

**APPENDIX C**

**CASE STUDY**  
**FOR RURAL WATER SUPPLY PROJECT**

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## C.1 INTRODUCTION

1. To obtain an insight into the applicability of the economic evaluation of water supply projects (WSPs) in a true rural setting, one small village named Loa Lepu in a remote area in Kalimantan, Indonesia was selected for purposes of this case study. For this village, the following steps in the economic analysis were carried out:

- (i) Determination of Scope and Objectives
- (ii) Assessment of Demand
- (iii) Least-Cost Analysis
- (iv) Economic Benefit-Cost Analysis
- (v) Financial Benefit-Cost Analysis
- (vi) Sustainability Analysis
- (vii) Distributional Analysis
- (viii) Analysis of Untangible Effects
- (ix) Analysis of Uncertainty

2. In this case study, each of the different steps in economic evaluation is dealt with in a separate section. The last paragraph summarizes the conclusions and recommendations.

3. The activities planned for Loa Lepu are part of the Rural Water Supply and Sanitation Sector Project in Indonesia, which supports the governments' policy to promote water supply and sanitation services in less developed villages and rural growth centers and focuses on the low-income population. The project aims at:

- (i) providing safe, adequate and reliable water supply and sanitation services to selected low-income rural communities through community-based arrangements; and,
- (ii) to support hygiene and sanitation education, water quality surveillance and community management activities in the project area. The project area covers 12 provinces and consists of 3,000 rural communities.

## C.2 The Village LOA LEPU

4. In order to obtain a first impression of the area to be studied, a reconnaissance visit was carried out in February 1996. Subsequently, a household survey was carried out in the village in March 1996. The results of both surveys form the basis for the economic analysis.

5. During the reconnaissance survey, basic data on the village was collected. These concerned population, rainfall, water resources, present water supply and sanitation facilities and the socio-economic situation. Based on these data, preliminary design options were formulated

and the questionnaire to be used in the household survey was adapted to fit the local situation. An overview of basic data for Loa Lepu is provided in Table C.1.

6. The selected village, Loa Lepu, is located in the Kabupaten Kutai in the province East Kalimantan. Suitable water sources in the area are limited. Ground water is available at a depth of about four meters, but the quality is often bad and dugwells run dry in the dry season. River water is becoming increasingly polluted. Rainfall is abundant in the rainy season but less regular in the dry season, which lasts from June to November. Periods without rain, however, are seldom very long.

| Table C.1 <b>Basic Data for Loa Lepu</b>             |             |                 |
|--|-------------|-----------------|
| <b>Indicator</b>                                     | <b>Unit</b> | <b>Loa Lepu</b> |
| Population   | Number      | 594             |
| Average HH Size in sample                            | Number      | 5.1             |
| <i>Existing Water Supply</i>                         |             |                 |
| Unprotected Wells                                    | %           | 20              |
| Untreated River Water                                | %           | 80              |
| Existing Sanitation                                  |             | latrines        |
| <i>Profession</i>                                    |             |                 |
| Farmers  | %           | 80              |
| Entrepreneur   | %           | 4               |
| Fixed employment                                     | %           | 12              |
| Informal sector                                      | %           | 4               |
| <i>Average Quantity of water carried home per HH</i> |             |                 |
| rainy season   | l/day       | 137             |
| dry season   | l/day       | 149             |
| <i>Average distance from source</i>                  |             |                 |
| rainy season   | meter       | 58              |
| dry season   | meter       | 62              |
| <i>Preferred alternative source</i>                  |             |                 |
| Rainwater collector                                  | %           | 4               |
| Hand pump  | %           | 52              |
| Public Tap   | %           | 40              |
| No reply   | %           | 4               |
| Average Income                                       | Rp/month    | 221,280         |
| Average Rainfall                                     | mm/year     | 1962            |

7. The total population in the village is 594, with an average household size of 5.1 persons. A large part of the population is occupied in agricultural activities from which they derive an average income of Rp221,280 per month.

8. The local public health unit (Puskesmas) in the area reported that a total of 3,718 persons or 4 percent of a total service population of 91,197 visited the unit with complaints about water-related diseases in 1994.

9. Approximately 70 percent of the population of Loa Lepu is concentrated near the Makaram river while the remaining 30 percent is living scattered at distances up to 10 km from the river. Potential water sources for water supply are: shallow ground water, the Makaram river and rainwater. The population is making use of unprotected water sources such as open dug wells and the river. The water in the dug wells is two to four meters below ground level but the quality is poor. In the dry season, the dug wells run dry. The average distance from the water source is approximately 60 meters. The average annual rainfall in the area is 1,962 mm.

10. People were asked how many buckets of water they carried on average to their homes per day. From this, an average water use of 143 liters per HH, or 28 liters per capita per day (lcd), could be derived. People also use water from wells and the river, which they do not carry home. This water is used for washing, bathing and sanitation purposes. For defecation purposes, simple latrines, mostly without septic tanks, are used. Domestic wastewater flows through small drainage canals into the fields or rivers. There is a clear interest in alternative water supply and sanitation facilities. There also exists a remarkable interest and willingness to pay for the upgrading of sanitary facilities.

### **C.3 PROJECT FRAMEWORK**

11. A detailed description of the project framework is provided in Annex C.1 of this chapter. A short explanation follows.

#### **C.3.1 Government Policies**

12. The provision of water supply and sanitation has been a central issue in government policy over the past 30 years, with priority on low-income communities and underdeveloped areas with poor water resources and a high incidence of waterborne diseases. The government has provided safe water supply to 14,000 villages during the fifth Five-Year Plan and aims to provide access to clean water to another 20,600 villages or 16.5 million people during the sixth Five-Year Plan (Repelita VI).

13. Based on experience from earlier RWSS programs, government activities in this field are now guided by the following policies:

- (i) increased community participation in planning, implementation, operation and rehabilitation of RWSS facilities;
- (ii) special attention on drinking water quality surveillance and sanitation;
- (iii) target communities in water scarce areas, coastal or transmigration areas or communities facing endemic diarrhoea and other waterborne diseases;
- (iv) flexible planning and channelling of funds;
- (v) decentralized project implementation and local accountability for delivery;
- (vi) an important role for women in program design and implementation;
- (vii) recovery of O&M costs and in addition, contribution in kind (labor) to capital costs.

### **C.3.2 Sector Objective**

14. The Rural Water Supply and Sanitation Project as a whole, of which the activities in Loa Lepu form a part, has set the following objectives:

- (i) providing safe, adequate and reliable water supply and sanitation services to selected low-income rural communities through community-based arrangements; and,
- ii) supporting hygiene and sanitation education, water quality surveillance and community management activities in the project area.

### **C.3.3 Case Study Objective**

15. Based on the results of both the reconnaissance and the household surveys, it was decided to formulate these objectives for improved water supply and sanitation facilities in Loa Lepu:

- (i) to provide safe and low-cost water supply alternatives to the population, which presently has no access to protected water sources;
- (ii) to provide latrines to that part of the population which is not satisfied with existing facilities and which expresses a willingness to pay for those facilities.

