

Table I.2.19 Summary and Countermeasures of Significant Negative Impacts on Natural Aspects

| Environmental Impact | Ecological Region No. ¹⁾ / Project Stage ²⁾ | | | | | |
|--|---|----|----|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | DC | PC | PC | PC | PC | PC |
| Biological and Ecological Issues | | | | | | |
| Impacts on important fauna & flora | | | | | | |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | |
| Degradation of ecosystem | | | | | | |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | |
| Proliferation of hazardous species | | | | | | |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | |
| Soil Resources | | | | | | |
| Soil erosion | | | | | | |
| Countermeasures : Monitoring of soil erosion to execute mitigation measures. | | | | | | |
| Soil salinization | | | | | | |
| Countermeasures : Monitoring of salt accumulation to execute mitigation measures. | | | | | | |
| Hydrology Issues | | | | | | |
| Changes in surface water hydrology | | | | | | |
| Countermeasures : Monitoring of hydrological impacts to execute mitigation measures. | | | | | | |
| Changes in groundwater hydrology | | | | | | |
| Countermeasures : Monitoring of impacts on groundwater to execute mitigation measures. | | | | | | |
| Riverbed degradation | | | | | | |
| Countermeasures : Monitoring of impacts on riverbed to execute mitigation measures. | | | | | | |
| Water Quality Issues | | | | | | |
| Water contamination & pollution | | | | | | |
| Countermeasures : Monitoring of water quality to execute mitigation measures. | | | | | | |
| Water eutrophication | | | | | | |
| Countermeasures : Monitoring of water to study and execute mitigation measures. | | | | | | |

Notes : 1) See Section 2.3.2 (3) and Figure I.2.6 for more detail of ecological regions.

2) DC = During the construction stage of the Project, and

PC = During the operation and post-construction stage of the Project

Table I.2.19 Summary and Countermeasures of Significant Negative Impacts on Natural Aspects

| Environmental Impact | Ecological Region No. ¹ | | | | | | Project Stage ² | |
|--|------------------------------------|----|----|----|----|----|----------------------------|----|
| | | 2 | 3 | 4 | 5 | 6 | | |
| | DC | PC | PC | PC | PC | PC | PC | PC |
| Biological and Ecological Issues | | | | | | | | |
| Impacts on important fauna & flora | | | | | | | | ? |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | | | |
| Degradation of ecosystem | | | | | | | | ? |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | | | |
| Proliferation of hazardous species | | | ○ | ○ | ○ | | | |
| Countermeasures : Monitoring of ecological impacts to execute mitigation measures. | | | | | | | | |
| Soil Resources | | | | | | | | |
| Soil erosion | | | | ○ | | | | |
| Countermeasures : Monitoring of soil erosion to execute mitigation measures. | | | | | | | | |
| Soil salinization | ? | ? | | | | | | |
| Countermeasures : Monitoring of salt accumulation to execute mitigation measures. | | | | | | | | |
| Hydrology Issues | | | | | | | | |
| Changes in surface water hydrology | | | | | | | | ? |
| Countermeasures : Monitoring of hydrological impacts to execute mitigation measures. | | | | | | | | |
| Changes in groundwater hydrology | | ? | | | | | | |
| Countermeasures : Monitoring of impacts on groundwater to execute mitigation measures. | | | | | | | | |
| Riverbed degradation | | | | | | | | ? |
| Countermeasures : Monitoring of impacts on riverbed to execute mitigation measures. | | | | | | | | |
| Water Quality Issues | | | | | | | | |
| Water contamination & pollution | | ? | | | | | ? | ? |
| Countermeasures : Monitoring of water quality to execute mitigation measures. | | | | | | | | |
| Water eutrophication | | | | | | | | ? |
| Countermeasures : Monitoring of water to study and execute mitigation measures. | | | | | | | | |

Notes: 1) See Section 2.3.2 (3) and Figure I.2.6 for more detail of ecological regions.

