | 125,000 | 21,075 | 12.0 | 13,500 | 1459 | 3317 | 663 | 68 | 2361 | 711 | 3078 | 1327 | 6604 | 5638 | 10,613 | 37,180 |
| Dump truck, 3.5T/68HP | E211 | 112,030 | 11,110 | 6.0 | 9,000 | 1111 | 1111 | 231 | 68 | 1577 | 857 | 1911 | 155 | 7767 | 7677 | 5,573 | 27,867 |
| Dump truck, 5.0T/68HP | E212 | 115,000 | 11,125 | 6.0 | 9,000 | 1113 | 1193 | 291 | 68 | 2361 | 711 | 3078 | 1111 | 1777 | 3704 | 7,553 | 31,115 |
| Flatbed truck 3.5T/68HP | E221 | 111,000 | 10,165 | 6.0 | 9,000 | 1015 | 1035 | 217 | 68 | 1521 | 167 | 1111 | 876 | 7067 | 7106 | 5,175 | 26,375 |
| Pickup truck 30HP | E222 | 15,000 | 1,175 | 6.0 | 9,000 | 118 | 118 | 100 | 31 | 7700 | 110 | 7101 | 318 | 3007 | 1975 | 1,177 | 28,780 |
| Jeep 4wheel drive 60HP | E223 | 11,600 | 8,155 | 6.0 | 9,000 | 816 | 856 | 171 | 12 | 2861 | 515 | 3379 | 716 | 1015 | 1970 | 6,655 | 30,375 |
| Flatbed truck 5T/68HP | E224 | 115,000 | 11,775 | 6.0 | 9,000 | 1113 | 1113 | 297 | 60 | 2361 | 711 | 3078 | 1111 | 1717 | 3701 | 7,555 | 37,776 |
| Flatbed trk with crane | E225 | 170,009 | 11,190 | 6.0 | 9,000 | 1110 | 1170 | 318 | 68 | 2361 | 711 | 3078 | 1517 | 6670 | 6171 | 9,019 | 45,735 |
| Motorcycle 8HP | E226 | 1800 | 715 | 6.0 | 9,000 | 85 | 80 | 16 | 1 | 351 | 63 | 611 | 66 | 677 | 675 | 653 | 3,263 |
| Mobile workshop 110HP | E231 | 135,000 | 31,875 | 6.0 | 9,000 | 3183 | 3183 | 817 | 68 | 2366 | 711 | 3078 | 2786 | 5066 | 7617 | 13,375 | 67,878 |
| Lube truck 68HP | E233 | 170,000 | 27,860 | 6.0 | 9,000 | 2786 | 2786 | 537 | 68 | 2361 | 711 | 3078 | 2271 | 3304 | 6177 | 11,138 | 37,778 |
| Conc. mixer 0.5m3/20HP | E252 | 120,600 | 17,100 | 3.6 | 7,700 | 6513 | 3700 | 716 | 20 | 1152 | 719 | 1371 | 5307 | 6661 | 11601 | 16,015 | 15,239 |
| Compressor,air 150m3/h | E301 | 18,000 | 7,760 | 12.0 | 13,500 | 531 | 1061 | 717 | 50 | 1730 | 525 | 7713 | 125 | 7600 | 1601 | 6,117 | 18,801 |
| Generator, 1.5-15KVA | E311 | 11,300 | 1,113 | 12.0 | 13,500 | 109 | 117 | 10 | 10 | 583 | 105 | 810 | 89 | 757 | 330 | 1,107 | 6,153 |
| Pump,water(5cm) 30m3/h | E331 | 1100 | 310 | 3.6 | 7,700 | 533 | 80 | 16 | 6 | 610 | 61 | 357 | 101 | 658 | 725 | 666 | 2,315 |
| Pump,water(10cm)100m3/h | E332 | 11,000 | 915 | 3.6 | 7,700 | 337 | 111 | 16 | 10 | 585 | 165 | 610 | 765 | 935 | 570 | 1,375 | 3,013 |
| Jackhammer equipment etc. | E351 | 11,500 | 3,183 | 3.6 | 7,700 | 1111 | 617 | 337 | 0 | 0 | 32 | 32 | 171 | 780 | 1117 | 2,157 | 7,317 |
| Tractor equipment etc. | E401 | 13,000 | 2,105 | 3.6 | 7,700 | 115 | 517 | 111 | 0 | 0 | 32 | 32 | 716 | 611 | 1111 | 2,331 | 8,387 |

E010 Grader 125HP
E051 Loader 95HP
E053 Tractor Comp.
E082 Vib roller
E084 Pneu. roller
E130 Chip spreader
E152 Asph. distrib.
E153 Asph. sprayer
E182 Water Truck
E211 3.5T Dump
E212 5.0T Dump
E221 Flatbed trk 3.5T
E224 Flatbed trk FT



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# APPENDIX C

## PROCEDURE FOR DERIVING INTERPOLATED VALUES IN REHABILITATION SCREENING TABLE (TABLE 10)

## INTRODUCTION

Although traffic counts have been reported for roads in the project area, the composition of this traffic has been reported for only three kabupatens: Sumba Barat, Ngada, and Gowa. A fairly large sample of 145 road links is represented, which indicates the average composition of minibuses, cars, light trucks, motorcycles, and jeeps. It is not known if this vehicle distribution is representative of all 14 kabupatens, however. These vehicle distributions change only slightly between ADT road classes in the groupings 500, 200-500, and 50-200 (see the the screening table and Appendix A). But for the earth road class 50, motorcycles rise to 58% of the total vehicle flow. This relative proportion imparts a special characteristic to the already low level of unit vehicle operating costs: still larger levels of ADT are now required to produce the desired IRR. The effects of vehicle composition and costs and savings upon ADT and IRR levels are immediate and direct. More will be said about this later, when a method is introduced to modify some of this sensitivity in order to generalize the approach to project area roads.

Section 2.5 attempted to measure the comparative differences between the kabupaten road class design-level ADT volumes and the IBRD-indicated level of IRR which would be obtained from a specified level of cost for rehabilitation and a specified composition of traffic. In that analysis, the question asked was: what level of ADT is needed to make feasible the rehabilitation and/or upgrading cost associated with asphalt, seal, gravel or earth at a 15% IRR? And, is that level of ADT the same as the existing standard now in use at the kabupaten level? This section will pursue the same analytic form, through the IBRD tables, but will use the sample survey field data from the project area (the three kabupatens reporting traffic composition), and will broaden the range of costs of rehabilitation/upgrading, while at the same time reducing the IBRD tables, by extrapolations, to a selected range of cases which apply most usefully to the project study area. The changes introduced here are:

- Sample survey data from the project area will supplant the prior analysis which used survey data from 20 kabupatens in Java, Bali, and NTB. ADT volume and composition of traffic will change fractionally.

- A new vehicle cost and vehicle savings basis will be used, which for each road type compares a "good" condition with a "bad," rather than the previous use of "fair" and "poor" which were endorsed by ADB 8th Loan and OECF in field analyses of expected rehabilitation works. The basis for this choice apparently rested with minimum standards and the recognition of no follow-on maintenance programs. A further reason for the use of these terms for VOC is that observed roads in the study area and contemplated works projects provide this basis for analysis. VOCS will, therefore, be greater than previously shown; ADT needs will be less, and more important, the Section 2.5 forecast will be now supplemented with greater detail of cost and ADT values which now relate wholly to the project study area. Such internal consistency will provide a back-up to the forecasts of Section 2.5, which used these same vehicle costs, traffic compositions by class of road, and vehicle savings levels.

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INITIAL INTERPOLATION RESULTS

At project start-up, and during the course of the project, field surveys will expect to find roads in all road classes that are designated "bad" but which have some level of traffic. Rehabilitation or upgrading of the roads will place them in good condition, which should be maintained thereafter. The relative cost range for vehicles can be identified as follows:

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| Apparent ADT: | 500 | 200 | 200 | 50-200 | 50 |
| (Rp/Km) Composite (Weighted Average) Vehicle Operating Costs: | | | | | |
| Good: | 58.0 | 71.6 | 72.8 | 77.7 | 97.8 |
| Bad : | 127.6 | 133.8 | 148.5 | 160.5 | 134.9 |
| % change: | 54.5 | 46.5 | 51.0 | 51.5 | 27.5 |
| Bad Condition: (US$ equiv.) | .114 | .119 | .133 | .143 | .120 |

(VOC on seal is taken at fair asphalt VOC)

The vehicle operating costs which are given above relate exclusively to the findings of the sample survey on project study area roads. They are the product of vehicle costs/km obtained from the ADB 8th Loan project evaluations and the vehicle compositions found in the project area. The vehicle distributions are:

| | Sealed | | | Unsealed | |
|---|---|---|---|---|---|
| | Asphalt | Seal | Gravel | Gravel | Earth |
| Apparent ADT: | 500 | 200 | 200 | 50-200 | 50 |
| (Rp/Km) Composite (Weighted Average) Vehicle Operating Costs: | | | | | |
| (%) Car/Jeep | 23 | 28 | 28 | 28 | 24 |
| Minibus | 15 | 11 | 11 | 11 | 2 |
| Lt. Truck | 16 | 18 | 18 | 24 | 16 |
| Motorcycle | 46 | 43 | 43 | 37 | 58 |
| % 4-wheel: | 54 | 57 | 57 | 63 | 42 |

The skewed distribution of motorcycle traffic on earth roads has the simultaneous effects of minimizing both VOC and VOCS, i.e., the percentage savings to vehicles in going from bad to good is only 27.5%, as compared to much higher savings for vehicles in other road classes which have fewer motorcycles in the traffic flow.

Because entry into the IBRD tables first requires identification of the unit vehicle operating costs (in US$ equivalent), based upon average ADT, the above five road classes have been merged into asphalt/seal, gravel/gravel, and earth composites, preliminary to further averaging. This averaging is consistent with the aim of obtaining a single ADT figure which incorporates explicit VOC and VOCS—and therefore describes the IRR which may be attained under different levels of road investment cost.

This merger of VOC and VOCS further simplifies entry into the tables of IRR, and broadens the base of analysis by relaxing the rigidly specified vehicle compositions shown above. By this device, other existing vehicle distributions, also found in the same approximate levels of traffic in the project area, may be accommodated in the "average" traffic flow, and be reflected in vehicle costing and savings levels. The effects are shown below:

| | Asphalt/Seal | Gravel/Gravel | Earth |
|---|---|---|---|
| VOC (US$): | .114 | .133 | .120 |
| | .119 | .143 | |
| Average | .1165 | .138 | .120 |
| VOCS (%): | 54.5 | 51.0 | 27.5 |
| | 46.5 | 51.5 | |
| Average | 50.5 | 51.25 | 27.5 |
| 4-wheel %: | 50.5 | 60.0 | 42.0 |
| Motorcycle %: | 49.5 | 40.0 | 58.0 |

It can now be said that the sample survey incorporates within its system of vehicle operating costs a somewhat broader range of the likely composition of these costs, and is therefore more representative of the more heavily trafficked roads in the 50 to +500 road classes (asphalt/seal/gravel). But the earth road cost system remains isolated, fixed at levels which condemn it to a meager rate of VOCS (savings) only slightly more than one-half the level of rehabilitated gravel.

Section 3.5 forecast that vehicle costs for the five road classes will continue to rise between year one (good) and the year in which expected service life and/or intervention by rehabilitation interrupted that rise. For the unmaintained roads, arrival at the end of service life meant arrival at "bad" VOC levels, and for four road classes, "worse" VOC could be forecast at one-half the rate of annual increase thereafter. But for the earth road case, no moderation in the rate of vehicle cost levels would spare the road from ruin by the end of the ten-year forecast period. Field observations since that forecast suggest that the composition of traffic and

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its present tabulation above (in a range from good to bad) do not fully account for the passage of the sampled earth road into the range of bad-to-worse. That is, the sampled statistics on earth road traffic characteristics, reviewed against pictures of these roads stated to be in moderate, poor, and bad condition, would confirm that "bad" is an understatement as a statistical data base. Four-wheel vehicles on such roads, which have generally not been maintained as a matter of policy, would quickly be supplanted by motorcycle traffic as the principal mode able to travel the road.

If deteriorated earth roads inhibit the use of 4-wheel vehicles, the vehicles distribution is unrepresentative of the vehicle flows to be expected on restored earth roads, and is unrepresentative of the traffic which may have operated on some of these earth roads when they were new. To provide another index of VOC on earth roads, similar to the averaging above of asphalt with seal, and low-volume gravel with higher-volume gravel, one can re-examine the cost levels between seal-gravel-earth (.1165-.138-.120) to see that the rate of cost increase does not reflect the higher costs of vehicle operation on earth roads normally associated with 4-wheel vehicle traffic. The rise in VOC between seal and gravel is 18%; higher costs on earth roads, in equal amount, would place the earth road VOC at .163 (if the vehicle composition had not been altered).

This increase for costs on earth roads would also make sense because many sections of Telford cobble (gravel) roads are deteriorated to earth standards, which makes distinctions between "gravel" and "earth" more difficult. Restoration to an earth or gravel standard is a later choice which will be determined by relative ADT and the relevant costs of restoration. The distinction that must be made between earth and gravel roads is more difficult. While VOCs are normally higher on earth roads than on gravel, the VOC savings produced by restoration of earth roads will be less, as a rate, than those achieved by going from Telford cobble to engineered gravel. This rate is likely to be 90% of gravel, or a 46.1% cost change induced by earth road restoration, compared to 51.25% induced by gravel road restoration.

If this new (higher) VOC level and its related VOC savings level are forecast for earth road traffic, interpolated for various IRRs, and combined with the earth road ADT requirements given by the skewed distribution of motorcycle traffic, the following comparisons may be made between the average ADT levels needed for a range of investment costs:

ROAD COSTS (Rp. 000)

| Apparent Road Class: | 8960 | 11200 | 20160 | 22400 | 28000 | 39200 |
|---|---|---|---|---|---|---|
| | ADT levels needed | | | | | |
| | | | 10% IRR | | | |
| Asphalt/Seal | 53 | 66 | 120 | 133 | 167 | 234 |
| Gravel | 47 | 58 | 105 | 116 | 146 | 205 |
| Earth | 74 | 93 | 168 | 186 | 233 | 315 |
| Average: | 58 | 72 | 131 | 145 | 182 | 251 |
| | | | 12% IRR | | | |
| Asphalt/Seal | 58 | 73 | 132 | 146 | 183 | 256 |
| Gravel | 51 | 64 | 115 | 128 | 160 | 224 |
| Earth | 81 | 102 | 183 | 203 | 254 | 357 |
| Average: | 63 | 80 | 143 | 155 | 199 | 279 |
| | | | 15% IRR | | | |
| Asphalt/Seal | 66 | 83 | 150 | 167 | 208 | 291 |
| Gravel | 58 | 72 | 131 | 146 | 182 | 255 |
| Earth | 93 | 115 | 209 | 243 | 289 | 406 |
| Average: | 72 | 90 | 163 | 185 | 226 | 317 |

This test result can be interpreted as follows: 1) Earth road class traffic levels, for less than 50 vehicles per day, require a higher ADT at any restoration cost level than do traffic levels which fall in the gravel road class of 50-200 ADT; present traffic levels on roads in the asphalt/seal class, or +200 ADT, also require less ADT than earth roads but slightly higher levels than gravel road traffic. 2) This cost configuration reflects traffic composition on different road links that carry traffic at different levels which place these links in certain kabupaten road classes. 3) The actual class of road is not known with certainty; if the road links have in fact been upgraded in accordance with the road design standards for kabupaten roads, then they will reflect the road classes and corresponding ADT levels shown by traffic counts in the project study area (as above). 4) The average ADT levels needed are therefore also shown, combining all apparent road classes as one; this merges traffic compositions into a single aggregate representative of the total traffic distribution found by the sample survey.

The average is believed to be more important than the individually stated "asphalt," "seal," "gravel" or "earth" categories, which wholly relate to probable road classes but not necessarily to the level of specific restoration cost which may be found to be appropriate to any of these ADT levels. By fusing the ADT levels into a single figure, and by broadening the scope of possible restoration costs, interpolated values of ADT can be found at alternative and marginally different cost levels which reflect generalized vehicle compositions (VOC and VOCS) and the narrow cost ranges expected to apply to new surfacing, resurfacing, or upgrading associated with a road rehabilitation activity.

# ANNEX I

# FINANCIAL ANALYSIS

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# 1. INTRODUCTION

A financial analysis of road maintenance must demonstrate two points: first, that a program of maintaining roads is the most cost-effective way to achieve a desired level of road service, and second, that the recurrent costs of a maintenance program can be financed from available or anticipated revenues. Section 2 below illustrates the cost effectiveness of maintenance. Section 3 estimates maintenance funding requirements for national/provincial and for district roads. Sections 4 and 5 analyze the adequacy of revenues available to meet those requirements, both under the RRMS project and nationwide.

The thesis of the analysis is that district road networks are open systems and, at any given time, their requirements for maintenance funding will depend on the networks' size, composition of surface types, condition, and desired level of service. Over time, and at different rates in different districts, each of these variables will change, thus making it extremely difficult to formulate generalized prescriptions to assure that adequate funds are available for maintenance in each district.

The analysis concludes that maintenance is the least-cost method to preserve the optimal level of service of roads. It also concludes that the level of funds now available for district road maintenance in Indonesia as a whole is perhaps 70% of the level required given the present condition of the network. (That present maintenance practices are ineffective is another matter.) Because the allocation of these funds is heavily biased toward Java and Bali (some districts in Java and Bali may actually have more funds than necessary at this time), there is a relative shortage of funds in the Outer Islands, including areas where the RRMS project will be located. Over time, as rehabilitation work and, increasingly, effective maintenance raise the percentage of the network in maintainable condition, additional revenues will be required everywhere. Sources of revenue must be identified and appropriate procedures developed for districts to determine and meet their needs.

For most of the project districts, there are insufficient funds to cover the counterpart costs to rehabilitate all links that qualify on economic grounds. The rehabilitation program must be reduced to account for this. The present availability of maintenance funds for rehabilitated roads is another constraint. Although the existing source of maintenance finance provides a stable base for initiating maintenance programs, it will have to be augmented to meet the needs of roads rehabilitated under the project. The amount of additional funds required is small in absolute terms, but large relative to the existing revenue base for each district's road program. Thus, although the GOI is able to commit additional funds for maintenance needs during the project's life, the real need is to assist the Government to identify and test alternative approaches to funding maintenance in the long term. The project will thus finance a series of pilot tests to mobilize additional maintenance revenue in the project areas.

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Maintenance funding, however, must be considered in the context of broader strategies to manage road networks. At any given time, portions of the networks (usually roads providing access to remote villages) are not in maintainable condition and do not merit, on economic grounds, the rehabilitation work required to make them so. Deep-seated political priorities to allocate funds to preserve access in such cases threaten to crowd out the additional maintenance expenditure required for maintainable road links. Assuring that the recurrent cost requirements of maintenance are met thus requires the development of network management strategies through which the variables of network size, surface type, condition and desired level of service can be monitored, analyzed and controlled, and funds for all types of road work allocated accordingly. Assistance to develop these strategies will be one of the primary tasks of long-term project consultants.

## 2. COST EFFECTIVENESS OF MAINTENANCE

The Economic Analysis (see Annex H) shows that the benefits from maintenance and from various combinations of rehabilitation and maintenance exceed the costs in almost all circumstances. The task of financial analysis is to demonstrate that maintenance is the least expensive means to achieve a given level of road service, a fixed benefit. The key concept is level of service, a measure of performance characterized by the type and volume of traffic the road can bear, and the speed and the roughness at which traffic can travel. The level of service of a road is determined by the road's standard, its surface type, and its condition. These, in turn, define the operating costs of transportation.

Attractive financial savings from maintenance are amply demonstrated in the literature. Table 1 adapts one conventional approach to illustrate conditions approximating those of engineered gravel roads in Indonesia. Two cases are compared: a maintenance option in which a gravel road with a 10-year design life receives both routine and periodic maintenance until rehabilitation is required in the 11th year; and a no-maintenance option in which the same road receives no maintenance but, in an effort to maintain a constant level of service, is rehabilitated before its design life is complete. The cases are not strictly comparable because the maintenance case, tailored to preserve the design level of service, succeeds in doing so whereas the no-maintenance option does not. (If unit vehicle operating costs were shown, they would rise rapidly for the no-maintenance case in step with the deterioration of the road, but much more gradually in the case where maintenance is applied.) The no-maintenance case is nonetheless useful for comparison purposes because it represents the best that established district practices (i.e., rehabilitation without maintenance) could achieve if rehabilitation were performed to standard and funds were available to repeat the rehabilitation as frequently as every six years. Table 1 shows that not only does the no-maintenance option yield lower levels of service (reduced benefits) but it also costs more to implement. Increasing the period between rehabilitations in the no-maintenance case from six to seven years for discount rates of 12% or 14% results in almost equal present values but the deterioration in level of service for the no-maintenance option in this case strains the comparison.

TABLE 1

PRESENT VALUE OF EXPENDITURE (GRAVEL ROAD) -
MAINTENANCE VS. NON-MAINTENANCE
(U.S.$)

| Year | Expenditure/Km (Maintenance Option)* | Expenditure/Km (No-Maintenance Option)* |
|---|---|---|
| 0 | 18,000 | 18,000 |
| 1 | 500 | 0 |
| 2 | 500 | 0 |
| 3 | 1,730 | 0 |
| 4 | 500 | 0 |
| 5 | 500 | 0 |
| 6 | 1,730 | 18,000 |
| 7 | 500 | 0 |
| 8 | 500 | 0 |
| 9 | 1,730 | 0 |
| 10 | 500 | 0 |
| 11 | 18,000 | 0 |
| 12 | 500 | 18,000 |
| 13 | 500 | 0 |
| 14 | 1,730 | 0 |
| 15 | 500 | 0 |
| 16 | 500 | 0 |
| 17 | 1,730 | 0 |
| 18 | 500 | 18,000 |
| 19 | 500 | 0 |
| 20 | 1,730 | 0 |
| 21 | 500 | 0 |
| 22 | 18,000 | 0 |
| NPV (10% discount) | 28,437 | 33,758 |
| NPV (12% discount) | 26,130 | 30,429 |
| NPV (14% discount) | 24,245 | 27,753 |

* Each expenditure of $18,000 is for rehabilitation and expenditures of $1,730 and $500 are for periodic and routine maintenance, respectively.

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Although the savings from maintenance are clear and the prospect of saving money intrinsically appealing, maintenance is rarely given the budget priority it deserves. One reason is that the concept of level of service is not easily grasped. Even if it is understood, the optimal level of service may not be the politically desirable choice. District officials place a premium on assuring access for remote populations. When resources are short and simple access the goal, regardless of the costs of transporting goods and people on the road, the level of service desired becomes whatever the budget can buy on as many links as possible. In the long-term, this strategy is self-defeating. Transport costs remain high, economic growth is retarded, and the capability to raise revenues to finance further improvement of the road network is constrained.

## 3. RECURRENT COST REQUIREMENTS

For national and provincial roads, the budget priority accorded to maintenance is increasing (see Annex M). Despite budget austerity since late 1985 due to the decline of oil prices, both the relative and absolute allocations for maintenance have been raised. Maintenance allocations are nonetheless still below those originally planned for Repelita IV (1984/85 - 1988/89). Maintenance expenditures for national and provincial roads for 1984/85 were 65% of the level planned in the Repelita. For 1985/86, the budget fell to 57% of the planned level.* At this time (1986/87), maintenance expenditures on national and provincial roads average $1,300 per kilometer - still quite low by international standards.

It is not yet possible to determine with precision the optimal levels of maintenance funding required for national and provincial roads. Maintenance is neither effective nor economic on severely deteriorated roads. Rules of thumb, which, for example, estimate maintenance expenditure as a fixed percentage of the updated capital cost or of the replacement cost of a road network, assume that road networks are in good condition to begin with. This is not yet the case for Indonesia's national and provincial roads (and even less so for district roads). It is now estimated that by the end of Repelita IV, only 50% of the national and provincial network will be in maintainable condition (reduced from the Repelita target of 60-70%) (World Bank, 1986). If applied to this 50%, existing allocations for national and provincial road maintenance would average $2,600 per kilometer. But these roads range from 4-lane highways to, in a few cases, earth or gravel tracks. A precise determination of maintenance requirements under these circumstances requires link-by-link surveys of the condition of road features and levels of traffic. The Directorate General of Highways, with IBRD assistance, is introducing new procedures for these surveys as part of a Pavement Management System (PMS) for the national and provincial networks. The PMS, to be extended to 14 of Indonesia's 27 provinces by 1989, will become the tool for establishing maintenance budget requirements in the future.

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* World Bank. Highway Maintenance and Betterment Program, Staff Appraisal Report, May 1986.

For district roads, the earmarking, since 1984, of funds exclusively for maintenance is a very positive step. But it is even more difficult to determine the maintenance funding requirements of districts than for the network of provincial and national roads. As with national and provincial roads, requirements cannot be determined with confidence unless estimates are based on link-by-link surveys which apply consistent criteria to assess traffic level, surface type and the condition of features. This information does not now exist but will be developed in project districts as part of the RRMS maintenance management program and is being developed with assistance from other donors in about one-half of the districts in the rest of the country. The crude estimates below consider both potential and present needs.

Calculations in Table 2 are based on potential ideal conditions that would prevail in a well managed network: it is assumed that all links in the district networks are in "good" or maintainable condition, that the design life of all links is 10 years, that existing surface types are appropriate to the level of traffic served (i.e., no premature deterioration due to use exceeding design tolerances), and that both routine and periodic maintenance are applied. With these assumptions, annual funding for periodic and routine maintenance on district roads nationwide (excluding bridges) should be $125 million or $880 per kilometer, four times the $31 million now provided under Inpres Dati II. For a variety of reasons, however, $125 million is at present a strictly hypothetical target. The primary reason is the unmaintainable condition of most of the network.

Present requirements are reduced because, according to economic and engineering analyses, maintenance is largely wasted on seriously deteriorated roads. Practical definitions to determine when a road has reached an unmaintainable state are elusive. Consultant engineers observing district roads concluded that, as a rough initial rule of thumb, all roads now described as being in "good" condition and between 10% and 20% of those now categorized in "fair" condition could be maintained.

The districts themselves report that a total of 55% of the nationwide district road network falls in the good or fair category (see Table 3). Although definitions of these condition categories exist, they are difficult to apply and are inconsistently interpreted by different district governments. The only nationwide condition survey using consistent definitions in the past five years covered 82,000 km of district roads and concluded that 63% of the kilometers surveyed were in damaged or heavily damaged condition, leaving only 37% potentially eligible for maintenance. Table 4 shows that, on this basis, present maintenance funding requirements

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TABLE 2

POTENTIAL DISTRICT ROAD MAINTENANCE FUNDING REQUIREMENTS (1)

1) Nationwide

| road type (a) | length (ha) (4) (b) | maintained (90%) (c) | rehabilitated (10%) (d) | maintenance cost/ha (2) (e) | rehabilitation cost/ha (f) | budget required: maintenance (g) | budget required: rehabilitation (h) | budget required: total (i) | budget available (5): maintenance (g) | budget available (5): rehabilitation (h) | budget available (5): total (i) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| asphalt | 46,292 | 41,592 | 4,620 | $1,160 | $29,600 | $48,254,858 | $135,757,920 | $184,292,808 | | | |
| gravel | 39,650 | 33,685 | 3,965 | $1,160 | $18,000 | $52,100,100 | $71,370,000 | $123,470,100 | | | |
| earth | 54,599 | 50,039 | 5,630 | $460 | $9,500 | $24,450,740 | $53,769,050 | $78,219,810 | | | |
| | 142,451 | 128,296 | 14,215 | | | $124,785,756 | $261,896,970 | $386,682,726 | $32,762,441 | $97,197,756,000 | $132,518,641 |

2) Extreme case: sparsely populated Outer Island district with large road network (TTS District, NTT)

| road type (a) | length (ha) (b) | maintained (90%) (c) | rehabilitated (10%) (d) | maintenance cost/ha (2) (e) | rehabilitation cost/ha (f) | budget required: maintenance (g) | budget required: rehabilitation (h) | budget required: total (i) | budget available: maintenance (g) | budget available: rehabilitation (h) | budget available: total (i) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| asphalt | 8 | 7 | 1 | $1,160 | $29,600 | $8,352 | $23,600 | $32,032 | | | |
| gravel | 291 | 262 | 29 | $1,160 | $18,000 | $382,374 | $523,800 | $906,174 | | | |
| earth | 1,151 | 1,018 | 113 | $460 | $9,500 | $468,292 | $1,074,050 | $1,543,052 | | | |
| | 1,450 | 1,287 | 143 | | | $879,318 | $1,621,950 | $2,501,268 | $86,370 | $272,185 | $352,555 |

3) Moderate case: densely populated Outer Island district with small road network (Bone District, South Sulawesi)

| road type (a) | length (ha) (b) | maintained (90%) (c) | rehabilitated (10%) (d) | maintenance cost/ha (2) (e) | rehabilitation cost/ha (f) | budget required: maintenance (g) | budget required: rehabilitation (h) | budget required: total (i) | budget available: maintenance (g) | budget available: rehabilitation (h) | budget available: total (i) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| asphalt | 66 | 59 | 7 | $1,160 | $29,600 | $68,904 | $195,360 | $264,264 | | | |
| gravel | 244 | 220 | 24 | $1,160 | $18,000 | $320,616 | $439,200 | $759,816 | | | |
| earth | 238 | 214 | 24 | $460 | $9,500 | $102,816 | $226,100 | $328,916 | | | |
| | 548 | 493 | 55 | | | $492,336 | $860,660 | $1,352,996 | $48,700 | $328,082 | $376,782 |

4) Extreme case: densely populated District on Java with small road network (Garut District, West Java)

| road type (a) | length (ha) (3) (b) | maintained (90%) (c) | rehabilitated (10%) (d) | maintenance cost/ha (2) (e) | rehabilitation cost/ha (f) | budget required: maintenance (g) | budget required: rehabilitation (h) | budget required: total (i) | budget available: maintenance (g) | budget available: rehabilitation (h) | budget available: total (i) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| asphalt | 376 | 338 | 38 | $1,160 | $29,600 | $392,544 | $1,112,960 | $1,505,504 | | | |
| gravel | 119 | 107 | 12 | $1,160 | $18,000 | $134,344 | $214,200 | $348,544 | | | |
| earth | 16 | 14 | 2 | $460 | $9,500 | $6,912 | $19,000 | $25,912 | | | |
| | 511 | 459 | 52 | | | $533,822 | $1,342,160 | $1,875,982 | $367,253 | $951,101 | $1,318,354 |

Notes: (1) All conversions at post-devaluation exchange rate of $1.00 = Rp.1,640.
Bridges excluded from all calculations.
Maintenance funds consist of 25% of Inpres Bati II. Rehabilitation includes actual Inpres Bati II for roads plus all IPJ.

(2) Includes routine and annualized periodic maintenance costs.

(3) Stated length of asphalt roads in Garut may include some sealed gravel roads.

(4) For nationwide distribution of surface types, "other" has been divided equally between the three surface types included above.

(5) Budget available drawn from 1985/86 fiscal year, pre-devaluation.

for district roads nationwide are reduced to approximately $47 million including requirements for bridges.*

TABLE 3

DISTRICT ROAD CONDITIONS
AS REPORTED BY DISTRICTS

| Surface Type | Km | % of Total |
|---|---|---|
| Asphalt | 41,091 | 29% |
| Gravel | 35,349 | 25% |
| Earth | 52,298 | 37% |
| Other | 12,904 | 9% |
| Total | 141,464 | 100% |

| Condition | Km | % of Total |
|---|---|---|
| Good | 36,426 | 26% |
| Fair | 41,236 | 29% |
| Damaged | 28,502 | 20% |
| Heavily Damaged | 35,478 | 25% |
| Total | 141,464 | 100% |

Source: BPS, 1984.

For individual districts, present funding requirements vary dramatically depending on the distribution of their roads between surface types and the length and condition of their networks. Table 4 shows several extreme cases. In Garut District, West Java, the currently available maintenance

* An independent estimate by Hoff & Overgaard, planning consultants for the World Bank-financed Rural Roads project, concludes that present requirements are $79 million. The difference between the estimates is explained by Hoff & Overgaard's use of much higher unit costs for periodic maintenance when a road is in fair rather than good condition. This may reflect differences of definition: the heavy periodic maintenance described by Hoff & Overgaard approaches unit costs which, in the model used here, might be defined as rehabilitation. Hoff & Overgaard's methodology is more sophisticated than that used above, but the data base is the same and weak; the planning consultants stressed the uncertainty of any such calculations.

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TABLE 4

MAINTENANCE FUNDING REQUIREMENTS FOR DISTRICT ROADS IN GOOD (100%) AND FAIR (20%) CONDITION

1) Nationwide

| Surface Type | Length (km) | Length in Good or Fair Condition (km)* | Less 17% (km)** | Maintenance Cost/km | Budget Required for Roads Only | Budget Required Including Bridges (+10%) | Maintenance Budget Available 1985/86 |
|---|---|---|---|---|---|---|---|
| asphalt | 46,202 | 17,095 | 14,189 | $1,160 | $16,458,816 | | |
| gravel | 39,650 | 14,671 | 12,177 | $1,460 | $17,777,712 | | |
| earth | 56,599 | 20,942 | 17,382 | $480 | $8,343,145 | | |
| total | 142,451 | 52,708 | 43,748 | | $42,579,673 | $46,837,640 | $32,762,341 |

* Includes 37% of each surface type in accordance with Sub-Directorate 1983 survey.
Probably overstates length of maintainable earth road and underestimates length of maintainable asphalt road.
** Assumes 17% receiving treatment other than maintenance rehab., upgrade, etc.) and thus not requiring maintenance.

2) Sparsely Populated Outer Island Island District with Large Network (TTS District, NTT)

| Surface Type | Length (km) | Length in Good or Fair Condition (km)* | Less 17% (km)** | Maintenance Cost/km | Budget Required for Roads Only | Budget Required Including Bridges (+10%) | Maintenance Budget Available 1985/86 |
|---|---|---|---|---|---|---|---|
| asphalt | 8 | 2 | 1 | $1,160 | $1,627 | | |
| gravel | 291 | 58 | 48 | $1,460 | $70,575 | | |
| earth | 1,131 | 226 | 188 | $480 | $90,118 | | |
| total | 1,430 | 286 | 237 | | $162,320 | $178,552 | $80,370 |

* District's own rating. Includes all in good and 20% of kilometers in fair category.
** Assumes 17% receiving treatment other than maintenance rehab., upgrade, etc.) and thus not requiring maintenance.

3) Moderately Populated Outer Island Island District with Small Network (Gowa District, South Sulawesi)

| Surface Type | Length (km) | Length in Good or Fair Condition (km)* | Less 17% (km)** | Maintenance Cost/km | Budget Required for Roads Only | Budget Required Including Bridges (+10%) | Maintenance Budget Available 1985/86 |
|---|---|---|---|---|---|---|---|
| asphalt | 66 | 28 | 23 | $1,160 | $26,958 | | |
| gravel | 245 | 34 | 28 | $1,460 | $41,201 | | |
| earth | 238 | 0 | 0 | $480 | $0 | | |
| total | 549 | 62 | 51 | | $68,159 | $74,976 | $68,700 |

* District's own rating. Includes all in good and 20% of kilometers in fair category.
** Assumes 17% receiving treatment other than maintenance rehab., upgrade, etc.) and thus not requiring maintenance.

4) Densely Populated District on Java with Small Network (Garut District, West Java)

| Surface Type | Length (km) | Length in Good or Fair Condition (km)* | Less 17% (km)** | Maintenance Cost/km | Budget Required for Roads Only | Budget Required Including Bridges (+10%) | Maintenance Budget Available 1985/86 |
|---|---|---|---|---|---|---|---|
| asphalt | 376 | 197 | 164 | $1,160 | $189,672 | | |
| gravel | 117 | 30 | 25 | $1,460 | $36,354 | | |
| earth | 16 | 0 | 0 | $480 | $0 | | |
| total | 511 | 227 | 189 | | $226,026 | $248,628 | $307,293 |

* Sub-Directorate of Local Roads rating based on 1986 survey (distinguished only "good" from "poor" condition).
** Assumes 17% receiving treatment other than maintenance rehab., upgrade, etc.) and thus not requiring maintenance.

funds may exceed the level required. Garut is heavily populated and thereby receives a large Inpres Dati II allocation. The 25% of that allocation earmarked for maintenance exceeds the requirements of its relatively small network given the present condition and distribution of its road surface types. Table 2 shows, however, that if all links were improved to a maintainable state, the 25% earmark would fall short, providing only about 55% of the funds needed.

Gowa District in South Sulawesi now receives about 92% of the maintenance funds necessary. The population density of Gowa is moderate and its road network is slightly larger than that of Garut. If all links were in maintainable condition, seven times the present Dati II earmark would be required for maintenance.

The final case is TTS District in NTT. The condition ratings for TTS shown in Table 4 are highly suspect, but demonstrate the large potential gap between the modest Inpres Dati II earmark and maintenance needs in the small number of Outer Island districts with networks of 1,000 km or more. Table 2 demonstrates the further influence of surface type on the size of Outer Island shortfalls: with 80% of its network composed of earth roads, TTS needs potentially only 79% more maintenance funding than does Gowa, even though TTS has almost three times the total length of road.

Adequate financing mechanisms for maintenance must be able to account for these differences in network size, surface type and condition. The flat-rate population-linked Inpres Dati II budgets for maintenance do not adequately respond to the varying maintenance needs of different districts. The distinction between Java and Bali on the one hand and the Outer Islands on the other is the most important. However, the adequacy of the earmark varies considerably within these two categories as well.