### C.3.4 Project Components

16. In order to achieve the project objectives mentioned above, the project includes three components:

- (i) the construction of simple low-cost piped and non-piped water supply systems and/or the rehabilitation of existing water supply systems;
- (ii) provision of sanitation sub-projects in the project area through the construction of sanitary public and private latrines;
- (iii) the provision of a) implementation support to the local offices of the Ministry of Public Works; b) a hygiene and sanitation education and water quality surveillance program to be implemented by the Ministry of Health; and c) community management and WSS institutional development programs to be implemented by the Ministry of Home Affairs.

### C.3.5 Project Resources

17. The resources to be allocated to the project will be utilized for land acquisition, civil works, equipment and materials, incremental Operation and Maintenance (O&M) costs and for consultancy services for feasibility studies, detailed design, supervision and for institutional support.

## C.4 DEMAND FORECAST

### C.4.1 Current Water Consumption

18. Current water consumption must be separated into two parts:

- (i) water carried to and consumed in the house;
- (ii) water used at the sites of the river and wells respectively.

19. The first component, water carried and used in the house, has been estimated at 143 liters per HH per day, or an average use of 28 lcd. In addition, it has been estimated that households use an additional 50 percent of that volume of water (14 lcd) outside the house for washing in the river or near the well, bathing in the river, etc. The total current water consumption is, therefore, estimated at 42 lcd.

20. Current annual water consumption in Loa Lepu is, therefore, estimated as follows:

$$\text{In-house consumption: } (594 \times 28 \times 365)/1,000 = 6,071 \text{ m}^3/\text{year}.$$

Outside the house:  $(594 \times 14 \times 365)/1,000 = 3,036 \text{ m}^3/\text{year}$

#### **C.4.2 Future Water Demand**

21. During the household survey, people were offered three technical alternatives for water supply to choose from, being:

Alternative 1: Communal hand pumps (one hand pump for ten families);

Alternative 2: A small piped system in the center of town with public taps (ten families per PT) and the remaining part of the village with communal hand pumps;

Alternative 3: Rainwater collectors (one rainwater collector per four families)

In the remaining text of this case study, alternative 1 will be indicated as HP, alternative 2 as HP/PT and alternative 3 as RWC.

22. The data collected during the reconnaissance survey and the household survey provide the expressed preference of the communities for the different types of water supply facilities offered to them. This preference is based on the consumers' perception of water, quality, reliability and convenience, which they relate to the different types of supply. The outcome of the survey is presented in columns 2 and 3 of Table C.2. It is assumed that water from the above facilities will be used for 'in house water consumption'.

23. Based on national standards and in line with figures observed in similar situations, the average consumption per person per day for the use of hand pumps and public taps is estimated at 50 lcd whereas the average use for rainwater collectors is estimated at 33 lcd (this figure is based on an average use of 50 lcd in the rainy season but only 16 lcd in the dry season).

24. If the different types of water supply facilities would be installed in accordance with the expressed preference of the community, and if the average water consumption per type of facility (based on national standards) is multiplied with the number of users, the quantity of water demanded by the community can be calculated at  $10,715 \text{ m}^3/\text{year}$ .

| Type of facility    | Number of HH interested | in % | Avg. Water Consumption (lcd) <sup>1</sup> | Calculated demand (m <sup>3</sup> /year) |
|---------------------|-------------------------|------|---|--|
| Rainwater Collector | 5                       | 4    | 33  | 286                                      |
| Communal Hand pumps | 61                      | 52   | 50  | 5,637                                    |
| Public Tap          | 47                      | 40   | 50  | 4,336                                    |
| No Reply            | 5                       | 4    | 49 <sup>2</sup>                           | 456                                      |
| Sanitation          | 107                     | 92   | -   | -  |
| <b>Total Demand</b> |                         |      |   | <b>10,715</b>                            |

<sup>1</sup> Based on national standards and field observations.  
<sup>2</sup>A weighed average of the other users.

25. It is likely that some households will also continue to use water from other sources than the above. In particular, households which choose rainwater collectors would have to rely on secondary sources in the dry season.

### C.4.3 Incremental vs. Nonincremental Water Demand

26. A distinction is made between nonincremental water and incremental water provided by the project. Nonincremental water will be water provided by the project which displaces water already used from existing sources and would be used in the without-project situation. Incremental water is water provided by the project, which will add to the existing and future water consumption without the project. For purposes of analysis, the future without-project scenario is assumed to remain at existing levels.

27. The volume of incremental water will depend on the technical option which will be selected. Table C.3 below shows the average incremental and nonincremental water demand, which is supplied for by the project.

| Alternative | Total Water Demand Without the Project |               |       | Total Water Demand With the Project |               |       | Water Supplied by the Project |             |       |
|-------------|--|---------------|-------|-------------------------------------|---------------|-------|-------------------------------|-------------|-------|
|             | In house                               | Outside house | Total | In house                            | Outside house | Total | Non Incremental               | Incremental | Total |
| HP          | 28                                     | 14            | 42    | 50                                  | 5             | 55    | 42                            | 8           | 50    |
| HP/PT       | 28                                     | 14            | 42    | 50                                  | 5             | 55    | 42                            | 8           | 50    |
| RWC         | 28                                     | 14            | 42    | 33                                  | 12            | 45    | 33                            | 0           | 33    |

28. Total water demand without the project is estimated at an average 42 lcd. Depending on the alternative chosen, in-house water consumption will increase to 33 lcd (RWC) or 50 lcd (HP and PT).

29. In the case of alternatives 1 and 2, the 50 lcd of water supplied by the project will fully replace the old sources (42 lcd = non incremental) and add an additional 8 lcd (which refers to incremental water). In addition, households are assumed to still use some water (5 lcd) outside the house. In the case of alternative 3 (RWC), the average of 33 lcd supplied by the project will be fully used to replace old sources and therefore the total volume of water supplied by the project is non-incremental (even though total demand of these customers increases).