2) DC : During the construction stage of the Project, and

PC : During the operation and post-construction stage of the Project

Table I.3.1 Population Data for Villages under Project

| VILLAGE | POPULATION | COVERAGE | | |
|---------------|------------|---------------|---------------|---------------|
| | | Existing Area | Expanded Area | Extended Area |
| Mabogini | 4,843 | X | O | O |
| Chekereni | 3,363 | X | X | O |
| Rau ya Kati | 1,998 | X | X | X |
| Oria | 4,463 | O | X | O |
| Mtakuja | 3,199 | X | X | O |
| Mvuleni | 2,174 | X | X | X |
| Mandaka Mnono | 1,599 | X | O | X |
| Kaloleni | 2,847 | X | O | X |
| Total | 24,486 | 1 villages | 3 villages | 4 villages |

Table I.3.2 Population Composition

| Village | Male | Female | Total | % |
|--|-------|--------|-------|-----|
| Mabogini | | | | |
| - No. of paddy farmers | 601 | 185 | 786 | 100 |
| - No. of CHAWAMPU members | 192 | 45 | 237 | 30 |
| - No. of paddy farmers living in the village | 176 | 100 | 276 | 35 |
| Rau ya Kati | | | | |
| - No. of paddy farmers | 284 | 58 | 342 | 100 |
| - No. of CHAWAMPU members | 116 | 20 | 136 | 40 |
| - No. of paddy farmers living in the village | 254 | 53 | 307 | 90 |
| Chekereni | | | | |
| - No. of paddy farmers | 412 | 138 | 550 | 100 |
| - No. of CHAWAMPU members | 198 | 59 | 257 | 47 |
| - No. of paddy farmers living in the village | 241 | 93 | 334 | 61 |
| Oria | | | | |
| - No. of paddy farmers | 186 | 12 | 198 | 100 |
| - No. of CHAWAMPU members | 141 | 12 | 153 | 77 |
| - No. of paddy farmers living in the village | 33 | 3 | 36 | 18 |
| Total | | | | |
| - No. of paddy farmers | 1,483 | 393 | 1,876 | 100 |
| - No. of CHAWAMPU members | 647 | 136 | 783 | 42 |
| - No. of paddy farmers living in the village | 704 | 249 | 953 | 51 |

Table I.3.3 Fish Catch Trend at NYM Reservoir

| Year | Catches (metric tons) | No. of Vessels | No. of Fishermen |
|------|-----------------------|--------------------|------------------|
| 1987 | 4,218 | not available (na) | na |
| 1988 | 1,666 | 334 | 1,165 |
| 1989 | 1,643 | 466 | 1,153 |
| 1990 | 2,033 | 593 | 1,170 |
| 1991 | 1,617 | 632 | 875 |
| 1992 | 1,469 | na | na |
| 1993 | 563 | na | na |
| 1994 | 507 | na | na |
| 1995 | 608 | na | na |
| 1996 | 408 | 294 | 624 |

Source : Kilimanjaro Regional Natural Resources Office,
Department of Fisheries

Table I.3.4 Water Quality Analysis at the Project Area

| PARAMETER | Unit | RESULT | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------------|-------|---------------------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | Sampling Point (SP) | | | | | | | | | | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | | | | | | | |
| 1. pH | | 8.0 | 8.1 | 8.4 | 8.4 | 8.4 | 8.8 | 8.8 | 8.5 | 8.6 | 6.4 | 6.5 | 5.7 | 5.7 | 6.1 | 6.2 | 6.09 | 6.09 | 6.2 | 6.2 | 6.4 | 6.5 | 5.6 | 5.6 |
| 2. EC | µS/cm | 1082.0 | 90.9 | 90.8 | 90.8 | 90.8 | 422.0 | 422.0 | 622.0 | 622.1 | 770.0 | 766.0 | 766.0 | 195.0 | 195.0 | 705.9 | 706.0 | 616.0 | 212.0 | 212.0 | 562.0 | 562.4 | 190.0 | 190.0 |
| 3. Ammoniac-Nitrogen | mg/l | 0.43 | 0.44 | 0.31 | 0.32 | 0.34 | 0.34 | 0.34 | 0.38 | 0.39 | 0.47 | 0.39 | 0.39 | 0.18 | 0.18 | 0.47 | 0.46 | 1.01 | 0.37 | 0.37 | 0.37 | 0.38 | 0.32 | 0.32 |
| 4. Nitrate-Nitrogen | mg/l | 1.62 | 1.63 | 1.67 | 1.66 | 1.66 | 1.32 | 1.32 | 1.62 | 1.62 | 1.67 | 1.97 | 1.97 | 2.01 | 2.01 | 64.7 | 64.6 | 1.17 | 1.36 | 1.36 | 0.52 | 0.53 | 1.44 | 1.44 |
| 5. Chemical Oxygen Demand (COD) | mg/l | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.0 | 20.0 | 0.0 | 0.0 | 51.0 | 106.0 | 106.0 | 41.0 | 41.0 | 0.0 | 0.0 | 0.0 | 10.0 | 10.0 | 199.0 | 199.3 | 41.0 | 41.0 |
| 6. Biochemical Oxygen Demand (BOD) | mg/l | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13.0 | 12.6 | 0.0 | 0.0 | 0.7 | 65.00 | 66.00 | 27.06 | 27.06 | 0.0 | 0.0 | 0.0 | 4.0 | 4.0 | 68.0 | 68.0 | 33.0 | 33.0 |
| 7. Sulphate (SO ₄) | mg/l | 41.0 | 41.2 | 0.0 | 0.0 | 0.0 | 18.6 | 18.6 | 28.5 | 29.0 | 30.5 | 28.5 | 28.5 | 11.9 | 11.9 | 10.7 | 10.6 | 24.6 | 18.6 | 18.6 | 19.3 | 19.4 | 1.6 | 1.6 |
| 8. Dissolved Oxygen (DO) | mg/l | 6.97 | 6.96 | 6.5 | 6.6 | 6.6 | 6.8 | 6.8 | 3.9 | 4.0 | 11.4 | 8.7 | 8.7 | 6.10 | 6.10 | 6.7 | 6.6 | 6.10 | 6.0 | 6.0 | 6.7 | 6.8 | 6.01 | 6.01 |
| 9. Phosphate (PO ₄) | mg/l | 0.10 | 0.10 | 0.14 | 0.15 | 0.15 | 0.14 | 0.14 | 0.13 | 0.13 | 0.18 | 0.10 | 0.10 | 0.07 | 0.07 | 0.18 | 0.17 | 0.10 | 0.09 | 0.09 | 0.10 | 0.11 | 0.07 | 0.07 |
| 10. Summation (Agro-chemical) | mg/l | | 2.04 | 2.04 | 2.04 | 2.04 | 1.67 | 1.66 | 2.99 | 2.98 | | | | 0.83 | 0.83 | | | | | | | | 0.68 | 0.68 |