Over the long-term, managing maintenance will require control of the growth of the networks. District networks are open systems in the sense that roads both enter and leave the inventory. Everything else being equal, maintenance requirements increase with network growth. To the extent that funding for new roads crowds out funding for maintenance, the availability of funds is decreased. However, if funding for all types of road work is outstripped by growth in network size, expenditures per kilometer may be forced downward and engineering standards compromised, leaving a greater portion of the network in unmaintainable condition and, ironically, reducing immediate maintenance requirements.

Several conclusions emerge from the analysis. First, maintenance funding requirements vary considerably among districts. Variation depends on network size, and the surface type and condition of network links. Much of the existing network is not in maintainable condition. Second, growth of the networks is not systematic and districts do not necessarily control the rate of growth. This creates demands for maintenance or competing demands for rehabilitation which perhaps cannot be anticipated. Third, no flat formula for maintenance funding, such as the 25% earmark under Inpres Dati II, can meet the maintenance needs of all districts. Shortages are particularly evident in the Outer Islands.

## 4. RECURRENT COST FUNDING AVAILABILITY

### 4.1 COST RECOVERY

Road user contributions, as low as 40% of the full financial cost of road investments and maintenance in the early 1980s, are now estimated to be adequate to fully cover expenditures on roads nationwide.* Direct user contributions include import duties on vehicles and parts, registration and vehicle ownership transfer fees, tolls, fines for overloading or other law infractions, and fuel sales profits.

Recent policy changes have increased the yield of road user contributions (World Bank, 1986). These include a major reform of vehicle tax laws (increasing tax rates and simplifying collection), a greater than 100% increase in toll rates, an increase in fuel prices, and a gradual phasing out of subsidies to urban bus companies. The future of road cost recovery will depend largely on oil price fluctuations, however. The recent increase in domestic vehicle fuel prices, combined with the decline of world oil prices, has converted the vehicle fuel subsidies of the early 1980s into revenue in-flows. A sharp rise in world oil prices without an increase in domestic fuel prices would reverse the trend (although gradual oil price increases and prudent fuel pricing policies are more likely).

Except for tolls,** however, user contributions are not re-invested per the incidence of fees or charges collected. Indonesian law prohibits the earmarking of revenues for specific expenditures. Thus, although vehicle registration and transfer of ownership fees (the only user contributions not retained by the central government, see Section 4.4) are collected by provincial governments and are a significant source of their revenue, there is no direct relationship to road expenditure. The result is that road budgets, including budgets for maintenance, are discretionary and vulnerable to general budget fortunes or policy shifts. With the minor exception of toll roads, maintenance expenditure bears no relation to the level of road user contributions. Estimating the sources and amounts of funds potentially available to meet maintenance needs requires an investigation of the broader revenue situation of the various levels of government.

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* Halcrow Fox and Associates with BIEC International, Inc. Republic of Indonesia, Ministry of Communications, Directorate General of Land Transport and Inland Waterways. Land Transport Development Plan - Phase I: Brief Review of Road User Charges. Draft final report, April 1986, p. 1-2.

** Tolls are exacted on major highways under the jurisdiction of a government corporation, P.T. Jasa Marga. See Annex M for discussion.

## 4.2 NATIONAL REVENUES

Government revenues are dominated by oil and gas receipts. Oil and gas provided 55-60% of total GOI revenues in the first half of the 1980s. Despite the drastic downturn in fuel prices since 1985, oil and gas still account for almost a third of government revenues in the planned budget for the upcoming 1987/88 fiscal year and for over 40% of revenues if external development assistance is excluded.

A variety of measures to reduce dependence on oil revenues have been taken over the past three years. New income taxes, a value added tax (VAT), and a land and buildings tax (PBB) have been introduced. Although each is suffering start-up implementation problems, receipts from the three are expected to increase by 34% between 1986/87 and 1987/88 and to yield 31% of total revenues in 1987/88 compared to 25% the previous year.

Progress in diversifying revenue sources has not significantly changed the pattern in which revenues are concentrated in central as opposed to local government hands. Receipts from oil and gas (which will continue to account for a large portion of total revenue for the forseeable future) and from the new income tax and VAT are collected by central authorities. The new tax on property (discussed in more detail below) is formally a central government tax, although fixed percentages of collections are returned to local governments.

With the exception of the PBB, results of the efforts to diversify national revenue sources and to respond to the oil revenue crunch are seen in the national government treasury and not at a local level. This continues an historical pattern of central government revenue re-distribution, leaving local government authorities dependent on the discretion of higher authorities.

## 4.3 LOCAL GOVERNMENT REVENUES

Both provincial and district governments are heavily dependent on grants from the central government to fund recurrent and development activities. Table 5 shows that provincial governments receive 73% of their total revenue from central grants, primarily through the Subsidy to Lower Regions (SDO), a grant to fund recurrent costs of administration (salaries, travel, etc.). Table 6 shows that 82% of district government revenues are received in the form of central grants. The largest single grant, as for the province, is the SDO. Other grants to districts include five Inpres programs. Four of these are for specific purposes, e.g., to build primary schools. Only one, Inpres Dati II, allows much discretion to the district in determining the uses to which it is put.

TABLE 5

PROVINCIAL REVENUES *

(Rp. Million)

| | Actual | | | | | | | Share of Provincial | Growth Per |
|---|---|---|---|---|---|---|---|---|---|
| | 1977/8 | 1978/9 | 1979/80 | 1980/81 | 1981/82 | 1982/83 | 1983/84 | Revenue | Year |
| **LOCAL OWN REVENUE & RETURNED REVENUE** | | | | | | | | | |
| Local Own Revenue | | | | | | | | | |
| - Local Taxes : Household Tax | 1.38 | 1.61 | 1.63 | 2.26 | 2.88 | 3.61 | 4.50 | 0.3% | 21.8% |
| Motor Vehicles | 56.16 | 81.26 | 105.83 | 163.00 | 206.91 | 229.71 | 255.39 | 14.7% | 28.7% |
| Other | 20.08 | 22.44 | 24.38 | 29.17 | 24.89 | 26.00 | 33.48 | 1.9% | 8.9% |
| Total Local Taxes | 77.62 | 105.32 | 131.84 | 194.43 | 234.68 | 259.34 | 293.37 | 16.9% | 24.3% |
| - Other | 43.24 | 50.22 | 75.51 | 93.01 | 128.21 | 121.16 | 115.19 | | |
| Total Local Own Revenue | 120.86 | 155.54 | 207.35 | 287.44 | 362.89 | 380.50 | 408.56 | 23.6% | 22.5% |
| Returned Revenues** | | | | | | | | | |
| - IPEDA (Local Land Taxes) | 7.13 | 9.51 | 10.84 | 13.94 | 15.35 | 17.47 | 25.90 | 1.5% | 26.0% |
| - IHPH/IHH etc (Forestry Taxes etc. | 22.84 | 14.76 | 36.08 | 59.47 | 36.62 | 24.21 | 31.25 | 1.8% | 5.4% |
| Total Returned Revenue | 29.97 | 24.27 | 46.92 | 73.41 | 51.97 | 41.68 | 57.15 | | |
| Total Local Own and Returned Revenue | 150.83 | 179.81 | 254.27 | 360.85 | 414.86 | 422.18 | 465.71 | 26.9% | 20.7% |
| **GRANTS FROM CENTRAL GOV'T** | | | | | | | | | |
| SDO | 325.77 | 367.63 | 482.82 | 667.98 | 818.59 | 899.16 | 1,008.47 | 58.2% | 20.7% |
| Inpres Dt.I | 75.00 | 85.67 | 102.22 | 166.59 | 215.00 | 253.00 | 253.00 | 14.6% | 22.5% |
| Total Grants | 400.77 | 453.30 | 585.04 | 834.57 | 1,033.59 | 1,152.16 | 1,261.47 | 72.8% | 21.0% |
| **LOANS** | 6.96 | 13.69 | 6.95 | 8.68 | 7.73 | 10.24 | 4.67 | 0.3% | -- |
| Total Provincial Revenue | 569.01 | 646.81 | 846.26 | 1,204.10 | 1,456.18 | 1,584.58 | 1,731.85 | 100.0% | 20.3% |

* Sum of all provinces except East Timor.

** Returned revenues are national taxes, collected locally, of which a portion are returned by national authorities to local government.

Source: Devas, 1986.

TABLE 6

DISTRICT REVENUES *

(Rp. Million)

| | Actual 1977/8 | 1978/9 | 1979/80 | 1980/81 | 1981/82 | 1982/83 | 1983/84 | 1984/85 | Share of Kabupaten Revenue | Growth* Per Year |
|---|---|---|---|---|---|---|---|---|---|---|
| **LOCAL OWN REVENUE & RETURNED REVENUE** | | | | | | | | | | |
| Local Own Revenue | | | | | | | | | | |
| - Local Taxes: Entertainment | 5.54 | 6.00 | 9.20 | 11.55 | 12.40 | N/A | N/A | N/A | 0.9% | 22.3% |
| Hotel and restaurants | 2.30 | 2.92 | 3.45 | 6.85 | 8.52 | N/A | N/A | N/A | 0.7% | 34.7% |
| Radio | 0.52 | 0.46 | 0.47 | 0.45 | 0.39 | N/A | N/A | N/A | .0% | -6.5% |
| Foreigners | 1.20 | 1.12 | 1.46 | 1.52 | 0.98 | N/A | N/A | N/A | 0.1% | -4.9% |
| Slaughter | 0.54 | 0.75 | 0.69 | 0.82 | 1.04 | N/A | N/A | N/A | 0.1% | 17.4% |
| Non-motorized vehicles | 0.44 | 0.41 | 0.49 | 0.53 | 0.53 | N/A | N/A | N/A | .0% | 4.3% |
| Advertisements | 0.39 | 0.41 | 0.62 | 0.85 | 1.08 | N/A | N/A | N/A | 0.1% | 29.0% |
| Roads | 0.86 | 0.90 | 1.09 | 1.52 | 1.26 | N/A | N/A | N/A | 0.1% | 10.0% |
| Business registration | 0.74 | 0.83 | 0.96 | 1.43 | 1.85 | N/A | N/A | N/A | 0.1% | 25.5% |
| Others | 2.23 | 2.42 | 2.49 | 2.86 | 3.69 | N/A | N/A | N/A | 0.3% | 13.4% |
| Total Taxes | 14.76 | 16.22 | 20.92 | 28.38 | 31.75 | N/A | N/A | N/A | 2.4% | 21.1% |
| - Other (Non Tax) | 43.39 | 46.66 | 64.03 | 80.56 | 99.42 | N/A | N/A | N/A | 7.3% | |
| Total Local Own Revenue | 58.15 | 62.88 | 84.95 | 108.94 | 131.17 | 150.61 | 162.90 | N/A | 10.0% | 22.5% |
| Returned Revenues (IPEDA)*** | 44.92 | 47.16 | 58.45 | 72.81 | 79.95 | 81.90 | 92.80 | N/A | 6.1% | 15.5% |
| Total Local Own and Returned Revenue | 103.07 | 110.04 | 143.40 | 181.75 | 211.12 | 232.51 | 255.70 | N/A | 16.2% | 19.6% |
| **GRANTS FROM CENTRAL GOVT.** | | | | | | | | | | |
| SDO etc. | 138.38 | 149.43 | 172.84 | 198.81 | 329.71 | 392.60 | 399.67 | N/A | 25.2% | 24.2% |
| Inpres | | | | | | | | | | |
| - Dati II | N/A | N/A | 87.04 | 119.58 | 162.65 | 193.89 | 197.17 | 201.91 | N/A | 18.3% |
| - Primary School | N/A | N/A | 135.50 | 250.80 | 374.36 | 589.16 | 589.16 | 580.80 | N/A | 15.7% |
| - Health | N/A | N/A | 30.00 | 50.00 | 79.00 | 98.45 | 98.45 | 98.45 | N/A | 26.8% |
| - Roads | N/A | N/A | 13.00 | 26.00 | 55.00 | 80.10 | 80.10 | 80.10 | N/A | 83.8% |
| - Re-greening | N/A | N/A | 16.16 | 24.16 | 37.65 | 46.59 | 50.13 | 39.80 | N/A | 19.6% |
| Total Inpres ** | 202.38 | 242.34 | 306.34 | 495.02 | 741.01 | 1,008.19 | 1,015.01 | 1,001.06 | 56.7% | 38.3% |
| Total Grants from Central Govt. | 340.76 | 391.77 | 479.18 | 793.83 | 1,070.72 | 1,400.59 | 1,414.68 | N/A | 81.9% | 33.1% |
| **GRANTS FROM PROVINCE** | 8.14 | 7.91 | 9.95 | 18.75 | 24.20 | N/A | N/A | N/A | 1.9% | 31.3% |
| **LOANS** | 2.35 | 1.38 | 2.66 | 2.17 | 0.98 | N/A | N/A | N/A | 0.1% | -13.6% |
| **Total District Revenue** | 454.32 | 511.10 | 635.19 | 996.50 | 1,307.02 | N/A | N/A | N/A | 100.0% | 30.2% |

* Sum of all districts excluding East Timor

** Total Inpres values shown differ slightly from sum of individual Inpres accounts shown for the years 1979/80 - 1981/82 due to discontinuous data.

*** Returned revenues are national taxes, collected locally, of which a portion are returned by national authorities to local government.

Source: Devas, 1986



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## 4.4 TAX REVENUES*

Although the ratio of total tax revenues (all levels of government) to GDP is relatively high for a developing country and is, with the recent tax reforms, increasing, the share of local taxation (province and district) in total tax revenues is extremely small and, through 1982 at least, declining further. Table 7 shows that in 1981/82 local taxes accounted for only 3% of total tax revenues, with district taxes accounting for just one-third of the local taxes collected. The growth rate for district tax revenue is also disproportionately low. According to Devas (1986), between 1977/78 and 1981/82, national tax revenue grew at an average 37% per year, while provincial tax revenues grew at 28%, and district revenues at only 17%.

TABLE 7

LOCAL TAXATION IN INDONESIA, 1981/82
(Rp. billions)

| | Tax Revenue | | Tax + Non-Tax Revenue | |
|---|---|---|---|---|
| National | 11,782 | (97%) | 12,118 | (95%) |
| Provincial | 287 | ( 2%) | 415 | ( 3%) |
| District | 112 | ( 1%) | 211 | ( 2%) |
| Total | 12,181 | (100%) | 12,744 | (100%) |
| Gross Domestic Product (1981) | | | 54,027 | |
| Total Tax revenues as a percentage of GDP: | | | 22.5% | |

(Note: National revenues exclude foreign aid; IPEDA (local land taxes) and royalties are treated as revenues for the level to which they are assigned; other transfers to local government are excluded; non-tax revenues include charges, earnings from enterprises, etc.; and all Jakarta revenues are treated as provincial revenues.)

Although much of the growth of national tax receipts during that period was accounted for by the very high growth of oil corporation tax revenue (at 45% per year) and reflected the oil boom, inflation during the period was approximately 16% per year, meaning that district receipts barely kept pace with inflation, provincial receipts grew significantly, and national receipts very substantially in real terms.

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* The following seven paragraphs draw heavily on Devas, Nick. Local Taxation, Papers on Regional Finance for the Government of the Republic of Indonesia, University of Birmingham, June 1986.

At the provincial level (excluding Jakarta), taxes on motor vehicles (annual registration and transfers of ownership) account for 97% of all tax revenue and are retained for the province government's own use. Revenue from this source is highly elastic, growing nearly 25% per year in the first half of the 1980s.

Districts impose a bewildering variety of taxes but very few yield significant income and together they provide less than 2.5% of total district revenue (see Table 6). If proceeds from the IPEDA land tax (now replaced by the PBB, see below) are added to this, district tax revenues are still a very small 8.5% of their total income (district authorities collect IPEDA on behalf of central authorities, but the central government returns 90% of this tax to the districts).

Over 57 district taxes have been identified, nearly half of which are collected in only one district or municipality. Two taxes, an entertainment tax and a tax on hotels and restaurants, provide almost two-thirds the revenue of all the district taxes combined (IPEDA excluded). Both, however, are biased toward municipalities, and rural Outer Island districts are unlikely to receive much benefit from them.

Two district taxes relate directly to roads but neither yields significant revenue nationally nor has much potential to do so in the future. Under the general term "roads tax" many districts impose charges for street frontage in urban areas and occasional tolls on road use. Devas' analysis of district taxes concludes that street frontage charges are essentially an urban property tax, with collection costs probably more than twice the yield. Efficiency argues that any continued imposition of these charges should be incorporated into the new PBB.

Tolls on roads other than on Jasa Marga highways were banned in early 1986 following a series of scandals concerning the illegal diversion of toll receipts. Historically, tolls were imposed in only a few locations. Eighty-eight percent of the revenue from this source nationwide in the early 1980s was derived from only four provinces. In the few locations where tolls were imposed, the yield was inelastic and the collection costs high. An analysis of district road tolls concluded:

> .....it could be argued that, in some cases, the collection costs are really the main reason for the tax, i.e. they provide someone with employment.....Because of the small amount of money involved, they cannot be regarded as having any significant economic efficiency or equity effects,.....(and) the ultimate payers.....may well be the poor.....In political terms,.....constant demands for small payments can only be regarded as a minor nuisance; in administrative terms, though, they present problems of control, since it is extremely difficult to check on the activities of collectors on remote roads. The location-specific nature of the tax makes it a comparatively suitable tax for local governments, and one from which most local governments can benefit. However.....it would be <u>much</u> more cost effective if local governments could obtain a share of (or surcharge on) provincial vehicle taxes, or national fuel taxes. (Devas, p. 67)

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Despite the mixed performance of the road tolls, road tax receipts were substantial in the project province of South Sulawesi, amounting to about Rp. 550 million in 1979/80 and comprising over 88% of all district taxes, excluding IPEDA, collected in the province in that year.

A land and building tax (PBB) launched in 1986 has limited potential in the near future as a source of funds for the recurrent costs of district infrastructure. The PBB replaced seven taxes, including a colonial land tax (IPEDA), a wealth tax, and taxes on the use of roads (above). The PBB is technically a national tax collected by district authorities. Of total receipts, 10% is retained by the central government, 10% by the districts to cover collection costs, 16% is assigned to the provincial government, and 64% returned to the district government as general revenue. The PBB taxes the market value of land and buildings and, given reliable assessment capability, would be a reliable and elastic revenue source for district governments, especially those with significant urban concentrations. It is considered the primary local government tax for the forseeable future.

The short-term impact of the PBB will not be great, however, and, over the short-term at least, few of the revenues generated are likely to be assigned to district road work. The IPEDA was the only significant revenue earner of the seven taxes the PBB replaced. But PBB revenues returned to the districts are, to date, not much higher than those received under IPEDA. In 1984/85, Rp. 166 billion ($101 million at today's exchange rates) was collected in IPEDA taxes. Of this, 90% or $91 million was returned to district authorities. The collection target for the PBB for the 1987/88 fiscal year is Rp. 274 billion ($167 million), of which only 64% or $107 million will be assigned to districts. The difference to the districts is not great and even though the PBB is considered more equitable and more elastic over the long term than the IPEDA and has a potentially much larger base, the share returned to districts is lower than under IPEDA and collection will be hampered for at least several years by a critical lack of property assessment capability.

PBB revenues are also unlikely to be available for infrastructure maintenance until the value of PBB collections significantly exceeds IPEDA receipts. IPEDA revenues were generally used to pay district personnel costs not covered by the SDO. Informal reports from consultants indicate that, in most cases, this consumed all IPEDA receipts. By regulation, 20% of the IPEDA was reserved for infrastructure maintenance, but there is no evidence that this was observed and the PBB contains no such provision.

A further reform of local taxation and central/local financial relations is being discussed (Devas, 1986). Along with the PBB, this has the potential to gradually increase province and district "own revenues" over the next fifteen years. It is unlikely, however, to quickly reverse the general pattern of local government dependence on central grants. The main features of the reform are likely to be a simplification of district taxation by eliminating the large number of taxes for which yields are low or inelastic, or for which collection costs are high. Among the possible substitutes are a tax to recover the costs of providing urban infrastructure and a gasoline tax. The gasoline tax is potentially significant because the

impact on district revenues of a surcharge on gasoline and diesel fuel would be considerable. Table 8 shows the estimated revenues.

A 5% tax would, by itself, yield almost four times the present total of district tax revenues nationwide (Rp. 45.2 billion in 1983/84). If assigned to road maintenance, fuel tax revenues would total about $100 million annually, or more than three times the present value of the Inpres Dati II maintenance earmark of $31 million. It would also be highly elastic with respect to increases in vehicle usage and the consequent stress on the road system.

Reform of local taxation is unlikely to be enacted until after the 1988 Presidential election. The issue of local government financial autonomy strikes at the core of Indonesian political sensitivities and delays well past 1988 would not be surprising despite the GOI's drive to increase non-oil sources of revenue. There are mixed reports on the gasoline tax with indications that, because domestic retail fuel prices now exceed international levels, it may be considered politically and economically undesirable to raise prices further. Decisions are not likely to be made until uncertainties surrounding the upcoming election are reduced and a clear direction in oil prices emerges.

TABLE 8

ESTIMATED REVENUES FROM A TAX ON FUEL

| Type of Fuel | Sales 1985/86 (million ltr) | Price (Rp/ltr) | Yield of a 5% Tax | Yield of a Rp. 10/ltr Tax |
|---|---|---|---|---|
| Premium | 4,129.6 | 350 | Rp. 72.3 bn | Rp. 41.3 bn |
| Super | 90.7 | 400 | Rp. 1.8 bn | Rp. 0.9 bn |
| Diesel | 8,177.2 | 220 | Rp. 90.0 bn | Rp. 81.8 bn |
| Total | 12,397.5 | | Rp. 164.2 bn | Rp. 124.0 bn |

Source: Devas, 1986.

In sum, the potential for local financing of district road maintenance costs is limited. District "own revenues" will increase gradually, largely with increases in PBB receipts. The gasoline tax could make a significant difference, particularly if earmarked for re-investment in district road networks. Its future, however, is uncertain. Of the remaining conventional revenue "handles" for road maintenance, all either already accrue to another level of government (vehicle import duties and retail fuel sales profits to national authorities, and vehicle registration and transfer fees to provincial authorities) or, like non-Jasa Marga tolls, have been recently banned. Finance for district road maintenance, as for all district expenditures, will remain largely dependent on central government grants for the forseeable future.

## 4.5 NON-TAX REVENUES FOR ROADS: THE INPRES PROGRAMS

Over nineteen different sources of funds for district roads have been identified, but two, Inpres Dati II (Inpres District) and Inpres Penunjangan Jalan (Inpres Roads), provide more than 90% of the total. Other non-tax sources may be significant locally but not nationwide. They include:

- occasional grants from provincial budgets (APBD I) to districts under a line item entitled "Development Expenditure on Heavy Repair and Maintenance." These are provided on an ad hoc basis, sometimes following natural disasters, for district roads or bridges deemed critical to provincial interests. Data are not available on the actual amounts received by districts.

- occasional APBD I grants to districts under a line item entitled "Capital Transfer from Development Budget to Lower Regions." This exists in most provinces including South Sulawesi, but not NTT. In South Sulawesi, about Rp. 800 million has been provided to districts annually over the past five years from this source, of which about 70% has been for rehabilitation or maintenance of district roads and bridges. On average, each district has received Rp. 27 million per year or $16,000 at present exchange rates. Funds are frequently applied to complement portions of road work financed from other sources including Inpres.

- a clove rehabilitation rebate apparently based on clove production or export taxes on cloves and which is allocated to clove-producing districts by provincial Offices of Finance and Trade. Of the project districts, only two appear to receive funds in this manner, receiving Rp. 69 and 48 million, or an average of $35,000 in 1985/86 at present exchange rates.

The Inpres grants are by far the largest and most regular sources of funds for district roads and are therefore crucial to the outlook on finance. Table 9 shows total Inpres allocations since 1970. Inpres Dati II is granted by central authorities to districts according to the size of their population. Since 1984, the basis of allocation has been Rp. 1,250 per capita with a minimum per district of Rp. 186 million or $113,000 at present exchange rates. Inpres Dati II is intended to be programmed for small-scale infrastructure projects, preferably ones which maximize labor utilization. Districts choose to allocate, on average, about 85% of their Inpres Dati II budget to roads.

The population basis for Inpres Dati II biases allocations to Java and Bali and results in a relative shortage of funds per kilometer of district road in the Outer Islands. In 1985/86, over 60% of Inpres Dati II funds were allocated to Java and Bali, which possess only 30% of the nationwide district network.

The Inpres Penunjangan Jalan program was initiated in 1979 primarily to correct the imbalance of Inpres Dati II funds for roads between Java/Bali and the Outer Islands. Over 80% of Inpres Penunjangan Jalan funds were programmed for the Outer Islands in 1985/86. On a nationwide basis, Inpres Penunjangan

TABLE 9

INPRES DATI II (IK) AND INPRES PENUNJANGAN JALAN (IPJ) BUDGETS

| Year | Inpres Dati II | | | IPJ | Total |
|---|---|---|---|---|---|
| | Per Capita Allocation (Rp) | Total (Rp. Billion) | Used for Roads and Bridges (Rp. Billion) | Used for Roads and Bridges (Rp. Billion) | Used for Roads and Bridges (Rp. Billion) |
| 1970/71 | 50 | 5.7 | (4.0)[a] | - | 4.0 |
| 1971/72 | 75 | 8.8 | (6.2) | - | 6.2 |
| 1972/73 | 100 | 12.9 | (9.0) | - | 9.0 |
| 1973/74 | 150 | 19.2 | (13.4) | - | 13.4 |
| 1974/75 | 300 | 42.5 | (29.8) | - | 29.8 |
| 1975/76 | 400 | 59.1 | (41.4) | - | 41.4 |
| 1976/77 | 400 | 62.4 | (43.6) | - | 43.6 |
| 1977/78 | 450 | 69.1 | (48.4) | - | 48.4 |
| 1978/79 | 450 | 70.9 | (49.6) | - | 49.6 |
| 1979/80 | 550 | 82.1 (86.1) [e] | 78.5 | 12.7 | 91.2 |
| 1980/81 | 750 | 114.2 (119.6)[e] | 83.6 | 25.5 | 109.1 |
| 1981/82 | 1,000 | 157.5 (162.6)[e] | 109.5 | 54.2 | 163.7 |
| 1982/83 | 1,150 | 185.9 (193.9)[e] | 130.3 | 78.8 | 209.1 |
| 1983/84 | 1,150 | 189.7 (197.2)[e] | 133.2 | 82.2 | 215.4 |
| 1984/85 | 1,150 | 190.3 (201.7)[e] | 137.5 | 93.5 | 231.0 |
| 1985/86 | 1,250 | 210.7 | 155.9[b] | 98.6 | 254.5 |
| 1986/87 | 1,250 | 215.0 | 175.2 | 130.7 (76.1)[d] | 251.3 |
| 1987/88 | 1,250 | 219.5 | N/A[c] | 130.0 | N/A |

a) Assumes an average of 70% of the IK budget was allocated to the roads and bridges sector in 1970/71 - 1978/79.
b) Includes DKI Jakarta (Rp 4.84 bn); other sources give Rp. 166.5 mn.
c) Excludes East Timor.
d) Net of Rp. 54.6 bn carried over from 1985/86, but including Rp. 3.6 million for equipment maintenance.
e) Including IPEDA (local tax) reimbursement, equipment assistance and other minor funds

Source: Amphico, 1986.

Jalan corrects the imbalance of Inpres Dati II road funds to Java and Bali, as shown in Table 10. However, unlike Inpres Dati II, there is no formula for its distribution and allocations to particular districts can vary tremendously from year to year. Beginning in 1986/87, in response to the critically deteriorated condition of transmigration and NES roads, about one-half of the Inpres Penunjangan Jalan budget was allocated exclusively to these areas. This will continue at a declining rate for several years and means that districts without transmigration sites will rely primarily on Inpres Dati II through the end of the 1980s.

TABLE 10

TOTAL INPRES ALLOCATIONS FOR ROADS, 1995/96

(Rp. million)

| | Outer Islands | Java/Bali |
|---|---|---|
| Inpres Dati II | 66,392 | 100,222 |
| Inpres Penunjangan Jalan | 76,124 | 17,874 |
| Total | 142,516 | 117,996 |

Until the diversion of Inpres Penunjangan Jalan to transmigration areas in 1986/87, RRMS project districts in the 1980s spent an average of about $500,000 per year per district in Inpres funds on roads. Budgets for 1985/86 are shown in Table 11.

The most significant difference between the two Inpres programs, aside from the bias of Inpres Dati II to Java and Bali and Inpres Penunjangan Jalan to the Outer Islands, is that only Inpres Dati II is used for maintenance. Beginning in 1984, each district has been required to set aside 25% of its Inpres Dati II budget for maintenance. On the one hand, because Inpres Dati II is allocated on a per capita basis, it is one of the most stable of all government funding channels and a flat-rate earmark provides a reliable base for maintenance planning. Nominal budgets for Inpres Dati II have steadily increased since the program began and it is one of the few budgets protected during the present austerity period. On the other hand, as discussed above, sparsely populated Outer Island districts are handicapped.

## 4.6 CONCLUSIONS

Despite the distortions inherent in the per capita basis for allocating Inpres Dati II maintenance funds, the 25% earmark is too valuable a claim on budget resources to be abandoned. The potential for locally-generated resources is too limited to risk an attempt to substitute them for the Inpres budget. And all of the conventional "handles" on maintenance revenue sources are already either claimed by other levels of government or have been expressly banned. A nationwide increase in the 25% earmark would not,

TABLE 11

INPRES BUDGETS FOR ROADS IN PROJECT DISTRICTS*, 1985/86
(Rp. million)

| District | Total Inpres Dati II | Inpres Dati II Spent on Roads | | | Inpres Penunjangan Jalan | Grand Total |
|---|---|---|---|---|---|---|
| | | Maintenance | Non-Maintenance | Total | | |
| **NTT** | | | | | | |
| Kupang | 595 | 149 | 59 | 208 | 333 | 541 |
| TTS | 408 | 102 | 205 | 307 | 305 | 612 |
| Belu | 254 | 64 | 170 | 233 | 236 | 469 |
| Sub Total | 1,257 | 315 | 434 | 748 | 874 | 1,622 |
| **South Sulawesi** | | | | | | |
| Takalar | 236 | 59 | 161 | 220 | 187 | 407 |
| Bone | 703 | 176 | 527 | 703 | 340 | 1,043 |
| Bulukumba | 415 | 104 | 259 | 362 | 200 | 562 |
| Jeneponto | 336 | 84 | 252 | 336 | 200 | 536 |
| Pinrang | 354 | 89 | 241 | 329 | 290 | 619 |
| Sidenreng | 282 | 70 | 211 | 282 | 250 | 532 |
| Sinjai | 229 | 57 | 225 | 282 | 150 | 432 |
| Sub Total | 2,555 | 639 | 1,876 | 2,514 | 1,617 | 4,131 |
| Grand Total | 3,812 | 954 | 2,310 | 3,262 | 2,491 | 5,753 |

* Data for TTU not available

Source: P.T. Hasfarm reports



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however, respond to the relatively greater need of Outer Island districts and would be wasteful on parts of Java and Bali where maintenance budgets may now exceed present needs. The preferred alternative is a mechanism to top off the 25% earmark that is sufficiently flexible to respond to growth in the proportion of maintainable roads in different districts and to varying mixes of surface types.

Two principles should be observed. First, to the extent possible, maintenance "top-off" funds should be drawn from local resources in order to foster a sense of accountability and responsibility for maintenance within the district. Second, even if specific revenues may not be earmarked for particular expenditures, a conceptual link between the revenue derived from road user contributions and expenditures for road upkeep should be encouraged.

Several alternatives for top-off maintenance funds are suggested: a voluntary increase in the portion of Inpres Dati II that districts budget for maintenance; a small but growing contribution from the district's own tax revenues (PBB, etc.); and increased grants from provincial budgets to districts through either the Development Expenditure on Heavy Repair Maintenance or the Capital Transfer from Development Budget to Lower Regions channels (these would represent a sharing of provincial government receipts from vehicle registration and transfer fees). A less desirable but administratively simpler alternative would be the budgeting of a portion of Inpres Penunjangan Jalan funds for maintenance.

## 5. RECURRENT COST AVAILABILITY FOR THE RRMS PROJECT

The major demands of the RRMS project on counterpart funding are for road rehabilitation (20% GOI-funded) and road maintenance (100% GOI-funded). The immediate financial concern for project implementation is whether the GOI can meet these obligations. This is addressed below. The deeper financial issue is whether districts can, over the long-term, manage their resources to 1) maximize the net benefits from economically-viable roads (through rehabilitating viable links and introducing effective maintenance on them), and 2) minimize the costs of preserving access on the rest of the network. Strategies to achieve this are an expected output of the project.

Maintenance funding requirements are determined by the length of existing "maintainable" roads, the length of additional roads that will be rehabilitated to a maintainable condition under the project, the surface type of each maintainable link, and the unit cost of maintaining each of the three basic surface types - asphalt (or sealed), gravel, and earth.

Tables 12, 13, 14 and 15 project maintenance funding needs for two sample districts from each of the project provinces and compare their needs to the anticipated availability of funds. Several assumptions are made in these tables:

- The existing stock of maintainable roads consists of 100% of the roads now classified by the district as being in "good" condition plus 20% of those classified in "fair" condition.

- Existing roads have a six-year economic life so that, each year, one-sixth (17%) of the existing maintainable stock falls out of the maintainable category. Those that fall out enter the project rehabilitation program.

- The selection of road links for rehabilitation is based solely on traffic volume, and uses the Simplified Table (see Summary of Economic Analysis) with a cutoff IRR of 12%.

- Rehabilitation unit costs include a 35% allowance for administrative overhead. Ten percent is added to the basic unit cost to allow for bridge rehabilitation. Costs are assumed to increase with inflation at 4% per year. Unit costs for follow-on rehabilitation, after the life of project-funded rehabilitated roads is over, are assumed to be 20% less (before inflation) than the cost of the original rehabilitation.

- Road links rehabilitated by the project have a ten-year design life and require rehabilitation again ten years later. During the year in which it is rehabilitated, a road link is not maintained.

- The project includes six years of civil works with rehabilitation implemented in increments of 10%, 15%, 20%, 20%, 20% and 15% of the total in successive years.

- Maintenance unit costs also include a 35% administrative overhead allowance and an additional 10% for the maintenance of bridges. These costs are also assumed to increase at 4% per year.

- The GOI finances 20% of all rehabilitation and 100% of all maintenance work. The sole source of GOI funds is Inpres Dati II. For rehabilitation, the district spends a maximum of 60% of its Inpres Dati II allocation. For maintenance, it utilizes the 25% now earmarked for that purpose. (Together, these contributions total 85% of the district's total Inpres Dati II budget, equal to the percentage now spent on road work by the average district.)

- The basis for allocating Inpres Dati II remains Rp. 1,250/capita with no increase, real or nominal. The nominal Inpres Dati II budget thus grows at 2% per year with the assumed rate of population growth but declines in real terms at 2% per year after the assumed 4% inflation rate is taken into account.

- There are no other sources of funds for road work (Inpres Penunjangan Jalan, transfers from provincial budgets, clove rehabilitation rebates, etc., are assumed not to be available).