## C.5 LEAST-COST ANALYSIS

### C.5.1 Technical Options at Project Level

30. The purpose of the Least-Cost Analysis is to identify the least-cost alternative option for water supply and sanitation, which will adequately achieve the project objective. For the project, standard low-cost water supply and sanitation options were developed by the Department of Public Works, including communal hand pumps (HP), rainwater collectors (RWC), small piped systems with public taps (PT), public and school latrines and private latrines, as follows:

#### (i) Water Supply Options

- |     |  |   |                                  |
|-----|--|---|----------------------------------|
| (a) | Rainwater Collector:                                 |   |                                  |
|     | Volume   | - | 10 m <sup>3</sup>                |
|     | Number of users                                      | - | 20 persons/RWC                   |
|     | Unit Price   | - | Rp1,725,000                      |
|     | Annual O&M costs                                     | - | approximately 0.5% of investment |
|     | Avg. consumption                                     | - | 33 lcd                           |
| (b) | Hand pump small bore wells:                          |   |                                  |
|     | Number of users                                      | - | 50 persons/HP                    |
|     | Unit Price   | - | Rp2,025,000                      |
|     | Annual O&M Costs                                     | - | approximately 2.5% of investment |
|     | Avg. consumption                                     | - | 50 lcd                           |
| (c) | Hand pump small bore wells with upflow filter units: |   |                                  |
|     | Number of users                                      | - | 50 persons/HP                    |
|     | Unit Price   | - | Rp2,625,000                      |
|     | Annual O&M Costs                                     | - | approximately 4% of investment   |
|     | Avg. consumption                                     | - | 50 lcd                           |

- |      |                        |   |                                  |
|------|------------------------|---|----------------------------------|
| (d)  | Piped system + PT:     |   |                                  |
|      | Number of users per PT | - | 50 persons                       |
|      | Investment Cost        | - | Rp40,000,000                     |
|      | Annual O&M Costs       | - | approximately 7% of investment   |
|      | Avg. consumption       | - | 50 lcd                           |
|      |                        |   |                                  |
| (ii) | Sanitation Options     |   |                                  |
|      |                        |   |                                  |
| (a)  | Private latrine:       |   |                                  |
|      | Number of users        | - | 10 persons                       |
|      | Unit Price             | - | Rp91,700                         |
|      | Annual O&M costs       | - | approximately 2.5% of investment |
|      |                        |   |                                  |
| (b)  | Public latrine:        |   |                                  |
|      | Number of users        | - | 600 persons                      |
|      | Unit Price             | - | Rp2,500,000                      |
|      | Annual O&M costs       | - | approximately 2.5% of investment |

31. The project approached the sanitation component by providing one public latrine to the village, to be located at a central location (school, market, etc). Furthermore, private latrines would be installed in accordance with demand from the population. The project support should be seen as promotion of improved hygiene behavior of the community.

### C.5.2 Technical Options for LOA LEPU

32. During the reconnaissance survey, the technical options for the village were determined. During the household survey, the interest of the population in each of the options was measured. Based on this, the following technical alternatives were formulated for Loa Lepu:

- Alternative 1: 100 percent coverage through hand pump wells provided with small upflow filtration units per well. Ground water is sufficiently available in the area, but the water quality is, in some cases, effected by high contents of iron. Therefore, these wells will be equipped with simple filtration units.
- Alternative 2: 70 percent covered by a small piped scheme with pumped/treated water from the Makaram river. The remaining 30 percent of the population will be covered with hand pump wells since this part of the population is living at a great distance from the river.
- Alternative 3: 100 percent coverage through rainwater collectors by using 10 m<sup>3</sup> ferro-cement reservoirs serving approximately 20 persons per collector.

Sanitation: Based on the Household Survey, it is assumed that the 92 percent of households who expressed interest will obtain a new latrine. Furthermore, one school latrine will be installed.

33. Table C.4 summarizes the size of the investment for each of the alternatives. For example, 20 people make use of one rainwater collector, which means that in order to cover the total population with RWC's, a total of 30 RWC's would have to be installed.

| Table C.4 <b>Determination of Size of Investment for Different Alternatives</b> |          |                    |                       |                     |
|---|----------|--------------------|-----------------------|---------------------|
| Item  | Unit     | Alternative1<br>HP | Alternative2<br>PT/HP | Alternative3<br>RWC |
| <b>COVERAGE</b>   |          |                    |                       |                     |
| Hand pump Wells   | % of pop | 100                | 33                    | 0                   |
| Rainwater Collectors  | % of pop | 0                  | 0                     | 100                 |
| Piped Water Public Taps   | % of pop | 0                  | 67                    | 0                   |
| Total Coverage  | % of pop | 100                | 100                   | 100                 |
| <b>NO. OF FACILITIES</b>  |          |                    |                       |                     |
| New. RWC's needed <sup>1</sup>  | Number   | 0                  | 0                     | 30                  |
| New HP Wells needed <sup>2</sup>  | Number   | 12                 | 4                     | 0                   |
| PT's needed   | Number   | 0                  | 8                     | 0                   |
| Number of private latrines  | Number   | 107                | 107                   | 107                 |
| Number of School Latrines   | Number   | 1                  | 1                     | 1                   |
| <sup>1</sup> Average number of users per RWC is 4 families or 20 persons        |          |                    |                       |                     |
| <sup>2</sup> Average number of users per PT/HP is 10 families or 50 persons     |          |                    |                       |                     |

### C.5.3 Capital and O&M Costs

34. The capital costs of the different alternatives, as well as the number of users per unit, are based on the standard designs as developed by the MPW. With proper maintenance, it is expected that these facilities will have a lifetime of 20 years. The O&M costs of the facilities differ per type of facility. Because the project will provide water supply and sanitation facilities to 3,000 small villages scattered over different provinces in Indonesia, it has been assumed that project funds will not be used for future investments, which will be necessary as a result of population growth. Therefore, only the initial investment and the related O&M costs have been taken into account.

35. Based on the cost estimates of the project loan, it has been assumed that overhead costs for project management, community development and water quality monitoring activities amount to 10 percent of the physical investment costs. The financial cost estimates for investment costs and O&M costs for the different alternatives are presented in Table C.5.

| Table C.5 <b>Investment Costs and annual O&amp;M Costs,</b><br><b>including 10% sales tax</b><br>(in Rp'000) |               |               |               |               |
|--|---------------|---------------|---------------|---------------|
|  | HP            | HP/PT         | RWC           | Sanitation    |
| <b>Investment Cost</b>   |               |               |               |               |
| Equipment  | 23,148        | 36,155        | 36,750        | 7,387         |
| Labor  | 8,352         | 14,345        | 15,000        | 4,925         |
| Sub Total  | 31,500        | 50,500        | 51,750        | 12,312        |
| Overhead Cost (10%)  | 3,150         | 5,050         | 5,175         | 1,231         |
| <i>Grand Total</i>   | <i>34,650</i> | <i>55,550</i> | <i>56,925</i> | <i>13,543</i> |
| <b>Annual O&amp;M Cost</b>   |               |               |               |               |
| Equipment  | 1,095         | 2,161         | 184           | 160           |
| Labor  | 209           | 209           | 75            | 148           |
| <i>Total</i>   | <i>1,304</i>  | <i>2,370</i>  | <i>259</i>    | <i>308</i>    |

#### C.5.4 Economic vs. Financial Prices

36. Least-Cost Analysis is carried out in economic prices and, in this case, using domestic price numeraire. First, the 10 percent sales tax included in the investment and O&M costs is deducted from the financial costs. The cost estimates are then apportioned into traded and nontraded components and (unskilled) labor. Finally, financial prices are multiplied with the respective conversion factors to arrive at economic prices.