Sampling Points (refer Figure I.3.1 for their locations)

1. Kikuletwa river upstream of proposed headworks (intake)
2. Kikafu river just before confluence with Kikuletwa river
3. Kikuletwa river after confluence with Kikafu river
4. Kikuletwa river just before joining the dam
5. In the middle of Nyumba ya Mungu dam overlooking Magadi village
6. Before the dam outlet.
7. Rau river downstream of existing project area after confluence with drainage
8. Pangani just before NYM entry
9. Ruvu Pangani just before the confluence
10. Rau river just before the confluence
11. After confluence of 9 & 10
12. Drainage channel from irrigated project
13. Rau ya kauri before the end of the canal
14. NAFCO and Project area Drainage channels confluence

| PARAMETER | Unit | RESULTS | | | |
|------------------------------------|-------|---------------------|-------|--------|--------|
| | | Sampling Point (SP) | | | |
| | | 13 | 14 | 13 | 14 |
| 1. pH | | 6.0 | 6.1 | 7.8 | 7.7 |
| 2. EC | µS/cm | 780.0 | 781.0 | 4200.0 | 4200.0 |
| 3. Ammoniac-Nitrogen | mg/l | 0.35 | 0.34 | 187.0 | 189.5 |
| 4. Nitrate-Nitrogen | mg/l | 0.33 | 0.34 | 0.29 | 0.29 |
| 5. Chemical Oxygen Demand (COD) | mg/l | 20.0 | 20.4 | 140.0 | 140.0 |
| 6. Biochemical Oxygen Demand (BOD) | mg/l | 10.0 | 11.5 | 67.0 | 67.0 |
| 7. Sulphate (SO ₄) | mg/l | 3.3 | 3.32 | 0.0 | 0.0 |
| 8. Dissolved Oxygen (DO) | mg/l | 6.31 | 6.30 | 5.9 | 5.9 |
| 9. Phosphate (PO ₄) | mg/l | 0.21 | 0.22 | 0.15 | 0.15 |
| 10. Summation (Agro-chemical) | mg/l | | | 0.0 | 0.0 |