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# TABLE 12

## SUMBA BARAT DISTRICT: MAINTENANCE FUNDING NEEDS
## REHABILITATION PROGRAM (100% OF POTENTIAL)

| Type of Work | No. of Links | Total Kilometers | Distribution | Unit Cost (Rp. 000) | Total Cost Roads Only (Rp. 000) | Total Cost Bridges 81% (Rp. 000) | AID Contribution (80%) (Rp. 000) | AID Contribution (80%) (US$000) | GOI Contribution (20%) (Rp. 000) | GOI Contribution (20%) (US$000) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rehab: Paved or Sealed | 1 | 28 | 35% | 48,600 | 1,360,800 | 1,496,880 | 1,197,504 | 6730 | 299,376 | 1683 |
| Rehab: Gravel | 1 | 20 | 25% | 29,700 | 594,000 | 653,400 | 522,720 | 6319 | 130,680 | 880 |
| Rehab: Earth | 1 | 24 | 30% | 15,500 | 372,000 | 409,200 | 327,360 | 5200 | 81,840 | 650 |
| Upgrade: Gravel to Seal | 0 | 0 | 0% | 46,500 | 0 | 0 | 0 | 50 | 0 | 50 |
| Upgrade: Earth to Gravel | 1 | 8 | 10% | 35,000 | 280,000 | 308,000 | 246,400 | 5150 | 61,600 | 638 |
| Total | 4 | 80 | 100% | | 2,606,800 | 2,867,480 | 2,293,984 | 21,399 | 573,496 | 3850 |

## FUNDS FLOW
## (Rp. 000 or km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 | 2000/01 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REHABILITATION** | | | | | | | | | | | | | | |
| Kilometers Rehabilitated | 9 | 12 | 16 | 16 | 16 | 12 | 0 | 0 | 0 | 0 | 8 | 17 | 16 | 116 |
| Total Rehabilitation Cost | 286,748 | 430,122 | 573,496 | 573,496 | 573,496 | 430,122 | 0 | 0 | 0 | 0 | 225,667 | 338,501 | 451,334 | 3,882,982 |
| (inflated @ 4% p.a.) | 286,748 | 447,327 | 620,293 | 645,105 | 670,909 | 523,303 | 0 | 0 | 0 | 0 | 334,043 | 521,106 | 722,601 | 4,771,441 |
| AID Share (80%) | 229,399 | 357,862 | 496,235 | 516,084 | 536,727 | 418,647 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,554,953 |
| GOI Share (20%) | 57,350 | 89,465 | 124,059 | 129,021 | 134,182 | 104,662 | 0 | 0 | 0 | 0 | 225,667 | 338,501 | 451,334 | 1,656,241 |
| GOI Funds (50% Impr.Kab.) | 209,264 | 215,450 | 217,719 | 222,073 | 226,515 | 231,045 | 235,666 | 240,379 | 245,187 | 250,090 | 255,092 | 260,194 | 265,398 | 3,072,071 |
| GOI Surplus (Deficit) | 151,915 | 125,984 | 93,660 | 93,052 | 92,333 | 126,383 | 235,666 | 240,379 | 245,187 | 250,090 | 29,425 | (78,307) | (185,937) | 1,417,830 |
| **MAINTENANCE** | | | | | | | | | | | | | | |
| Kilometers Maintained | 40 | 40 | 44 | 51 | 59 | 68 | 80 | 80 | 80 | 80 | 75 | 73 | 70 | 841 |
| Total Maintenance Cost | 104,489 | 98,517 | 100,010 | 109,268 | 118,526 | 130,302 | 153,296 | 153,296 | 153,296 | 153,296 | 140,707 | 134,442 | 128,118 | 1,677,834 |
| (inflated @ 4% p.a.) | 104,489 | 102,354 | 108,171 | 122,312 | 138,259 | 158,537 | 193,988 | 201,727 | 209,796 | 218,188 | 208,281 | 206,922 | 205,121 | 2,179,120 |
| GOI Funds (50% Impr.Kab.) | 87,194 | 88,937 | 90,716 | 92,530 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| GOI Surplus (Deficit) | (17,296) | (13,417) | (17,455) | (30,381) | (44,278) | (62,263) | 195,774 | (101,549) | (107,435) | (113,984) | (101,992) | (98,508) | (94,539) | (999,090) |
| NET GOI SURPLUS (DEFICIT) | 134,619 | 110,568 | 76,205 | 62,671 | 48,055 | 64,120 | 139,891 | 138,830 | 137,552 | 136,107 | (72,567) | (176,814) | (280,475) | 518,740 |



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# TABLE 13

## NGADA DISTRICT: MAINTENANCE FUNDING NEEDS REHABILITATION PROGRAM (80% OF POTENTIAL)

| Type of Work | No. of Links | Total Kilometers | Distribution | Unit Cost (Rp. 000) | Total Cost Roads Only (Rp. 000) | Total Cost Bridges 810% (Rp. 000) | AID Contribution (80%) (Rp. 000) | AID Contribution (80%) (1000) | GOI Contribution (20%) (Rp. 000) | GOI Contribution (20%) (1000) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rehab:Paved or Sealed | 0 | 0 | 0% | 48,600 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rehab:Gravel | 0 | 0 | 0% | 29,700 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rehab:Earth | 9 | 118 | 92% | 15,500 | 1,822,800 | 2,605,080 | 1,604,064 | 1978 | 401,016 | 8245 |
| Upgrade:Gravel to Seal | 0 | 0 | 0% | 45,500 | 0 | 0 | 0 | 0 | 0 | 0 |
| Upgrade:Earth to Gravel | 2 | 10 | 8% | 35,000 | 336,000 | [illegible] | 292,680 | 8180 | 73,920 | 845 |
| Total | 11 | 127 | 100% | | 2,158,800 | 2,374,580 | 1,899,744 | 11,158 | 474,936 | 9290 |

## FUNDS FLOW
(Rp. 000 or km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 | 2000/01 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REHABILITATION | | | | | | | | | | | | | | |
| Kilometers Rehabilitated | 13 | 19 | 25 | 25 | 25 | 19 | 0 | 0 | 0 | 0 | 13 | 19 | 25 | 184 |
| Total Rehabilitation Cost | 237,468 | 356,202 | 474,936 | 474,936 | 474,936 | 356,202 | 0 | 0 | 0 | 0 | 185,497 | 278,245 | 370,994 | 3,309,416 |
| (Inflated @ 4% p.a.) | 237,468 | 370,450 | 515,591 | 534,238 | 555,608 | 433,374 | 0 | 0 | 0 | 0 | 274,581 | 429,346 | 593,973 | 3,941,730 |
| AID Share (80%) | 189,974 | 296,360 | 410,953 | 427,391 | 444,486 | 346,699 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,115,864 |
| GOI Share (20%) | 47,494 | 74,090 | 102,738 | 106,848 | 111,122 | 86,675 | 0 | 0 | 0 | 0 | 274,581 | 429,346 | 593,973 | 1,825,866 |
| GOI Funds (60% Impr.Kab.) | 144,827 | 147,724 | 150,678 | 153,692 | 156,766 | 159,901 | 163,099 | 166,361 | 169,688 | 173,082 | 176,544 | 180,075 | 183,676 | 2,126,114 |
| GOI Surplus (Deficit) | 97,334 | 73,634 | 47,940 | 46,844 | 45,644 | 73,226 | 163,099 | 166,361 | 169,688 | 173,082 | (98,037) | (249,271) | (410,297) | 300,248 |
| MAINTENANCE | | | | | | | | | | | | | | |
| Kilometers Maintained | 8 | 19 | 37 | 60 | 84 | 108 | 127 | 127 | 127 | 127 | 126 | 125 | 125 | 1,203 |
| Total Maintenance Cost | 7,215 | 18,489 | 36,145 | 60,173 | 84,203 | 108,408 | 127,538 | 127,538 | 127,538 | 127,538 | 126,569 | 125,235 | 125,800 | 1,203,487 |
| (Inflated @ 4% p.a.) | 7,213 | 19,229 | 39,092 | 67,687 | 98,506 | 131,894 | 161,377 | 167,832 | 174,545 | 181,527 | 187,502 | 194,333 | 203,416 | 1,632,146 |
| GOI Funds (25% Impr.Kab.) | 60,345 | 61,552 | 62,783 | 64,038 | 65,319 | 66,625 | 67,958 | 69,317 | 70,703 | 72,118 | 73,560 | 75,031 | 76,532 | 885,881 |
| GOI Surplus (Deficit) | 53,132 | 42,323 | 23,691 | (3,648) | (33,187) | (65,269) | (93,419) | (98,515) | (103,842) | (109,409) | (113,942) | (119,302) | (124,879) | (746,265) |
| NET GOI SURPLUS (DEFICIT) | 150,466 | 115,957 | 71,631 | 43,196 | 12,457 | 7,957 | 69,680 | 67,846 | 65,847 | 63,673 | (211,979) | (267,573) | (535,176) | (446,017) |



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# TABLE 14

## WAJO DISTRICT: MAINTENANCE FUNDING NEEDS
## REHABILITATION PROGRAM (60% OF POTENTIAL)

| Type of Work | No. of Links | Total Kilometers | Distribution | Unit Cost (Rp. 000) | Total Cost: Roads Only (Rp. 000) | Total Cost: Bridges 810% (Rp. 000) | AID Contribution (80%) (Rp. 000) | AID Contribution (80%) ($000) | GOI Contribution (20%) (Rp. 000) | GOI Contribution (20%) ($000) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rehab: Paved or Sealed | 2 | 16 | 10% | 48,000 | 787,320 | 866,052 | 692,242 | $422 | 173,210 | $106 |
| Rehab: Gravel | 11 | 51 | 30% | 29,700 | 1,514,700 | 1,666,170 | 1,332,936 | $813 | 333,234 | $203 |
| Rehab: Earth | 7 | 34 | 20% | 15,500 | 530,100 | 583,110 | 466,486 | $284 | 116,622 | $71 |
| Upgrade: Gravel to Seal | 3 | 57 | 34% | 46,500 | 2,650,500 | 2,915,550 | 2,332,440 | $1,422 | 583,110 | $356 |
| Upgrade: Earth to Gravel | 2 | 9 | 5% | 35,000 | 315,000 | 346,500 | 277,200 | $169 | 69,300 | $42 |
| Total | 30 | 167 | 100% | | 5,797,620 | 6,377,382 | 5,101,906 | $3,111 | 1,275,476 | $778 |

## FUNDS FLOW
## (Rp. 000 or km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 | 2000/01 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REHABILITATION | | | | | | | | | | | | | | |
| Kilometers Rehabilitated | 17 | 25 | 33 | 33 | 33 | 25 | 0 | 0 | 0 | 0 | 17 | 25 | 33 | 243 |
| Total Rehabilitation Cost | 637,738 | 956,607 | 1,275,476 | 1,275,476 | 1,275,476 | 956,607 | 0 | 0 | 0 | 0 | 516,527 | 774,790 | 1,033,055 | 8,701,752 |
| (Inflated @ 4% p.a.) | 637,738 | 994,872 | 1,379,525 | 1,434,737 | 1,492,127 | 1,163,859 | 0 | 0 | 0 | 0 | 764,585 | 1,192,753 | 1,653,951 | 10,714,179 |
| AID Share (80%) | 510,191 | 795,897 | 1,103,644 | 1,147,790 | 1,193,702 | 931,087 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,682,311 |
| GOI Share (20%) | 127,548 | 198,974 | 275,911 | 286,947 | 298,425 | 232,772 | 0 | 0 | 0 | 0 | 764,585 | 1,192,753 | 1,653,951 | 5,031,868 |
| GOI Funds (50% Impr.Kab.) | 378,556 | 386,127 | 393,850 | 401,727 | 409,761 | 417,957 | 426,316 | 434,842 | 443,539 | 452,410 | 461,458 | 470,687 | 480,101 | 5,557,331 |
| GOI Surplus (Deficit) | 251,009 | 187,153 | 117,939 | 114,779 | 111,336 | 185,185 | 426,316 | 434,842 | 443,539 | 452,410 | (303,128) | (722,066) | (1,173,851) | 525,463 |
| MAINTENANCE | | | | | | | | | | | | | | |
| Kilometers Maintained | 2 | 18 | 43 | 76 | 109 | 142 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 1,561 |
| Total Maintenance Cost | 3,469 | 36,870 | 87,325 | 154,036 | 222,347 | 289,942 | 341,108 | 341,108 | 341,108 | 341,108 | 340,696 | 340,421 | 340,292 | 3,180,663 |
| (Inflated @ 4% p.a.) | 3,469 | 38,344 | 94,451 | 174,170 | 260,115 | 352,758 | 431,610 | 448,875 | 466,830 | 485,503 | 504,304 | 524,155 | 544,786 | 4,329,369 |
| GOI Funds (25% Impr.Kab.) | 157,732 | 160,896 | 164,104 | 167,356 | 170,734 | 174,149 | 177,632 | 181,184 | 184,808 | 188,504 | 192,274 | 196,120 | 200,042 | 2,315,556 |
| GOI Surplus (Deficit) | 154,262 | 122,552 | 69,653 | 16,793) | (89,381) | (178,610) | (253,979) | (267,691) | (282,022) | (296,999) | (312,030) | (328,035) | (344,744) | (2,013,815) |
| NET GOI SURPLUS (DEFICIT) | 405,271 | 309,695 | 187,592 | 107,996 | 21,955 | 6,575 | 172,337 | 167,152 | 161,517 | 155,411 | (615,158) | (1,050,101) | (1,518,595) | (1,488,352) |



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# TABLE 15

## GOWA DISTRICT: MAINTENANCE FUNDING NEEDS RECONSTRUCTION PROGRAM (60% OF POTENTIAL)

| Type of Work | No. of Links | Total Kilometers | Distribution | Unit Cost (Rp. 000) | Total Cost Roads Only (Rp. 000) | Total Cost Bridges (Rp. 000) | Total Cost (Rp. 000) | AID Contribution (80%) (Rp. 000) | AID Contribution (80%) (000) | GOI Contribution (20%) (Rp. 000) | GOI Contribution (20%) (000) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rehab:Paved or Sealed | 6 | 22 | 14% | 45,600 | 1,054,620 | 1,140,082 | 928,066 | 6566 | 232,016 | 1640 |
| Rehab:Gravel | 12 | 65 | 41% | 29,706 | 1,933,470 | 2,126,817 | 1,701,454 | 11,037 | 425,363 | 2759 |
| Rehab:Earth | 12 | 54 | 34% | 15,500 | 835,450 | 918,995 | 735,196 | 4448 | 183,799 | 1112 |
| Upgrade:Gravel to Seal | 14 | 10 | 6% | 46,500 | 455,700 | 501,270 | 401,016 | 3245 | 100,254 | 811 |
| Upgrade:Earth to Gravel | 14 | 10 | 6% | 35,000 | 343,000 | 377,300 | 301,840 | 2184 | 75,460 | 546 |
| Total | 58 | 160 | 100% | | 4,622,240 | 5,084,464 | 4,067,571 | 32,480 | 1,016,893 | 8620 |

## FUNDS FLOW
## (Rp. 000 or km)

| | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 | 2000/01 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REHABILITATION | | | | | | | | | | | | | | |
| Kilometers Rehabilitated | 16 | 24 | 32 | 32 | 32 | 24 | 0 | 0 | 0 | 0 | 16 | 24 | 32 | 232 |
| Total Rehabilitation Cost | 508,446 | 762,670 | 1,016,893 | 1,016,893 | 1,016,893 | 762,670 | 0 | 0 | 0 | 0 | 493,997 | 605,996 | 807,995 | 6,902,452 |
| (inflated @ 4% p.a.) | 508,446 | 793,176 | 1,099,871 | 1,143,856 | 1,189,621 | 927,904 | 0 | 0 | 0 | 0 | 598,015 | 832,903 | 1,293,626 | 8,487,429 |
| AID Share (80%) | 406,757 | 634,541 | 879,897 | 915,093 | 951,697 | 742,323 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,530,308 |
| GOI Share (20%) | 101,689 | 158,635 | 219,974 | 228,773 | 237,924 | 185,581 | 0 | 0 | 0 | 0 | 598,015 | 832,903 | 1,293,626 | 3,957,121 |
| GOI Funds (50% Impr.Kab.) | 286,997 | 292,737 | 298,591 | 304,553 | 310,655 | 316,868 | 323,205 | 329,669 | 336,262 | 342,988 | 349,847 | 356,844 | 363,981 | 4,218,268 |
| GOI Surplus (Deficit) | 185,308 | 134,101 | 78,617 | 75,790 | 72,730 | 131,287 | 323,205 | 329,669 | 336,262 | 342,988 | (248,167) | (476,059) | (929,646) | 256,687 |
| MAINTENANCE | | | | | | | | | | | | | | |
| Kilometers Maintained | 51 | 57 | 70 | 92 | 113 | 136 | 160 | 160 | 160 | 160 | 154 | 151 | 148 | 1,615 |
| Total Maintenance Cost | 123,072 | 128,906 | 150,260 | 187,134 | 224,009 | 263,849 | 310,410 | 310,410 | 310,410 | 310,410 | 295,592 | 288,168 | 280,756 | 3,183,374 |
| (inflated @ 4% p.a.) | 123,072 | 134,062 | 162,521 | 210,500 | 262,058 | 321,012 | 392,768 | 408,479 | 424,818 | 441,810 | 437,534 | 443,622 | 449,496 | 4,211,752 |
| GOI Funds (25% Impr.Kab.) | 119,582 | 121,974 | 124,413 | 126,901 | 129,439 | 132,028 | 134,669 | 137,362 | 140,109 | 142,912 | 145,770 | 148,685 | 151,659 | 1,755,503 |
| | | | | | | | | | | | | | | 0 |
| GOI Surplus (Deficit) | (3,490) | (12,088) | (38,108) | (83,599) | (132,619) | (188,984) | (258,099) | (271,116) | (284,708) | (298,899) | (291,764) | (294,935) | (297,837) | (2,456,249) |
| NET GOI SURPLUS (DEFICIT) | 181,817 | 122,013 | 40,509 | (7,809) | (59,889) | (57,697) | 65,106 | 58,553 | 51,554 | 44,089 | (539,931) | (870,995) | (1,227,482) | (2,200,562) |

This model is very conservative and, given the number of uncertain assumptions and the uncertainty of data, not useful for making precise predictions. The projected trends are revealing, however. First, few districts can afford the counterpart costs to rehabilitate 100% of the links that are eligible at an IRR of 12%. Except for Sumba Barat, the rehabilitation program must be cut back to fit the availability of funds. In most districts, there are more viable roads than can be financed. Second, the existing 25% Inpres Dati II earmark is not sufficient, even with a reduced rehabilitation program, to finance the maintenance requirements of existing maintainable and newly-rehabilitated links. In some cases (Sumba Barat and Gowa), the need for additional funds is immediate, although initially small - about $10,500 and $2,100 per year. In others (Ngada and Wajo), it arises around 1992. The requirements for additional funds in the last year of the project range from $40,000 in Sumba Barat to $115,000 in Gowa. Third, for every district, maintenance funding requirements peak and stabilize about 1999, four years after the project is over (declines shown thereafter are an error in the model and should be disregarded). The 1999 level represents the projected permanent funding requirement for each district to maintain the core of its total road system which would be rehabilitated under the RRMS project. These permanent shortages range from about $60,000 per year in Sumba Barat to approximately $145,000 in Wajo. Fourth, there are insufficient funds to pay for the new investments in rehabilitation which are, in theory at least, required once the design lives (assumed to be ten years) of links rehabilitated by the project are over. This can be seen in the sudden increase in rehabilitation costs beginning around 1999/2000. Although the net balance of funds available for rehabilitation and maintenance together (net GOI surplus) is positive in most years for all districts, and although the funds are fungible between these categories of work, the availability of Inpres Dati II for roads that the project does not touch will also be a key concern of district officials and must be taken into account.

Several factors reduce the requirement for maintenance funds below those estimated in the model. First, unit maintenance costs are based on a generous contract standard ("generous" to account for initial inexperience), including full equipment "rental" rates, a 35% overhead, and full staff expenses. Initially, the RRMS project will use force account crews and, although alternatives are expected to be adopted after several years, force account will continue to be used for some maintenance tasks in most districts. For force account in Indonesia, perhaps half of equipment costs, overheads and staff expenses are included in the routine budget (or, in the case of equipment depreciation are not accounted for at all) and are not, therefore, drawn from the 25% Inpres Dati II earmark. This could reduce the demand on Inpres by perhaps 25%. Second, many consultants have recommended that neither Telford nor existing earth roads should be maintained. These have been included in the maintainable category in the model. Excluding them would further reduce maintenance funding requirements through the first four to five years of the RRMS project. Finally, experiments with the roadman and other alternative systems may lead the project to less costly approaches to maintenance.

On the negative side, the greatest risk to the sustainability of district contributions to either maintenance or rehabilitation will be the political demand to divert district resources to preserve a minimum level of service on road links that receive no attention under the project. This risk is difficult to evaluate. Records of districts' expenditures for the most recent year for which Inpres Penunjangan Jalan was still freely available (1983/84), show that the fourteen districts studied performed some form of treatment on an average of about 45 km per district per year at an average unit cost of roughly $9,000/km. The length of road rehabilitated under the RRMS project will vary between districts but, if the sample projections in Tables 12-15 were followed, residual Inpres Dati II allocations available for non-project road work in those districts would be as shown in Table 16.

The crucial period for the districts will be the middle three years of the project when 15-25 km of road per district are being rehabilitated with project funds but resources for non-project roads are stretched tightly. This is the period when GOI budget prospects are expected to improve (see the Economic Analysis). Inpres Penunjangan Jalan funds are still being channeled to the project districts, although in smaller amounts than during the early 1980s, and the potential for this to continue during the crucial period is high.

TABLE 16

AVAILABILITY OF INPRES DATI II REHABILITATION FUNDS
FOR NON-PROJECT REHABILITATION WORK*
(Rp. 000)

| | Sumba Barat | Ngada | Wajo | Gowa |
|---|---|---|---|---|
| 1988/89 | 151,915 | 97,334 | 251,009 | 185,308 |
| 1989/90 | 123,984 | 73,634 | 187,153 | 134,101 |
| 1990/91 | 93,660 | 47,940 | 117,939 | 78,617 |
| 1991/92 | 93,052 | 46,844 | 114,779 | 75,790 |
| 1992/93 | 92,333 | 45,644 | 111,336 | 72,730 |
| 1993/94 | 126,383 | 73,226 | 185,185 | 131,287 |
| 1994/95** | 235,666 | 163,099 | 426,316 | 323,205 |

* An additional 15% of each district's Inpres Dati II is assumed to be used for purposes unrelated to roads.

** Large surpluses continue until 1998.

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## 6. CONCLUSIONS

The districts will be able to finance the counterpart costs of a reduced RRMS rehabilitation program, reduced from level which would eligible if economic criteria rather then financial capability were the constraint. Based on sample traffic counts, consultant observations of traffic volume beyond the sample areas, and the limits imposed by the availability of GOI funds, it is estimated that rehabilitation will average about 125 km per district in NTT (primarily earth and gravel rehabilitation) and 150 km in South Sulawesi (primarily gravel and asphalt rehabilitation with a limited amount of upgrading). The estimation of the distribution of work among districts will require complete traffic and condition surveys in year 1 and will be combined with financial data for all districts as is done for the sample districts in Tables 12-15.

Existing maintenance funds will not be sufficient to finance the increased maintenance requirements of rehabilitated roads. The additional amounts needed will vary among districts so that a flexible mechanism to allocate funds among districts in accordance with information generated by maintenance management systems, and in addition to the 25% Inpres Dati II earmark, is necessary. The source of additional maintenance funding chosen is critical to institutionalizing a higher priority to maintenance in district road budgets. Several considerations have determined the strategy chosen for the project:

- The minimum requirement is a guaranteed source of additional funding adequate to maintain project-rehabilitated roads through the PACD.

- The desired outcome is increased resources for both maintenance and rehabilitation sufficient to finance the many potential high-return investments in the sector. Within budgets for the sector, an increased proportion of funds for maintenance is required so that the availability of maintenance funds is not a constraint to further investments in rehabilitation.

- Although inequitably distributed, earmarked Inpres Dati II funds are a solid foundation to build on and should be retained. Tailoring the earmark to individual district needs is not practical. As long as central grants dominate district finances, obtaining a share of Inpres Penunjangan Jalan budgets for maintenance is a preferred method to rectify the imbalance of present maintenance allocations between Inner and Outer Islands.

- Although prospects are limited now, work should be initiated to operationalize the principle that locally-generated funds and road user contributions should be tapped to ultimately replace or complement the Inpres budgets. Methods to capture a share of the income generated by improved roads are particularly important for the future maintenance of the networks.

- Given the districts' inexperience with maintenance, at least one year of supervised maintenance management, using the 25% earmark only, is desirable before maintenance funds are significantly increased.

Additional funding requirements are estimated to be $3.0 million during the life of the project. This figure was derived by comparing the present Inpres earmark with the present need in each district (defined in the same manner as shown in Table 4), deducting about one-half of the "maintainable" gravel roads on the grounds that it is Telford construction, eliminating most of the earth links, and adding the maintenance costs for the estimated length of links rehabilitated under the project. It is planned that additional funds for maintenance will be provided beginning in the second year of civil works (1989/90) and that the 1988/89 program will utilize only the existing Inpres earmark. The need for additional funds will increase gradually, as estimated in Table 17.

The project will rely on additional contributions from national budget sources for the required additional funds, but will test a variety of alternative revenue-generating approaches focused on generating local funds. The Special Studies program will, under the auspice of the Highway Steering Committee, survey the potential approaches to be tested and will assist to initiate and monitor pilot efforts in those recommended. Potential pilot efforts include:

- Revenue-sharing of vehicle registration and transfer fees between provincial and district governments. Alternatively, a surcharge on existing province fees could be made, with the proceeds accruing to the districts.

- An earmarked percentage of PBB revenues for road maintenance, as under the previous IPEDA.

- A surcharge on retail fuel sales.

Funding for rehabilitation for the last three years of civil works will require that pilot efforts be underway in each province and evidence that proceeds are being allocated to road maintenance.

The budget allocation of $3.0 million for additional maintenance requirements will be programmed through Inpres Penunjangan Jalan each year roughly one third to NTT and two-thirds to South Sulawesi, in accordance with the DPUPs' assessment of the relative shortage of maintenance funds among the project districts in their respective provinces.

TABLE 17

ESTIMATED ADDITIONAL MAINTENANCE FUNDS REQUIRED

(U.S. $)

| Year | Amount |
|---|---|
| 1989/90 | 300,000 |
| 1990/91 | 450,000 |
| 1991/92 | 600,000 |
| 1992/93 | 750,000 |
| 1993/94 | 900,000 |
| Total | 3,000,000 |

# ANNEX J

# INSTITUTIONAL AND SOCIAL SOUNDNESS ANALYSIS

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As a project to improve the maintenance of district roads, which should result in a portion of district road networks being in better condition, this project does not share many of the potential impact characteristics of road construction or expansion projects. The changes in the socio-economic environment which will be brought about are largely incremental — enhancing or diminishing processes and trends that are already occurring.

The focus of the RRMS project on institutional change, rather than simply on the physical outputs which will also be produced, means that the project activities are aimed first at the organizations, individuals, policies and procedures which govern present approaches to dealing with Indonesia's district road networks. As already discussed in the summary of this analysis, although the characteristics of road users (and tax payers) who are the ultimate beneficiaries will influence project success, the non-economic dimensions of these characteristics will not immediately affect the project's feasibility. Similarly, the predictable effect which the project's approach to establishing priorities according to use levels will have on people's access to roads is an issue (e.g., some remote areas may have poorer access as a result), but one which cannot effectively be dealt with until the recommended project procedures are initiated.

These are intended to be subjects for Special Studies during the course of the project. Their influence on the direction and formulation of the project has been summarized in Section 5.4 of the Project Paper. The discussion below focuses in detail on the critical constraints to road maintenance and management imposed by the institutional environement in which these tasks take place. It focuses on the direct beneficiaries of (and actors within) the project.

## 1. INTRODUCTION: THE INDONESIAN GOVERNMENT STRUCTURE

Efforts to strengthen the institutional capacities of local government agencies in Indonesia are complicated by the horizontal and vertical divisions between public institutions at all levels of government. There is no aspect of an institution's role and function, human resources, equipment, budget, organizational structure or performance that is unaffected by these divisions. The lower the level of government, the more profound their effect.

First, vertical divisions separate one ministry from another through the carefully-defined functions assigned to various agencies. These functions are generally sectoral in nature and tend to ignore functional responsibilities that may require the integration of several different sectors. As with sectoral agencies in other countries, the definition of a ministry's responsibility creates barriers which serve both to protect it from intrusions and to restrain its capacity to coordinate its programs with the activities of other agencies. Vertical divisions between agencies at the national level are mirrored at the provincial, district and subdistrict levels of government.

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Second, horizontal separations, which distinguish different levels of government, further complicate this structure. For the management of public works, responsibility is divided among national, provincial and district governments. The national Ministry of Public Works has regional offices (Kantor Wilayah or Kanwil) which represent it at the provincial level to oversee the public works in the province that are part of the national government's jurisdiction. The provincial and district governments, in turn, have their own separate sectoral offices (Dinas) which report to the heads of the local government and are accountable for their separate respective parts of the infrastructure system. The Dinas are part of the "autonomous" regional government and have no direct relationship with the Kanwil or with public works agencies at the national level. Furthermore, the Dinas at the provincial level (Level I, Tingkat I) have no direct administrative link with the Dinas at the district level (Tingkat II). This isolates the latter from higher-level agencies that may have the expertise and resources to provide technical support, but have no administrative channel to do so.

Despite the apparent "autonomy" of the Dinas and their isolation from the support of higher agencies, the Dinas have relatively little scope or opportunity for initiative and independence. In matters of personnel policy, organizational structure, and the disposition of funds transferred to them by central authorities, they are bound by the rules and regulations established in Jakarta that govern virtually all areas of their activities. All permanent Dinas staff, for example, must be approved by central authorities. Further, roughly 85% of all district budget resources are comprised of grants from the national government and the use of these monies is controlled by central government guidelines.

In theory, the head of the local government (the Governor for a province or the Bupati for a district), is responsible for pulling these diverse lines of responsibility together and coordinating the activities of the Kanwil and the Dinas.* Formally, the Kanwil reports both to the higher sectoral authority at the national level and to the provincial Governor. However, because the budget for development activities under the national ministries' (and Kanwils') jurisdiction is channeled through national sectoral agencies, Kanwil offices tend to be more responsive to the ministries headquartered in Jakarta.

The consequence of this pattern of vertical and horizontal divisions is that an institutional map resembles a matrix of squares. The diverse collection of institutions is primarily held together by funding channels (emphasizing vertical linkages) and local government responsibilities (emphasizing horizontal linkages). Figure 1 illustrates the general pattern, although each ministry and each local government has devised its own variations on this theme.

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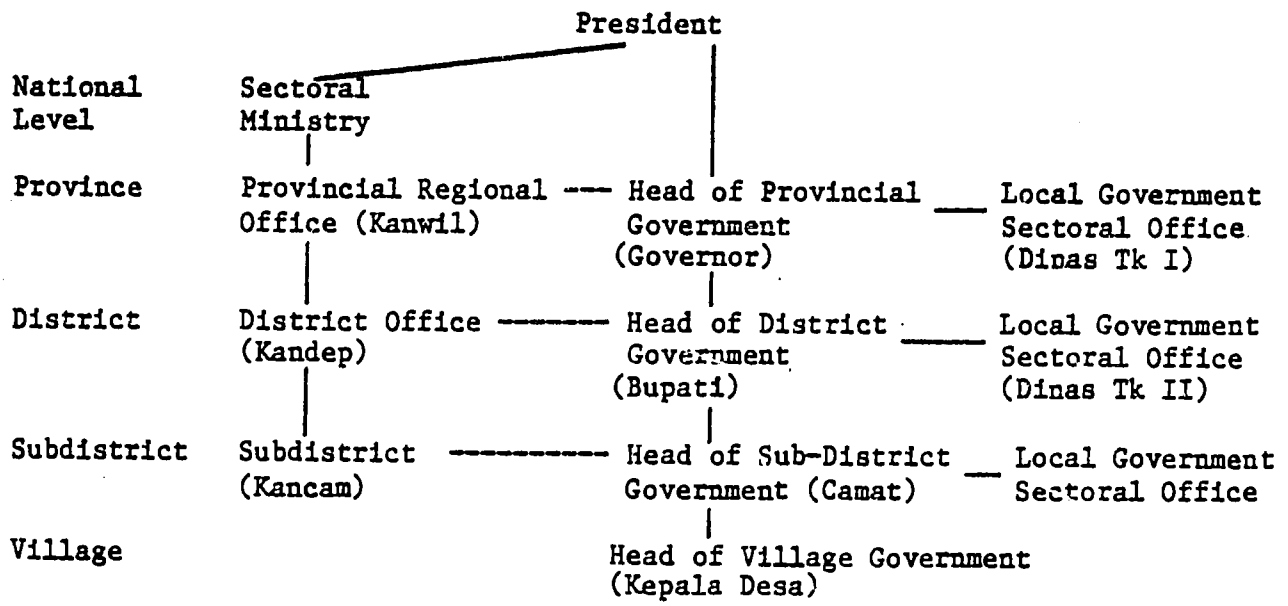
* Frequently, because of staffing shortages, the head of the Kanwil and provincial Dinas are the same person (this is the case in both South Sulawesi and NTT).

FIGURE 1

GENERALIZED MATRIX OF INDONESIAN GOVERNMENT STRUCTURE




## 2. IDENTIFICATION OF GOVERNMENT OF INDONESIA AGENCIES FOR THE PROJECT

Donor agency projects are necessarily negotiated at the national level, and donor funds are routed to lower levels of government through national agencies. This situation generally strengthens the role of national agencies, increases the dependency of lower levels of government, and restricts the opportunities for local initiative. Because it is not possible to target district agencies directly, efforts to strengthen their capabilities must work with and through national and provincial agencies.

To the extent that a project involves more than one sector or more than one funding channel, the matrix identifying key agencies expands and becomes more complex. With the addition of more agencies, each with its own organizational structure, specific functions, procedures and requirements, the project faces additional institutional barriers that must be overcome to coordinate activities.

Figure 2 presents an elaborated matrix, identifying the key actors in the Rural Roads Maintenance Systems Project and their primary function in its implementation. Although the target of the project is the district Public Works office, the matrix illustrates the extent to which a variety of agencies at several levels of government must be taken into account. These other agencies will strongly influence the level of human and financial resources available, the terms and conditions under which they can be used, and the organizational structure within which they will be developed.

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# 3. FUNDING

## 3.1 FUNDING CHANNELS

Indonesia is renowned for the complexity of its development project financing and the multiplicity of its budget channels. Funding for a given activity (primary schools or road construction, for example) may flow through a dozen or more different channels. This complexity both reflects and reinforces the vertical divisions that separate sectoral agencies. Almost all public resources are collected, nationally aggregated and then allocated along sectoral lines by agencies in Jakarta. They are then reallocated, generally for specific purposes, to progressively lower levels of government. In this way, the budget process binds each agency to its "older brother" at the next-higher level of government, establishing a pattern of cooperation and dependency. The exceptions to this pattern are the Inpres (Presidential Instruction) funding accounts, which are grants from the Home Affairs Ministry of the central government to provincial, district, or village governments. These grants bypass intermediate government levels and thereby reinforce dependency on the center rather than the next higher level.

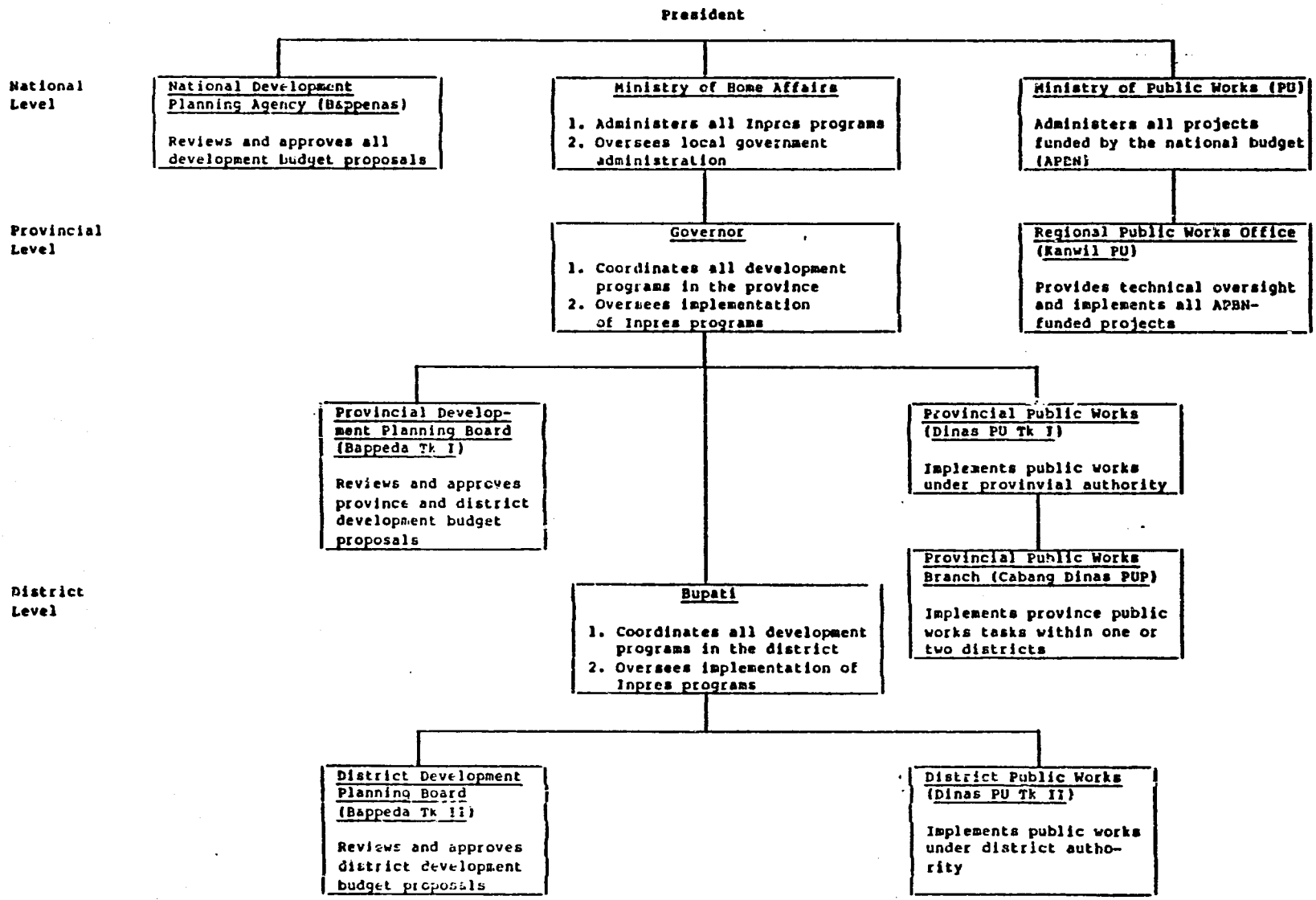
Each budget channel imposes different terms and conditions on the use of funds at lower levels of government, and each involves different key agencies. It is useful to distinguish between national development budget funds (APBN), which are allocated to and channeled through sectoral ministries in Jakarta, and Inpres funds. APBN budgets have constituted approximately 75% of all development expenditures over the past five years, while Inpres funds have constituted about 25%.

For the RRMS project, two Inpres programs are of particular importance: Roads (Inpres Penjungangan Jalan) and District (Inpres Dati II). These are the primary sources of funding for the construction, management and maintenance of district roads, but they differ in several important respects.