37. The shadow exchange rate factor for foreign exchange has been estimated at 1.06. The figure was obtained from an ADB regional study on Shadow Pricing in 1993. The conversion factor for unskilled labor has been estimated at 0.65, reflecting the fact that the real market price of labor is lower than the official wage rates which are used in the financial cost estimates.

38. An example of the calculation of the economic prices for alternative 1 (communal hand pumps) is given in Table C.5 below, whereas the calculation for the other options is attached as Annex C.2 to this Appendix.

| <b>Table C.6 Calculation of Economic Price<br/>of the Communal Hand pumps Option</b><br>(Rp'000) |                                    |  |                      |                |
|--|------------------------------------|--|----------------------|----------------|
|  | Financial Costs<br>including taxes | Financial costs<br>excluding sales tax | Conversion<br>Factor | Economic Value |
| <b>Investment Cost</b>   |                                    |  |                      |                |
| Traded (60%)   | 13,889                             | 12,500                                 | 1.06                 | 13,250         |
| Non Traded (40%)   | 9,259                              | 8,333                                  | 1.00                 | 8,333          |
| Labor  | 8,352                              | 7,517                                  | 0.65                 | 4,886          |
| Overhead Cost (10%)  | 3,150                              | 3,150                                  | 1.00                 | 3,150          |
| <i>Grand Total</i>   | <i>34,650</i>                      | <i>31,500</i>                          |                      | <i>29,619</i>  |
| <b>Annual O&amp;M Cost</b>   |                                    |  |                      |                |
| Traded (60%)   | 657                                | 591                                    | 1.06                 | 627            |
| Non Traded (40%)   | 438                                | 394                                    | 1.00                 | 394            |
| Labor  | 209                                | 188                                    | 0.65                 | 122            |
| <i>Total</i>   | <i>1,304</i>                       | <i>1,174</i>                           |                      | <i>1,143</i>   |

39. In the area, no shortage of water is expected in the foreseeable future; therefore, the opportunity costs of water are considered to be zero. The environmental impact of the project is considered negligible; therefore, the environmental costs have not been valued. The costs of draining the additional volume of water supplied are assumed to be covered by the costs for additional sanitation facilities.

#### **C.5.5 Costs for the Household**

40. Besides the investment and direct O&M costs, the future users of the facilities will also make costs. These costs differ per selected alternative and will have to be taken into account in the Least-Cost Analysis. The costs per household are presented in Table C.7.

| Option     | Quantity of Water Used l/day per HH | Average distance to source meters | Avg. Time needed for Collection hrs/month | Collection Costs per HH rp/month | Other Costs per HH rp/month | Average Costs per HH rp/ month | Total Costs per HH rp/year |
|------------|-------------------------------------|-----------------------------------|---|----------------------------------|-----------------------------|--------------------------------|----------------------------|
| No. Column | 1                                   | 2                                 | 3   | 4                                | 5                           | 6                              | 7                          |
| RWC        | 168                                 | 15                                | 3   | 436                              | 50                          | 486                            | 5,832                      |
| HP         | 255                                 | 30                                | 6   | 871                              | 50                          | 921                            | 11,052                     |
| PT         | 255                                 | 30                                | 6   | 871                              | 50                          | 921                            | 11,052                     |

**Explanation:**

Column 1: The average household size is 5.1, which is multiplied by the average consumption per capita per day for each of the alternatives (e.g. for RWC:  $5.1 \times 33 = 168.3$  liters per day);

Column 2: With regard to distance, it has been assumed that the average distance for RWC is less than for PT and HP because only four houses make use of one RWC and ten households use one PT or HP.

Column 3: At present, the average time needed for water collection is 12 hours per HH per month. It has been estimated that households with RWC's will save 75 percent collection time as compared to the situation before the project; and households with HP/PT will save 50 percent collection time.

Column 4: The costs of time used for collecting water has been estimated at 65 percent of the minimum wage rate of Rp343.75 per hour. This is subsequently multiplied with the shadow wage rate of 0.65, resulting in a cost of Rp145 per hour, which is multiplied by the number of hours needed per month.

Column 5: The column of other costs include the costs for storage which has been assumed at 50 percent of the current storage costs of Rp50 per month. These costs are considered to be nontraded costs and therefore, no conversion factor has been applied. No costs for chemicals will be needed after the introduction of the new facilities. Boiling of water for drinking and cooking will still be needed; but as no data were available, these costs have not been included in the calculations.

Columns 6 & 7: The costs per HH per month and per year are calculated by adding columns 4 and 5 and multiplying by 12.

### C.5.6 LEAST-COST ANALYSIS for LOA LEPU

41. For each of the alternatives, the investment costs and the annual O&M costs have been calculated, as well as the annual costs made by the households (see Annex C.3 to this Appendix). The figures are now used to calculate the present values of the costs for each of the alternatives. Subsequently, the present values of the costs are related to the volume of water supplied for each of the options in order to calculate the AIEC. The calculations are presented in Table C.8. The economic costs have been discounted at the EOCC of 12 percent. The calculations lead to the following results:

| Number | Investments                                     | Unit                | Alt.1  | Alt. 2 | Alt.3  |
|--------|---|---------------------|--------|--------|--------|
|        |   |                     | HP     | HP/PT  | RWC    |
| 1      | Investment Cost Water Supply Yr 1               | Rp'000              | 29,619 | 47,153 | 48,216 |
| 2      | Investment Costs for Sanitation Yr 1            | Rp'000              | 10,920 | 10,920 | 10,920 |
| 3      | PV Investment Costs Water Supply and Sanitation | Rp'000              | 36,196 | 51,851 | 52,800 |
| 4      | PV of O&M and HH Costs for WS&S Year 1-20       | Rp'000              | 17,571 | 23,948 | 7,446  |
| 5      | Total Present Value                             | Rp'000              | 53,767 | 75,799 | 60,246 |
| 6      | PV of Water Supplied Year 1-20                  | '000 m <sup>3</sup> | 71,290 | 71,290 | 47,054 |
| 7      | AIEC of Water Supply                            | Rp/m <sup>3</sup>   | 754    | 1,063  | 1,280  |

Lines 1 & 2: present the estimated costs of investment of water supply and sanitation works in year 1.

Line 3: gives the Present Value of the total investment costs in year 0 using a discount rate of 12 percent.

Line 4: gives the Present Value of the annual O&M costs plus the annual costs made by households over the project life using a discount rate of 12 percent.

Line 5: gives the Total Present Value for each of the alternatives.

Line 6: gives the discounted value of the annual volumes of water supplied by each of the project alternatives over the project life.

Line 7: divides the present value of total costs by the present value of the volume of water supplied to calculate an AIEC for each of the options.

42. Based on the Least-Cost Analysis, it is concluded that the quantity of water demanded is most efficiently supplied by means of communal hand pumps with an AIEC of water of Rp774 per m<sup>3</sup>. Therefore, this alternative is selected as the preferred option.