Table 1.3.5 Total Cases of Water and Vector-Borne Diseases at Mabogini Dispensary (1987 ~ 1990)

| Disease/Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
|------------------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-----|-------|--------|
| Malaria | 1,703 | 203 | 1,718 | 1,843 | 187 | 1,768 | 1,865 | 1,896 | 1,910 | 1,935 | 205 | 1,989 | 19,107 |
| Diarrhoea | 536 | 770 | 697 | 731 | 800 | 846 | 806 | 780 | 846 | 580 | 625 | 550 | 8,567 |
| Intestinal Worms | 280 | 316 | 344 | 379 | 369 | 398 | 395 | 411 | 405 | 454 | 468 | 449 | 4,668 |
| Schistosomiasis | 38 | 51 | 41 | 51 | 75 | 69 | 51 | 38 | 237 | 235 | 58 | 43 | 987 |
| Eye Diseases | 176 | 217 | 184 | 197 | 196 | 202 | 197 | 204 | 199 | 172 | 189 | 168 | 2,301 |
| Total | 2,733 | 1,557 | 2,984 | 1,542 | 331 | 3,283 | 3,314 | 3,329 | 3,597 | 3,376 | 339 | 3,199 | 35,630 |

Source : Final Report, Water and Vector-Borne Diseases Survey, 1994, Ardhi Institute

Table 1.3.6 Total Number of Reported Cases at Mabogini Dispensary (1987 ~ 1992)

| Year | 1987 | | 1988 | | 1989 | | 1990 | | 1992 | |
|------------------|-------|------|--------|------|-------|------|--------|------|--------|------|
| | Cases | % | Cases | % | Cases | % | Cases | % | Cases | % |
| Malaria | 3,590 | 51.6 | 6,025 | 64.3 | 6,293 | 59.1 | 6,936 | 65.0 | 5,013 | 81.5 |
| Diarrhoea | 2,003 | 28.8 | 2,286 | 22.7 | 1,593 | 17.0 | 2,145 | 20.2 | 1,617 | 15.1 |
| Intestinal Worms | 755 | 10.9 | 1,214 | 12.0 | 1,030 | 11.1 | 1,471 | 13.8 | 1,590 | 14.9 |
| Schistosomiasis | 180 | 2.6 | 199 | 2.0 | 214 | 2.3 | 203 | 1.9 | 147 | 1.4 |
| Eye Diseases | 429 | 6.1 | 724 | 7.2 | 511 | 5.4 | 534 | 5.0 | 388 | 3.6 |
| Total | 6,976 | 100 | 10,078 | 100 | 9,373 | 100 | 10,646 | 100 | 10,678 | 100 |

Source : Final Report, Water and Vector-Borne Diseases Survey, 1994, Ardhi Institute

Table I.3.7 Main Fish Species in Nyumba ya Mungu Reservoirs and Surrounding River Systems

| Species Name | Distribution |
|---|---|
| 1) Mormyrus | rare and confined to the inflows |
| 2) Rhabdalestes | abundant throughout the lake |
| 3) Garra | found only in running water in the Kikuletwa delta at Samanga |
| 4) Labeo | common, particularly in the inflow deltas |
| 5) Barbus | common and widely distributed in the lake |
| 6) Clarias | distributed throughout the lake, but more abundant in the northern region |
| 7) Synodontis | frequently recorded at sampling sites and in fishermen's catches, except in running water |
| 8) Chiloglanis | caught only in the Kikuletwa delta |
| 9) Anguilla | |
| 10) Haplochromis | generally common and widely distributed |
| 11) Sarotherodon/Areochromis Tilapia with mouth-brood - S. jipe - S. pangani | endemic to the Pangani basin and inhabiting littoral areas, the shallow northern region and the inflow deltas |
| 12) S. esculenta | occupying deeper and open water |
| 13) Tilapia (guide their eggs and young) - T. rendalii | occurring close inshore, especially in south lake |
| 14) Haplochromis | uncertain |
| 15) Rhabdalestes | uncertain |

Source : Bailey, 1974

Table I.3.8 Crocodile Attack for 1996/97

| District | Place | People Attacks | | Animals Killed | | | | |
|----------|-----------------|----------------|---------|----------------|-------|---------|------|-------|
| | | Killed | Injured | Cows | Goats | Donkeys | Dogs | Sheep |
| Moshi | rivers, NYM Dam | 9 | 0 | 10 | 12 | 8 | 8 | 20 |
| Mwanga | rivers, NYM Dam | 0 | 6 | 28 | 17 | 20 | 37 | 5 |
| Same | rivers | 5 | 12 | 18 | 100 | 12 | 50 | 0 |
| Hai | Chemka Spring | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 15 | 18 | 56 | 129 | 40 | 95 | 25 |