Inpres Penunjangan Jalan (IPJ) is specifically targeted for the improvement of district road networks. IPJ funds are used exclusively for the construction of new roads or the rehabilitation of significantly deteriorated existing roads. Maintenance is not specifically included as an allowable activity under this program. The regulations governing the use of these Inpres funds are determined annually at the national level, with the Directorate General of Regional Development (Bangda) of the Ministry of Home Affairs taking the leading role. The Ministry of Public Works, however, makes an important contribution to the determination of the regulations by preparing a brief technical manual each year which provides the engineering standards that accompany the IPJ instructions to district authorities.

**FIGURE 2**

**PROJECT-SPECIFIC MATRIX OF INDONESIAN GOVERNMENT STRUCTURE**



Inpres Dati II funding, in contrast, constitutes a block grant to the district and thus provides it with much greater latitude in making discretionary judgments about the grant's use. Although districts generally choose to allocate most of their Inpres Dati II funds to roads, they are not required to do so. Districts are required, however, to use at least 25% of their total Inpres Dati II allocation for road maintenance, but are free to develop their own priorities with regard to specific sites and technical approaches. As with IPJ, the regulations governing the use of Inpres Dati II funds are formulated in Jakarta by Bangda. However, unlike IPJ, and because Inpres Dati II is a general fund, the Ministry of Public Works plays no formal part in this process and there is no technical manual establishing road standards. Therefore, although Inpres Dati II specifically earmarks funds for road maintenance, and although the majority of the remainder is also used for roads, it does not provide the technical guidance required to help ensure that maintenance or other road work is carried out properly. Because the district Public Works office is in all other respects isolated from Public Works institutions at higher level, other modes for technical guidance are not used.

The reliance on Inpres for district road funding exacerbates the isolation of district Public Works offices and contributes to the poor quality of work performed. Because the two Inpres accounts bypass the provincial government, districts are not directly bound or accountable to these authorities. Rather, accountability is to the central government which is too distant to exert effective supervision or to provide the technical support (training, field advice, etc.) required to improve performance. Thus, the horizontal division prevents the relatively skilled provincial Public Works department from playing a role in developing the capabilities of district Public Works staff. At the same time, the vertical division between the Ministry of Home Affairs in Jakarta and the Ministry of Public Works prevents the latter from requiring district accountability or from offering technical support to districts, even if the formidable logistics of doing so from Jakarta could be overcome. Further, Inpres accounts are the responsibility of Home Affairs, which lacks the technical expertise and staff to effectively monitor or assist districts on engineering issues.

## 3.2 ROUTINE AND DEVELOPMENT BUDGETS

While the Routine Budget provides basic salaries and many routine operating costs, it is only part of the total package of resources flowing into the Dinas. A key source of funding for the activities of all agencies is the Development Budget. In addition to financing the direct costs of projects, this budget is used to augment staff salaries through project honoraria, make travel payments, and provide per diem expenses. Routine office needs are often met through development project funds for automobiles, gasoline, repair costs, report production costs, and materials. For district political leaders, the amount of the Development Budget and its size relative to Routine expenditures is a key political concern, regardless of the routine nature of many Development expenditures.

Given the built-in organizational and individual incentives provided by the Development Budget, road maintenance - ideally perceived and budgeted as a routine activity - will likely remain under the Development Budget.

Although the Development Budget is broken down according to broad sectors at the national level, operationally it is comprised of a series of projects. Each project has its own budget, which is specified in the List of Project Activities (Dafter Isian Proyek or DIP). Project-specific DIPs are the driving force behind almost all the activities of any agency, determining who gets what kinds of salary supplements, where the agency will focus its attention, and what kinds of resources it has available.

DIPs are drawn up and approved annually. Almost all planning activities are focused on this annual process, rather than on long-term plans. Although there is a district and provincial five-year plan (Repelita Daerah), this is made after and in response to the national Repelita and provides only very general guidance for the annual budget process. Furthermore, there is no intermediate step between the five year plan and the annual DIP which would serve to link different projects together in any one year or annual projects together over a series of years.

This emphasis on individual projects inhibits the development of any broader agency strategy that cuts across individual projects and establishes a long-term strategic plan. This is particularly true at lower levels of government, where agencies most commonly act as the implementing force, carrying out the plans formulated at a higher level of government. For road maintenance and rehabilitation, there is rarely a strategy at the district level; rather, there is evidence of and hoc annual responses to the perennial problem of too little money for too many needs.

## 4. KEY AGENCIES

This section describes the two major agencies involved in road management and maintenance (the Ministry of Public Works and the Ministry of Home Affairs) and analyzes their working relationship in this sector. This leads to a description of the Project Management Unit, the needs it is designed to meet, and the way in which it functions. Finally, the structure, organization and institutional strengths and weaknesses of the provincial and district Public Works offices are examined. Because the latter agency is the focal point of the project's institutional development efforts and the key to the achievement of project objectives, particular attention is given to its financial and human resources, organizational structure, and road management and maintenance procedures.

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## 4.1 MINISTRY OF PUBLIC WORKS

This ministry has the primary responsibility for the development and management of Indonesia's water resources, urban infrastructure and roads. Compared with other ministries, Public Works receives the largest allocation of the national development budget and is one of the strongest and most organizationally developed ministries. From its headquarters in Jakarta to the provincial and district levels, the Public Works office has high visibility.

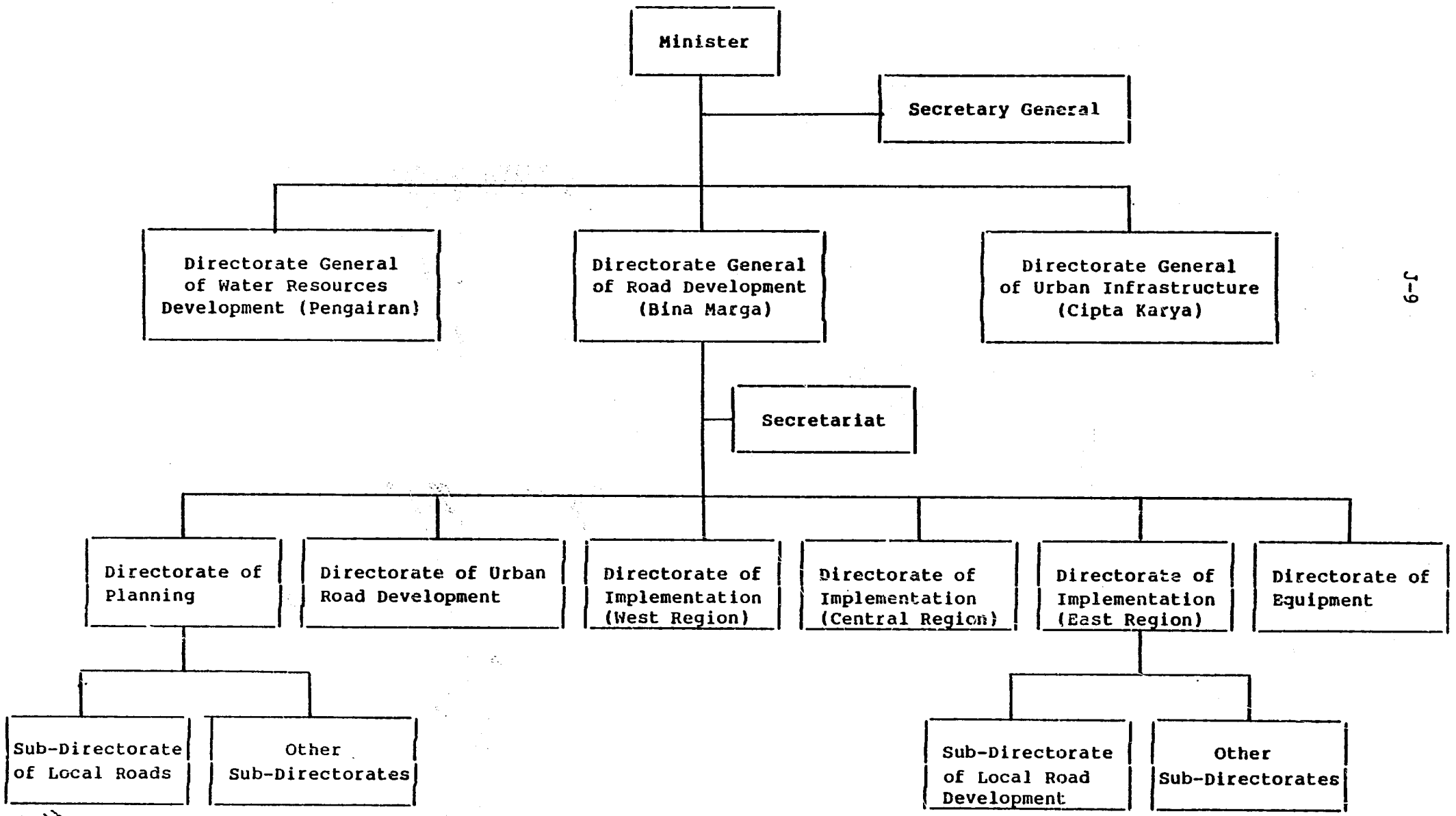
As shown in Figure 3, ministry responsibilities are divided amongst three large Directorate Generals: water resources (Pengairan), urban infrastructure (Cipta Karya), and roads (Bina Marga). Formally, these directorate generals are coordinated by the office of the Secretary General, but in practice they operate as semi-autonomous bodies reporting directly to the Minister. The division of responsibilities into three functional areas at the national level is reflected at the provincial and often at the district levels of government, with separate offices or divisions within each office for these distinct functions.

The Ministry of Public Works, like the provincial or district Public Works offices, is essentially a technical organization staffed by engineers with expertise in road construction, water resources, or urban infrastructure and buildings. While there is some urban planning capacity in Cipta Karya, most Public Works offices are focused on construction and maintenance. Broader issues of development planning are the responsibility of other agencies.

At the national level, the Directorate-General of Road Development (Bina Marga) is the key Ministry of Public Works office for the RRMS project. Bina Marga's organization reflects a distinction between planning and policy functions (where responsibilities cut across all aspects of road development throughout the country) and implementation (where responsibilities fall on particular geographic regions). The Directorate of Planning oversees road sector planning and policy. It includes a Sub-Directorate of Local Roads which monitors district road development throughout Indonesia, advises on budget priorities, and establishes (within limits determined by the Ministry of Home Affairs) district road standards. The Directorate of Implementation (Eastern Region) is responsible for implementing all Bina Marga activities in eastern Indonesia. Within this Directorate there is a Sub-Directorate of Local Road Development which focuses on the implementation of district road development activities.

FIGURE 3

MINISTRY OF PUBLIC WORKS ORGANIZATIONAL CHART



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This distinction between planning and implementation means that the project must work with two separate Sub-Directorates within Bina Marga. Because a fundamental project objective is to establish a replicable road maintenance system that can be duplicated in other areas of the country, the project must work closely with the Sub-Directorate of Local Roads to establish project objectives, review project progress, and review the project's implications for policy. At the same time, because the project will support the implementation of road maintenance and rehabilitation in two provinces in eastern Indonesia, it must also work closely with the Sub-Directorate of Local Road Development (Eastern Region). Project implementation will have to take into account potential problems involving coordination and consultation between these agencies, and develop strategies to overcome them.

The Ministry of Public Works' representative office in the provinces is the Kanwil. While the Kanwil consults with the provincial Governor, it also oversees the implementation of public works that are under the authority of and funded by the national Ministry. The Kanwil, like the Ministry, has no formal role in provincial or district public works affairs. The close links between the Kanwil and Jakarta established by budgetary dependence are reinforced by the personnel system, which allows a Kanwil staff member to aspire to promotion to the senior levels of the Ministry in Jakarta. Greater career possibilities and larger funding have made service in the Kanwil office more attractive than service in the Dinas office, where career prospects are limited to the provincial or district level, and project size and total project funds are much more modest. Consequently, Kanwil offices tend to be staffed with more qualified and experienced civil servants who have greater access to professional upgrading programs, outside expertise and new technologies.

## 4.2 MINISTRY OF HOME AFFAIRS

The Ministry of Home Affairs, through its Directorate General of Regional Development (Bangda), has very broadly-defined responsibility for the development of local government capacities. In contrast to the Ministry of Public Works, with its strong sectoral orientation and linkages to Kanwil offices, Bangda's relationship to local government is neither simple nor direct.

Under the provisions of Basic Law No. 5 of 1974, which establishes the framework of local government responsibilities and authorities, both the provincial and district governments are officially described as autonomous regions. The law makes it clear that the autonomy of a region establishes more of an obligation than a right, where local government authorities are obligated to carry forward national development. In meeting this obligation, they may exercise only those powers granted to them by the central government. At all times the authority of the national government remains supreme, and local governments are required to organize and manage their affairs in accordance with regulations determined at the national level.

Bangda in Jakarta is the primary agency responsible for overseeing and supervising the development of regional autonomy in this sense. Although a provincial governor is appointed to his office by the President, he reports to the President through the Ministry of Home Affairs. Acting for and on behalf of the Minister of Home Affairs, Bangda issues the instructions establishing the rules and regulations within which provincial and district government agencies operate. Therefore, in contrast to Bina Marga, Bangda is generally not in a position to manage directly a specific sectoral or local project. It does not have a regional representative at the provincial or district level, but instead works through local government agencies by establishing the ground rules for sectoral Dinas offices.

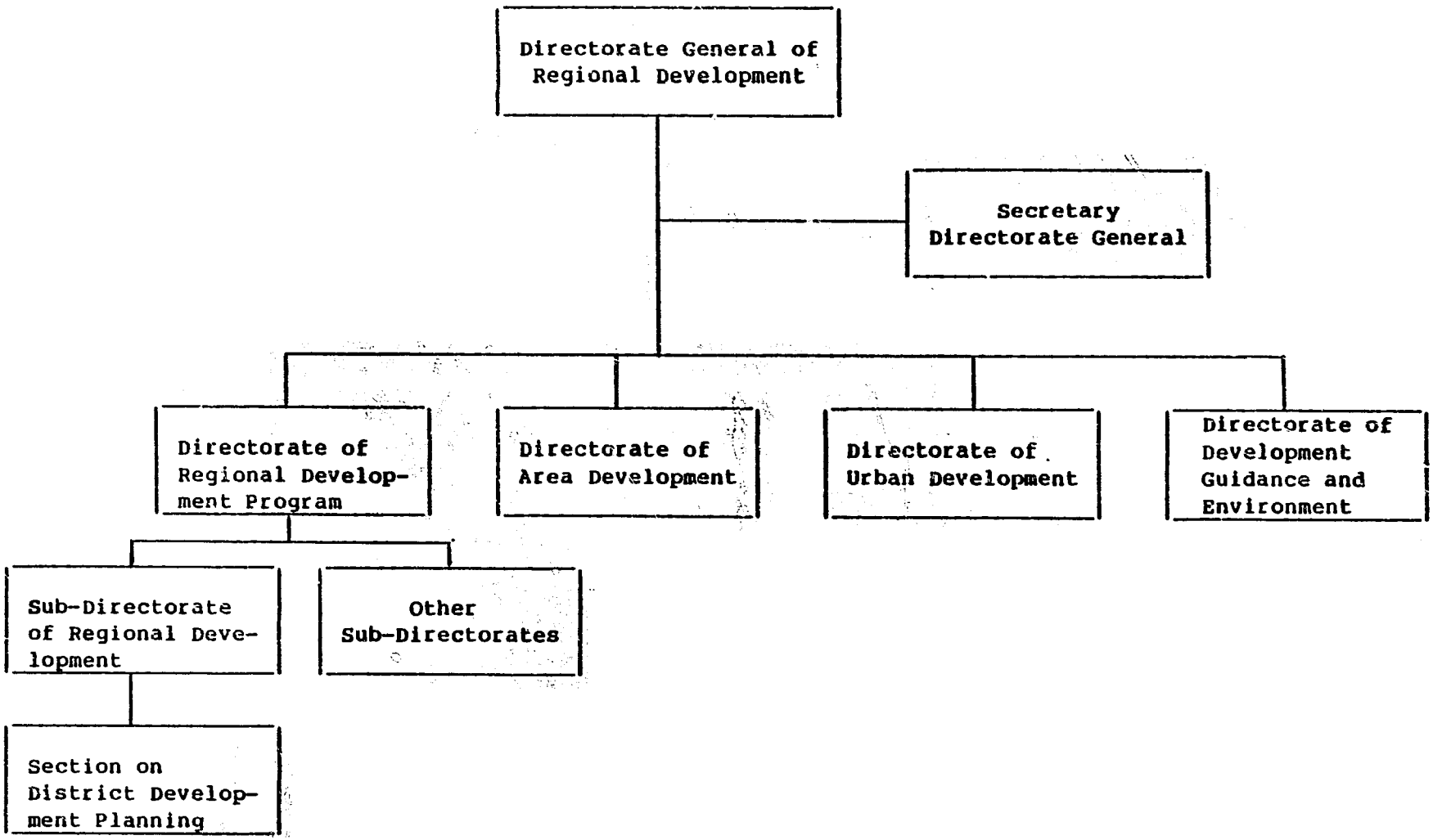
Within this broad mandate, Bangda supervises all Inpres programs by establishing the rules and regulations governing their operation and by channeling funds to local authorities. These programs were originally intended to decentralize government authority by bypassing sectoral ministries and providing local government agencies direct access to resources to plan and develop programs to meet local needs. Bangda's supervision of all Inpres programs does not mean it necessarily possesses any particular technical expertise, and in general, Bangda does not attempt to exercise specialized technical judgments. However, it is inevitably involved in one way or another with the technical work of Dinas offices using Inpres funds.

Bangda's concern with regional development also gives it a special relationship with the provincial (or district) Development Planning Agency (Bappeda I or II). This is the agency of the Governor or Bupati which is responsible for reviewing and approving all proposals for the use of development budget funds. The Bappeda is supposed to ensure that sectoral activities are properly coordinated and integrated into a coherent development plan. Therefore, through its relationships with the Bappedas and its scrutiny and approval of local development budget projects in every sector, Bangda is involved to some extent in a wide variety of sectoral activities.

For the purposes of the RRMS project, the key unit within Bangda is the Directorate of Regional Development Program and, within its Sub-Directorate of Regional Development, a section for District Development Planning (see Figure 4). This is the unit which is most directly concerned with institutional development and the use of Inpres funds at the district level. However, because a major element of the project strategy is the establishment of new linkages between provincial and district public works agencies, enabling provincial offices to support the development of district capabilities, the project will have to coordinate with the Directorate of Area Development as well.

FIGURE 4

BANGDA ORGANIZATIONAL CHART



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## 4.3 PROJECT MANAGEMENT UNIT

District road development and maintenance activities funded through Inpres programs involve both the Ministry of Public Works and the Ministry of Home Affairs. Coordinating the Ministry of Public Works' technical expertise with Bangda's authority to establish budget and planning procedures for local government has been particularly problematic when donor projects have both increased the level of resources channeled through the system and required increased technical performance from the implementing Dinas offices. Poor coordination between Bangda and the Ministry of Public Works at the national level has been further complicated because neither the Ministry of Public Works nor the Provincial Department of Public Works may communicate directly, even on technical matters, with the district. Instead, all communications travel within Ministry of Home Affairs channels to Governors' and Bupatis' offices and are then retransmitted to district Public Works staff. The process is long and, given the lack of technical expertise within the Home Affairs structure, frequently results in incorrect messages being received. Successful implementation requires bridging these strongly-established divisions in the Indonesian public administration system.

A Highway Steering Committee was formed in 1984 to address this and a broad range of policy issues in the district roads sector. The Committee, chaired by the National Planning Agency (Bappenas), includes high-level representatives from the Ministries of Home Affairs, Public Works and Finance. It continues to meet periodically to determine policies for district roads.

One of the Committee's first actions was to establish a Project Management Unit (PMU) in 1985 to facilitate the administration of donor-funded road projects and to expedite project communications among Bangda, the Ministry of Public Works and the district Dinas. The PMU is staffed by approximately 25 Public Works and Bangda professionals, seconded on a part-time basis. District road rehabilitation projects financed by the IBRD and the Asian Development Bank are coordinated by the PMU which is responsible to the Highway Steering Committee rather than to any one of the participating Ministries.

The PMU's responsibilities are focused on the implementation of civil works and include:

- assisting districts to prepare designs and budgets for project funding;
- monitoring implementation progress;
- coordinating equipment procurement;
- coordinating training; and
- administering requests for reimbursement to donors.

*As this Project Paper was being finalized, the PMU was given legal sanction and moved under Bangda jurisdiction. It retains, however, its Public Works top management and staff.

## 4.4 PROVINCIAL PUBLIC WORKS OFFICES (DPUP)

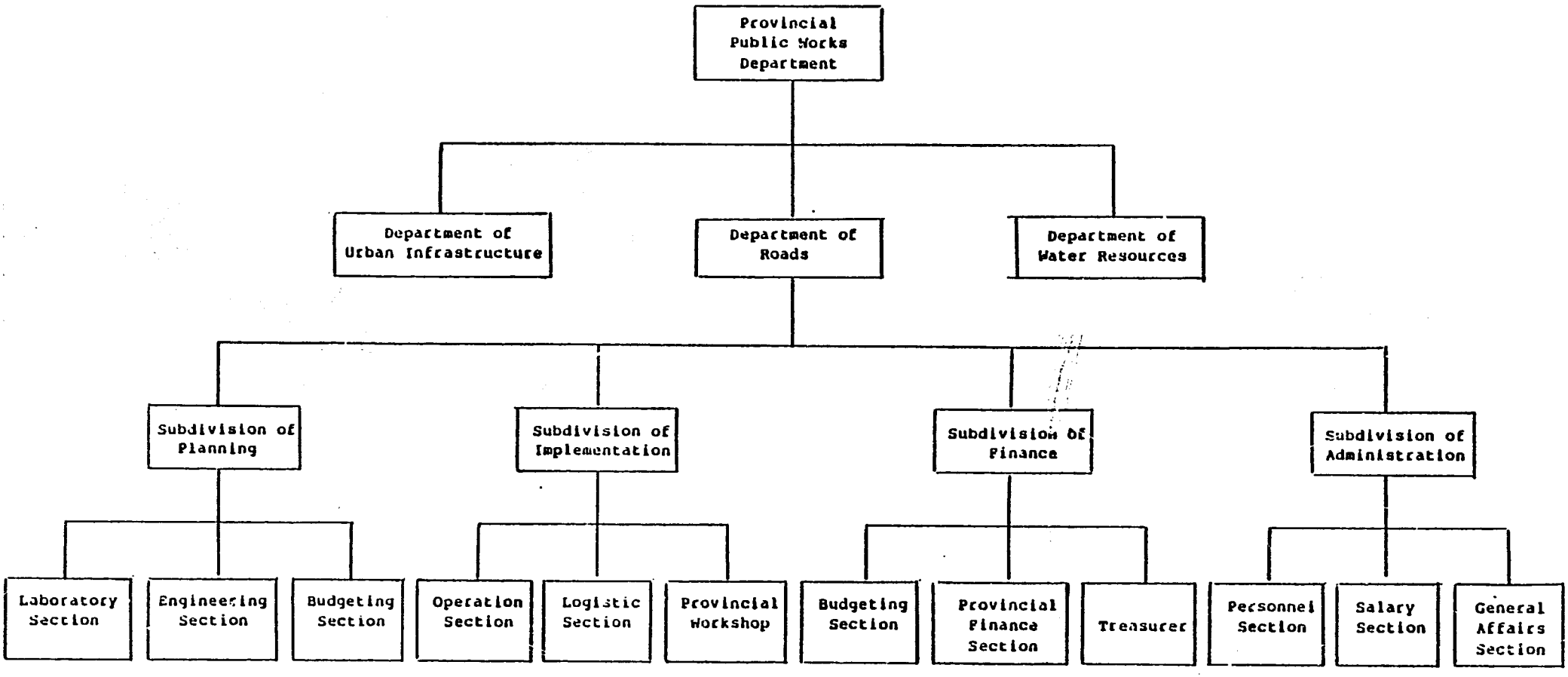
The provincial government's Office of Public Works (Dinas PU Propinsi or DPUP) has a similar structure to that of the Ministry of Public Works, with separate divisions for water resources, urban infrastructure, and roads (see Figure 5). (Occasionally, there are provincial variations on this general pattern because each Governor has some latitude to establish an organizational structure to meet perceived needs or characteristics of his province. The same is true at the district level, where the Bupati may exercise some discretionary control over the structure of local government organizations under his authority.)

To implement civil works, each DPUP has branch offices (Cabang Dinas) distributed around the province. The geographic area of responsibility of a Cabang Dinas does not necessarily coincide with the boundaries of a district and there is no link between the Cabang Dinas and district government. In the Outer Islands (including South Sulawesi), a Cabang Dinas will commonly cover two or more districts, while on Java and Bali, where infrastructure is dense, a single district may be split between two separate Cabang Dinas. Therefore, although the Cabang Dinas works at a level lower than the province, it is responsible to the provincial government and has no direct relationship with the district government. Depending on the size and relative development of the province, there may be separate Cabang Dinas for water resources, urban infrastructure, and roads. In most of the Outer Islands, these are combined under one Cabang Dinas.

Some of the more remote provinces have not yet established DPUKs because the amount of work and the availability of skilled staff and funds are insufficient to justify both Cabang Dinas and DPUKs in the same area. This is the case in NTT where one Cabang Dinas per district serves the needs of national, provincial and district governments. This facilitates strengthening the DPUP-DPUK link, but creates potential conflicts of priority in scheduling staff time. The project will not establish DPUKs in NTT but must carefully monitor the impact of conflicting priorities on the project and adjust personnel and schedules accordingly.

Within the DPUP, the road office is responsible for maintaining both provincial and national roads, using funds from both levels. Normally, the DPUP also implements any rehabilitation or new construction of provincial roads whereas major, non-maintainance, work on national roads is handled by project teams dispatched from Jakarta. Increasingly, however, the DPUP acts on behalf of the Kanwil, using national development budget (APBN) funds to carry out national programs in accordance with procedures and directives established by the Ministry of Public Works in Jakarta. At the same time, the DPUP also has some provincial development budget funds (APBD I) as well as an Inpres allocation (Inpres Province) which may be used to work on the provincial road network. Because APBN funds are significantly larger than APBD funds, much of the time and attention of DPUP staff is taken up with national programs. There is thus an incentive for the DPUP to respond to initiatives from Jakarta rather than from the provincial capital.

FIGURE 5
ORGANIZATIONAL STRUCTURE OF PROVINCIAL PUBLIC WORKS DEPARTMENT
(DPUP)



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## 4.5 DISTRICT PUBLIC WORKS OFFICES (DPUK)

Most district Public Works Offices (Dinas PU Kabupaten or DPUK) are organized by function in a similar fashion to the Dinas office at the provincial level (see Figure 6). There are similar divisions between water resources, urban infrastructure, and roads. There are, however, important differences which constrain the institutional capacity of the DPUK.

First, the DPUK is physically and institutionally isolated from the technical expertise and institutional resources of other Public Works offices. It has no direct line of communication with either the Cabang Dinas or the DPUP, and no access to the Kanwil. Personal contacts may allow the DPUK to develop a positive relationship with these agencies. However, the DPUK are often a considerable physical distance from the Cabang Dinas, DPUP or Kanwil, depriving them of a means to create systematic and on-going support and supervisory relationships. There are also no institutional incentives to encourage DPUK staff to seek assistance from the province or DPUP staff. Although district bridges over a specified length must be designed and constructed under the supervision of DPUP staff, the political autonomy of the district is carefully guarded by district officials in almost all other aspects of road management. From the DPUP's perspective, the sensitivity of this district independence and the absence of a source of funds to pay for the travel and related costs that would be required to provide technical support to DPUKs in the field, create a disincentive for their involvement.

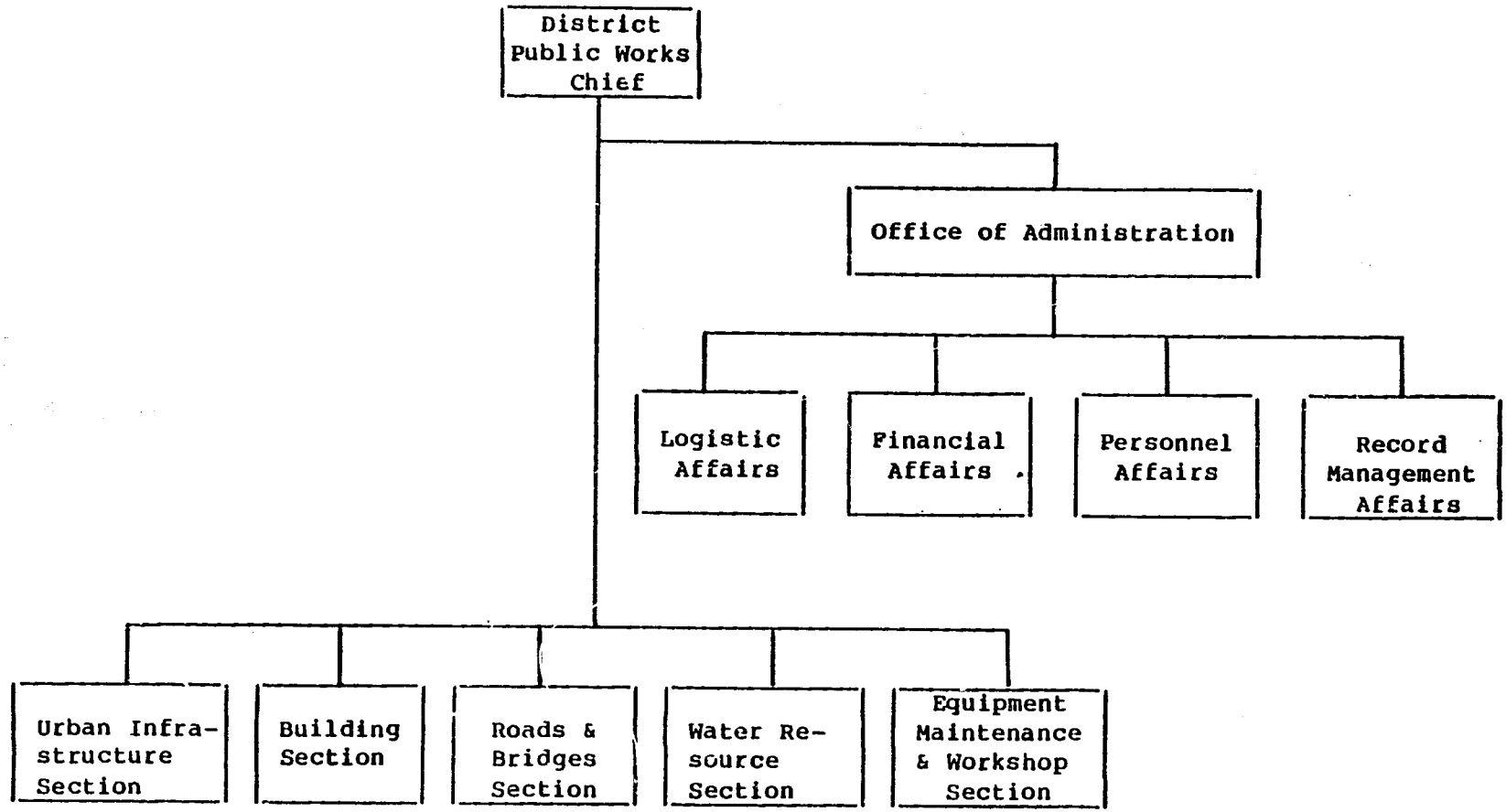
Second, the DPUK have less qualified staff than the DPUP or Cabang Dinas. It is difficult to recruit technically-qualified staff for DPUKs because they offer very limited career advancement prospects in comparison with the DPUP, Cabang Dinas or Kanwil.

Other constraints to the institutional development of DPUKs are shared with all Government of Indonesia agencies. Internal management is weak: although the DPUK has a general description of its responsibilities, and each division has specific tasks allocated to it, these general statements are not augmented by a more specific identification of tasks or the development of periodic office workplans. It is possible to derive an overall plan based upon the different project funding documents (DIPs), but there is no single articulation of office tasks with benchmarks of achievement to track progress towards clearly-defined objectives. Similarly, individual officers have a general job description, but no individual workplan establishing a long-term schedule of activities and indicators for assessing the achievement of objectives.

This reliance on general office responsibilities and job titles rather than specific workplans encourages staff to move from one immediate problem or crisis to another, responding to pressing demands on an ad hoc basis. Supervision becomes difficult because there are no clear standards upon which judgments can be based. Consequently, a performance-based reward system, encouraging high professional standards, becomes almost impossible to implement. At higher levels of management, the coordination of different work units becomes difficult and overall objectives are put in jeopardy.

FIGURE 6

TYPICAL ORGANIZATIONAL STRUCTURE OF
DISTRICT PUBLIC WORKS DEPARTMENT (DPUK)



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A second factor is the general absence of an effective and efficient information system, providing routine and timely feedback to project managers. Although periodic reports are required on project implementation, they are limited to a statement of financial expenditures and the physical targets achieved. Only infrequently are these supplemented with the identification of critical constraints or problems encountered. Even less often are they used as a tool for project management. Reporting formats and requirements are imposed upon the DPUK by Jakarta and for the most part, are completed in summary fashion and sent to Jakarta simply to fulfill a formal administrative requirement.

One reason why periodic reports are not used more as a management tool is that the overall government monitoring system puts a high priority on tracking inputs, primarily funding, rather than quality of outputs or impact. To the extent that an agency is concerned with physical infrastructure projects, tracking outputs is somewhat easier. However, there is no established system for effectively assessing the quality of rehabilitation work or the effectiveness of road maintenance programs. (Road condition inventories are maintained by DPUKs, but they are updated only sporadically (there is no program or source of funds to do so regularly); conditions are generalized over entire links rather than by feature; and the classifications used do not lend themselves to the management decisions that need to be made.) Furthermore, all reporting requirements to Jakarta cease once DIP funds are disbursed and a road project is officially completed. Consequently, there is no system or incentive to examine the extent to which project achievements are successfully sustained over time. This reduces awareness at higher administrative levels of the effects of ignoring maintenance.

Last, the annual budget process discourages the use of project monitoring information to improve performance. Budget proposals focus only on the year immediately ahead. There is no systematic provision for examining past performance and developing improved plans for the future. Monitoring information from past years, therefore, has no clear institutional utility in the development of next year's budget proposal. While there are many concerned civil servants who are technically qualified and experienced, the present system creates no individual incentive to focus on past experience and learn systematically from it. Consequently, individual learning is piecemeal and contingent, and there is little institutional memory to guide new or inexperienced staff members.

## 5. MEASURES TO OVERCOME INSTITUTIONAL CONSTRAINTS

The preceding description identified a number of institutional constraints to effective district roads management and maintenance. They include: the lack of coordination at various levels between the two principal ministries responsible for road rehabilitation and maintenance; the isolation of the DPUK from support or accountability on technical performance to Public Works institutions at any other level of government; disincentives for qualified technical staff to work at the district level;

the ad hoc nature of "projectized" annual development budgets to fund road maintenance and rehabilitation activities; the absence of technical guidance and supervision for the use of Inpres Dati II funds for road work, particularly maintenance; a lack of management information for DPUKs to track road and traffic conditions and to make planning decisions accordingly; and the lack of clearly-defined responsibilities for DPUK personnel.

Some of these constraints are inherent in the GOI administrative system and cannot be resolved by the RRMS project alone. The GOI has initiated a number of reforms to address others. The RRMS project will undertake several activities to address those institutional constraints which remain.

## 5.1 RECENT GOI REFORMS

The GOI has recently undertaken a number of reforms that will significantly improve the management of district roads. First, the decision has been made to establish a link between the DPUP and the DPUK. Under the new structure, the DPUP is required to provide technical support and supervision for DPUK work. This will decrease the DPUK's isolation and should, over time, facilitate improvement in the quality of district roads maintenance and rehabilitation. A second reform, aimed at the shortage of qualified engineers at the district level, has established an intern program in which newly-hired Bina Marga road engineers are seconded to DPUKs for a minimum of two years before assuming Bina Marga positions (200 interns are being seconded in 1987/88 and the program will continue in future years). Finally, a two-year cycle has been introduced in which the design and implementation of civil works are funded in successive years. Although this does not solve the problem of the lack of long-term plans to link annual programs, it does allow a more measured pace for design and implementation and is expected to allow improved planning, particularly design.

## 5.2 RRMS PROJECT ACTIVITIES

The project will assist the GOI to implement the recent reforms, primarily through project consultants at the provincial level who will assist DPUP staff in developing procedures to monitor DPUKs' technical performance, to identify when DPUKs require assistance, and to provide assistance when needed.

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The improvements to be introduced by the project fall into two broad categories: internal management and monitoring/planning. Many of these improvements will be direct results of the introduction of maintenance management systems. Internal management improvements include:

- A minimum organizational structure for planning and managing road maintenance and rehabilitation and for managing equipment will be established. Uniformity will not be necessary as long as minimum needs are met.

- Office tasks will be defined and systematic procedures to implement them will be established.

- Standards of work for maintenance and equipment management will be introduced. A routine information flow will be established on the extent to which standards are being met. For maintenance, standards and performance are integral parts of maintenance management systems. For equipment, these are compared through service, repair and utilization records.

Planning and monitoring improvements will be the core of the project's efforts to increase the impact of road investments. They include:

- A planning framework for annual road rehabilitation programs will be established by introducing traffic-based procedures to determine priorities and by assisting the GOI to devise definitions of Very Important Networks which can be sustained over the long term.

- Maintenance management systems which allow districts to assign priority to maintenance tasks, with full knowledge of the tasks' cost-effectiveness in preserving road conditions, will be introduced.

- Routine condition surveys and traffic counts, both required for the tasks above and which permit the impact of district work to be evaluated, will be introduced.

Finally, the technical and management skills of district Public Works staff will be improved through both formal and on-the-job training.