43. It could be argued that the three alternatives provide different benefits to the consumers. However, besides the costs of investment and O&M, also the costs to the household in terms of time needed for water collection has been taken into account; and these costs have been related to the quantity of water provided. Therefore, it is considered that the choice between the alternatives in this case can be made based on the Least-Cost Analysis.

## C.6 ECONOMIC BENEFIT-COST ANALYSIS

### C.6.1 Introduction

44. The economic benefit-cost analysis will show whether economic benefits exceed economic costs and whether the project is economically viable.

### C.6.2 Methodology to Estimate Economic Benefits

45. The economic benefits of the project consist of two components:

- (i) Cost savings on nonincremental supply
- (ii) The Willingness-to-Pay based on average demand price for incremental water supplies

46. Table C.9 shows how incremental demand is calculated. The existing supply without the project can be divided into two components being in-house consumption and consumption outside the house. In-house consumption is estimated at 28 lcd which would amount to 6,071 m<sup>3</sup> per year; whereas water used outside the house (14 lcd) is estimated at 3,035 m<sup>3</sup>/year. As the future without-project supply is maintained at the existing supply level, the incremental demand is equal to the difference in the water supplied by the project and existing supplies evaluated annually.

### C.6.3 Cost Savings Method for Estimating Nonincremental Water Benefits

| Technical Option | Supplied by the Project<br>(lcd) | Total Supply with-<br>project (m <sup>3</sup> /year) | Existing Supply<br>without-project<br>(m <sup>3</sup> /year) | Incremental<br>Demand<br>(m <sup>3</sup> /year) |
|------------------|----------------------------------|--|--|---|
| 100% HP          | 50                               | 10,840   | 9,106  | 1,734   |

47. When the new supply facilities will be introduced, it is predicted that households will shift from the old sources of water to the new sources of water. The old sources of water will be displaced with the new water source and the costs related to the 'old' sources will therefore be saved.

48. Nonincremental water consists of water carried to the house for in-house consumption and water used outside the house. The estimated cost components related to these different uses are explained below:

- (i) Water for in-house consumption:
  - (a) **Time needed to collect water.** Time has been valued at Rp145/hour — which is 65% of the official minimum wage rate of Rp2750 per day divided by 8 hours per day and subsequently multiplied by the shadow wage rate factor (SWRF) of 0.65. Based on past economic growth figures, it has been assumed that the minimum wage rate will show a real increase of 3 percent per annum;
  - (b) **Chemicals to clean the water will no longer be needed.** Villagers used calcium hypochlorite to disinfect water used from unprotected sources. One family uses about 100 grams per month, which cost Rp250. These costs will be saved when new water supply facilities are introduced. Chemicals and filters in this case are considered nontraded goods. Boiling will still be needed, but these costs have not been included in the calculations.
  - (c) **Costs of storage.** All households store water in drums with an average value of Rp13,200. The related construction works are considered nontraded. Assuming a 10-year lifetime for these drums, the average costs amount to Rp100 per month.

The costs related to the in-house water consumption differ between the dry season and the rainy season. The results of the HH survey are presented in Table C.10. From the table it can be seen that the weighted average costs per household for the existing in house water supply is Rp1,738 per HH per month. With an average consumption of 143 liters per HH per day, this amounts to a weighted average of Rp472 per m<sup>3</sup>(see Table C.2.2, Annex C below). The total costs per year for the in-house water supply in Loa Lepu will then be  $6,071 \text{ m}^3 \times \text{Rp}472 = \text{Rp}2,865,512$  (rounded off to Rp2,866,000) per year. These costs will be saved by switching to an alternative source of water.

| Table C.10 <b>Economic Costs of Nonincremental Water</b> (results from HH survey) |          |                                |                                     |                                       |                                       |                             |                             |             |                                    |
|---|----------|--------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|-----------------------------|-----------------------------|-------------|------------------------------------|
| Source  | No of HH | Average Quantity liters per HH | Average distance to source (meters) | Average Collect. Time hours per month | Collect. Costs in Rp per month per HH | Other Costs in Rp per month | Average Costs per HH/ Month | Month/ Year | Total Cost per HH per season in Rp |
| <b>Rainy Season</b>   |          |                                |                                     |                                       |                                       |                             |                             |             |                                    |
| Dugwell   | 3        | 138                            | 89                                  | 16.59                                 | 2,410                                 | 350                         | 2,760                       | 6           | 16,560                             |
| River/<br>Waterpond   | 19       | 147                            | 58                                  | 11.52                                 | 1,673                                 | 350                         | 2,023                       | 6           | 12,138                             |
| Neighbors   | 3        | 69                             | 23                                  | 2.14                                  | 311                                   | 350                         | 661                         | 6           | 3,968                              |
| Average Rainy Season  |          | 137                            | 58                                  | 11                                    | 1,598                                 | 350                         | 1,948                       | 6           | 11,689                             |
| <b>Dry Season</b>   |          |                                |                                     |                                       |                                       |                             |                             |             |                                    |
| Dugwell   | 1        | 92                             | 92                                  | 11.44                                 | 1,661                                 | 350                         | 2,011                       | 6           | 12,065                             |
| River/<br>Waterpond   | 21       | 163                            | 66                                  | 14.54                                 | 2,111                                 | 350                         | 2,461                       | 6           | 14,766                             |
| Neighbors   | 3        | 69                             | 23                                  | 2.14                                  | 311                                   | 350                         | 661                         | 6           | 3,968                              |
| Average dry season  |          | 149                            | 62                                  | 13                                    | 1,877                                 | 350                         | 2,227                       | 6           | 13,362                             |
| Average/<br>Total   |          | 143                            | 60                                  | 12                                    | 1,738                                 | 350                         | 2,088                       | 12          | 25,056                             |

Source: Table C.2.2 in Annex C

(ii) Water used outside the house:

Water outside the house is used for washing, bathing and sanitation purposes. Users will have to walk to the source and maybe carry clothes to the river/well. The water used outside the house is not treated or cleaned in any way. The value of nonincremental water used outside the house is estimated at half the value of the water used in the house. The total costs per year for the water used outside the house is  $3,035 \text{ m}^3 \times \text{Rp}236 = \text{Rp}716,260$  per year.

#### C.6.4 Valuation of Incremental Demand for Water

49. Incremental water is valued at the average demand price, which is approximated by the average between the current and future costs of water supply in financial prices. The future supply costs of water with the project to the consumers are as follows:

- (i) In accordance with government policies, users will have to pay for the costs of O&M. Construction works will be carried out by local contractors and therefore, users will not contribute to the costs of investment. The financial costs of O&M of water supply are estimated at Rp1,304,000 per year.
- (ii) Furthermore, households themselves still make costs which are calculated in financial prices. These costs are calculated in the same manner as was demonstrated in Table C.10 above; but in this case, the costs of time of collecting the water is calculated at its financial value of  $0.65 \times 2750/8 = \text{Rp}223/\text{hour}$ . This adds up to Rp1,294,000 per year.