Source : Local Offices, 1997

Table I.3.9 Monthly Discharge Data for IDD1 and IDD54 Gauging Stations

(Unit : m³/s)

| Station | Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Annual |
|---------|---------|------|------|------|------|------|------|------|------|------|------|------|------|--------|
| IDD54 | Average | 12.1 | 11.9 | 12.8 | 24.3 | 25.4 | 19.6 | 14.4 | 11.7 | 11.5 | 11.4 | 12.6 | 13.0 | 15.1 |
| | 80 % | 10.4 | 10.5 | 10.6 | 13.2 | 16.4 | 11.8 | 11.1 | 11.0 | 10.7 | 10.9 | 10.4 | 10.3 | 11.4 |
| IDD1 | Average | 15.6 | 14.2 | 16.1 | 40.3 | 56.4 | 34.0 | 22.6 | 17.4 | 14.6 | 13.7 | 17.9 | 18.8 | 23.5 |
| | 80 % | 9.8 | 11.0 | 11.5 | 24.3 | 38.1 | 22.2 | 17.2 | 14.0 | 11.6 | 11.0 | 6.2 | 10.2 | 15.6 |

Table I.3.10 Results of Flood Occurrence Analysis

| Probability (%) | Return Period (years) | Discharge IDD54 (m ³ /s) | Discharge IDD1 (m ³ /s) |
|-----------------|-----------------------|-------------------------------------|------------------------------------|
| 10 | 10 | 136 | 235 |
| 5 | 20 | 166 | 275 |
| 2 | 50 | 205 | 327 |
| 1 | 100 | 234 | 366 |
| 0.5 | 200 | 263 | 404 |

Table I.3.11 Results of Low Flow Occurrence Analysis

| Probability (%) | Return Period (years) | Discharge IDD54 (m ³ /s) | Discharge IDD1 (m ³ /s) |
|-----------------|-----------------------|-------------------------------------|------------------------------------|
| 50 | 2 | 10 | 10 |
| 20 | 5 | 9 | 9 |
| 10 | 10 | 8 | 8 |
| 5 | 20 | 8 | 7 |
| 2 | 50 | 7 | 7 |

Table I.3.12 Monthly Discharge Data for IDC3A Gauging Station

(Unit : m³/s)

| Station | Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Annual |
|-------------|---------|------|------|------|------|------|------|------|------|------|------|------|------|--------|
| Mabo-gini | Average | 1.27 | 1.17 | 1.17 | 1.41 | 1.50 | 1.40 | 1.43 | 1.54 | 1.52 | 1.40 | 1.33 | 1.21 | 1.36 |
| | 80 % | 0.98 | 0.91 | 0.94 | 1.10 | 1.33 | 1.18 | 1.07 | 1.16 | 1.16 | 1.07 | 0.94 | 0.83 | 1.06 |
| Rau ya Kati | Average | 1.30 | 1.15 | 1.30 | 5.78 | 6.19 | 3.95 | 2.76 | 2.15 | 1.97 | 1.10 | 1.35 | 1.25 | 2.52 |
| | 80 % | 0.73 | 0.53 | 0.58 | 1.32 | 3.05 | 2.25 | 1.35 | 1.02 | 0.76 | 0.64 | 0.82 | 0.87 | 1.16 |

Table I.3.13 Mean Monthly Discharge of Njoro River at Mabogini Intake Weir (1980 - 1995)

| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Annual Average |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|----------------|
| Discharge (m ³ /s) | 1.27 | 1.17 | 1.17 | 1.41 | 1.50 | 1.40 | 1.43 | 1.54 | 1.52 | 1.40 | 1.33 | 1.21 | 1.36 |

Table I.3.14 Results of Mean Annual Water Balance Analysis for Nyumba Ya Mungu Reservoir (September 1973 - August 1974)

(Unit : million m³)

| Item | Twelve Months | Monthly Mean | Daily Mean |
|------------------------------------|---------------|--------------|------------|
| 1. Water loss from evaporation | 329 | 27.4 | 0.90 |
| 2. Water loss from dam discharge | 863 | 71.9 | 2.36 |
| 3. Total water loss (1 + 2) | 1,192 | 99.3 | 3.26 |
| 4. Water gain from precipitation | 57 | 4.8 | 0.16 |
| 5. Water gain from inflows (3 - 4) | 1,135 | 94.4 | 3.10 |

Source : Bailey, 1974

Table I.3.15 Alternative Cropping Patterns

| Item | Intake Discharge | 1st (Rainy) Season Cropping Intensity | 2nd (Dry) Season Cropping Intensity |
|-----------------|--|---------------------------------------|-------------------------------------|
| Alternative - 1 | Maximum use of available water source : 11 m ³ /s at peak time | Paddy : 100 % | Paddy : 100 % |
| Alternative - 2 | 9 m ³ /s for 1st season crops, 5 m ³ /s for 2nd season crops | Paddy : 100 % | Paddy : 50 % |