# ANNEX K

# ADMINISTRATIVE ANALYSIS

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This analysis assesses the administrative roles and capabilities of Implementing Agency(s) in areas relevant to the RRMS project to determine if the plan for project implementation is workable. Many of the elements of this analysis are discussed in detail in either Annex G (Technical Analysis) or Annex J (Institutional and Social Soundness Analysis). The Administrative Analysis therefore will summarize and cross-reference those sections rather than repeat the details they provide.

Considerable experience of other donors in supporting district road programs forms the basis for much of this analysis. A reform of institutional arrangements for district roads effected by a recent GOI Decree (May 18, 1987) and supplementary Implementation Guidelines (May 25, 1987) changes some roles of participating agencies in district roadwork but mitigates rather than raises several major questions concerning administrative capability. The reform has the added benefit of providing legal sanction for key elements of the management framework for district roads, much of which had hitherto been ad hoc and ambiguous.

## 1. GOI ORGANIZATION AND ROLES

### 1.1 LEGAL STATUS AND SANCTION

The roles and structure of participating agencies are defined in the following documents:

1. The Organization and Administration of District and Province Public Works Offices (Instruction of the Minister of Home Affairs, No. 14, 1986)

2. Mechanism and Administration of Technical Guidance for District Road Works (Decree of the Minister of Home Affairs, No. 056.2/923/Bangda, May 18, 1987)

3. Detailed Guidelines for the Administration of Technical Guidance for District Road Works (Letter of the Director General of Regional Development, No. 620/958/Bangda, May 25, 1987)

Government of Indonesia contracting regulations are defined in Presidential Decrees Nos. 29 and 30 of 1984. Land ownership issues are not significant in the RRMS project since only roads already registered in district networks are involved.

### 1.2 RESPONSIBILITIES

The responsibilities of the primary GOI agencies for RRMS administration, within the framework of the documents above, can be divided between national, provincial and district levels. At the <u>national</u> level,

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responsibility for technical policy (including planning procedures) and standards is assigned to the Bureau of Planning in Bina Marga; the functions of local government agencies and the rules and regulations for administration of district road programs are controlled by the Ministry of Home Affairs. Issues or conflicts which involve both roles are resolved by a Highway Steering Committee (HSC) led by the National Planning Agency (Bappenas). A Project Management Unit (PMU), staffed by Public Works technical staff but located in the Ministry of Home Affairs, coordinates the administration of donor-funded district road projects.

1. Highway Steering Committee: the HSC is chaired by the Deputy Chairman of Bappenas for Economic Affairs and includes, as members, the Director General of Regional Development (BANGDA, Ministry of Home Affairs), the Director General of Bina Marga (Ministry of Public Works), the Directorate General for General Administration and Provincial Autonomy (PUOD) (Ministry of Home Affairs), the Deputy Chairman of Bappenas for Regional and Local Affairs, and the Director General of Budget (Ministry of Finance). HSC decisions on district roads policy and implementation in general are binding on the agencies concerned. For the RRMS project, the HSC will review the progress of the project and the findings and recommendations of the RRMS Special Studies program once a year. This will allow major implementation and policy issues to be raised to a level within the GOI which has the authority to resolve them.

2. Directorate General of Regional Development (Bangda, Ministry of Home Affairs): Bangda's general functions and structure are described in Annex J, Section 4.2 and Figure 4. As the overseer of the administration of district road programs and the Inpres budgets, Bangda will be the final signatory to RRMS local cost funding documents (annual road rehabilitation and maintenance programs, workshop upgrading and construction budgets, equipment maintenance budgets, etc.). Bangda will be the GOI counterpart agency for the RRMS project. The burden of day-to-day administration, however, will be borne for Bangda by the Project Management Unit (below).

3. Directorate General of Bina Marga (Ministry of Public Works): Bina Marga's general functions and structure are described in Annex J, Section 4.1 and Figure 3. Bina Marga, acting through its Bureau of Planning and its Sub-Directorate of Local Roads within the Bureau of Planning, determines the technical and planning guidelines for district roads. Thus, although it will not play a direct role in the administration of RRMS activities, it is key to establishing the technical and planning policy framework for the project and for district roads nationwide. The May 1987 reforms give specific responsibility to Bina Marga to:

   - establish technical guidelines for district roads planning, implementation and supervision;
   - prepare standard tender formats for district use;
   - second technical staff as required to support district public works offices;
   - determine the amount and allocation of equipment between provinces and districts;

- assign Bina Marga-owned equipment to districts, as required, to complement district fleets'
- through Bina Marga regional depots, assist on any heavy repairs required for equipment under district control;
- implement training programs for district public works staff; and
- second staff to the Project Management Unit (below) as required.

4. Project Management Unit: the PMU is described in Annex J, section 4.3. The PMU, under Bangda, but staffed primarily by Bina Marga engineers, will bear primary responsibility for the implementation of civil works and equipment activities of the RRMS project. Specific responsibilities will include:

   - coordinating the preparation of annual road maintenance and rehabilitation plans;
   - facilitating GOI and AID approval of annual plans;
   - monitoring and reporting the progress and quality of project civil works;
   - coordinating certification for AID reimbursement of civil works and the preparation of reimbursement requests;
   - coordinating the procurement and distribution of project equipment and monitoring its use; and
   - arrange project training programs.

   With the exception of a consultant transport economist, assigned to advise on road planning approaches in Bina Marga's Bureau of Planning, project consultants located in Jakarta will be assigned to the PMU.

At the province level, the key organization for project administration will be the Provincial Public Works Office (DPUP) under the general supervision of the provincial Governor's Development Bureau (Biro Pembangunan). DPUPs are described in Annex J, Section 4.4. The May 1987 institutional reform gives the DPUP significant responsibilities to guide and monitor the technical performance of district public works offices in road work. These responsibilities include:

- assistance and guidance in the conduct of road surveys, selection of links for work;
- review of district road selection and designs to assure adherence to selection criteria and design standards;
- assistance to DPUKs on pre-qualifying and selecting contractors
- secondment of DPUP staff, as needed, to DPUKs;
- serve on district quality Supervision Teams (including certification of work for payment) for all contracted road work and assist, as needed, on supervision of force account works;
- advise Bina Marga on the province's requirements for district equipment and monitor the use of equipment within districts;
- assign province-owned equipment to districts, as required, to complement district fleets;
- provide heavy repair services for district-controlled equipment
- review district annual materials procurement plans; and
- assist DPUKs to select candidates for district training programs.

Operationalizing the new support and guidance role of the DPUP will be a major emphasis of the RRMS project. Province-level project TA will be assigned to the DPUP.

At the district level, the District Public Works Office (DPUK, described in Annex J, Section 4.5) will be the key institution with direct responsibility for road and traffic surveys, road rehabilitation selection and design, contractor selection and supervision, and maintenance implementation and equipment management, including light equipment repair and maintenance. A consulting engineer, part of the long-term A&E services team, will be assigned to each project DPUK.

## 2. GOI MANAGEMENT

### 2.1 DELEGATIONS OF AUTHORITY

As explained in Annex J, the "autonomy" of district government masks a heavily centralized system of approvals for district road programs. District road work selection must be approved at both the province and central government levels. Subsequent detailed designs and budgets undergo the same review. Budget documents are highly detailed and, once approved by central government authorities, cannot easily be adjusted to suit changing needs. This has direct implications for road maintenance which can rarely be prescribed in detail in advance. Appointments of permanent staff are also highly centralized, often requiring up to four years between application and approval. Organizational changes require several national-level agencies' approval and are rarely approved quickly.

These factors constitute a ponderous and heavily centralized system for implementation and raise risks that plans carefully worked out in the field can be arbitrarily adjusted at higher administrative levels. The RRMS project will seek to develop and test solutions to many of these problems. Provision has been made, however, in the project design to deal with them as they currently exist so that implementation can proceed while improvements are being achieved.

First, local government specialists/coordinators included in the TA team will assist to coordinate and facilitate approvals of planning and funding documents for project activities. Similar arrangements under other USAID projects involving district government programs have proved invaluable. The Project Management Unit will complement this assistance. Second, budget planning meetings, to be held in each province once a year at the appropriate time in the annual budgeting cycle, will bring the parties from each level of government together to discuss the upcoming year's needs and plans in order to forestall unexpected delays in approvals. This too has been successful in other projects. Third, project consultants will assist to develop budget document formats with sufficient detail for central government approval but sufficient flexibility for effective maintenance. Finally, consistent with the May 1987 reform of institutional roles, the RRMS project will assist to operationalize a more active role for DPUPs.

AID and GOI project funds will finance a program of DPUP staff travel to DPUKs to assess difficulties in the field, rather than exercising passive authority over formal documents. It is expected that increased DPUP involvement will over time reduce the need for and extent of central government review of district budget documents and implementation actions.

2.2 EXPERIENCE AND CAPABILITY OF MANAGERS

The primary management weaknesses will be faced in the Ministry of Home Affairs (Bangda) in Jakarta and, to a lesser extent, within the DPUKs. Provincial Public Works offices and the Bina Marga division of the Ministry of Public Works in Jakarta are staffed with capable managers. Bangda lacks capabilities in technical road matters to effectively administer district road programs. Management skills and administrative systems are also poorly developed and the number of staff assigned to road matters (see below) is insufficient to overcome these weaknesses. Manager capabilities within DPUKs are extremely variable, from very good to very poor. The level of technical skills is also quite variable (see Annex G, Section 5).

Several factors help to alleviate these constraints. The Project Management Unit will provide both the technical and administrative capability which Bangda otherwise lacks (with the formation of the PMU, for example, the average time between certification of rehabilitation works and presentation to the World Bank of documents for reimbursement was reduced from twelve months to two). Project consultants, located in the PMU, will further strengthen the PMU's capability. The Jakarta team will include both a local government specialist familiar with GOI procedures and a management assistant responsible for administration. At the DPUKs, formal and on-the-job training in equipment management, crew management, planning and budgeting for maintenance and rehabilitation, etc. will assist to meet both the immediate management needs of the project as well as provide long-term improvements in management and administrative skills at the district level. One full-time Indonesian consultant engineer in each district, one Bina Marga graduate engineer intern seconded to each district, the enhanced supervision of DPUK road operations provided by DPUP staff under the new institutional arrangements for district roads, and frequent visits/consultations by the long-term A&E consultant based in the provincial capitals are expected to be adequate to overcome present inadequacies of DPUK management.

## 3. GOI STAFFING

Staff levels are of concern primarily at the DPUK level. This is discussed in detail in Annex G, Sections 5.5 and 5.6 and summarized in Section 4.1.4 of the body of the Project Paper. Briefly, it appears that districts in NTT have limited need for additional staff but there may ultimately be a shortage of as many as 62 permanent staff in South Sulawesi, primarily mechanics, design technicians and maintenance supervisors. However, USAID's experience with province public works offices in both South Sulawesi and NTT is that existing staff are poorly organized and managed and that improvements in these areas frequently reduce or eliminate the need for additional staff.

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For the short-term, personnel required at the district level will be supplemented by the provincial staff responsible for monitoring and supporting the work of the DPUKs. These staff will assist the DPUK in road management planning; the management of equipment, materials and manpower; oversight and supervision of design and implementation; monitoring standards; and reviewing budgets. In addition, particularly in South Sulawesi, the DPUP has excess equipment operators and mechanics made redundant by the province's shift to using contractors rather than force account for all provincial road work. The provincial Government has agreed to second the number of these staff required to the project districts. Finally, the Ministry of Public Works in Jakarta will second one recent graduate engineer to each district. He/she will work in the design office to further upgrade and reinforce DPUK in-house capabilities. Needs that cannot be met by these methods will, as a short-term measure, be met by the hiring of temporary personnel. Staff needs will be reviewed again, in detail, prior to consideration of the initiation of Phase II of the project.

The increased role of provincial public works offices will make additional demands on DPUP staff. This is not expected to present a problem. DPUPs nationwide have shifted, over the past two years, from primarily force account operations to operations where all provincial public works, except road maintenance, are let to contractors. This has created a surplus of tenured technical staff at the province level which the RRMS project will tap (see above).

Staff levels of the PMU may be of concern. The May 1987 institutional reform which formalized the PMU also changed its administrative status from an independent organization under the Highway Steering Committee to an adjunct of Bangda in the Ministry of Home Affairs. It is not yet certain whether the change will affect staff levels. For this reason the RRMS Project Agreements will require, through a Condition Precedent to AID commitment for rehabilitation work, satisfactory PMU staffing levels, organization and definitions of staff responsibilities with specific responsibilities to RRMS.

## 4. MATRIX OF CRITICAL IMPLEMENTATION TASKS AND RESPONSIBILITIES

The table on the following page consolidates observations on administrative capability into matrix form, identifying critical implementation tasks, the organization responsible for each, administrative weaknesses, and steps under RRMS to address each identified weakness.

## 5. AID MANAGEMENT

### 5.1 AID ROLE

As already summarized, the GOI, through regular or project augmented bodies, will be responsible for all major implementation actions under the project. Because of the institutional and policy changes being sought under the project, however, there will have to be an adequate level of AID management attention devoted to assuring that satisfactory progress is being

made on these aspects of the project. There will be three major roles carried out by AID as part of its project management: awarding and management of TA contracts; ensuring that the procurement of goods and services under the project is being properly and productively done; and monitoring progress on and promoting the policy and institutional development goals of the project.

### 5.1.1 Technical Assistance

Given the assignment of project implementation responsibilities within the GOI structure and current GOI services procurement policies and procedures, it has been determined that all TA and A&E contracting will be done by AID. Technical contributions to competition and awards and subsequent technical management will be carried out by the full-time project staff working with the Mission Contract Management office. The primary A&E contract for the project is designed to minimize the need for routine AID direction and support and to optimize the autonomy of the experts and advisors under this contract. In addition to "bridging engineering services," possible interim PSC specialists and the long-term A&E contract, an engineer to carry out field certification of AID supported rehabilitation and workshop construction will be secured through a PSC. Provision has also been made for additional PSC assistance to supplement Mission staff if necessary using contingency funds.

### 5.1.2 Project Monitoring

Although most routine monitoring of the design and implementation of maintenance programs, rehabilitation and workshops, and review/certification of completed work will be carried out first hand by contractors, there will be a necessary level of review and spot checking by AID US and FSN staff to ensure that AID policies and procedures are being adhered to. Much of this work will be carried out by the two experienced FSN engineers who will be working full time on the project.

### 5.1.3 Policy and Institutional Development

One of the primary concerns for AID staff working on the project will be to ensure that adequate attention is being directed to and progress made on the institutional development and policy goals of the project. Working with the Highway Steering Committee, the PMU and selected consultants, AID US and FSN staff will ensure that the routine concerns of project implementation, funds disbursement, procurement and construction problems do not eclipse attention to the basic goals of the project. In addition to routine management attention to these issues, direct involvement in the management of Special Studies, participation in periodic reviews with the Highway Steering Committee, and monitoring compliance with the performance goals built into the project will help to ensure that these goals receive adequate attention.

MATRIX OF CRITICAL IMPLEMENTATION TASKS AND RESPONSIBILITIES

| Task | Organization Responsible | Administrative Weakness | Remedial Measures |
|---|---|---|---|
| Conduct traffic and condition surveys | DPUK | no prior experience | first-year counts by independent contractor, subsequent oversight by TA and DPUP |
| Select road links | DPUK (with BAPPEDA II participation) | no prior experience with RRMS methodology | TA and DPUP oversight |
| Design rehabilitation works | DPUK | poorly developed skills | one Bina Marga intern per district concentrating on design, short courses, TA and DPUP oversight |
| Preparation Annual Maintenance Plans | DPUK | no prior experience | TA and DPUP assistance |
| Contract civil works | DPUK | (no major weakness) | N/A |
| Supervise contractors | DPUK | poorly developed skills | TA and DPUP oversight including participation in quality Supervision Team, short courses |
| Equipment procurement | Ministry of Public Works (Equipment Directorate) | (no major weakness) | N/A |
| Equipment management and maintenance | DPUK | poorly developed skills | TA and DPUP (ALKAL) oversight, establishment of Equipment Management System, short courses |
| Project administration | Ministry of Home Affairs | insufficient staff, lack of technical knowledge | use of Project Management Unit, inclusion of local government coordinators/specialists in TA team |

## 5.2 USAID MANAGEMENT RESOURCES

Within USAID the project will be managed under the Office of Agriculture and Rural Development as part of its portfolio of rural infrastructure/ institutional development projects. A full-time USDH project officer, anticipated to be a rural development officer with considerable experience with infrastructure projects, will be assigned to the project. He/she will be assisted by two full-time FSN engineers with considerable experience in various types of development and consturction projects, AID and GOI policies and procedures, procurement of goods and services, and the direction and management of technical assistance contracts. In addition to applying their own experience, these full-time staff will be able to draw on the support and experience of other staff within the ARD Office on issues of local government, administration and local revenue mobilization and allocation.

An OE-funded, experienced, US PSC engineer will assist with project management for one year - 1988 - until the full-time USDH project officer is assigned, settled in and has completed language training (anticipated to be by September 1988). The GOI has agreed that up to two years of the services of an additional PSC may be funded from the contingency portion of Grant funds to supplement AID "in-house" staff resources if necessary.

# ANNEX L

# ENVIRONMENTAL ANALYSIS

The Rural Roads Maintenance Systems Project has as its purpose to develop effective, sustainable systems of road maintenance and management at the district level. Data from 1985 show that the total national, provincial and district road network throughout Indonesia had reached 192,396 km, of which 146,102 km, or 76%, were classified as district roads. It was estimated by USAID's consultants that only about 5% of the district roads are currently in a maintainable state. In effect, the nation's investment in its road network is rapidly disappearing. The project posits that this deterioration results from a number of deficiencies, the major ones being: lack of a system for the evaluation, maintenance and rehabilitation of rural roads; insufficient funds; and deficiencies in the skills of local government staff to implement the necessary actions.

The project seeks to model solutions to the deficiencies noted. To do this, it has been agreed with the GOI that AID will fund activities focused in two separate locations, seven districts in the Province of South Sulawesi and four districts in the province of Nusa Tenggara Timur (NTT). In 1985 in South Sulawesi out of total 17,638 km, 86%, or 15,156 km, were district roads; in NTT there were 9,856 km of district roads out of a total of 12,874 km or 76%. These provinces appear to be typical of the other outer island provinces in Indonesia. It is the project thesis that solutions found to the maintenance problems for district roads in these provinces can be applied to other provinces with only minimum modifications.

To develop these solutions the project includes $18.6 million in technical assistance, training, special studies and other activities. There are no direct environmental effects from this category of assistance. In the long run, well-trained technical personnel working with a rational, adequately funded planning system can be anticipated to benefit the environment as well as the local population. Both in training, and in the implementation of design, maintenance and rehabilitation activities, the TA contractor will be directed to develop an understanding that concern for development and concern for the environment are mutually reinforcing and can be incorporated into and reinforced in day-to-day designs, inspection and planning.

The project also includes $7.4 million of loan funds and $2.7 million in PL 480 funds for workshops and equipment. All but two of the workshops exist and will be upgraded, and two will be new. The design criteria and the TA oversight will stress environmental issues, especially potential problems from chemicals, fuels, etc. which will be waste from the equipment and equipment workshops. Safety on or near equipment will also be stressed.

The third category of activity funded by the loan is $25.6 million for road rehabilitation. This funding will be augmented by $6.4 million from the GOI. The GOI will provide $6.5 million to fully fund the maintenance program.

This third category is the primary focus of Mission environmental concern because it includes the rehabilitation of 1600 km of rural roads and the maintenance of that portion of the district network that meets basic agreed-upon economic criteria. In accordance with AID/W directions when the PID was approved, there will be no new roads, no penetration roads and, generally, no realignments. That is, no roads will be considered in this program which are not already in existence and this program will not provide

new access to any area. On the assumption that most original alignments followed paths or prior roadways, realignments will not be permitted in designs. However, if a road meets the economic criteria but the current alignment clearly has been the cause of environmental damage in a local area, a change of alignment for the section of road affected will be considered if it can be shown that the proposed new alignment would repair or not increase environmental damage already incurred.

The project will not upgrade the design capacity of the roads. However, roads that have become unmaintainable because of inadequate design and/or construction will be rehabilitated to meet current traffic requirements. Particular attention will be paid to the inspection and design of road elements that commonly cause poor road performance and major environmental damage, including but not limited to:

- drainage ditches: sizes, slopes, depth stability; check dams
- culverts: sizes, inverts, alignment, protective structures for inlets and outlets
- bridges, alignment, size of openings for discharge, foundations, protection from scouring and from debris
- embankments and/or cuts; slopes, elevation above flood water, drainage, stability, protection
- quality of foundation and pavement materials
- identification and proper rehabilitation of borrow pits, etc.

Routine maintenance will be limited to clearing drains and culverts, filling potholes and reshaping the pavement. Repair beyond these activities will require the same design and environmental scrutiny that will be set as criteria for the rehabilitation program.

To date, areas of the two provinces visited by the project designers do not have undegraded forest. However, an initial responsibility of the TA team will be to delineate any such areas. Should such areas exist, the Mission will review the situation with the GOI and make a formal environmental determination as to what activities, if any, are permissible.

The constraints on the permissible activities of this project are such that potentially significant adverse effects on the environment are unlikely. However, it is the intent of the project through training and design to increase the awareness and sensitivity of local government officials to potential environmental problems and to improve their capability to resolve them.

In each year of the project, selection for design and implementation of work will be made by the GOI and USAID based on the economic, engineering and environmental criteria established. This selection will be cleared by the Mission Environmental Officer. A copy of the resulting approval documentation will be provided to the ANE Bureau Environmental Coordinator for information purposes.

# ANNEX M

# OVERVIEW OF ROAD DEVELOPMENT IN INDONESIA

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## 1. OVERVIEW OF THE TRANSPORT SECTOR AND ROAD NETWORK*

Roads and sea shipping dominate Indonesia's transport sector. Roads carry 82% of total passenger traffic and 70% of the country's total freight, while shipping carries 2% and 27%, respectively. The concentration of population and economic activity on Java is reflected in the distribution of transport modes and consumption: Java accounts for 80% of total road freight movement in the country and, with its well-established road network, almost all freight movement on the island (96%) is by road. Off-Java, 57% of intra-island and almost 100% of inter-island freight is carried by ship.

Transport, as a sector, has grown at roughly twice the rate of the gross domestic product (GDP) since the mid-1960s. The potential of the sector and a strong political interest in integrating the archipelago have assured transport a steady share of public development investment since the 1960s. Through the first and second Five Year Development Plans, Repelitas I and II (1969-1978), approximately 16% of all development budget funds were allocated to transport development. Although this dropped to a planned 13% and 12% for Repelitas III and IV (1979-1988), absolute amounts increased dramatically with the rapid growth of oil-fueled budgets in the early 1980s. The priority accorded to the sector has been confirmed in the austerity period following the rapid decline of oil revenues in late 1985: although the development budget for the upcoming 1987/88 fiscal year has declined in nominal terms by 6.5% over 1986/87, transport allocations have been increased by 21% and are now back to 15% of the planned total development expenditure.

During Repelitas I and II, 75% of transport expenditure was for roads, reflecting the dominance of roads in the transport system and a determination to address the deteriorated state of the road network inherited from the period of political and economic turmoil of the 1950s and 1960s. In Repelita III increased priority was given to sea transport, rail and aviation, and the share of roads in total transport expenditure dropped to about 43%. This trend has been reversed in the mid-1980s, with roads accounting for 60% of transport spending since 1985.

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* The first three paragraphs of this discussion are drawn from World Bank. Staff Appraisal Report, Highway Maintenance and Betterment Project, Jakarta, May 1986.

## 2. THE ROAD SUBSECTOR

Responsibility for a total of 218,000 kilometers of registered roads is distributed among government authorities as follows:

TABLE 1

THE ROAD NETWORK

| | Length (km) | Share of Total |
|---|---|---|
| National Roads | 12,986 | 6% |
| Provincial Roads | 39,207 | 18% |
| District Roads | 141,600 | 65% |
| Other | | |
| - Municipal | 10,800 | 5% |
| - Transmigration | 9,200 | 4% |
| - Nucleus Estates | 3,800 | 2% |
| Total | 217,593 | 100% |

Source: Amphico Consortium, Indonesia, in association with Hoff & Overgaard A/S Denmark, Project Preparation Document for IBRD Rural Roads Development Project, Phase II, September 1986.

National roads, which typically carry between 4,000 and 10,000 vehicles per day, are the responsibility of the Directorate General of Highways (Bina Marga) in the Ministry of Public Works in Jakarta. Bina Marga plans the development of the national network, monitors traffic and road conditions, and screens links of the national network for improvement work. It manages both major improvements and any new construction. Maintenance of the national network is delegated to the public works departments of the provincial governments.

Provincial roads, with traffic levels commonly between 1,000 and 4,000 vehicles per day, are under the authority of provincial government public works departments (DPUP) which manage both improvements and maintenance on the provincial network. Major improvements may be delegated to national Bina Marga authorities if the technical requirements of the work are beyond DPUP capabilities.

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District roads are the responsibility of the district governments' public works departments (DPUK). On Java, traffic levels on district roads may reach 1,000 vehicles a day, but off-Java they range from a few to perhaps 600 vehicles at most. The DPUKs handle all aspects of district road work with the exception of the construction of bridges over specified lengths, which are a DPUP responsibility. Municipalities have the same administrative status as districts but represent urban concentrations sufficient to justify a distinct administrative identity.

Transmigration and nucleus estate roads are temporary classifications for roads constructed as a part of transmigration or plantation development projects. Initially under the authority of project officials, they later enter the district networks and become the responsibility of the DPUKs.

Village roads are not included in the registered network because there is neither an inventory of their length or locations nor an administrative body responsible for their development or upkeep. Village roads may be no more than traditional foot- or cart-paths. Significant numbers are constructed or upgraded under the Ministry of Manpower's labor-intensive (Padat Karya) program for off-season rural employment. Padat Karya roads, however, may be absorbed into district networks once their construction is complete.

A final road category, not included in the networks listed above, is toll roads. Toll roads are generally constructed on routes where traffic exceeds 20,000 vehicles per day. These roads are planned by the Directorate General of Highways in Jakarta, but operated and maintained by a government toll road corporation (P.T. Jasa Marga). Their construction is financed by the issuance of bonds and by equity investments from foreign aid bodies or private investors. The Government of Indonesia finances land acquisition costs only.

## 3. ROAD DEVELOPMENT POLICY AND NETWORK GROWTH

During the Repelitas I and II, government programs for roads emphasized the consolidation of the existing network, with particular attention to recovering and improving the national and provincial networks. About 13% of the total development budget during this period was allocated to such roads, most of which were built during the colonial period but had seriously deteriorated in the two decades following independence.

A rapid increase in oil revenues at the end of the 1970s and modest success in consolidating national and provincial networks allowed Repelita III (1979/80 - 1983/84) to give increased priority to the improvement and expansion of the low-class rural roads in the district networks, particularly in the Outer Islands. The primary instrument for the shift in policy was Inpres Penunjangan Jalan, a program launched in 1979 which has provided approximately $80 million per year for district road works. Funds for national and provincial roads, although dramatically increased in real terms over Repelita II levels, declined to about 6% of the total development budget The results of policies through Repelita III are shown in Table 2.

TABLE 2

ROAD NETWORK GROWTH (1965-1985)

(kilometers)

| | 1965 | 1971 | 1975 | 1980 | 1985 |
|---|---|---|---|---|---|
| National | 10,167 | 10,628 | 11,267 | 12,152 | 12,016 |
| Provincial | 22,068 | 24,466 | 28,196 | 33,164 | 34,278 |
| District | 51,031 | 51,170 | 58,651 | 88,920 | 146,102 |
| Total | 83,266 | 86,264 | 98,114 | 134,236 | 192,396 |

Source: Various documents.

Plans for Repelita IV stressed the continuation of Repelita III policies for continued consolidation, through betterment projects, of the national and provincial network and for the further development of district networks. The major target was for 60%-70% of the national and provincial networks to be in maintainable condition by 1989. Maintenance funding, almost ignored through Repelita III, was planned to increase to about 31% of the total expenditure on national and provincial roads by 1989 compared to 17% in 1984/85. The assessment in 1984 appeared to be that the government would gain control of national and provincial networks during Repelita IV, that recovery and major betterment of the system would be almost complete, and that the emphasis would shift to maintenance.

No such confidence was evident for district roads. Coherent planning for the district network is immeasurably more complex than for national and provincial roads due to institutional factors (see the Institutional Analysis, Annex J), the size of the network, a diffusion of decision-making authority for controlling the growth of the network, and the very poor condition of the roads (see the Technical Analysis, Annex G). Although Repelita IV witnessed the first allocation of funds specifically for the maintenance of district road networks, this Repelita projected these funds would total only 13% of total district road budgets by 1989. The planners appear to have concluded that consolidation and control of the district networks would not be achieved in Repelita IV but would, perhaps, be a major focus under Repelita V (1989/90 - 1993/94).

The rapid decline of oil prices and oil revenues since late 1985 has thrown plans for Repelita IV off course. New strategies for the road subsector, consistent with the reduction in resources available, have not yet been articulated. The uncertainty of future oil prices complicates attempts to develop new approaches and it is unlikely that new strategies

will be formalized until April 1988 when Repelita V is formally completed. However, the short-term response for the fiscal years thus far affected by the decline in oil revenues (1985/86 and 1986/87) indicates that, for national and provincial roads, new construction will be virtually stopped, funding for betterment reduced, and maintenance budgets increased in both absolute and relative terms. Table 3 illustrates the shift.

Policies to re-orient the pattern of expenditure on district roads have not yet emerged because the Inpres grants, from which almost all district roadwork is financed (see Financial Analysis, Annex I), have been relatively protected from budget cuts. Reductions on the order of 9% in real terms are expected for 1987/88, even though nominal levels are being sustained. Maintenance of district roads is funded almost exclusively from Inpres Dati II, with the amounts established as a fixed 25% of each district's Inpres Dati II allocation. This percentage will not be reduced, and the total share of maintenance funding in the total district road program will thus remain the same. There is evidence (see Table 6) that districts are choosing to initiate less new construction, although there has been no explicit policy command to this effect.

## 4. SOURCES OF NEW DISTRICT ROADS

There is no consolidated policy to govern the growth of district networks, and as a result, their expansion has been rapid and haphazard. The data available do not fully explain the marked growth in district networks between 1975 and 1985. But because roads enter the network in several ways, there were at least three sources of new roads: new construction financed by the districts, transmigration and nucleus estate roads absorbed into district networks, and labor-intensive (Padat Karya) roads.

The Padat Karya program, under the authority of the Ministry of Manpower, funds small labor-based infrastructure projects throughout Indonesia. The program was initiated in 1974 with the goal of providing off-season employment, primarily in rural areas. Padat Karya includes roads (roughly 60% of the program budget) and small irrigation systems (about 30%), with the remaining 10% allocated mainly to fish ponds, slope terracing and various flood control measures.

Padat Karya road work consists almost entirely of upgrading existing village tracks or paths to a macadam surface. No new alignments are created. The Ministry of Manpower has its own field staff to supervise implementation and its own standards for such roads. Although local DPUK staff are required to approve each project design and although DPUK steam rollers are borrowed for compaction, the standard is below those normally enforced for DPUK work, primarily in that no running surface is applied.

# TABLE 3

## ROAD BUDGETS

| NATIONAL & PROVINCIAL ROADS (1) | 1984/85 Actual Rp. million | 1984/85 Actual % of total | 1985/86 Budget Rp. million | 1985/86 Budget % of total | 1986/87 Budget Rp. million | 1986/87 Budget % of total |
|---|---|---|---|---|---|---|
| Maintenance | | | | | | |
| periodic (APBN-funded) | 22,429 | | 22,681 | | 31,496 | |
| routine (APBN-funded) | 37,119 | | 39,058 | | 34,841 | |
| unspecified (APBD I-funded) | 28,071 | | 34,098 | | 42,323 | |
| total maintenance | 87,619 | 17% | 95,837 | 21% | 108,660 | 25% |
| Betterment | | | | | | |
| APBN-funded | 218,956 | | 177,425 | | 158,930 | |
| APBD I-funded | | | | | 19,560 | |
| total betterment | 218,956 | 42% | 177,425 | 38% | 158,490 | 37% |
| New Construction | | | | | | |
| APBN-funded | 121,372 | | 43,137 | | 10,512 | |
| total new construction | 121,372 | 23% | 43,137 | 9% | 10,512 | 2% |
| Bridge Replacement | | | | | | |
| APBN-funded | 24,352 | | 32,704 | | 20,755 | |
| APBD I-funded | 6,451 | | 7,741 | | | |
| total bridge replacement | 30,803 | 6% | 40,445 | 9% | 20,755 | 5% |
| Technical Assistance | | | | | | |
| APBN-funded | 63,143 | | 104,525 | | 130,308 | |
| total technical assistance | 63,143 | 12% | 104,525 | 23% | 130,308 | 30% |
| GRAND TOTAL | 521,893 | 100% | 461,369 | 100% | 428,725 | 100% |

| KABUPATEN ROADS | 1985/86 Budget (2) Rp. million | 1985/86 Budget (2) % of total | 1986/87 Budget (3) Rp. million | 1986/87 Budget (3) % of total |
|---|---|---|---|---|
| Maintenance | | | | |
| Inpres Penunjangan Jalan | 373 | | 373 | |
| Inpres Dati II | 42,604 | | 43,827 | |
| total maintenance | 42,977 | 17% | 44,200 | 17% |
| Betterment | | | | |
| Inpres Penunjangan Jalan | 63,733 | | 63,733 | |
| Inpres Dati II | 88,630 | | 82,897 | |
| total betterment | 152,363 | 59% | 146,630 | 58% |
| New Construction | | | | |
| Inpres Penunjangan Jalan | 9,097 | | 9,097 | |
| Inpres Dati II | 15,339 | | 8,244 | |
| total new construction | 24,436 | 9% | 17,341 | 7% |
| Bridge Replacement (4) | | | | |
| Inpres Penunjangan Jalan | 19,510 | | 19,510 | |
| Inpres Dati II | 19,910 | | 25,079 | |
| total bridge replacement | 39,420 | 15% | 44,589 | 18% |
| Technical Assistance (not applicable) | | | | |
| total technical assistance | 0 | 0% | 0 | 0% |
| GRAND TOTAL | 259,196 | 100% | 252,751 | 100% |

(1) Directorate General of Highways, March 1986, in Staff Appraisal Report, Highway Maintenance & Betterment Project, IBRD, May 1986.
(2) Sub-Directorate of Rural Roads, Directorate General of Highways, in Project Preparation Document for IBRD Rural Roads Development Project Phase II, September 1986.
(3) data on Inpres Penunjangan Jalan not available (figures straightlined from 1985/86). Data on Inpres Dati II from source (2) above.
(4) includes some culverts and bridge maintenance but primarily bridge replacement, rehabilitation or new construction.



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Once completed, Padat Karya roads become the district's responsibility. They are often, but not always, entered into the district network. Funding for the program (see Table 4) increased rapidly in the 1980s with the result that as much as 22,000 km of road may have entered district road inventories since 1979 due to Padat Karya projects.

TABLE 4

PADAT KARYA ROAD FUNDING

| Fiscal Year | Total Funds* (Rp. billion) | Funding for Roads (Rp. billion) | ($ million) | Implied Road Length Upgraded** |
|---|---|---|---|---|
| 1979/80 | 6.59 | 3.03 | 4.85 | 606 km |
| 1980/81 | 8.14 | 4.64 | 6.63 | 928 km |
| 1981/82 | 12.28 | 7.24 | 9.99 | 1,448 km |
| 1982/83 | 20.32 | 13.11 | 17.03 | 2,622 km |
| 1983/84 | 22.74 | 17.06 | 17.06 | 3,412 km |
| 1984/85 | 23.16 | 17.27 | 16.95 | 3,454 km |
| 1985/86 | 29.00 | 21.75 | 19.77 | 4,350 km |
| 1986/87 | 31.00 | 23.00 | 20.35 | 4,600 km |
| 1987/88 | 4.50 | 3.40 | 2.07 | 680 km |
| | | | | 22,100 km |

* includes operational expenses and administrative costs.
** based on standard Rp. 5 million/km cost.

Source: Ministry of Manpower

From the district government's perspective, Padat Karya projects may relieve pressures on the DPUK to construct or upgrade roads for access to or within villages. But since the Padat Karya program does not finance maintenance, the district must assume the recurrent costs for upkeep. Moreover, because Padat Karya roads are not constructed to DPUK standards, they add to the category of roads that may not be maintainable in the conventional sense, but which nonetheless create a demand for occasional but expensive rehabilitation or upgrading.

The construction of transmigration and nucleus estate (NES) roads is coordinated by the Ministries of Transmigration and Agriculture, respectively. These roads are financed from national budgets (non-Inpres) as part of multi-ministry area-specific projects. As with Padat Karya roads, completed transmigration and NES roads are usually released to district authorities for upkeep and are often entered into the district network inventory. Over 26,000 km of transmigration roads were constructed during Repelita III, the period of greatest growth for the transmigration

program.* Systematic monitoring of the status of these roads began only in 1986/87. It is known that at least 3,250 km, but probably considerably more, have been transferred to district authorities (Amphico, 1986). Roads in nucleus estates are reported to total about 4,000 kilometers but data are not available on how many of these roads are now under district jurisdiction.