50. The future supply costs to the household per  $\text{m}^3$  of water supplied with the project are  $(\text{Rp}1,304,000 + \text{Rp}1,294,000) / 10840 = \text{Rp}239/\text{m}^3$ .

51. The supply costs of water without the project in economic prices have been calculated in Table C.10, applying the SWRF of 0.65 to the value of time needed for water collection. The resulting weighed average supply costs of water without the project are then calculated as Rp679 per  $\text{m}^3$ .

52. The average demand price is approximated by the average between future and current costs of water supply to the consumer which is  $(\text{Rp}697 + \text{Rp}239.7)/2 = \text{Rp}468/\text{m}^3$ . The value of incremental water is thus estimated at  $1734 \text{ m}^3 \times \text{Rp}468/\text{m}^3 = \text{Rp}811,512$ .

#### C.6.5 Valuation of Sanitation Benefits

53. For sanitation, no data are available with regard to current resource cost savings in the without-project situation. Using the contingency valuation methodology, an average WTP was expressed by the users of Rp1,641 per month. This WTP is taken as an approximation of the benefits which can be attributed from the sanitation component provided by the project. The total annual value of benefits derived from the sanitation component is thus calculated as follows:

$$\text{No. of HH} \times \text{monthly WTP} \times 12 = 107 \times 1641 \times 12 = \text{Rp}2,107,044 \text{ per year.}$$

### C.6.6 Economic Gross Benefits

54. Gross benefits are defined as the cost savings on nonincremental water and the average demand price for incremental water as calculated in the previous sections. As investments for sanitation are also included in the project, the WTP for sanitation facilities is also added to this, which results in the following:

| Component                                   | Gross Annual Benefits |
|---|-----------------------|
| Nonincremental Water used in the house      | 2,866                 |
| Nonincremental Water used outside the house | 716                   |
| Incremental Water                           | 812                   |
| Sanitation                                  | 2,107                 |
| Total Gross Benefits per annum              | 6,501                 |

### C.6.7 Economic Benefit-Cost Analysis

55. Based on the estimates of costs and benefits, the EIRR can now be calculated as is shown in Table C.12. Detailed calculations are presented in Annex C.4.

| Present Value of Investment Cost<br>Rp'000 | Present Value of O&M Costs Year 1-20<br>Rp'000 | Present Value of Benefits Year 1-20<br>Rp'000 | Net Present Value<br>Rp'000 | EIRR |
|--|--|---|-----------------------------|------|
| 36,196                                     | 17,571   | 53,767  | -568                        | 12 % |

56. Based on the EIRR rates as shown above, the project would be viable with an EIRR of 12 percent and a NPV of Rp-568,000.

### C.6.8 Sensitivity Analysis

57. The sensitivity analysis appraises the impact of changes in key parameters on the EIRR as calculated in the previous section. The following changes have been investigated:

- (i) An increase in the investment cost;
- (ii) A reduction in the economic benefits;
- (iii) A reduction in the lifetime of the investments.

58. For variations in each of the above parameters, the sensitivity indicators and the switching values have been determined. The **sensitivity indicator** is the ratio of percentage change in the ENPV divided by the percentage change in the parameter. A **switching value** indicates the percentage change in a certain parameter required to reduce the EIRR equal to the opportunity cost of capital, or the ENPV equal to zero. The calculations show the following results:

| Table C.13 <b>Switching Values (SV) and Sensitivity Indicators (SI)</b>   |          |                                |                              |        |    |
|---|----------|--------------------------------|------------------------------|--------|----|
| Parameter   | % change | NPV before change<br>( Rp'000) | NPV after change<br>(Rp'000) | SV     | SI |
| Increase in Investment Cost   | + 10%    | -568                           | -5,947                       | 1.05%  | 95 |
| Reduction in Benefits   | - 10%    | - 568                          | -5,890                       | 1.06%  | 94 |
| Reduction in assets lifetime  | - 10%    | - 568                          | -2,868                       | 2.46 % | 41 |
| E.g. the Switching Value in the first row is calculated as follows:<br>$SV = 100 \times (NPV_b / NPV_b - NPV_i) \times (X_b - X / X_b) = 100 \times [-568 / (-568 + 5,947)] \times (.10) = 1.06\%$<br>and the Sensitivity Indicator as follows:<br>$SI = [(NPV_b - NPV_i) / NPV_b] / [(X_b - X_i) / X_b] = [(-568 + 5,947) / -568] / 0.10 = 95$ |          |                                |                              |        |    |

59. From Table C.13, it can be seen that an increase in the investment costs of 1.05 percent will result in an ENPV of zero. The same result will be reached if benefits differ 1.06 percent from the estimated values, or if the lifetime of assets will vary with 2.46 percent. The percentages are very low, which is not surprising, because the value of the calculated EIRR is 12 percent, which is equivalent to the cut-off rate.

60. The Sensitivity Indicator shows that the project results are most sensitive to both changes in the estimated benefits and costs. The factor is larger than one, indicating that the relative change in ENPV is larger than the relative change in the parameter, which means that these parameters are important for the project result.

## C.7 FINANCIAL BENEFIT-COST ANALYSIS

### C.7.1 Financial Costs

61. The cost estimates for the project, as presented in Table C.14, are expressed in financial prices, including taxes.

| No. | INVESTMENTS                                      | Unit                | PV in<br>Rp'000 |
|-----|--|---------------------|-----------------|
| 1   | Investment Cost Water Supply and Sanitation Yr 1 | Rp'000              | 48,330          |
| 2   | PV Investment Costs Water Supply and Sanitation  | Rp'000              | 43,152          |
| 3   | PV of O&M Costs for WS&S Year 1-20               | Rp'000              | 10,601          |
| 4   | Total Present Value                              | Rp'000              | 53,753          |
| 5   | PV of Water Supplied Year 1-20                   | '000 m <sup>3</sup> | 71,290          |
| 6   | AIFC of Water Supply                             | Rp/m <sup>3</sup>   | 754             |

The AIFC for the project is estimated at Rp754/m<sup>3</sup> (which happens to be equal to AIEC).

### C.7.2 Financial Benefits

62. In the project under consideration, there are no fixed financial revenues. The recovery of O&M costs is the responsibility of the households and, where applicable, local village organizations. For this reason, no attempt was made to carry out a financial benefit-cost analysis.

## C.8 SUSTAINABILITY ANALYSIS

### C.8.1 Introduction

63. Economic analysis encompasses testing for project sustainability. For a project to be sustainable, it must be both financially and economically viable and have sufficient annual cash flow to meet O&M and financing costs at a minimum. Unless the project is financially viable, economic benefits will not materialize. If the project's EIRR is above the cut-off rate, the project is economically viable to society. However, if its FIRR is below the cut-off rate, the project does not provide sufficient incentives for the project sponsors to invest and will only be sustainable if subsidized by the government.

64. In urban piped water supply projects, calculations for financial and economic sustainability make use of the average incremental cost formula, which equals the present value of the stream of future capital and O&M costs (at either financial or economic costs), divided by the present value of future quantities of water. The value of the AIC is subsequently compared with the average tariff.

65. The AIC calculations mentioned above can also be used in the case of rural water supply and sanitation projects, but because the future quantity of water is unknown (or

uncertain) and because there is no formal tariff structure to compare with, the figures will only be indicative.

### **C.8.2 Comparison between AIC and Average Tariff**

66. The AIFC as well as the AIEC have been both calculated at Rp754 per m<sup>3</sup>. The average tariff or revenues could be calculated as the estimated O&M costs per m<sup>3</sup> which is covered by the users themselves. The annual O&M costs for WS&S have been estimated at Rp1,612,000 per year. The average 'tariff' in this case would be  $\text{Rp1,612,000}/10,840 \text{ m}^3 = \text{Rp149 per m}^3$ . The financial subsidy amounts to  $\text{Rp754} - \text{Rp149} = \text{Rp605 per m}^3$  or  $(10,840 \text{ m}^3 \times \text{Rp605}) = \text{Rp6.6 million per year}$ .

### **C.8.3 Sustainability Analysis**

67. The policy of the Government of Indonesia for water supply and sanitation in rural areas is that the O&M costs for the project will be covered by the community and that the investment costs will be financed by the Government. Where possible, the community may also contribute to the investment cost of the project by providing labor.

68. The large amounts needed for financial subsidies are due to the fact that the consumers do not contribute to the investment related costs of the project. As the investment costs will be financed up front by the Government, the sustainability of the project will depend on whether or not the users will cover the expenditures for Operation and Maintenance.

69. The O&M costs for the type of facilities installed in the villages under consideration (hand pumps), will partly consist of (own) labor, and partly of buying replacements for parts of the equipment. The responsibility for this is put upon the village authorities or the user groups.

70. For water supply, a system to collect monthly fees apparently does not exist. For sanitation, there is the possibility to create a revolving fund from which the population can obtain a credit and pay back on a monthly basis.

71. For the above reasons, it can be assumed that O&M will take place on an ad hoc basis, where labor will be provided in kind by the communities and where money will be collected from the users to pay for replacement of items of equipment at the time when this is needed.

72. As the average expressed willingness to pay for water and sanitation exceeds by far the required O&M costs, it can be concluded that the schemes in principle are sustainable. It is strongly recommended that the village authorities or user groups establish some kind of collection system on a regular basis to ensure that sufficient funds are available when breakdowns occur. It is also recommended that simple organizational arrangements be made at village level to take care of regular O&M facilities.

## **C.9 DISTRIBUTIONAL ANALYSIS**

### **C.9.1 Introduction**

73. The poverty reducing impact of a project is traced by evaluating the expected distribution of net economic benefits to different groups. As the financial prices determine which participating group controls the net economic benefits, the first step would be to estimate the present value of net financial benefits per participating group. Next, the difference between net benefits by group at economic and financial prices is added to net financial benefits by group, to give the distribution of net economic benefits per group. Finally, the net economic benefits are allocated in proportion to each group. A Poverty Impact Ratio (PIR) expressing the proportion of net economic benefits accruing to the poor can be calculated by comparing which part of net economic benefits accrues to the poor as compared to the economic benefits of the project as a whole.

74. In this case, no attempt has been made to calculate the net financial benefits and therefore, the above procedure will not be fully applied. However, a qualitative assessment will be attempted below.

### **C.9.2 Participating Groups**

75. For the purpose of poverty impact analysis, project beneficiaries are divided into three groups: the poor, the non-poor and the government. Net economic benefits by group are distributed between these three groups in accordance with the extent that they benefit from the project. In the case that net economic benefits are allocated to the government, it is assumed that 50 percent of these amounts will benefit the poor. For Loa Lepu, it is has been assumed that 80 percent of the population consists of poor households with an income of less than Rp300,000 (\$128) per month. With regard to the group 'labor', it has been assumed that 80 percent of this group is poor.

76. The benefits for each of the groups are briefly explained in the following table:

| <b>Group</b>                  | <b>Financial vs. Economic Benefits</b>  |
|-------------------------------|---|
| Consumers<br>(80percent poor) | Consumers will benefit from the fact that they derive gross benefits estimated at Rp53.8 million. For this they will 'pay' only Rp17.6 million, which is the present value of the annual O&M costs and other costs made by the households. Consumers will therefore have a net benefit of about Rp36.2 million, which is mainly caused by the fact that the government will cover the costs of investments.   |
| Government                    | The government will cover the costs of investments made in the project. Ten percent of these costs will be refunded to the government as sales tax. Furthermore, the economic costs of investments differ from the financial costs. The economic costs of traded goods are higher than the financial costs and these extra costs are paid by the economy as a whole. The economic costs of labor are lower as compared to the financial costs. These costs can be considered as a kind of subsidy to the labor force. |
| Labor<br>(80percent poor)     | Labor benefits from the project, in the assumption that they are willing to work at lower wages than they actually receive. The difference between the official wage rates and the actual market rates are considered as a benefit to labor.  |

As 80 percent of both consumers and the labor force are considered poor, and because most of the benefits of the project can be allocated to these groups, it can be concluded that the project will benefit the poor groups in society.

## **C.10 NONQUANTIFIABLE EFFECTS**

77. Below, some nonquantifiable effects of the project are presented. These effects, which are beneficial to the communities concerned, can be considered as benefits derived from the project. The calculated EIRR is therefore most likely underestimated. The positive health impact must especially be considered as a major positive effect of the project.

### **C.10.1 Social and Gender Effects**

78. The provision of water supply facilities which are closer to the families' homes and are of better quality will save resources of (in general) poor families which have previously been devoted to collecting and treating water. These family resources can now be spent on other activities such as education, income generating activities and leisure time.

79. Improved water supply will most likely be particularly beneficial for women because of their role in managing the households. The improved water supply situation will allow them more time for other activities.

80. Women, in general, also have the primary responsibility for the health and hygiene education of their children. Improved water supply and sanitation facilities may facilitate their role in this respect.

### **C.10.2 Health Effects**

81. The provision of water supply and sanitation facilities may be considered as a major health intervention which is expected to decrease health care expenditures and the total number of healthy days lost. This may especially apply to those people who are presently making use of river water.

82. From the data of the district health office in the project area, it appears that in 1994, 4 percent of the population visited the office with a water-related disease. Considering that only those persons who have a more serious form of disease are likely to visit the health office, the actual occurrence of water-related diseases is probably much higher. It is expected that the occurrence of water-related diseases will decrease as a result of the project. These cost-savings, however, could not be quantified and have therefore not been included in the calculated cost savings.

## **C.11 TREATMENT of UNCERTAINTY**

### **C.11.1 Introduction**

83. The purpose of Risk Analysis is to estimate the probability that the project EIRR will fall below the opportunity cost of capital or that the NPV will fall below zero. In this particular case study, no quantitative Risk Analysis has been attempted because the case study only dealt with one small village out of a total of 3,000 villages to be covered by the project. Instead, the focus has been on a qualitative analysis of the main risks involved and on proposing mitigative measures which can be taken to reduce the risks involved in project implementation.