Transmigration roads transferred to district jurisdiction have been particularly problematic. Built by land-clearing contractors who usually lack experience in road construction, they are constructed to a standard below those now established for district use. Because they are not maintained during the several years prior to their release to district authorities, they are in seriously deteriorated condition at the time they enter the district inventory. The regions affected are among the most remote in Indonesia where DPUK capabilities are weak. Due to low populations in these areas, Inpres Dati II allocations (made on a per capita basis) are too small to finance the rehabilitation and maintenance required. As discussed below, this led, in 1986/87, to the allocation of about one-half of the Inpres Penunjangan Jalan budget to transmigration areas (and some NES sites) for a crash program to recover severely deteriorated transmigration roads.

The final source of roads being added to district networks are those financed with Inpres Dati II or Inpres Penunjangan Jalan funds and planned and implemented by the districts themselves. Data on these roads are not reliable due largely to the confusing terms used in reporting. Reported "new construction" is usually an upgrading of a village road and thus difficult to distinguish from reported "upgrading" work. In fiscal year 1985/86 about 2,200 km were added to district networks in this fashion. It can be inferred from the rough figures for Padat Karya, transmigration and NES roads, that up to 55,000 km of village roads were upgraded with Inpres funds and incorporated into district networks between 1975 and 1985.

The figures in Tables 5 and in 6 indicate that the use of Inpres to build new roads is slowing down. While 23% (about Rp. 44 billion) of Inpres Dati II funds were spent on "new construction" in 1984/85, for example, this declined to 10% (Rp. 15 billion) in 1985/86, and 5% (Rp. 8 billion) in 1986/87. New construction funded with Inpres Penunjangan Jalan is normally less that financed by Inpres Dati II and, although exact data are unavailable, is known to have decreased to almost nil from the 793 km funded with 10% of the IPJ budget in 1985/86.

The rate of growth of non-Inpres funded new roads is also slowing. The austerity budgets for 1986/87 and 1987/88 reduce spending for transmigration, NES and Padat Karya projects dramatically. And the sobering experience with the rapid deterioration of transmigration roads (see Annex K) is likely to inject more caution into the expansion of transmigration roads in the future.

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* World Bank. Transmigration Sector Review, Oct. 24, 1986.

District roads also exit the networks. It appears that few, if any, are formally abandoned, but some are deregistered for transfer to provincial authorities. Data are not available on the length of roads that have been handed over, but such roads explain some of the increase in the provincial network shown in Table 2. Discussions are now underway in Bina Marga to conduct a systematic review of district networks in order to determine if increased numbers of district roads should be transferred to provincial jurisdiction.

TABLE 5

NEW ROADS FUNDED BY INPRES, 1985/86 - 1986/87

| | 1985/86 | | | 1986/87 | | |
|---|---|---|---|---|---|---|
| | Length (km) | Rp. Million | % of Total Inpres for Roads | Length (km) | Rp. Million | % of Total Inpres for Roads |
| Inpres Dati II | 1,450 | 15,339.4 | 9.21% | 486.9 | 8,243.9 | 4.71% |
| Inpres Penunjangan Jalan | 793 | 9,096.9 | 9.81% | N/A | N/A | N/A |
| Total | 2,243 | 24,436.3 | | | | |

Source: 1985/86 figures on Inpres Dati II length from Ministry of Home Affairs; the remainder are taken from Amphico, 1986.

# TABLE 6

## DISTRICT CIVIL WORKS BY TYPE OF WORK IN REPRESENTATIVE DISTRICTS IN SOUTH SULAWESI AND NTT, FISCAL YEAR 1985/86

| | NEW CONSTRUCTION | | | | | | REHABILITATION OR UPGRADING | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inpres Dati II (IK) | | | Inpres Penunjangan Jalan | | | Inpres Dati II (IK) | | | Inpres Penunjangan Jalan | | |
| | Rp million | % of total IK Budget Spent on Roads | Length (km) | Rp million | % of Total IPJ Budget | Length (km) | Rp million | % of Total IK Budget Spent on Roads | Length (km) | Rp million | % of Total IPJ Budget | Length (km) |
| Java/Bali (1) | 9356.2 | 9% | N/A | 136.8 | 4% | 29 | 50652.7 | 51% | 4643 | 13,030.9 | 77% | 769 |
| Outer Islands (1) | 5983.2 | 9% | N/A | 8458.1 | 11% | 764 | 37977.5 | 57% | 3514 | 49,902.4 | 66% | 4366 |
| Indonesia Total (1) | 15339.4 | 9% | 1450 | 8596.9 | 10% | 793 | 88630.2 | 53% | 8157 | 63,733.3 | 69% | 5134 |
| South Sulawesi (1) | 592 | 7% | 36 | 342.5 | 6% | 49 | 4,643.4 | 58% | 302 | 2,970.2 | 55% | 292 |
| Pinrang | 0 | 0% | 0 | 0 | 0% | 0 | 228.7 | 69% | 22.4 | 232.2 | 100% | 55.4 |
| Gowa | 24.3 | 5% | 0.2 | 0 | 0% | 0 | 308.1 | 68% | 14.1 | 0.0 | 0% | 0 |
| Wajo | 9 | 0% | 0 | 0 | 0% | 0 | 276.9 | 65% | 14.7 | 150.0 | 100% | 22 |
| Bone | 0 | 0% | 0 | 0 | 0% | 0 | 396.0 | 56% | 25.0 | 150.0 | 72% | 15.5 |
| Bulukumba | 37.5 | 10% | 4 | .0 | 0% | 0 | 164.4 | 45% | 11 | 190.0 | 100% | 50.1 |
| Jeneponto | 0 | 0% | 0 | 0 | 0% | 0 | 154.9 | 46% | 15 | 200.0 | 100% | 10.0 |
| Sidenreng | 0 | 0% | 0 | 0 | 0% | 0 | 195.3 | 69% | 9 | 250.0 | 100% | 20.3 |
| NTT (1) | 715.3 | 25% | 76 | 0 | 0% | 0 | 665.8 | 23% | 53 | 2,421.6 | 82% | 323 |
| Kupang | 0 | 0% | 0 | 0 | 0% | 0 | 200.0 | 100% | 10 | 330.0 | 100% | 34.0 |
| TTS | 0 | 0% | 0 | 0 | 0% | 0 | 307.4 | 100% | 35.2 | 303.2 | 100% | 32 |
| Belu | 0 | 0% | 0 | 0 | 0% | 0 | 111.2 | 48% | 19 | 195.1 | 83% | 19 |
| Sumba Barat | 0 | 0% | 0 | 0 | 0% | 0 | 211.5 | 78% | 20.9 | 265.0 | 100% | 22 |
| Manggarai | 0 | 0% | 0 | 0 | 0% | 0 | 65.3 | 27% | N/A | 200.3 | 84% | 50 |
| Ngada | 0 | 0% | 0 | 0 | 0% | 0 | 14.6 | 9% | 1 | 259.3 | 100% | 30 |
| Sikka | 0 | 0% | 0 | 0 | 0% | 0 | 133.7 | 67% | 19.66 | 200.0 | 100% | 21 |

| | MAINTENANCE | | | | | | OTHER (BRIDGES, CULVERTS, ETC.) | | | | | | Total Inpres Dati II Spent on Roads and Bridges (Rp million) | Total Inpres Penunjangan Jalan (Rp million) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inpres Dati II (IK) | | | Inpres Penunjangan Jalan | | | Inpres Dati II (IK) | | | Inpres Penunjangan Jalan | | | | |
| | Rp million | % of total IK Budget Spent on Roads | Length (km) | Rp million | % of Total IPJ Budget | Length (km) | Rp million | % of Total IK Budget Spent on Roads | Length meters | Rp million | % of Total IPJ Budget | Length meters | | |
| Java/Bali (1) | 26066.4 | 26% | 13570 | 0 | 0% | 0 | 14846 | 14% | 28063 | 3403.2 | 19% | 9654 | 100,121.9 | 17,953.1 |
| Outer Islands (1) | 16536 | 25% | 5426 | 373 | 8% | 32 | 5863 | 9% | 11461 | 16046.3 | 21% | 43949 | 66,391.6 | 76,123.9 |
| Indonesia Total (1) | 42604.4 | 26% | 19095 | 373 | 8% | 32 | 19989.6 | 12% | 32324 | 19599.5 | 21% | 53603 | 166,513.5 | 94,077.0 |
| South Sulawesi (1) | 2864.4 | 26% | 185 | 0 | 0% | 0 | 637.3 | 8% | 260 | 1699.6 | 31% | 3539 | 7,930.1 | 5,439.2 |
| Pinrang | 59.2 | 18% | 13 | 0 | 0% | 0 | 41.4 | 13% | 3 | 0 | 0% | 0 | 329.3 | 232.2 |
| Gowa | 118.4 | 26% | 11 | 0 | 0% | 0 | 0 | 0% | 0 | 196.9 | 100% | 15 | 450.7 | 196.9 |
| Wajo | 148.6 | 35% | 165 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 419.5 | 150.0 |
| Bone | 213.6 | 30% | 40.4 | 0 | 0% | 0 | 93.1 | 13% | 23 | 57 | 20% | N/A | 702.7 | 207.0 |
| Bulukumba | 97.1 | 27% | 20.9 | 0 | 0% | 0 | 63.2 | 17% | 20.3 | 0 | 0% | 0 | 362.2 | 190.0 |
| Jeneponto | 86.3 | 26% | 1.5 | 0 | 0% | 0 | 95 | 28% | 36.5 | 0 | 0% | 0 | 336.2 | 200.0 |
| Sidenreng | 70 | 25% | 16 | 0 | 0% | 0 | 16.5 | 6% | 10 | 0 | 0% | 0 | 281.0 | 250.0 |
| NTT (1) | 816.7 | 28% | 285 | 0 | 0% | 0 | 695.1 | 24% | 2285 | 589.7 | 17% | 3661 | 2,892.9 | 2,945.0 |
| Kupang | 0.0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 200.0 | 330.0 |
| TTS | 63.5 | 21% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 307.4 | 303.2 |
| Belu | 76.4 | 33% | 1.2 | 0 | 0% | 0 | 58.5 | 25% | 25 | 41 | 17% | N/A | 233.1 | 236.0 |
| Sumba Barat | 0.0 | 0% | N/A | 0 | 0% | 0 | 56.2 | 19% | N/A | 0 | 0% | 0 | 302.7 | 205.0 |
| Manggarai | 0.0 | 0% | 0 | 40 | 12% | N/A | 177.9 | 73% | N/A | 14.0 | 4% | N/A | 243.2 | 335.0 |
| Ngada | 0.0 | 0% | 0 | 0 | 0% | 0 | 147.1 | 91% | 50 | 0.7 | 0% | 6 | 161.9 | 259.3 |
| Sikka | 65.6 | 33% | 91 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% | 0 | 199.3 | 200.0 |

N/A = Data not available

# ANNEX N

# MONITORING AND EVALUATION PLAN

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The monitoring system for this project will be structured to monitor several types or levels of activity. It will monitor: 1) the development of an overall road management system and provide information on progress in overcoming systemic constraints and establishing the parameters within which road maintenance work takes place; 2) the development of institutional capacities (particularly at the district level) to carry out rehabilitation and maintenance activities; 3) the progress made in rehabilitating the local road network and maintaining it on an ongoing basis; and 4) the impact of the road management system, including its efficiency and effectiveness. Below, for each of these levels, an operational plan is proposed to implement this approach to monitoring and evaluation.

## 1. MONITORING SYSTEMIC ISSUES

The establishment of a replicable road management system is an essential part of achieving improved road maintenance. Without the appropriate policies, guidelines and procedures to allocate funds between maintenance and rehabilitation and to prioritize tasks within each category of work, district resources will not be utilized effectively and will not lead to a sustained improvement in the condition of district roads. Therefore, project monitoring will track the progress made in improving the road management system.

There are several key factors which will be the focus of this aspect of project monitoring. One is the creation of a planning system which integrates allocations for new construction, road rehabilitation and routine maintenance, enabling district planners to assess the trade-offs between each type of work and to assess the future maintenance implications of present decisions to build new roads or rehabilitate existing ones. Without this integration, it will not be possible to establish a coherent road management system or to make realistic plans to meet routine maintenance requirements. The primary indicator of achievement will be the adoption of a practical and sustainable definition of Very Important Networks for district planning purposes.

A second key factor is the articulation of a policy which places a clear priority on maintenance as an essential part of a road management program. This means creating and staffing a separate section within the DPUK with specific responsibility for road maintenance work. It also means the provision of sufficient funds for maintenance on a continuing basis. In addition it means the allocation of maintenance funds in accordance with the cost-effectiveness of different maintenance tasks and the condition of road features, as determined by maintenance management.

A third factor is the development of practical guidance for allocating road rehabilitation funds between competing links. The critical features here will be prioritization of links with high traffic levels and the budgeting of sufficient funds to meet the standards which the level of road use requires.

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Finally, the road management system can be established and continue to function only to the extent that each level of government understands and fulfills its appropriate role. A fourth key factor, therefore, is the extent to which national agencies focus on policy formulation and general oversight, while provincial agencies provide technical support and exercise quality control and district agencies assume responsibility for planning the management of their road system and implement rehabilitation and maintenance activities.

Progress in each of these four key areas will, for the most part, be made in the project districts on a pilot basis before affecting policy beyond the project locations. Measurement of progress will thus initially depend on subjective consultant assessments and government documents indicating decisions specific to the project districts alone. The ultimate indicators of progress in these four key areas will be policy documents issued by the GOI at the national level. These will include ministerial decrees and instructions as well as annual budget documents (this aspect of project monitoring will not require extensive data gathering efforts at the field level or the use of outside resources and technical expertise. Routine project management at the national level, both within the GOI and USAID, will be sufficient to collect the documents and use them to assess progress on these systemic issues). Several key benchmarks, some specific to project areas and others of a national nature, will be established:

- development by the GOI of a strategy by the end of 1987 to prioritize maintenance in district road budgets nationwide, including Inpres Roads as well as Inpres District funds for maintenance;
- in project districts, the formation and staffing of DPUK maintenance divisions during Indonesian Fiscal Year 1987/88;
- in project districts, agreement on a working Very Important Network model by the fourth year of project implementation;
- the initiation of maintenance revenue generation or revenue sharing pilots in selected project districts by the fourth year of project implementation.

An assessment of progress will be formulated in an annual policy appraisal statement to be produced by project Technical Assistance. This will be a critical input for the annual project planning meeting and will be used as a basis for formulating guidance documents for the next year.

## 2. MONITORING INSTITUTIONAL ISSUES

Within the framework of appropriate policies and procedures, the project will support the development of institutional capacities, particularly within the DPUK but also to some extent within the DPUP. Therefore, project monitoring will track the extent to which the DPUK is able to establish priorities, develop appropriate plans, formulate realistic budgets, manage the implementation of rehabilitation and maintenance activities, and create a functioning information system.

The factors which are required to do this can be broken down into several different categories. First are the human resources to manage the district road networks effectively, including both the level of staff and the structure of the organization within which that staff works. Indicators of progress are:

- an appropriate organization structure has been established with a separate unit responsible for road maintenance (and workshop) activities;
- sufficient staff have been appointed to carry out planning, rehabilitation and maintenance;
- staff have the skills required to perform their work at an acceptable standard;
- an on-going training program is established which targets appropriate staff members to improve their skills and provides the necessary training required by new staff members.

These indicators can be monitored largely through the collection of routinely produced documents, such as organizational reports, letters of appointment, approved training plans and certification of training completed. During the initial start-up phase of the project, attention will need to be given to the guidance and instructions required to ensure that the appropriate information is collected and reported in an acceptable format, but this should not require significant project resources or training programs to ensure that it is carried out.

The second factor is the equipment and material resources base which provides the tools required for the staff to fulfill their functions. Indicators of progress include:

- provision of necessary equipment to the DPUK;
- equipment routinely and properly maintained, with the minimum number of non-operational machines;
- district workshops established with sufficient tools, equipment and stock of parts.

Routine tracking of project inputs and the formulation of the quarterly Equipment Status Report (described in the following section) will be sufficient to monitor these indicators. No special data collection efforts will be required and no resources outside the established PU offices will be needed to complete this task.

Finally, the existence of human and material resources is significant only to the extent to which they are used effectively and efficiently. Therefore, the third factor is the way that these resources are brought together in performing specified activities. Indicators of the successful management of these resources for planning purposes (implementation is discussed in a separate section below) include:

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- establishment of a functioning information system capable of providing relevant information on road condition, traffic volume, equipment and materials on a timely basis;
- development of maintenance plans and rehabilitation programs which utilize the information generated;
- evidence that lessons learned from past experience are incorporated into plans for the future.

Monitoring these indicators will require greater exercise of judgment than the previous two groups of indicators cited above. Monitoring the development of the information system within the DPUK will in part focus on the completion of the various reports described in the next section. The accuracy of the information presented in the reports will also be subject to spot checks by DPUP and consultant staff, with national level staff either initiating or participating in these spots checks as required. To the extent that reports are completed accurately and on a timely basis, the DPUK is succeeding in the development of an information system for road management and maintenance.

Using the information appropriately, however, is another important part of the institutional development of the DPUK. This is to be assessed by examining the annual action plans prepared by the DPUK. These should show a clear integration of planning for rehabilitation with planning for maintenance. They should be based on the road condition inventory, relate standards to level of service, and prioritize maintenance tasks according to cost effectiveness. They should also show how the proposed plan of action for the coming year is based upon an examination of past experience. A strong action plan will identify problems encountered in the past, how they are expected to be addressed, and ways in which the proposed plan has been adopted from the previous one to take these changes into account. A weak action plan, in contrast, merely presents a proposed budget and list of roads, with no explanation of how implementation is to be improved and past problems overcome.

Consistent with its new function to provide technical support and quality control to DPUKs, monitoring these indicators is primarily the responsibility of the DPUP. It will use this information for the formulation of a Quarterly Progress Report which is to be submitted to the national counterparts. As noted below, this report will address both institutional development and implementation issues, and will be used to assess the appropriateness of the system which has been established and identify problems which need to be addressed at a policy level. In it, the DPUP will give an assessment of the progress made in strengthening the capacities of the DPUK and in achieving the project objectives. In addition, the DPUP will use this information to develop its plans to support the DPUK in carrying out project activities, including site visits, consultations and training programs.

Because the Quarterly Progress Report does not merely present data collected by the DPUK and DPUP, but also tries to interpret those data to arrive at an assessment of the progress made in developing institutional capacities, reporting will require particular attention in the early stages of project implementation. It will first be necessary to establish the kinds of information to be received in the Quarterly Progress Report, specify the format and issue the necessary instructions to the DPUP and DPUK. Following this, the technical assistance team will have to work closely with DPUP officials to ensure that the objective of the instructions is clear and that DPUP staff understand what they are supposed to do and how they are supposed to do it. Some training sessions, involving both DPUP and DPUK officials, will be required to ensure that there is a common understanding about the kinds of information required and how they are to be used at each level of government.

## 3. MONITORING IMPLEMENTATION ISSUES

The objective of the road management system and purpose of institutional development efforts is to ensure that the district road network is gradually improved and maintained on an ongoing basis. A key focus of the monitoring system, therefore, is on the actual implementation of road rehabilitation and maintenance work.

One important element of this monitoring activity is the road condition inventory. This will be established as a routine part of the DPUK annual work plan and will provide an accurate and up to date picture of the condition of the district road network. This will be an important management tool for the DPUK, helping to identify road links which should be targeted for rehabilitation work and to develop routine maintenance plans. In addition, however, it will serve as an indicator of progress in the improvement of road conditions throughout the district. As the project proceeds, its success will in part be determined on the basis of improvements reported through this monitoring instrument. To ensure the accuracy of this inventory, the DPUP and project consultants will conduct periodic spot checks to determine if actual road conditions have been properly reported. National agencies will also initiate or participate in these spot checks as required.

For rehabilitation work, the DPUP will utilize the monthly reporting system now in use for all GOI development projects. This provides information on the financial disbursements and achievement of physical targets. These forms, which are already familiar to DPUK and DPUP staff and have a recognized function within the current system, will be used by the DPUP to assess progress, spot problems and plan support activities where required. These monthly reports will be supplemented by site visits conducted by the DPUP. Such visits will be a part of their support function, helping to identify problems faced by the DPUK, to provide assistance and guidance, and to correct any mistakes before it is too late

or too expensive. It is essential that the results of these site visits, complete with an identification of problems and recommended actions to overcome them, be documented in reports prepared by the DPUP staff.

The low quality of rehabilitation work has been a particular problem in the past. Increasing DPUK skills and supervision systems to control contractor performance will receive special project attention. Since present supervision system are inadequate and part of the problem, they cannot be used to monitor progress toward improved implementation capability. Until new systems are attempted, regular project consultant monitoring reports on rehabilitation quality and certification inspections will provide the information required.

For certification, the DPUP and a direct AID contractor will inspect completed rehabilitation work and certify its completion according to project standards. This quality control function is an important part of the role of the DPUP in the project. The AID contractor's responsibilities will be limited to ensuring that the DPUP certification is valid.

The key indicators of effective maintenance implementation are performance against performance standards, the measurement of which will be an integral part of the maintenance management system (MMS) adopted by the DPUKs. The frequency of summary reporting will be determined when the MMS is introduced. As with rehabilitation, existing GOI disbursement and physical progress reports will be channeled to the DPUP. For non-force account maintenance, either by roadmen, contractors or community initiative, alternate monitoring indicators may be required. Project consultants will assist to develop alternate monitoring techniques as needed.

In addition to these reports, the Workshop of each DPUK will summarize the information maintained for its equipment management system into quarterly equipment status reports. These will indicate which pieces of equipment have been repaired, how long repairs have taken, which pieces of equipment remain out of service, the status of material and parts stocks, and problems or constraints which have been encountered. This information will indicate the extent to which the Workshop is functioning effectively and whether the DPUK has the necessary equipment for rehabilitation and maintenance work. Reports indicating special problems will trigger a special site visit by DPUP staff to investigate the problem more thoroughly.

The monthly reporting forms, together with site visit reports, consultations between DPUP and DPUK staff, certification and equipment status reports will form the basis for the Quarterly Progress Reports. These will be completed by the DPUP and will focus on implementation constraints, progress made in addressing those constraints, and recommended future actions. They will provide a general picture of overall progress in the province and will be forwarded to the Ministries in Jakarta where they will help in the identification of policy issues requiring action at the national level.

The following table provides a summary of these diverse monitoring activities, indicating the monitoring instrument proposed, what variable or factor it is intended to monitor, who is to carry out monitoring activities, and how frequently these are to be done.

Summary of Implementation Monitoring

| Instrument | Variable | Responsible Agency | Frequency |
|---|---|---|---|
| Condition Inventory | Condition of network | DPUK | annual |
| Status Report (rehabilitation) (maintenance) | Financial disbursement<br>Physical achievements | DPUK | monthly |
| Site Visit Report (rehabilitation) | Rehabilitation quality performance<br>Constraints | DPUP | periodic |
| Maintenance Management Summaries | Maintenance performance | DPUK | tbd |
| Provincial Progress Report | Implementation progress<br>Constraints | DPUP | quarterly |
| Certification (rehabilitation) | Rehabilitation quality performance | DPUP<br>Consultant | periodic |
| Equipment Report | Condition of equipment | DPUK | quarterly |

## 4. EVALUATING IMPACT

At the end of the first phase of project implementation, the project will support a mid-term evaluation to determine the adequacy of the policies and procedures which have been established in meeting the project purpose of developing sustainable and replicable systems for maintenance and road management. This evaluation will first focus on the procedures governing the identification of roads to be rehabilitated and the provision of routine maintenance. Specific issues to be examined include the following:

- have the procedures for identifying roads for rehabilitation (such as the calculation of internal rates of return using traffic counts and vehicle cost savings) been appropriate?
- has the combination of rehabilitation and routine maintenance resulted in cost savings to the government and/or the public?

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- have sufficient funding sources been identified to allow the kabupaten to continue a routine maintenance program in the future?

- do emerging definitions of Very Important Networks offer an acceptable and practical approach to balance resource availability with conflicting claims for economic and non-economic welfare benefits?

Answering these questions will require special data collection efforts and the provision of funds for outside technical assistance to complete this task in the two project provinces.

The second focus will be the appropriateness of project measures to improve institutional capacities for planning and implementation of maintenance and rehabilitation. Information collected through the monitoring activities described above will enable the evaluation team to address questions concerning the quality of rehabilitation and maintenance work, the adequacy of support from the DPUP, and the appropriateness of the project's training program.

To carry out this task, it is estimated that a total of six person months of technical assistance will be required. This will consist of two person months each of the services of a transportation economist (team leader), a civil engineer with experience in road maintenance programs, and a public administration specialist. A similar level of assistance will be required to address the same issues in the final year of project implementation.

# ANNEX O

## DRAFT SCOPES OF WORK FOR TECHNICAL ASSISTANCE

DRAFT SCOPES OF WORK FOR TECHNICAL ASSISTANCE

1. Bridging Technical Assistance: the services of an engineering team will be required for approximately 13 months to supervise first year project preparation activities. It is anticipated this need will be filled by an (8a) firm in joint venture with a local engineering company and that (8a) procedures will permit a rapid start-up of work. The primary tasks will be:

   a. conduct the first-year condition survey and traffic count excercise: it is expected that the surveys will be implemented by the contractor with Bina Marga's Sub-Directorate of Local Roads. The Bridging TA team will assure that the methodology used is sound, organize field work, and manage its own staff and DPUK assistants in the collection and analysis of counts.

   b. survey miscellaneous office and field equipment needs: the contractor will assess the initial nine project districts' needs for non-workshop and non-construction equipment, e.g. drafting tables, hand calculators, survey instruments, etc. The contractor will define the maximum requirements per district for these items, will inventory their present availability and condition in the districts, and will draw up a costed procurement list of all requirements.

   c. adjust the Simplified Selection Table for use by project districts: the contractor will prepare micro-computer templates, using a common spreadsheet program, for future updating of the Simplified Table. The templates will incorporate new features including: non-motorized traffic costs and the impact of non-motorized traffic shifting to motorized modes with improvement in road conditions. Using data on vehicle costs collected for Outer Island locations by World Bank consultants in 1986, and using the traffic mode distributions from the traffic count exercise above, the contractor will prepare versions of the Simplified Table for immediate use and will train Sub-Directorate of Local Roads and DPUP staff in the updating procedure. It is anticipated that separate Tables will be required for each province.

   d. review GOI guidelines for drainage and advise USAID on their acceptability for project use.

   e. review proposed GOI contract formats for use during the first years of rehabilitation work and advise USAID on their appropriateness for adequate control of performance. Assist GOI counterparts to revise formats as necessary.

   f. supervision of workshop construction and upgrading: the contractor will supervise constructions and inspect completed work for certification to USAID.

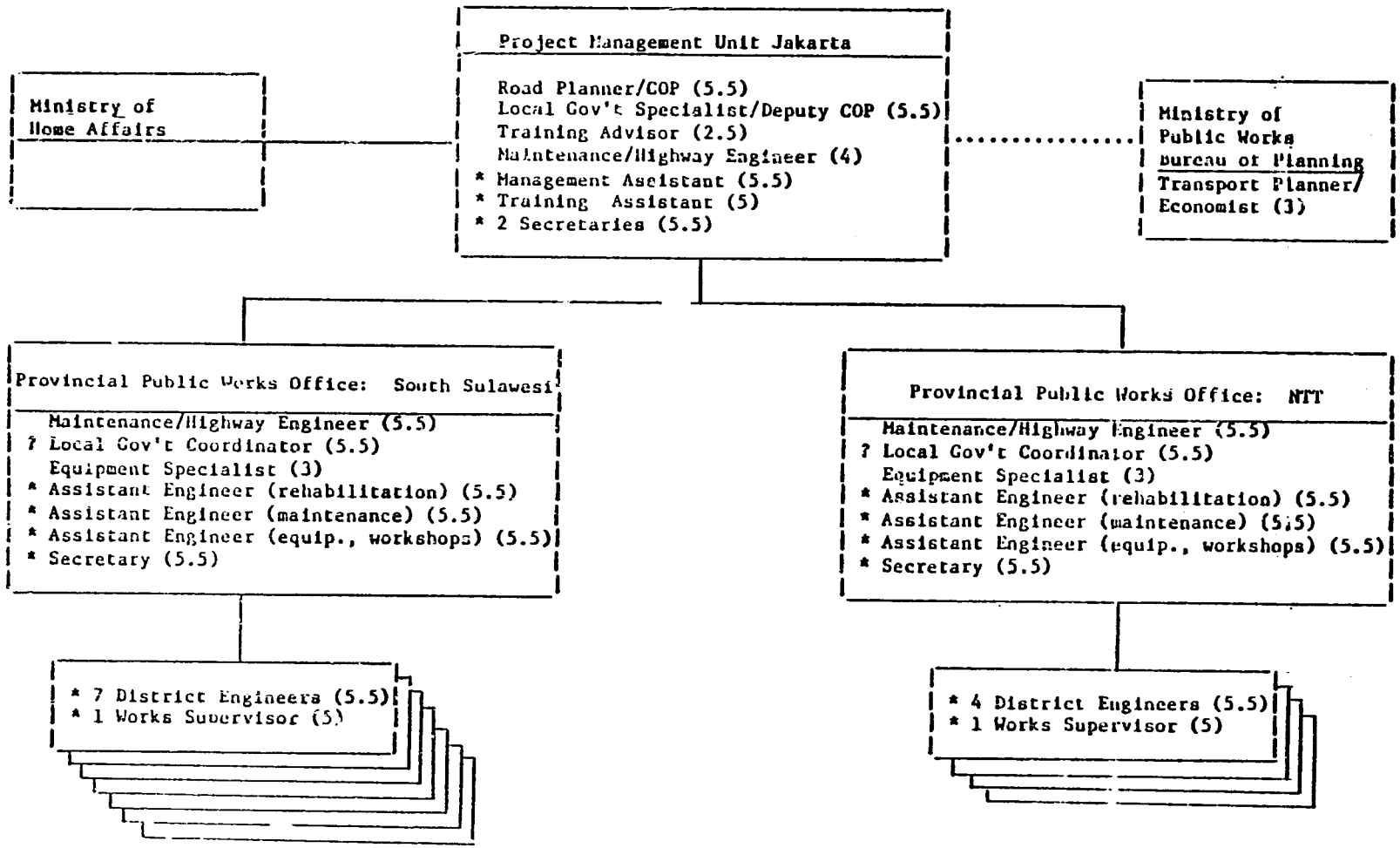
h. design supervision for first year's maintenance and rehabilitation program: the contractor will assist each of nine districts to prepare maintenance plans for GOI fiscal year 1988/89. The contractor's responsibility will be limited to assuring that the budget for the plan is reasonable and that the work chosen by each district reflects generally sound priorities. For rehabilitation, the contractor will supervise the design, by the DPUK, of one rehabilitation project per district for which construction work may begin in mid-1989. The contractor will review the final design and advise USAID of its adherence to project standards.

i. review training availability: the contractor will conduct a first-hand review of eleven training courses now offered to DPUK staff under the ADB II project. The review will consider the adequacy to DPUK needs of curriculum and mode of delivery. The contractor will advise USAID on the extent to which these courses should be utilized in the RRMS project over the following two years. The contractor will also review equipment training available from private equipment suppliers in Indonesia and will prepare a plan and a budget for any recommended use of this training source.

2. Preparation of Equipment Lists and Specifications for Tender (PDS-funded): the services of an equipment specialist will be required for approximately three months to assist the GOI to finalize lists, specifications and tender documents for the procurement of maintenance, workshop, support and rehabilitation equipment. PDS funds are available for this task so work may begin before initial project Conditions Precedent are met. The contractor will:

a. review the project procurement list and plan;
b. examine GOI procurement procedures;
c. check all equipment reported in operating condition in each of the nine districts to determine its suitability for project use and adjust the project procurement list accordingly;
d. assist Bina Marga staff to finalize final procurement and specificatons and tender documents.

The contractor will also review Bina Marga workshop construction and workshop upgrade designs and will advise USAID on their acceptability for project use.




* Indonesian

** Numbers in brackets ( ) refer to expected person-years

DRAFT

LONG-TERM TA CONTRACT
JAKARTA -LEVEL

## ROAD PLANNER/CHIEF OF PARTY

**Location of Assignment:** Project Management Unit, Jakarta; occasional travel.

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** the road planner/chief of party (COP) will be a senior roads engineer with extensive experience, in an advisory or executive capacity, in road policy and planning. This experience may have been gained with U.S. state or federal highway authorities, national road authorities of developing countries, or major international bodies such as the International Road Federation. The COP will have had successful experience managing infrastructure and/or road planning projects in developing countries and an understanding of the constraints facing project implementation in that environment. The COP will have had direct experience with the maintenance and rehabilitation of low-volume rural roads and a sensitivity to the organizational, financial and social issues involved in developing the capability of institutions to manage them. He/she will have had formal training or, at a minimum, be conversant with the concepts and techniques of transport economics. Experience with roads financing issues will be viewed favorably. The COP will have a proven ability to communicate effectively both orally and in writing for effective and tactful interaction with GOI policy-makers. The COP will be assisted by an administrative assistant and a secretary.

Responsibilities: the road planner will be the chief of party of the technical assistance team, responsible for managing the teams' work, administering the technical assistance contract, monitoring project progress, managing the Special Studies agenda, participating directly in selected Special Studies, and representing the technical assistance team to the GOI and USAID. Specifically, the COP will:

1. Manage the overall effort of the technical assistance team:
   - prepare annual workplans for individual and collective team members' tasks
   - assess team's progress against workplan and project benchmark targets

2. Administer the technical assistance contract:
   - manage the assignment of individual team members
   - coordinate logistics of housing, leave, etc.
   - control contract finances

3. Monitor project progress: by means of a Quarterly Report to the GOI and USAID, the COP will report and assess:

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- the status of the technical assistance contract including
  - contract finances
  - status of personnel assignments
  - staff and performance against workplans

- project implementation progress including
  - quantitative and qualitative achievement of project targets for each project element
  - impediments to implementation

- indicators of achievement of institutional development goals including
  - introduction of various systems for DPUK use
  - organizational improvements
  - development of the DPUP/DPUK link
- anticipated progress in the upcoming quarter

The COP will make appropriate recommendations for improvement in each Quarterly Report and will prepare a synopsis of project achievements, impediments and recommendations with special emphasis on issues of policy import for an annual presentation to the Highway Steering Committee.

4. Manage the Special Studies agenda:
   - prepare, for GOI and USAID review, annual agendas for Special Studies topics including draft scopes of work, a plan of work, schedules and a budget for each
   - identify appropriate candidates to perform Special Studies work. For consultant assistance financed outside the long-term technical assistance contract (i.e., from the Special Studies fund), coordinate preparation of background and briefing materials for these consultants' use
   - manage the conduct of any Special Studies performed in-house by the long-term technical assistance team

5. Assume direct responsibility for Special Studies concerning Sustainable District Road Management Strategies

## LOCAL GOVERNMENT SPECIALIST/DEPUTY CHIEF OF PARTY

Location of Assignment: Project Management Unit, Jakarta; extensive travel (two weeks per month).

Duration of Assignment: five and one-half years (66 person-months).

Qualifications: minimum Masters degree in business, public finance, administration, economics or related social science preferred. Extensive experience in institution-building projects in developing countries. At

least three years previous experience with local government planning, budgeting, and/or personnel procedures in Indonesia required. Previous experience in project or impact evaluation desirable. Ability to communicate effectively in Bahasa Indonesia (FSI 3/3 minimum) necessary. Facility with common micro-computer programs required.

Responsibilities: the local government specialist will be the Deputy Chief of Party. He/she will be based in the PMU and will develop working contacts with Bangda, PUOD and province counterparts in the Home Affairs structure. The specialist will have general responsibility to: monitor and facilitate the development of procedures for project implementation, particularly the flow of funds; assist and evaluate the development of institutional capabilities to maintain and manage district networks; and contribute to Special Studies which have special implications for institutional development. Specifically, the specialist will:

1. Monitor and facilitate development of procedures for project implementation:
   - assist PMU and Bangda counterparts to assure: that project funds are budgeted in time for field implementation; that funds for different project activities are budgeted through appropriate funding channels and are under the spending authority of the appropriate implementing agency at the appropriate level of government.
   - assist to develop formats for annual budget proposals (DUPs) for project activities which retain the flexibility necessary for field implementation needs, particularly for road and equipment maintenance.
   - assist Bangda, PUOD and province counterparts to develop decrees, letters of decision and other documents related to formalizing decisions concerning changes in organization, authorities, personnel or funding.
   - establish within the PMU a monitoring system, using common micro-computer software, to monitor the disposition of project funds.

2. Assist and evaluate development of institutional capabilities
   - assist GOI counterparts to identify benchmarks and measure progress against them for achieving project objectives concerning the improvement of DPUK capabilities to manage and maintain district road networks.
   - assess the appropriateness of organizational, staffing and financial arrangements for maintenance management, equipment and workshop management and works supervision. Recommend improvements accordingly.
   - assist GOI counterparts to identify benchmarks and to measure progress against them for developing DPUP support and assistance to DPUKs. Assist to identify required improvements.
   - analyze the flow of GOI funds, contracting and contract payment procedures, identifying impediments and calculating losses attributable to delays. Recommend improvements accordingly.

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3. Special Studies
   - assist the Chief of Party to develop annual Special Studies agendas, focusing on institutional and financial concerns
   - identify special social science skills (sociology, public finance, public administration, etc.) needed for particular Special Studies
   - participate directly in, or assist to prepare background and briefing papers for Special Studies on Local Revenues for Maintenance, Alternative Approaches to Conducting Maintenance, District Equipment Policy, Improving Performance of Small Contractors, DPUK Organizational Structure and Personnel Needs, and Budget Procedures and Work Delays
   - monitor and evaluate performance of Special Studies follow-on field trials of alternative approaches to conduct maintenance and local revenue pilots

4. Other
   - assist Training Advisor as required, particularly in developing locally-appropriate maintenance promotional materials.