### **C.11.2 Key Assumptions to Achieve Project Targets and Possible Mitigative Actions**

84. Some general risks and/or assumptions made for the project have been described in Chapter 2 and include political and economic stability as well as the non-occurrence of natural disasters. These risks are difficult to assess but, certainly in the long run, they cannot be neglected. (For example, in 1996 the above risks were not considered as large whereas in 1998, both economic and political situations have undergone considerable changes and enormous forest fires have destroyed large parts of the project area).

85. Aside from the more general risks described above, the effects of changes in certain specific variables have been calculated in paragraph 6.6 of this Handbook. These changes involve:

(i) an increase in investment costs; (ii) a decrease in project benefits; and, (iii) a reduced lifetime

of the installations. The chances that these variables may actually occur and possible mitigative actions are discussed below:

- (i) **Increases in Investment Costs.** The risk that investment costs will actually increase is not considered very likely because the project is dealing with a large number of relatively small investments which are produced on a large scale. It is, however, recommended that the costs of the project are closely monitored during the lifetime of the project.
- (ii) **Decreases in Project Benefits.** From section 6.6, it can be seen that the EIRR is most sensitive to variations in project benefits. The risk that project benefits are substantially below the results in the three villages can, however, be substantially reduced by a careful selection of the villages to be included in the project. In general, it can be said that in villages where water resources are of poor quality or far from the demand point, WTP and cost savings will be higher as compared to villages with adequate water resources. If the distance from the households to the water sources in the village in this case study is increased to an average of 150 meters, the EIRR would double.
- (iii) **Reduced Lifetime of Installations.** The effect of a reduced lifetime of project installations is considered a major threat to the success of the Project. In many villages in Indonesia, the remnants of on site water supply and sanitation facilities, which were installed in previous water supply and sanitation projects, can be found. Reduced lifetime of facilities is mainly due to a lack of O&M which, in turn, is caused by a lack of commitment and involvement of the communities. This issue may be addressed by: a) ensuring that the facilities meet a real need in the villages where they are installed; and b) that the communities are closely involved and made responsible in the planning and operation. The project design, to some extent, includes provisions to enable sufficient community involvement; but it is recommended that this issue is closely monitored during project implementation.

86. From the above it can be concluded that the most important mitigative measures to reduce the risk for the project lie in a careful selection of the villages to be included in the project and a close involvement of the communities in the planning, implementation and O&M of water supply and sanitation facilities.

## Annex C.1 Urban Water Supply and Sanitation Project Framework

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| Design Summary   | Project Targets   | Project Monitoring Mecha-   | Risks/Assumptions   |
|--|---|---|---|
| <p><b>1. Sector/Area Goals</b></p> <p>1.1 Improved Health Situation</p> <p>1.2 Improved Living Conditions and reduced poverty</p> <p>1.3 Improved Productivity</p>   | <ul style="list-style-type: none"> <li>- Prevalence of water-related diseases among target population reduced by 15% by 1999;</li> <li>- 75% of people below poverty line have access to safe W&amp;S facilities by 1999;</li> <li>- time spent on collection of water in target area reduced by 50%;</li> <li>- number of sick days in the project area has been reduced by 20%</li> </ul> | <ul style="list-style-type: none"> <li>- Yearly epidemiological reports of the district Health Office</li> <li>- Progress reports</li> <li>- End of project report</li> <li>- Special reports</li> </ul>  | <ul style="list-style-type: none"> <li>- no political instability</li> <li>- no natural disaster in project area</li> <li>- macro-economic development continues</li> </ul>         |
| <p><b>2. Project Objective/Purpose</b></p> <p>2.1 Provide safe and reliable water supply and sanitation facilities to the population in the project area.</p> <p>2.2 Carry out a hygiene and sanitation campaign and water quality monitoring program.</p> | <ul style="list-style-type: none"> <li>- Access to safe water supply and sanitation facilities for 75% of the target population by December 1999.</li> <li>- Improved capacity to carry out hygiene and sanitation campaigns and water quality monitoring programs</li> </ul>   | <ul style="list-style-type: none"> <li>- Water Enterprise Reports</li> <li>- Progress reports</li> <li>- Epidemiological/ Health Surveys</li> <li>- Reports of the Ministries of Home Affairs and Health</li> <li>- Project Progress Reports</li> </ul> | <ul style="list-style-type: none"> <li>- current water tables will not decrease dramatically because of drought.</li> <li>- loan effectiveness by first of January 1996.</li> </ul> |

## Annex C.1 Urban Water Supply and Sanitation Project Framework

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|  |  |  |  |
|--|--|--|--|
| <p><b>3. Project Components/Outputs</b></p> <p>3.1 Carry out construction / rehabilitation of water supply facilities.</p> <p>3.2 Carry out construction &amp; rehabilitation of sanitation facilities.</p> <p>3.3 Implement project, carry out water quality surveillance program and hygiene and sanitation campaign.</p>  | <ul style="list-style-type: none"> <li>- Water supply facilities for 75% of target population installed &amp; operational.</li> <li>- Sanitation facilities for 75% of target population installed &amp; operational.</li> <li>- water surveillance program carried out on regular basis.</li> <li>- hygiene and sanitation programs carried out on regular basis</li> </ul>   | <ul style="list-style-type: none"> <li>- Progress Reports</li> <li>- Water Enterprise Reports</li> <li>- Reports of MOPW, MOHA, MOH</li> </ul> | <ul style="list-style-type: none"> <li>- no delays in contracting (building) contractors and delivery of materials;</li> <li>- WS&amp;S facilities properly installed;</li> <li>- adequate O&amp;M systems established.</li> </ul> |
| <p><b>4. Activities</b></p> <p>4.1 Develop Physical Infrastructure for Water Supply and Sanitation Facilities</p> <ul style="list-style-type: none"> <li>- Surveys</li> <li>- acquire Land</li> <li>- Procurement</li> <li>- Construction</li> <li>- Supervision</li> <li>- Comm. Mgt.</li> </ul> <p>4.2 Set up and carry out Water Surveillance, Sanitation and Hygiene campaigns</p> | <p><b>5. Inputs</b></p> <p>5.1 Water Supply: Land, Civil Works, Equipment and Materials, Studies and DED, Construction, Supervision and O&amp;M: \$104,6 million;</p> <p>5.2 Sanitation: Civil Works, equipment and materials, incremental O&amp;M: \$12,0 million</p> <p>5.3 Institutional Support: implementation assistance, hyg. ed. program, water surv. program, inst. devt. progr, comm. mgt. program, project administration: \$15,6 million</p> | <ul style="list-style-type: none"> <li>- Progress Reports and Review missions</li> <li>- Special Reports</li> </ul>                            | <ul style="list-style-type: none"> <li>-loan approval</li> <li>-government funds approved</li> </ul>   |