## TRANSPORT PLANNER ECONOMIST

Location of Assignment: Sub-Directorate of Local Roads, Directorate of Planning, Bina Marga, Ministry of Public Works, Jakarta; occasional travel (one week per month).

Duration of Assignment: three years (36 person-months) with short-term follow up visits as needed (up to 6 person-months).

Qualifications: at least a Masters Degree in transport economics; extensive experience with low volume rural roads in developing countries; facility with micro-computer applications of common spreadsheet programs; demonstrated ability to present ideas to non-specialists.

Responsibilities: the economist will have responsibilities for aspects of routine project implementation, background studies, and Special Studies. In conducting these tasks he will work primarily with the staff of the Sub-Directorate of Local Roads in Bina Marga's Bureau of Planning in the Ministry of Public Works and will report to the Director of Planning. Primary responsibilities will include:

1. Routine implementation:
   - assist Sub-Directorate staff and, by the fourth year, DPUP staff to update the Simplified Table year-by-year;
   - prepare alternative approaches to the use of the Simplified Table for selecting roads for rehabilitation when present road condition clearly impedes traffic and makes traffic-based calculations unreliable indicators of rehabilitation benefit. Alternative approaches will be simple, low-cost and easy for DPUK staff to

apply in the field and will be prepared in time for use in the 1990/91 GOI fiscal year;

- as needed, develop simple origin/destination survey formats and procedures for measuring maintenance and rehabilitation impact on transportation costs and volume. Oversee their introduction to district staff;
- provide on-the-job training to Sub-Directorate and DPUP (DPUK and Bappedas?) staff in the application of the Simplified Table, alternative selection methodologies, and O/D surveys.

2. Background studies:

- with the assistance of the local government specialist and the teams's engineers, survey the history of the networks now in place in the project districts and analyze how roads entered the networks, the pattern of DPUK attention to them, and the degree to which existing road surface and conditions correlate to traffic levels.
- for later application in defining Very Important Networks and for maintenance promotional materials, calculate for road surfaces and conditions actually found in project districts:
  - life cycle comparisons of costs and benefits (economic and financial) of maintenance regimes versus non-maintenance regimes on representative road links;
  - whole network models demonstrating costs and benefits and the budgetary implications of maintenance versus non-maintenance regimes;
  - models which optimize the economic return to given levels of expenditure from district budgets for roads.

The calculations and models will be presented in a form easily comprehended by GOI counterparts and local politicians.

3. Special Studies:

- assist the Chief of Party to identify and prioritize Special Studies topic agendas each year and to prepare background/briefing materials for any Special Studies performed by outside parties;
- assume primary responsibility for conducting the Very Important Network Special Study.

## TRAINING ADVISOR

Location of Assignment: Project Management Unit, Jakarta; extensive travel (two weeks per month).

Duration of Assignment: two and one-half years (30 person-months) with short-term follow up visits as needed (up to 6 person-months).

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**Qualifications:** a registered engineer with at least five years specialization in organizing and managing training programs for road maintenance or rehabilitation field staff in developing countries.

**Responsibilities:** the Training Advisor will based in the PMU and will work primarily with DPUP and Diklat Bina Marga training staff. The advisor be assisted by a Training Assistant, gradually transferring responsibility to the Assistant. The Training Advisor's primary tasks will include:

1. Develop an overall project training plan. Specifically, the advisor will:
   - survey existing in-country formal training courses. Drawing on work performed by Bridging consultants, the advisor will review the 11 standard Diklat courses for DPUK staff; assess equipment training from private equipment suppliers; with Diklat Bina Marga assistance, inventory existing training materials available at the Diklat, the PusDiklat, RTCs and DPUPs; and identify and assess any other relevant training resources available including long-term in-country academic courses.
   - assess the training needs of project DPUK staff, minimum requirements for DPUP staff to develop a guidance and supervision role for the work of DPUKs, and additional requirements for Sub-Directorate staff.
   - assist DPUP and PMU counterparts to develop appropriate trainee selection criteria
   - prepare an overall project training plan identifying skill achievement targets, and the timing, duration, venue and a budget for each type of training required. The plan will place particular emphasis on practical hands-on training methods, increasingly conducted in the project districts and increasingly involving DPUP and ALKAL staff in the training of DPUK personnel. The plan will also pay particular attention to developing Model Force Account Crews as a training mechanism for road rehabilitation skills.

2. Assist DPUK and DPUP staff to develop annual training plans.

3. Assist PMU staff to develop and implement a training monitoring system which:
   - tracks training inputs provided (funds and person-months by type of training)
   - tracks training outputs achieved
   - identifies the present locations and job responsibilities of former trainees
   - assesses the degree to which skill achievement targets are being met and skills taught are actually used.

4. Assist PMU staff to develop a management system for long-term in-country academic training.

5. Assist _____ to develop maintenance promotional materials for _____.

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LONG-TERM TA CONTRACT
JAKARTA -LEVEL

## MAINTENANCE/HIGHWAY ENGINEER

**Location of Assignment:** Project Management Unit, Jakarta; occasional travel (one week per month).

**Duration of Assignment:** four years (48 person-months).

**Qualifications:** the maintenance/highway engineer will be a roads engineer registered with _____. The engineer will have had management experience with low-volume road projects in developing countries, including all aspects of road operations: traffic and condition surveys, design, materials testing and control, equipment and workshop management, and force account and contractor implementation. He/she will be familiar with all aspects of Maintenance Management Systems. Prior experience implementing maintenance management in developing countries will be required. Experience with non-force account approaches to maintenance is desirable.

**Responsibilities:** the maintenance/highway engineer will be responsible for the overall implementation, monitoring and evaluation of the project civil works program. The engineer will assist as needed with engineering and management aspects of the Special Studies program. He/she will report to the Chief of Party and will work on a daily basis with PMU counterparts, developing contacts outside the PMU with the Sub-Directorate and PALAN in Jakarta, while establishing province contacts with province-level consultant engineers. Specific responsibilities will include:

1. develop civil works program
   - assist Sub-Directorate to establish guidelines for annual maintenance and rehabilitation plans
   - assist Sub-Directorate to develop and improve technical standards for district maintenance programs (performance standards, etc.)
   - assist PMU to establish and operate an information system to consolidate province reports of physical progress of civil works
   - assist PMU to determine timing and procedures for works certification by AID, and to coordinate the certification and reimbursement process
   - perform spot checks of maintenance and rehabilitation works

2. monitor and assess project achievements in increasing DPUK technical performance: working with the Local Government Specialist, the engineer will assist the Sub-Directorate to identify performance indicators and to track progress against performance targets for:

   - conducting road rehabilitation to standard
   - planning and managing maintenance
   - managing equipment
   - conducting traffic counts and condition surveys

   The engineer will identify problems in each of these areas and recommend improvements accordingly.

3. assist in the planning and/or conduct of selected Special Studies
   - advise on engineering aspects of the Special Studies agenda, preparing background and briefing materials as needed.
   - assume primary responsibility for engineering aspects of Special Studies into Alternative Maintenance Approaches and for evaluating the technical quality of follow-on maintenance trials

4. other
   - assist Sub-Directorate to form and administer a Maintenance Technical Panel to periodically review progress of maintenance programs and alternative maintenance techniques
   - inventory technical manuals, guidebooks, planning forms, etc. available within Bina Marga. Determine which are or should be made available for district use and assist the Sub-Directorate and Bangda to develop a program for their dissemination and for appropriate training to accompany distribution
   - assist Training Advisor to identify training needs and to assess training availability and appropriateness
   - assist Training Advisor to develop maintenance promotional materials and to monitor the effectiveness of Model Force Account Crews as a training vehicle.

## TRAINING ASSISTANT*

**Location of Assignment:** Project Management Unit, Jakarta; frequent travel (two weeks per month).

**Duration of Assignment:** five years (60 person-months).

**Qualifications:** a minimum Bachelors Degree in engineering, administration or another social science. Proven administrative capability with at least five years administrative experience. Prior experience with training programs, preferably related to public works training, desirable. Micro-computer skills for spreadsheet and data-base management software necessary. Ability to write and speak basic English required.

**Responsibilities:** the training assistant will assist the Training Advisor. It is expected the assistant will handle day-to-day communications with Indonesian public and private sector training institutions, develop and operate micro-computer monitoring systems for the training program, administer training finances and assume full responsibility for administering the training program upon the departure of the Training Advisor.

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## MANAGEMENT ASSISTANT*

**Location of Assignment:** Project Management Unit, Jakarta

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** minimum Bachelors degree in business, accounting, public administration or related fields. At least five years administrative experience. Familiarity with common micro-computer spreadsheet or database programs desirable. Good written and spoken English capability necessary.

**Responsibilities:** the management assistant will be directly responsible to the Chief of Party for administering contract accounts, vouchers, organizing project reports and other duties.

## SECRETARIES*

(the consultant team will arrange for secretarial support in Jakarta as required. It is anticipated that two secretaries in the PMU will be required and that micro-computer word processing and spreadsheet skills will be desirable).

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LONG-TERM TA CONTRACT
PROVINCE-LEVEL

## MAINTENANCE/HIGHWAY ENGINEER

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** the maintenance/highway engineer will be a senior roads engineer registered with _____. The engineer will have had extensive management experience with low-volume road projects in developing countries, including all aspects of road operations: traffic and condition surveys, design, materials testing and control, equipment and workshop management, and force account and contractor implementation. He/she will be familiar with all aspects of Maintenance Management Systems. Prior experience implementing maintenance management in developing countries will be required. Experience with non-force account approaches to maintenance is desirable.

**Responsibilities:** the Maintenance/Highway Engineer will be the Team Leader of the consultant group in each province. The engineer's counterpart will be the PCU Director. The Engineer will manage the overall effort of the province consultant team. He/she will work directly with provincial staff, developing the strengths of DPUP and ALKAL offices, to support improved performance of district road works and to introduce effective road management and maintenance to the DPUK. Specific responsibilities will include:

1. manage province consultant team
   - prepare annual workplans, with province counterparts, for the work of the team as a whole and for individuals
   - periodically assess team's performance and individuals' performance against workplan targets
   - administer province-specific contract accounts, personnel matters, etc.

2. develop province civil works program: as the senior engineer for project work within the province, the engineer will be directly responsible for the quality of road planning, road maintenance and road rehabilitation activities. This will require that the engineer:
   - supervise the introduction and implementation of traffic count and road condition surveys
   - oversee the selection, design, budget preparation and implementation of rehabilitation work (the engineer will review each design for adherence to project standards and engineering soundness. His/her formal approval of designs will be required prior to any AID commitment of funds for rehabilitation)

- initiate the introduction of Maintenance Management Systems to each district (the engineer's approval of a district's Annual Maintenance Plan will be required prior to any AID commitment of funds for rehabilitation in that district for that year) and oversee the implementation of both force account and alternative approaches to conducting maintenance in the field

3. report project progress periodically to the PMU

4. monitor and assess achievements in increasing DPUK capabilities to
   - conduct traffic counts and condition surveys
   - conduct road rehabilitation to standard
   - plan and manage maintenance
   - manage equipment

5. identify training needs within the province and assist the Training Advisor to develop annual training plans and programs accordingly. Directly monitor the performance of the Model Force Account Crew

6. serve on the Sub-Directorate of Local Roads' Maintenance Technical Panel to periodically review progress in developing effective maintenance programs.

7. represent the project team to political leaders within the province to increase awareness and understanding of maintenance benefits.

## EQUIPMENT MANAGEMENT SPECIALIST

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** three years (36 person-months).

**Qualifications:** the Equipment Management Specialist will have had long experience in the management and repair of all types of heavy construction equipment and vehicles including hands-on experience as an operator and/or mechanic, preferably starting as an apprentice and gaining experience on the job. He/she will have had supervisory experience managing equipment shops or depots including assigning equipment, controlling it, servicing it, cost accounting and ensuring its productivity. The Equipment Management Specialist will be familiar with procurement procedures for heavy equipment, spare parts, interchangeability of makes, requirements for standardization of equipment, etc. The Specialist will have intimate knowledge of warehouse requirements and procedures needed to support an operating equipment group including fuels, lubricants, etc., and the proper stocking, management and control of parts and fuels. Experience in budgeting for equipment

maintenance and for the equipment components of construction work is required. Experience as a trainer of operators, mechanics, service personnel and/or workshop administrators is required. The Equipment Management Specialist will have had prior experience working in developing countries.

Responsibilities: working with DPUP and ALKAL counterparts, the Equipment Management Specialist will develop effective equipment operation and management programs in each project district gradually transfering this responsibility to the Assistant Engineer for Equipment and Workshops. Specifically, the Specialist will:

1. adapt equipment and workshop management procedures now in use at province-level ALKALS to district needs. This will require the Specialist to:
   - review equipment operations now underway in each district
   - introduce ALKAL procedures to each DPUK, simplifying and modifying to district needs as appropriate
   - organize seminars, conduct frequent on-the-job training visits to effect the smooth implementation of new systems, making maximum use of skills available at the province level for this purpose
   - assess progress and adjust approach accordingly

2. develop effective procedures for the ALKAL/DPUP to support DPUK equipment operations, including procedures for heavy repairs, training, any equipment pooling, etc.

3. define organizational responsibilities and job descriptions for key individuals within workshop and equipment operations groups. Develop job descriptions and identify minimum skill requirements for key staff within these units and assist Training Advisor to assess annual training needs and opportunities

4. introduce the use of equipment management system (EMS) information as a tool to measure organizational performance

5. for later application under Special Studies, analyze a) the effectiveness of equipment use (cost of operating different fleet configurations), and b) the appropriateness of different equipment types, sizes and fleet sizes to district needs (in carrying out (b), assess other donors' current experience including ILO experiments with labor-based "appropriate" equipment)

6. assess needs, and prepare lists, specifications and tender documents for equipment procurement planned for the mid-year of the project

7. assist in annual planning and budgeting
   - for the distribution of annual equipment maintenance funds
   - for direct equipment operation and repair costs ("rental rate" calculations) within roadwork DIPs

8. oversee, through frequent visits, the equipment operations of the Model Force Account Crew. Assist to develop Model Crew equipment operations as an example and an effective teaching mechanism for equipment operators and administrators from other districts.

## LOCAL GOVERNMENT COORDINATOR
(note: local or expatriate to be determined)

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** the local government coordinator will have intimate knowledge of GOI administrative processes and procedures including: the budgeting process for both routine and development accounts; accounting systems; personnel and contracting procedures; etc. He/she will be familiar with district tax structures. The coordinator will also be familiar with district and province government relationships between agencies at each level and between the two levels. He/she will have had previous experience with donor-funded projects aimed at building local government institutional capabilities, and will be familiar with basic concepts of data gathering for survey purposes. Good written and spoken English language capability required.

**Responsibilities:** the Local Government Coordinator will have general responsibility to integrate the technical requirements of road maintenance and management with the administrative procedures prevailing in the project areas. Specifically, the Coordinator will:

1. monitor the organization and staff structure of project DPUKs, identifying problem areas and assisting to effect improvements

2. facilitate the smooth flow of GOI project funds
   - assist to prepare annual DUPs for project activities so that the flexibility required for field work (especially for road and equipment maintenance) is retained and so that activities financed from different funding channels are coordinated
   - monitor status of DUPs, DIPs and DIP funds for all project activities
   - identify impediments to the flow of funds and assist to overcome them

3. advise on changes to local government legal/administrative procedures required for new project initiatives, including:
   - equipment, parts and materials procurement
   - contractor supervision procedures, contractor payment procedures, contract formats
   - district or province regulations concerning equipment rental rates, fuel allocations, disposition of routine budgets, etc.

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4. assess the social acceptability of project initiatives, including:
   - systems approaches to maintenance and equipment management
   - alternative maintenance approaches

5. conduct background research as required for Special Studies on administrative, financial and social aspects of road programs.

## ASSISTANT ENGINEER (REHABILITATION)*

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** the rehabilitation engineer will be a senior engineer with a minimum civil engineering degree (Ir. level) from a recognized university with specialization in road engineering. At least ten years of experience in road and bridge design and supervision. Work experience with donor-funded projects for district or province roads required. Familiarity with materials testing procedures, traffic count and condition survey techniques required. Project management experience required. Basic English language reading and conversational ability required.

**Responsibilities:** the rehabilitation engineer will work with DPUP counterparts to oversee the quality of planning, design and implementation for project-funded rehabilitation works. This will require frequent travel to project districts. Specifically, the rehabilitation engineer will:

1. supervise the implementation of periodic traffic and road condition surveys by DPUKs

2. oversee the districts' preparation of rehabilitation designs
   - assure that designs are to standard and sound
   - advise on soil or other tests required
   - identify design alternatives (e.g. paved fords versus bridges)
   - identify needs for any specialized outside design assistance or additional training
   - review budget estimates and determining the feasibility of implementing the design with the resources and staff available

3. oversee implementation of rehabilitation works
   - establish effective contractor supervision practices by DPUKs
   - assure that both contracted and force account work is conducted to standard
   - monitor the performance of the Model Force Account crew.

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LONG-TERM TA CONTRACT
PROVINCE-LEVEL

## ASSISTANT ENGINEER (MAINTENANCE)*

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** five and one-half years (66 person-months).

**Qualifications:** the assistant maintenance engineer will have a minimum civil engineering degree (Ir. level) from a recognized university with specialization in road engineering. At least ten years of experience in road and bridge design and supervision. Work experience with donor-funded projects for district or province roads desirable. Familiarity with simple materials testing procedures, traffic count and condition survey techniques required. Prior exposure to road maintenance and/or maintenance management systems highly desirable. Project management experience desirable. Basic English language reading and conversational ability required.

**Responsibilities:** the assistant maintenance engineer will assist the province consultant Maintenance/Highway Engineer and DPUP counterparts to introduce Maintenance Management Systems to each district, to prepare Annual Maintenance Plans, to guide the development of maintenance feature monitoring procedures and field work methods for conducting maintenance, and to monitor and evaluate the relative performance of force account and alternate means of conducting maintenance.

## ASSISTANT ENGINEER (EQUIPMENT, WORKSHOPS)*

**Location of Assignment:** one in each Provincial Public Works Office, Ujung Pandang and Kupang; frequent field travel.

**Duration of Assignment:** five and one-half years (60 person-months).

**Qualifications:** the equipment and workshops engineer will have had at least five years experience managing equipment shops or depots with responsibility for controlling and scheduling equipment for repair and maintenance, stocking and accounting for spare parts and fuels/lubricants, and maintaining workshop accounts. He/she will be familiar with all types of road construction equipment and will, preferably, have had additional experience as a master mechanic and/or equipment operator. Basic reading and spoken English language capability is required.

**Responsibilities:** the assistant engineer for workshops and equipment will assist the Equipment Management Specialist (EMS) in all aspects of the Specialists tasks and will be expected to assume the full duties of the EMS upon the EMS' departure.

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LONG-TERM TA CONTRACT
PROVINCE-LEVEL

## SECRETARIES*

(the consultant team will arrange for secretarial support in each province as required. It is anticipated that one Secretary in each of the two DPUPs will be necessary and that micro-computer word processing and spreadsheet skills will be desirable).

## DISTRICT ENGINEERS*

**Location of Assignment:** one engineer in each project district.

**Duration of Assignment:** for districts Kupang, Belu, Takalar, Jeneponto, Sinjai, Bone, Pinrang and Sidrap five and one-half years (66 person-months) each; for TTU and TTS three and one-half years (40 person-months) each.

**Qualifications:** a minimum civil engineering degree (Ir. level) from a recognized university with specialization in road engineering. At least eight years of experience in road and bridge design and supervision. Work experience with donor-funded projects for district or province roads desirable. Familiarity with simple materials testing procedures, traffic count and condition survey techniques required. Some exposure to maintenance and equipment management systems desirable. Project management experience desirable. Basic English language reading and conversational ability required. Willingness to work in rural areas required.

**Responsibilities:** the district engineers will be responsible to the DPUK Chief but will work on a daily basis with the head of the roads section, assisting to:

1. prepare annual design proposals that meet project design standards
2. conduct periodic traffic count and condition surveys
3. prepare Annual Maintenance Plans and budgets
4. develop Maintenance Management Systems and implement maintenance effectively
5. supervise contractors on rehabilitation works
6. develop effective equipment and workshop management procedures and skills

District engineers will be responsible for learning maintenance management techniques and procedures during the first six months of their contract.

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LONG-TERM TA CONTRACT
PROVINCE-LEVEL

## DISTRICT WORKS SUPERVISORS*

**Location of Assignment:** one works supervisor in each Model Force Account district (anticipated to be Kupang and Jeneponto).

**Duration of Assignment:** five years (60 person-months) each.

**Qualification:** a minimum of twelve years of experience managing large crews, materials supplies and fleets of equipment for road projects. Work experience with donor-funded projects desirable. Prior training experience desirable. Familiarity with implementation planning and monitoring techniques, equipment management concepts, scheduling and resource-levelling procedures, and various quality control techniques required. Basic conversational English required. Willingness to work in rural areas necessary.

**Responsibilities:** the district works supervisors will be responsible to the DPUK chief but will work on a daily basis with the head of the DPUK reconstruction group. It is expected that at least half of the works supervisors time will be spent at the job site. The works supervisor will assist and advise the reconstruction chief in planning and controlling the work of the Model Force Account crew. He/she will be responsible to assure that crews, equipment and materials are managed effectively, and that the skills and reporting systems for effective management are transferred to district counterparts. The works supervisor will work with the province consultant engineer, the province consultant equipment specialist, and the consultant training advisor to assure that the Model Force Account Crew serves as an effective training exercise for staff on on-the-job training from other project districts.

Doc.No.: 5544P

# ANNEX P

# PROCUREMENT LIST

proc1 June 5, 1982

| ITEM | TOTAL NUMBER | UNIT COST* | TOTAL COST** | YEAR 1 PROCUREMENT NUMBER | TOTAL COST | FUNDING SOURCE LOAN | FUNDING SOURCE PL480 *** | YEAR 2 PROCUREMENT NUMBER | TOTAL COST | FUNDING SOURCE LOAN | FUNDING SOURCE PL480 | YEAR 4 PROCUREMENT NUMBER | TOTAL COST | FUNDING SOURCE LOAN | FUNDING SOURCE PL480 | ANTICIPATED SOURCE/ORIGIN (FOR LOAN-FUNDED YEAR ONE PROCUREMENT ONLY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAINTENANCE & REHABILITATION EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Bulldozer 90 HP,12 tons,w/ripper | 1 | 110,000 | 130,075 | 1 | 130,075 | 130,075 | | | 0 | | | 0 | 0 | 0 | | 941 |
| 2. Motorgrader,100HP | 19 | 70,000 | 1,572,725 | 5 | 413,875 | | 455,263 | | 0 | | | 14 | 1,159,850 | 1,159,850 | | |
| 3. Wheelloader,1.2 m3 | 11 | 70,000 | 910,525 | 3 | 248,325 | 248,325 | | | 0 | | | 8 | 662,200 | 662,200 | | 941 |
| 4. Roller,Vibratory 6 tons | 15 | 60,000 | 1,064,250 | 1 | 70,950 | | 78,045 | | 0 | | | 14 | 993,300 | 993,300 | | |
| 5. Asphalt Sprayer,800 ltr | 10 | 8,500 | 100,513 | 8 | 80,410 | 80,410 | | | 0 | | | 2 | 20,103 | 20,103 | | 941 |
| 6. Dump Truck, 5 tons | 8 | 25,000 | 236,500 | 8 | 236,500 | | 260,150 | | 0 | | | 0 | 0 | 0 | | |
| 7. Water Tank Truck, 4000 ltr | 15 | 25,000 | 443,438 | 11 | 325,188 | | 357,706 | | 0 | | | 4 | 118,250 | 118,250 | | |
| 8. Flatbed Truck, 3.5 tons | 11 | 19,900 | 258,847 | 10 | 235,318 | | 258,849 | | 0 | | | 1 | 23,532 | 23,532 | | |
| 9. Dump Truck, 3.5 ton | 71 | 20,000 | 1,679,150 | 4 | 94,500 | | 104,050 | | 0 | | | 67 | 1,584,550 | 1,584,550 | | |
| 10. Hand Compactor | 14 | 1,200 | 19,826 | 1 | 1,319 | | 1,561 | | 0 | | | 13 | 18,447 | 18,447 | | |
| 11. Multipurpose Tractor w/attach. | 20 | 39,000 | 922,350 | 9 | 415,058 | 415,058 | | | 0 | | | 11 | 507,293 | 507,293 | | 941 |
| 12. Gasoline Engine Jack Hammer | 20 | 3,000 | 70,950 | 9 | 31,928 | 31,928 | | | 0 | | | 11 | 39,023 | 39,023 | | 941 |
| 13. Jeep Towed Trailer, 2 ton | 40 | 1,500 | 70,950 | 13 | 31,928 | | 35,120 | | 0 | | | 22 | 39,023 | 39,023 | | |
| 14. Mini Vibro Roller, 1 ton | 20 | 10,000 | 236,500 | 9 | 106,425 | 106,425 | | | 0 | | | 11 | 130,075 | 130,075 | | 941 |
| 15. Concrete Mixer, 0.1 m3 | 40 | 900 | 42,570 | 18 | 19,157 | | 21,072 | | 0 | | | 22 | 23,414 | 23,414 | | |
| 16. Concrete Vibrator | 40 | 550 | 26,015 | 16 | 11,707 | 11,707 | | | 0 | | | 22 | 14,308 | 14,308 | | |
| 17. Sheep Foot Roller-Towed | 2 | 3,000 | 7,095 | 2 | 7,095 | 7,095 | | | 0 | | | 0 | 0 | 0 | | |
| Sub-total | 327 | | 7,792,320 | 135 | 2,459,955 | 1,031,022 | 1,571,326 | 0 | 0 | 0 | 0 | 222 | 5,332,366 | 5,332,366 | 0 | |
| SUPPORT EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. Pick-up Utility | 24 | 15,000 | 425,700 | 11 | 195,113 | 0 | 214,624 | | 0 | | | 13 | 230,588 | 230,588 | | |
| 2. Pick-up 1 ton | 24 | 10,000 | 283,800 | 11 | 130,075 | 0 | 143,083 | | 0 | | | 13 | 153,725 | 153,725 | | |
| 3. SSB Radio | 27 | 2,900 | 92,590 | 27 | 92,590 | 0 | 101,839 | | 0 | | | 0 | 0 | 0 | | |
| 4. Motor Cycle 100 cc | 70 | 1,200 | 99,330 | 32 | 45,408 | 0 | 49,949 | | 0 | | | 38 | 53,922 | 53,922 | | |
| Sub-total | 145 | | 901,420 | 81 | 463,185 | 0 | 509,504 | 0 | 0 | 0 | 0 | 64 | 438,235 | 438,235 | 0 | |
| WORKSHOP EQUIPMENT | | | | | | | | | | | | | | | | |
| 1. New Workshop | 2 | 100,000 | 236,500 | 2 | 236,500 | 0 | 260,150 | | | | | 0 | 0 | 0 | | |
| 2. Existing Workshop | 9 | 40,000 | 425,700 | 7 | 331,100 | 0 | 364,210 | | | | | 2 | 94,600 | 94,600 | | |
| Sub-total | 11 | | 662,200 | 9 | 567,600 | 0 | 624,360 | 0 | 0 | 0 | 0 | 2 | 94,600 | 94,600 | 0 | |
| MISCELLANEOUS OFFICE/FIELD TOOLS | | | | | | | | | | | | | | | | |
| Average estimated cost of package per district | 11 | 2,000 | 22,000 | | | | | 11 | 22,000 | 22000 | | | | 0 | | |
| Actual need determined by Year one Survey | | | | | | | | | | | | | | 0 | | |
| Sub-total | 11 | | 22,000 | 0 | 0 | 0 | 0 | 11 | 22,000 | 22,000 | 0 | 0 | 0 | 0 | 0 | |
| Grand-total | 524 | | 9,377,940 | 225 | 3,490,740 | 1,031,022 | 2,705,690 | 11 | 22,000 | 22,000 | 0 | 288 | 5,865,200 | 5,865,200 | 0 | |

*CIF Jakarta, no spareparts included **CIF Ujung Pandang and Kupang, also includes an additional 10% of CIF Jakarta price for spare parts *** Includes Tax (PPn 10%

Note : Figures do not add because cost is included in the cost for equipment procured with PL 480 proceeds



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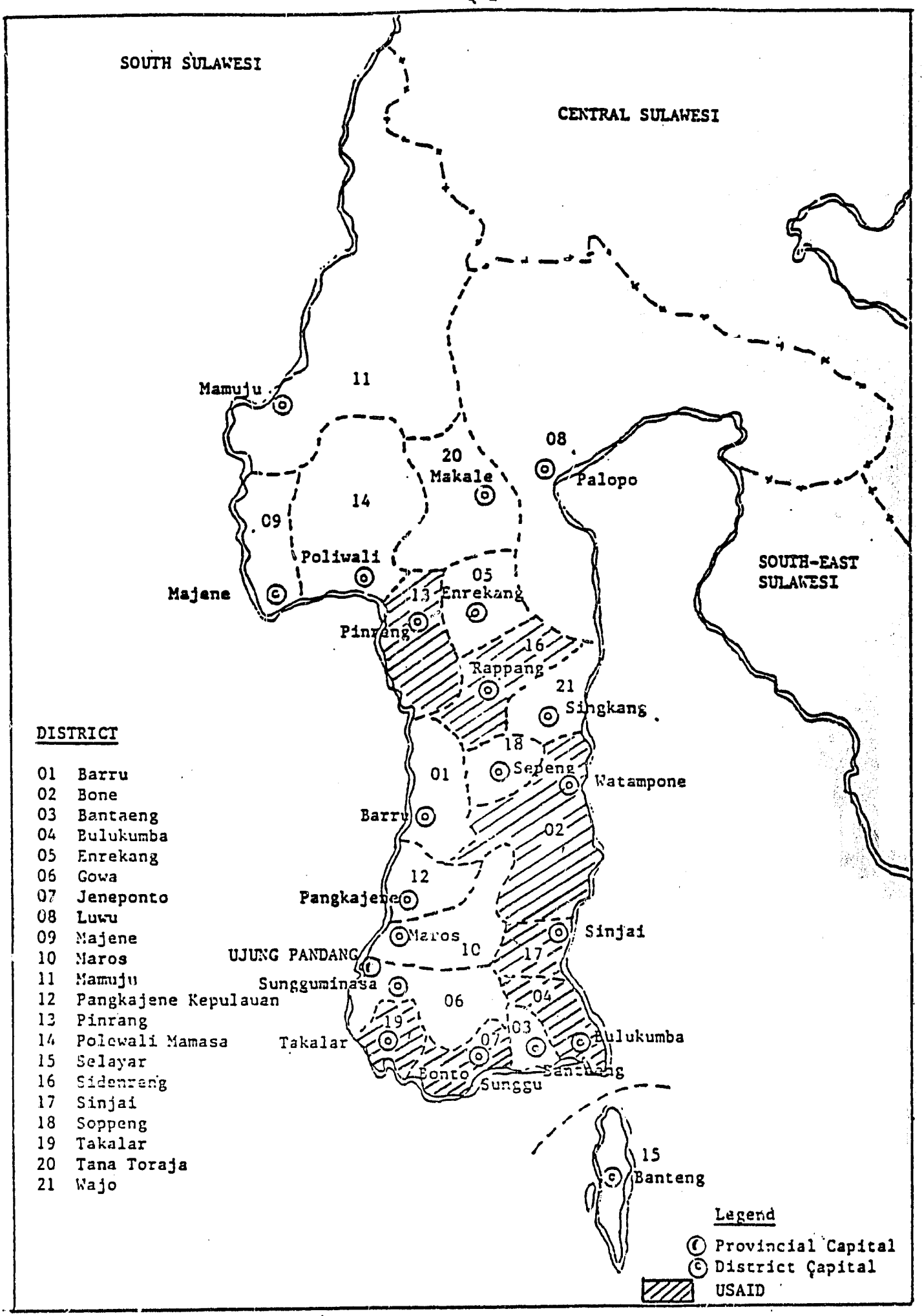
# ANNEX Q

# MAPS

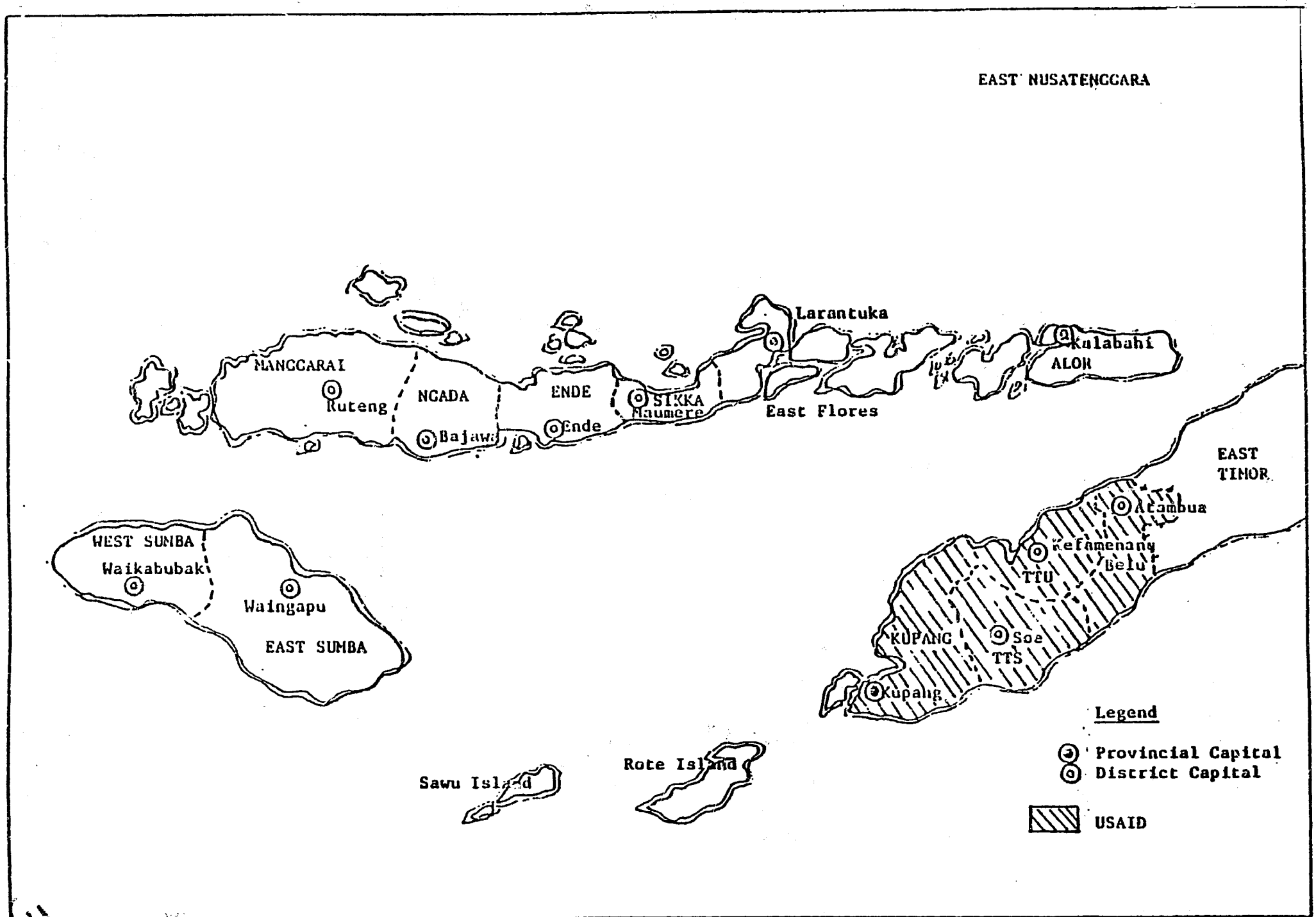
# INDONESIA

Q-1

3714


SOUTH SULAWESI
CENTRAL SULAWESI
SOUTH-EAST SULAWESI
Mamuju
11
08
20
Makale
Palopo
14
09
Poliwali
05
Majene
13
Enrekang
Pinrang
16
Rappang
21
Singkang
18
Sepeng
Watampone
01
Barru
02
12
Pangkajene
Maros
Sinjai
UJUNG PANDANG
10
17
Sungguminasa
06
04
19
03
Takalar
07
Bulukumba
Bonto
Sungguminasa
Sunggu
15
Banteng
DISTRICT
01 Barru
02 Bone
03 Bantaeng
04 Bulukumba
05 Enrekang
06 Gowa
07 Jeneponto
08 Luwu
09 Majene
10 Maros
11 Mamuju
12 Pangkajene Kepulauan
13 Pinrang
14 Polewali Mamasa
15 Selayar
16 Sidenreng
17 Sinjai
18 Soppeng
19 Takalar
20 Tana Toraja
21 Wajo
Legend
Provincial Capital
District Capital
USAID

392


EAST NUSATENGGARA
MANGGARAI
Ruteng
NGADA
Bajawa
ENDE
Ende
SIKKA
Maumere
Larantuka
East Flores
Kalabahi
ALOR
EAST TIMOR
Atambua
Kefamenanu
Belu
TTU
KUPANG
Soe
TTS
Kupang
WEST SUMBA
Waikabubak
Waingapu
EAST SUMBA
Sawu Island
Rote Island
Legend
Provincial Capital
District Capital
USAID

# ANNEX R

# DETAILED BUDGET TABLES

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROAD REHABILITATION | | | | | | | | | | | | | | | | | | | |
| a. Rehabilitation: | | | | | | | | | | | | | | | | | | | |
| -Paved and Sealed (km) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 198 | 0 | 0 | 0 | 20 | 0 | 30 | 0 | 40 | 0 | 40 | 0 | 40 | 0 | 30 | 0 | 0 | 0 | |
| AID LC (Construction) | 198 | 25,090 | 0 | 0 | 20 | 496,782 | 30 | 745,173 | 40 | 993,564 | 40 | 993,564 | 40 | 993,564 | 30 | 745,173 | 0 | 0 | |
| GOI FX (None) | 198 | 0 | 0 | 0 | 20 | 0 | 30 | 0 | 40 | 0 | 40 | 0 | 40 | 0 | 30 | 0 | 0 | 0 | |
| GOI LC (Construction) | 198 | 6,265 | 0 | 0 | 20 | 124,047 | 30 | 186,071 | 40 | 248,094 | 40 | 248,094 | 40 | 248,094 | 30 | 186,071 | 0 | 0 | |
| -Gravel (km) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 411 | 0 | 0 | 0 | 41 | 0 | 62 | 0 | 82 | 0 | 82 | 0 | 82 | 0 | 62 | 0 | 0 | 0 | |
| AID LC (Construction) | 411 | 15,280 | 0 | 0 | 41 | 627,186 | 62 | 940,779 | 82 | 1,254,372 | 82 | 1,254,372 | 82 | 1,254,372 | 62 | 940,779 | 0 | 0 | |
| GOI FX (None) | 411 | 0 | 0 | 0 | 41 | 0 | 62 | 0 | 82 | 0 | 82 | 0 | 82 | 0 | 62 | 0 | 0 | 0 | |
| GOI LC (Construction) | 411 | 3,810 | 0 | 0 | 41 | 156,591 | 62 | 234,887 | 82 | 313,182 | 82 | 313,182 | 82 | 313,182 | 62 | 234,887 | 0 | 0 | |
| -Earth (km) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 675 | 0 | 0 | 0 | 68 | 0 | 101 | 0 | 135 | 0 | 135 | 0 | 135 | 0 | 101 | 0 | 0 | 0 | |
| AID LC (Construction) | 675 | 8,050 | 0 | 0 | 68 | 543,375 | 101 | 815,063 | 135 | 1,086,750 | 135 | 1,086,750 | 135 | 1,086,750 | 101 | 815,063 | 0 | 0 | |
| GOI FX (None) | 675 | 0 | 0 | 0 | 68 | 0 | 101 | 0 | 135 | 0 | 135 | 0 | 135 | 0 | 101 | 0 | 0 | 0 | |
| GOI LC (Construction) | 675 | 2,013 | 0 | 0 | 68 | 135,878 | 101 | 203,816 | 135 | 271,755 | 135 | 271,755 | 135 | 271,755 | 101 | 203,816 | 0 | 0 | |
| total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total AID LC | | | | 0 | | 1,667,343 | | 2,501,015 | | 3,334,686 | | 3,334,686 | | 3,334,686 | | 2,501,015 | | 0 | 16,673,430 |
| total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI LC | | | | 0 | | 416,516 | | 624,773 | | 833,031 | | 833,031 | | 833,031 | | 624,773 | | 0 | 4,165,155 |
| total road rehabilitation | | | | 0 | | 2,083,859 | | 3,125,788 | | 4,167,717 | | 4,167,717 | | 4,167,717 | | 3,125,788 | | 0 | 20,838,585 |
| b. Betterment | | | | | | | | | | | | | | | | | | | |
| -Gravel to seal (km) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 200 | 0 | 0 | 0 | 20 | 0 | 30 | 0 | 40 | 0 | 40 | 0 | 40 | 0 | 30 | 0 | 0 | 0 | |
| AID LC (Construction) | 200 | 24,150 | 0 | 0 | 20 | 483,000 | 30 | 724,500 | 40 | 966,000 | 40 | 966,000 | 40 | 966,000 | 30 | 724,500 | 0 | 0 | |
| GOI FX (None) | 200 | 0 | 0 | 0 | 20 | 0 | 30 | 0 | 40 | 0 | 40 | 0 | 40 | 0 | 30 | 0 | 0 | 0 | |
| GOI LC (Construction) | 200 | 6,040 | 0 | 0 | 20 | 120,800 | 30 | 181,200 | 40 | 241,600 | 40 | 241,600 | 40 | 241,600 | 30 | 181,200 | 0 | 0 | |
| -Earth to gravel (km) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 114 | 0 | 0 | 0 | 11 | 0 | 17 | 0 | 23 | 0 | 23 | 0 | 23 | 0 | 17 | 0 | 0 | 0 | |
| AID LC (Construction) | 114 | 17,800 | 0 | 0 | 11 | 202,920 | 17 | 304,380 | 23 | 405,840 | 23 | 405,840 | 23 | 405,840 | 17 | 304,380 | 0 | 0 | |
| GOI FX (None) | 114 | 0 | 0 | 0 | 11 | 0 | 17 | 0 | 23 | 0 | 23 | 0 | 23 | 0 | 17 | 0 | 0 | 0 | |
| GOI LC (Constr. and Admin.) | 114 | 4,445 | 0 | 0 | 11 | 50,673 | 17 | 76,010 | 23 | 101,346 | 23 | 101,346 | 23 | 101,346 | 17 | 76,010 | 0 | 0 | |
| total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total AID LC | | | | 0 | | 685,920 | | 1,028,880 | | 1,371,840 | | 1,371,840 | | 1,371,840 | | 1,028,880 | | 0 | 6,859,200 |
| total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI LC | | | | 0 | | 171,473 | | 257,210 | | 342,946 | | 342,946 | | 342,946 | | 257,210 | | 0 | 1,714,730 |
| total road betterment | | | | 0 | | 857,393 | | 1,286,090 | | 1,714,786 | | 1,714,786 | | 1,714,786 | | 1,286,090 | | 0 | 8,573,930 |
| Sub-Total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total AID LC | | | | 0 | | 2,353,263 | | 3,529,895 | | 4,706,526 | | 4,706,526 | | 4,706,526 | | 3,529,895 | | 0 | 23,532,630 |
| Sub-Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |

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RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjusted)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Total GOI LC | | | | 0 | | 587,989 | | 881,983 | | 1,175,977 | | 1,175,977 | | 1,175,977 | | 881,983 | | 0 | 5,879,885 |
| Sub-Total Road Rehabilitation | | | | 0 | | 2,941,252 | | 4,411,877 | | 5,882,503 | | 5,882,503 | | 5,882,503 | | 4,411,877 | | 0 | 29,412,515 |
| BRIDGE REHABILITATION (a) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 1,690 | 0 | 0 | 0 | 169 | 0 | 254 | 0 | 338 | 0 | 338 | 0 | 338 | 0 | 254 | 0 | 0 | 0 | |
| AID LC (Construction) | 1,690 | 1,220 | 0 | 0 | 169 | 206,180 | 254 | 309,270 | 338 | 412,360 | 338 | 412,360 | 338 | 412,360 | 254 | 309,270 | 0 | 0 | |
| GOI FX (None) | 1,690 | 0 | 0 | 0 | 169 | 0 | 254 | 0 | 338 | 0 | 338 | 0 | 338 | 0 | 254 | 0 | 0 | 0 | |
| GOI LC (Construction) | 1,690 | 305 | 0 | 0 | 169 | 51,545 | 254 | 77,318 | 338 | 103,090 | 338 | 103,090 | 338 | 103,090 | 254 | 77,318 | 0 | 0 | |
| Sub-Total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total AID LC | | | | 0 | | 206,180 | | 309,270 | | 412,360 | | 412,360 | | 412,360 | | 309,270 | | 0 | 2,061,800 |
| Sub-Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI LC | | | | 0 | | 51,545 | | 77,318 | | 103,090 | | 103,090 | | 103,090 | | 77,318 | | 0 | 515,450 |
| Sub-Total Bridge Rehabilitation | | | | 0 | | 257,725 | | 386,588 | | 515,450 | | 515,450 | | 515,450 | | 386,588 | | 0 | 2,577,250 |
| ROAD AND BRIDGE MAINTENANCE | | | | | | | | | | | | | | | | | | | |
| For all types of Roads (ha) | | | | | | | | | | | | | | | | | | | |
| AID FX (None) | 6,113 | 0 | 0 | 0 | 544 | 0 | 582 | 0 | 681 | 0 | 846 | 0 | 1,011 | 0 | 1,174 | 0 | 1,275 | 0 | |
| AID LC (None) | 6,113 | 0 | 0 | 0 | 544 | 0 | 582 | 0 | 681 | 0 | 846 | 0 | 1,011 | 0 | 1,174 | 0 | 1,275 | 0 | |
| GOI FX (None) | 6,113 | 0 | 0 | 0 | 544 | 0 | 582 | 0 | 681 | 0 | 846 | 0 | 1,011 | 0 | 1,174 | 0 | 1,275 | 0 | |
| GOI LC (Matrl.,Lbr,Eq.,Mgmt) | 6,113 | 1,151 | 0 | 0 | 544 | 626,144 | 582 | 669,882 | 681 | 783,831 | 846 | 973,746 | 1,011 | 1,163,661 | 1,174 | 1,351,274 | 1,275 | 1,467,525 | |
| Sub-Total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI LC | | | | 0 | | 626,144 | | 669,882 | | 783,831 | | 973,746 | | 1,163,661 | | 1,351,274 | | 1,467,525 | 7,036,063 |
| Sub-Total Road and Bridge Maintenance | | | | 0 | | 626,144 | | 669,882 | | 783,831 | | 973,746 | | 1,163,661 | | 1,351,274 | | 1,467,525 | 7,036,063 |
| EQUIPMENT | | | | | | | | | | | | | | | | | | | |
| a. Rehabilitation and Maint.Equipment | | | | | | | | | | | | | | | | | | | |
| -Bulldozer 100 HP, 12 ton w/Ripper | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 1 | 130,000 | 0 | 0 | 1 | 130,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (None) | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (None) | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Motor Grader, 100HP | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp..fee) | 19 | 82,780 | 5 | 0 | 0 | 0 | 0 | 0 | 14 | 1,158,920 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 19 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (None) | 19 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 19 | 0 | 5 | 455,290 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Wheelloader,1.2m3 | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 82,780 | 0 | 0 | 3 | 248,340 | 0 | 0 | 8 | 662,240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (None) | 11 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (None) | 11 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

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RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -Roller,Vibrator,.6 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 15 | 70,950 | 1 | 0 | 0 | 0 | 0 | 0 | 14 | 993,300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 15 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 15 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 15 | 0 | 1 | 78,045 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Asphalt Sprayer,200 liters | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 10 | 10,050 | 0 | 0 | 8 | 80,400 | 0 | 0 | 2 | 20,100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 10 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 10 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 10 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -DumpTruck, 5 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 8 | 29,560 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 8 | 0 | 8 | 260,128 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Water Tank Truck, 4000 liters | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 15 | 29,560 | 11 | 0 | 0 | 0 | 0 | 0 | 4 | 118,240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 15 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 15 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 15 | 0 | 11 | 357,676 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Flatbed truck,3.5 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 23,530 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 23,530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 11 | 0 | 10 | 258,830 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Dump Truck, 3.5 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 71 | 23,650 | 4 | 0 | 0 | 0 | 0 | 0 | 67 | 1,584,550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 71 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 71 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 71 | 0 | 4 | 104,060 | 0 | 0 | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Hand Compactor | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 14 | 1,420 | 1 | 0 | 0 | 0 | 0 | 0 | 13 | 18,460 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 14 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 14 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 14 | 0 | 1 | 1,562 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Concrete Mixer, 0.1 m3 | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 40 | 1,064 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 23,408 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 40 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 40 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 40 | 0 | 18 | 21,067 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Multipurpose Tractor w/Attach. | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 20 | 46,120 | 0 | 0 | 9 | 415,080 | 0 | 0 | 11 | 507,320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Gasoline Engine Jack Hammer | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 20 | 3,550 | 9 | 31,950 | 9 | 31,950 | 0 | 0 | 11 | 39,050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AID LC (None) | 20 | 0 | 9 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 20 | 0 | 9 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 20 | 0 | 9 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Jeep Towed Trailer, 2 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 40 | 1,774 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 39,028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 40 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 40 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (cost,frght,ins.,insp.,fee) | 40 | 0 | 18 | 35,125 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Mini Vibro Roller, 1 ton | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 20 | 11,825 | 0 | 0 | 9 | 106,425 | 0 | 0 | 11 | 130,075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 20 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Concrete Vibrator | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 40 | 651 | 0 | 0 | 18 | 11,718 | 0 | 0 | 22 | 14,322 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 40 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 40 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 40 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Sheepfoot Roller | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 2 | 3,548 | 0 | 0 | 2 | 7,096 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| total AID FX | | | | 31,950 | | 1,031,089 | | 0 | | 5,332,543 | | 0 | | 0 | | 0 | | 0 | 6,395,582 |
| total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI LC | | | | 1,571,783 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 1,571,783 |
| total rehab.and equipment | | | | 1,603,733 | | 1,031,089 | | 0 | | 5,332,543 | | 0 | | 0 | | 0 | | 0 | 7,967,365 |
| b. Workshop Equipment | | | | | | | | | | | | | | | | | | | |
| -Lubrication Service Equipment | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 20,100 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 14,618 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 96,480 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Tire Service Equipment | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 20,100 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 14,618 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 96,480 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Battery & Electric Section Eq. | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 5,913 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 4,300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 28,382 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -Diesel Injection and Hydr.Sec.Eq. | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 3,548 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 2,580 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 17,030 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Repair Section Equipment | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 17,738 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 12,900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 85,142 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Welding, Body and Paint Section Eq. | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 41,388 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 30,100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 198,662 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Machine Shop Section Eq. | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 8,278 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 6,020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 39,734 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -MISCELLANEOUS | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 11 | 1,183 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 860 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 11 | 0 | 9 | 5,678 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| total AID FX | | | | 0 | | 0 | | 0 | | 85,999 | | 0 | | 0 | | 0 | | 0 | |
| total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 85,999 |
| total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI LC | | | | 567,590 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total workshop equipment | | | | 567,590 | | 0 | | 0 | | 85,999 | | 0 | | 0 | | 0 | | 0 | 567,590 |
| | | | | | | | | | | | | | | | | | | | 653,589 |
| c. Support Equipment | | | | | | | | | | | | | | | | | | | |
| -Pick-up Utility | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 24 | 17,740 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 230,620 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 24 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 24 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 24 | 0 | 11 | 214,654 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Pick-Up 1 ton | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,frght,ins.,insp.,fee) | 24 | 11,825 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 153,725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 24 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 24 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,tax/costs,w.h) | 24 | 0 | 11 | 143,083 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -SSB Radio, Base and Mobile Unit | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 27 | 3,430 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 27 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | FY 87/88 Units | FY 87/88 Costs | FY 88/89 Units | FY 88/89 Costs | FY 89/90 Units | FY 89/90 Costs | FY 90/91 Units | FY 90/91 Costs | FY 91/92 Units | FY 91/92 Costs | FY 92/93 Units | FY 92/93 Costs | FY 93/94 Units | FY 93/94 Costs | FY 94/95 Units | FY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOI FX (none) | 27 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,Tax+cstm,w.h) | 27 | 0 | 27 | 101,871 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Motorcycles 100 cc | | | | | | | | | | | | | | | | | | | |
| AID FX (cost,freight,ins.,transp.,fee) | 70 | 1,420 | 32 | 0 | 0 | 0 | 0 | 0 | 38 | 53,960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 70 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 70 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (Cost,transp,handling,Tax+cstm,w.h) | 70 | 0 | 32 | 49,984 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| (total AID FX | | | | 0 | | 0 | | 0 | | 438,305 | | 0 | | 0 | | 0 | | 0 | 438,305 |
| (total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| (total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| (total GOI LC | | | | 509,592 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 509,592 |
| total support equipment | | | | 509,592 | | 0 | | 0 | | 438,305 | | 0 | | 0 | | 0 | | 0 | 947,897 |
| d. GOI in-kind Contribution | | | | | | | | | | | | | | | | | | | |
| -Bulldozer 100 HP, 12 ton w/Ripper | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 8 | 55,000 | 8 | 440,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Motor Grader, 140HP | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 11 | 35,000 | 11 | 385,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Wheelloader,1.2m3 | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 13 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 13 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 13 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 13 | 35,000 | 13 | 455,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Roller,Vibratory/16 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 18 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 18 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 18 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 18 | 30,000 | 18 | 540,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Roller,Rubber Tired | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 9 | 20,000 | 9 | 180,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Asphalt Sprayer,800 liters | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (value of ex.equipment) | 1 | 4,250 | 1 | 4,250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Dumptruck, 5 tons | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AIB LC (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 1 | 12,500 | 1 | 12,500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Flatbed truck,3.5 tons | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AIB LC (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 1 | 9,950 | 1 | 9,950 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Rock Crusher | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AIB LC (None) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 11 | 50,200 | 11 | 552,200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Dump truck, 3.5 tons | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 98 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AIB LC (None) | 98 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 98 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 98 | 10,000 | 98 | 980,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Hand Compactor | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 30 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AIB LC (None) | 30 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 30 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 30 | 600 | 30 | 18,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -Concrete Mixer, 0.1 m3 | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AIB LC (None) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI FX (None) | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BOI LC (value of ex.equipment) | 9 | 450 | 9 | 4,050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| total AIB FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| total AIB LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total BOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total BOI LC | | | 3,580,950 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| total BOI In-kind equipment | | | 3,580,950 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 3,580,950 |
| Sub-total AIB FX | | | 21,950 | | 1,031,089 | | 0 | | 5,856,847 | | 0 | | 0 | | 0 | | 0 | | 6,919,886 |
| Sub-total AIB LC | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| Sub-total BOI FX | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| Sub-total BOI LC | | | 6,229,915 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 6,229,915 |
| Sub-total Equipment | | | 6,261,865 | | 1,031,089 | | 0 | | 5,856,847 | | 0 | | 0 | | 0 | | 0 | | 13,149,801 |
| EQUIPMENT MAINTENANCE COST | | | | | | | | | | | | | | | | | | | |
| AIB FX (None) | 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| AIB LC (None) | 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| BOI FX (None) | 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOI LC (equipment maint.) | 7 | 300,000 | 0 | 0 | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | |
| total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| total GOI LC | | | | 0 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | 2,100,000 |
| total equipment maintenance | | | | 0 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | | 300,000 | 2,100,000 |
| WORKSHOP | | | | | | | | | | | | | | | | | | | |
| a. In-kind GOI Contribution | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (land,value of ex.workshops,and admin.cost) | 1 | 476,000 | 1 | 476,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| b. Construction | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (construction 90%) | 2 | 81,180 | 2 | 162,360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (construction 10%) | 2 | 9,020 | 2 | 18,040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| c. Upgrading Existing Workshops | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 9 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (upgrading) | 9 | 31,680 | 7 | 221,760 | 0 | 0 | 0 | 0 | 2 | 63,360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 9 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (upgrading) | 9 | 3,520 | 7 | 24,640 | 0 | 0 | 0 | 0 | 2 | 7,040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| d. Personnel (person-years) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 858 | 0 | 0 | 0 | 108 | 0 | 108 | 0 | 108 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | |
| AID LC (none) | 858 | 0 | 0 | 0 | 108 | 0 | 108 | 0 | 108 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | |
| GOI FX (none) | 858 | 0 | 0 | 0 | 108 | 0 | 108 | 0 | 108 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | 132 | 0 | |
| GOI LC (salary-benefit,transp.) | 858 | 450 | 0 | 0 | 108 | 48,600 | 108 | 48,600 | 108 | 48,600 | 132 | 59,400 | 132 | 59,400 | 132 | 59,400 | 132 | 59,400 | |
| e. Administrative | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 71 | 0 | 0 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | |
| AID LC (none) | 71 | 0 | 0 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | |
| GOI FX (none) | 71 | 0 | 0 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | 44 | 0 | |
| GOI LC (materials and supplies) | 71 | 1,500 | 6 | 0 | 9 | 13,500 | 9 | 13,500 | 9 | 13,500 | 44 | 66,000 | 44 | 66,000 | 44 | 66,000 | 44 | 66,000 | |
| Sub-total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total AID LC | | | | 384,120 | | 0 | | 0 | | 63,360 | | 0 | | 0 | | 0 | | 0 | 447,480 |
| Sub-total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total GOI LC | | | | 518,680 | | 62,100 | | 62,100 | | 69,140 | | 125,400 | | 125,400 | | 125,400 | | 125,400 | 1,213,620 |
| Sub-total Workshop | | | | 902,800 | | 62,100 | | 62,100 | | 132,500 | | 125,400 | | 125,400 | | 125,400 | | 125,400 | 1,661,100 |
| TRAINING | | | | | | | | | | | | | | | | | | | |
| a.Short-term:Mgt.,Plang,& Org.Arr. | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (mtrl dev./repro/sppls,instr.cost) | 6 | 45,046 | 0 | 0 | 1 | 45,046 | 1 | 45,046 | 1 | 45,046 | 1 | 45,046 | 1 | 45,046 | 1 | 45,046 | 0 | 0 | |



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RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 1,680 | 0 | 0 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 0 | 0 | |
| b.Short-term:Maintenance Management System. | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 41,996 | 0 | 0 | 1 | 41,996 | 1 | 41,996 | 1 | 41,996 | 1 | 41,996 | 1 | 41,996 | 1 | 41,996 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 1,680 | 0 | 0 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 1 | 1,680 | 0 | 0 | |
| c.Short-term:Foreman Skill Training | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 7,400 | 0 | 0 | 1 | 7,400 | 1 | 7,400 | 1 | 7,400 | 1 | 7,400 | 1 | 7,400 | 1 | 7,400 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 300 | 0 | 0 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 0 | 0 | |
| d.Short-term:Contractor Supervision | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 8,300 | 0 | 0 | 1 | 8,300 | 1 | 8,300 | 1 | 8,300 | 1 | 8,300 | 1 | 8,300 | 1 | 8,300 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 600 | 0 | 0 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 0 | 0 | |
| e.Short-term:Ctrl.Control/Road Design and Surveying. | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS.instr.cost) | 6 | 41,012 | 0 | 0 | 1 | 41,012 | 1 | 41,012 | 1 | 41,012 | 1 | 41,012 | 1 | 41,012 | 1 | 41,012 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 840 | 0 | 0 | 1 | 840 | 1 | 840 | 1 | 840 | 1 | 840 | 1 | 840 | 1 | 840 | 0 | 0 | |
| f.Short-term:Equip.Orientation Course(Mech.&Oprts) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS.instr.cost) | 6 | 35,880 | 0 | 0 | 1 | 35,880 | 1 | 35,880 | 1 | 35,880 | 1 | 35,880 | 1 | 35,880 | 1 | 35,880 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 600 | 0 | 0 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 1 | 600 | 0 | 0 | |
| g.Short-term:Equipment Management System | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 26,726 | 0 | 0 | 1 | 26,726 | 1 | 26,726 | 1 | 26,726 | 1 | 26,726 | 1 | 26,726 | 1 | 26,726 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 720 | 0 | 0 | 1 | 720 | 1 | 720 | 1 | 720 | 1 | 720 | 1 | 720 | 1 | 720 | 0 | 0 | |
| h.Short-term:Info.System for Road Mat Maint. | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 9,520 | 0 | 0 | 1 | 9,520 | 1 | 9,520 | 1 | 9,520 | 1 | 9,520 | 1 | 9,520 | 1 | 9,520 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 300 | 0 | 0 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 0 | 0 | |
| i.Short-term:Operational Program for DFUF Staff. | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (ctrl dev./repro/spplS,instr.cost) | 6 | 4,258 | 0 | 0 | 1 | 4,258 | 1 | 4,258 | 1 | 4,258 | 1 | 4,258 | 1 | 4,258 | 1 | 4,258 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (Org.committee) | 6 | 300 | 0 | 0 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 1 | 300 | 0 | 0 | |
| j.Long-term:Domestic Eng.Degree(22 degrees) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 110 | 0 | 0 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (tuition,fee,maint,dom.travel,entry exp) | 110 | 6,420 | 0 | 0 | 22 | 141,240 | 22 | 141,240 | 22 | 141,240 | 22 | 141,240 | 22 | 141,240 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 110 | 0 | 0 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 110 | 0 | 0 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | |

RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,650)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.Long-term:Domestic Master Degree(B degrees) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (tuition,fee,maint,doc.travel,entry exp) | 16 | 6,675 | 0 | 0 | 0 | 0 | 8 | 53,400 | 8 | 53,400 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 16 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 16 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Sub-Total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total AID LC | | | | 0 | | 361,378 | | 414,778 | | 414,778 | | 361,378 | | 361,378 | | 220,158 | | 0 | 2,133,828 |
| Sub-Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI LC | | | | 0 | | 7,020 | | 7,020 | | 7,020 | | 7,020 | | 7,020 | | 7,020 | | 0 | 42,120 |
| Sub-Total Training | | | | 0 | | 368,398 | | 421,798 | | 421,798 | | 368,398 | | 368,398 | | 227,158 | | 0 | 2,175,948 |
| TECHNICAL ASSISTANCE | | | | | | | | | | | | | | | | | | | |
| a. Briefing Team (Team-Years) | | | | | | | | | | | | | | | | | | | |
| AID FX (sal.,benefit,intrnl trvl,O.H.,fee, | 1 | 750,000 | 0.25 | 187,500 | 0.75 | 562,500 | 0 | 0 | 0 | | 0 | | 0 | | 0 | | 0 | 0 | |
| AID LC (none) local travel, per-diem) | 1 | 0 | 0.25 | 0 | 0.75 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | | 0 | 0 | |
| GOI FX (none) | 1 | 0 | 0.25 | 0 | 0.75 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | | 0 | 0 | |
| GOI LC (none) | 1 | 0 | 0.25 | 0 | 0.75 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | | 0 | 0 | |
| b. [illegible] Services (Years of Service) | | | | | | | | | | | | | | | | | | | |
| AID FX (sal.,benefit,intrnl trvl,O.H.,fee, | 5.5 | 2,318,000 | 0 | 0 | 0.5 | 1,159,000 | 1 | 2,318,000 | 1 | 2,318,000 | 1 | 2,318,000 | 1 | 2,318,000 | 1 | 2,318,000 | 0 | 0 | |
| AID LC (none) housing,utilities,furnishing) | 5.5 | 0 | 0 | 0 | 0.5 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI FX (none) | 5.5 | 0 | 0 | 0 | 0.5 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (none) | 5.5 | 0 | 0 | 0 | 0.5 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| c. PSL Certification Service (Years of Service) | | | | | | | | | | | | | | | | | | | |
| AID FX (Salar.,benefit,overhead, etc) | 5 | 60,000 | 0 | 0 | 0 | 0 | 1 | 60,000 | 1 | 60,000 | 1 | 60,000 | 1 | 60,000 | 1 | 60,000 | 0 | 0 | |
| AID LC (none) | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI FX (none) | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (None) | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| Sub-Total AID FX | | | | 187,500 | | 1,721,500 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 0 | 13,799,000 |
| Sub-Total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-Total GOI LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total Technical Assistance | | | | 187,500 | | 1,721,500 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 2,378,000 | | 0 | 13,799,000 |
| SPECIAL STUDIES | | | | | | | | | | | | | | | | | | | |
| AID FX (sal.benefit,intrnl trvl,O.H.,fee, | 6 | 200,000 | 0 | 0 | 1 | 200,000 | 1 | 200,000 | 1 | 200,000 | 1 | 200,000 | 1 | 200,000 | 1 | 200,000 | 0 | 0 | |
| AID LC (none) local travel,per-diem) | 6 | 50,000 | 0 | 0 | 1 | 50,000 | 1 | 50,000 | 1 | 50,000 | 1 | 50,000 | 1 | 50,000 | 1 | 50,000 | 0 | 0 | |
| GOI FX (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (none) | 6 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| Sub-Total AID FX | | | | 0 | | 200,000 | | 200,000 | | 200,000 | | 200,000 | | 200,000 | | 200,000 | | 0 | 1,200,000 |
| Sub-Total AID LC | | | | 0 | | 50,000 | | 50,000 | | 50,000 | | 50,000 | | 50,000 | | 50,000 | | 0 | 300,000 |

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RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES
(US $, US $1.00 = Rp.1,640)

June 5, 1987 (Adjustment)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/87 Units | IFY 88/87 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total GOI LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total Special Studies | | | | 0 | | 250,000 | | 250,000 | | 250,000 | | 250,000 | | 250,000 | | 250,000 | | 0 | 1,500,000 |
| PLANNING AND MONITORING | | | | | | | | | | | | | | | | | | | |
| a. Traffic counts/cond.surveys (11 kabs) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 71 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | |
| AID LC (travel,honorarium and per-diem) | 71 | 2,250 | 9 | 20,250 | 9 | 20,250 | 9 | 20,250 | 9 | 20,250 | 11 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | |
| GOI FX (none) | 71 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | |
| GOI LC (travel,honorarium and per-diem) | 71 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 9 | 0 | 11 | 24,750 | 11 | 24,750 | 11 | 24,750 | 11 | 24,750 | |
| b. Budget preparation meetings | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 8 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| AID LC (travel and per-diem) | 8 | 14,104 | 1 | 14,104 | 1 | 14,104 | 1 | 14,104 | 1 | 14,104 | 1 | 14,104 | 1 | 14,104 | 1 | 14,104 | 0 | 0 | |
| GOI FX (none) | 8 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| GOI LC (none) | 8 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| c. OFUF Field Cost (Year of Service) | | | | | | | | | | | | | | | | | | | |
| AID FX (none) | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AID LC (trvl,per-diem,space rentl,supplies) | 4 | 25,000 | 0 | 0 | 1 | 25,000 | 1 | 25,000 | 1 | 25,000 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI FX (none) | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GOI LC (none) | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 25,000 | 1 | 25,000 | 1 | 25,000 | 1 | 25,000 | |
| Sub-total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total AID LC | | | | 34,354 | | 59,354 | | 59,354 | | 59,354 | | 14,104 | | 14,104 | | 14,104 | | 0 | 254,728 |
| Sub-total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total GOI LC | | | | 0 | | 0 | | 0 | | 0 | | 49,750 | | 49,750 | | 49,750 | | 49,750 | 199,000 |
| Sub-total Planning and Monitoring | | | | 34,354 | | 59,354 | | 59,354 | | 59,354 | | 63,854 | | 63,854 | | 63,854 | | 49,750 | 453,728 |
| EVALUATION AND AUDIT | | | | | | | | | | | | | | | | | | | |
| AID FX (eval.,Safitz,D.M.,les.intal trvl) | 3 | 100,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 200,000 | 0 | 0 | 0 | 0 | 1 | 100,000 | |
| AID LC (none) D.M.,per diem & trvl) | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| GOI FX (none) | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| GOI LC (none) | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| Sub-total AID FX | | | | 0 | | 0 | | 0 | | 0 | | 200,000 | | 0 | | 0 | | 100,000 | 300,000 |
| Sub-total AID LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total GOI LC | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Sub-total Evaluation and Audit | | | | 0 | | 0 | | 0 | | 0 | | 200,000 | | 0 | | 0 | | 100,000 | 300,000 |
| GRAND TOTAL | | | | | | | | | | | | | | | | | | | |
| Grand Total AID FX | | | | 219,450 | | 2,952,389 | | 2,578,000 | | 8,434,847 | | 2,778,690 | | 2,578,000 | | 2,578,000 | | 100,000 | 122,218,886 |
| Grand Total AID LC | | | | 418,474 | | 3,030,175 | | 4,363,297 | | 5,766,378 | | 5,544,368 | | 5,544,368 | | 4,123,407 | | 0 | 28,750,466 |
| Grand Total GOI FX | | | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |
| Grand Total GOI LC | | | | 6,748,595 | | 1,634,798 | | 1,958,302 | | 2,439,058 | | 2,734,983 | | 2,924,898 | | 2,792,744 | | 1,942,675 | 23,216,053 |
| Grand Total Project | | | | 7,386,519 | | 7,617,562 | | 8,939,599 | | 16,580,283 | | 11,057,351 | | 11,047,266 | | 9,494,151 | | 2,042,675 | 174,185,405 |

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RURAL ROADS MAINTENANCE SYSTEMS PROJECT COST ESTIMATES

(US $, @ $1.00 = Pp.1,640)

June 5, 1987 (Adjusted)

| | Total Units | Per Unit Base Cost | IFY 87/88 Units | IFY 87/88 Costs | IFY 88/89 Units | IFY 88/89 Costs | IFY 89/90 Units | IFY 89/90 Costs | IFY 90/91 Units | IFY 90/91 Costs | IFY 91/92 Units | IFY 91/92 Costs | IFY 92/93 Units | IFY 92/93 Costs | IFY 93/94 Units | IFY 93/94 Costs | IFY 94/95 Units | IFY 94/95 Costs | Life of Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONTINGENCY | | | | | | | | | | | | | | | | | | | |
| Sub-total AIB FX | | | 17,596 | 236,739 | | 204,704 | | 676,306 | | 222,740 | | 206,704 | | 206,704 | | 8,018 | | [illegible],781,510 |
| Sub-total AIB LC | | | 33,553 | 242,959 | | 349,849 | | 457,537 | | 444,547 | | 444,547 | | 330,615 | | 0 | | 2,303,609 |
| Sub-total GOI FX | | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| Sub-total GOI LC | | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| Sub-total Contingency | | | 51,149 | 479,698 | | 556,553 | | 1,133,843 | | 667,287 | | 651,251 | | 537,319 | | 8,018 | | 4,085,119 |
| GRAND TOTAL PLUS CONTINGENCY | | | | | | | | | | | | | | | | | | | |
| Total AIB FX | | | 237,046 | 3,189,328 | | 2,784,704 | | 9,111,153 | | 3,000,740 | | 2,784,704 | | 2,784,704 | | 108,018 | | 24,000,396 |
| Total AIB LC | | | 452,027 | 3,273,134 | | 4,713,146 | | 6,163,915 | | 5,988,915 | | 5,988,915 | | 4,454,021 | | 0 | | 31,034,075 |
| Total GOI FX | | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| Total GOI LC | | | 6,748,595 | 1,634,798 | | 1,998,592 | | 2,439,658 | | 2,734,983 | | 2,924,898 | | 2,792,244 | | 1,942,675 | | 23,216,053 |
| Total or grand total and contingency | | | 7,437,668 | 8,097,260 | | 9,496,152 | | 17,714,126 | | 11,724,638 | | 11,698,517 | | 10,031,470 | | 2,050,693 | | 78,250,524 |

# ANNEX S

# SPECIAL STUDIES

It is expected that several Special Studies will be conducted by the resident long-term consultant team. Field trials of new approaches and specialized consultant assistance which cannot be obtained through the long-term consultant contract will be financed from the Special Studies fund. Resident consultants will prepare each year's proposed agenda of topics, prepare background materials, and assist to draft scopes of work for any work performed by outside parties. For all Studies, a review of previous donor experience will be included. Participation of representatives of other donors will be encouraged in the GOI review of Study recommendations. The program will include at least the following topics (topics expected to be performed by the resident consultants are marked with an asterisk):

Local Revenues for Maintenance. This study will assess the potential for local governments to generate or share revenue to finance the maintenance of district roads. It will recommend specific pilot maintenance revenue efforts to be undertaken in project districts and will provide a plan and estimated budget for implementing pilot efforts under the project.

*Sustainable District Road Management Strategies: This study will analyze planning models for district networks and recommend planning approaches to be applied during the second half of the project. The study will presume that road budgets are insufficient to meet the needs of all links in the networks and that clear guidelines are therefore needed to determine priorities. Consideration will be given to: 1) the adequacy of existing budgets and mechanisms to determine additional budget requirements, 2) rules for adding new roads or removing roads from district responsibility, 3) definitions of Very Important Networks to prioritize attention within each network, and 4) low-cost alternatives for low priority roads (e.g., the use of paved fords, redirection of the Padat Karya program to rehabilitate old Padat Karya roads again or to maintain them, etc.).

*Alternative Approaches to Conducting Maintenance: This study will review past experience with alternatives to force account for conducting maintenance and will recommend, plan and budget for pilot trials of non-force account efforts in selected project districts. The purpose will be to determine the most cost-effective techniques possible. Alternatives considered will include: roadman systems, contracting selected maintenance tasks, and community initiative. Special Studies funds will be available for financing adaptive trials of alternative systems in selected districts.

District Equipment Policy: This study will review present district equipment practices including rental policies and the sources and adequacy of maintenance and repair funds. It will recommend alternative policies to assure that districts can financially sustain the equipment fleets required over the long term.

Improving Performance of Small Contractors. This study will review policies toward small contractors under the Inpres programs and analyze their effectiveness in promoting quality performance and increasing the

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capabilities of the contractors concerned. The analysis will focus on the incentives and disincentives to contractors that are built into present policies. It will make specific recommendations for improvement in at least six areas: correlation of contract size with contractor class, contract terms and conditions, equipment policy, supervision procedures, allowance for profit, and single-year versus multi-year contracts.

DPUK Organizational Structure and Personnel Needs. This study will analyze the effectiveness of DPUK organizational structures and recommend minimum elements for inclusion in all. It will review present systems for establishing the size, skills and work responsibilities of key staff units in the DPUK structure and recommend improvements accordingly. Explicit consideration will be made of the incentives and disincentives which stem from: permanent versus temporary employment status, rewards for performance, career advancement, and competition with the private sector.

Budget Procedures and Work Delays. This study will assess the impact on work quality of delays caused by budget procedures and recommend specific improvements. It will cover at least: the costs of delays in asphalt distribution and alternatives such as stocking in the prior fiscal year, and the costs, particularly for maintenance, of delayed disbursement of Inpres funds to district authorities and potential alternatives including stocking of materials in prior fiscal years, transfering maintenance allocations from the development to the routine budget, etc.