Table I.3.16 Estimated Rate of Groundwater Recharge from Irrigation Water during Project Implementation Phase

| Alternative | (A) Maximum Irrigable Area | (q) Monthly Average Water Requirement | (Q) Total Average Water Requirement | Monthly Average (Q x 60 %) |
|-------------|----------------------------|---------------------------------------|-------------------------------------|----------------------------|
| Unit | ha | l/s/ha | m ³ /s | m ³ /s |
| 1 | 16,220 | 1.408 | 8.758 | 5.25 |
| 2 | 4,354 | 1.275 | 5.551 | 3.33 |

Table I.3.17 Water Quality at Selected Points in Project Area

| Sampling point | Water quality parameters (mg/l) | | | | | |
|--|---------------------------------|-----------|--------------------|---------------------------------|-------------------------------|--|
| | pH | DO | NH ₄ -N | NO ₃ ⁻ -N | SO ₄ ²⁻ | SS |
| Proposed Kikuletwa intake site | 7.26 | 7.53 | 0.107 | 0.24 | 39.0 | 14.7 |
| Chemko spring | 6.6 | 5.16 | Nil | 2.60 | 41.0 | 0.67 |
| Kikuletwa TPC pump station | 7.70 | 6.21 | 0.12 | 0.65 | 14.3 | 32.0 |
| Kikafu river | 6.80 | 7.81 | 0.07 | 1.10 | 1.3 | 22.3 |
| Njoro river at Mabogini intake | 6.53 | 4.80 | 0.79 | 3.80 | 3.0 | 26.7 |
| Rau river at Rau intake | 6.97 | 5.58 | 0.20 | 0.83 | 1.0 | 81.3 |
| Mabogini main canal | 7.02 | 7.60 | 0.18 | 4.17 | 3.3 | 47.7 |
| Rau ya Kati main canal | 7.05 | 5.43 | 0.23 | 0.27 | 1.3 | 95.7 |
| Range | 6.53-7.26 | 4.80-7.81 | 0-0.79 | 0.65-4.17 | 1.0-41 | 0.67-95 |
| Tanzania Temporary standards for receiving waters category 2 | 6.5-9.0 | 3 | 2.0 | 100 | 600 | Discharge of effluents shall not cause formation of sludge or scum in the receiving water. |
| Tanzania Temporary standards for receiving waters category 3 | 6.5-8.5 | 5 | 0.5 | 50 | 600 | Discharge of effluents shall not cause formation of sludge or scum in the receiving water. |

Table 1.3.18 Receiving Water Standards in Tanzania (1/2)

| Physical characteristics | Unit | Maximum permissible concentration | | |
|--|--------------------------|--|------------|------------|
| | | Category 1 | Category 2 | Category 3 |
| Suspended matter (turbidity) | mg/l as SiO ₂ | Discharge of effluents shall not cause formation of sludge or scum in the receiving water. | | |
| Temperature | °C | Discharge of effluent shall not raise the temperature of the receiving water by more than 5°C. | | |
| Total dissolved solids | mg/l | 2000 | 2000 | No limit |
| pH | - | 6.5 - 8.5 | 6.5 - 8.5 | 6.5 - 9.0 |
| Dissolved oxygen | mg/l | 6 | 5 | 3 |
| Oxygen solution | % | 80 | 60 | 40 |
| BOD, 5 days 20 °C | mg/l | 5 | 5 | 10 |
| 5 days 25 °C | mg/l | 6 | 6 | 12 |
| 5 days 30 °C | mg/l | 6 | 6 | 12 |
| 5 days 35 °C | mg/l | 7 | 7 | 13 |
| Permanganate value | mg/l | 20 | 20 | 20 |
| Inorganic substances | | | | |
| Aluminium (Al) | mg/l | 0.3 | 0.3 | 0.5 |
| Arsenic (As) | mg/l | 0.05 | 0.1 | 0.1 |
| Barium (Ba) | mg/l | 1.0 | 1.0 | 1.5 |
| Boron (B) | mg/l | 1.15 | 1.5 | 1.5 |
| Cadmium (Cd) | mg/l | 0.03 | 0.1 | 0.2 |
| Chromium, III (Cr ³⁺) | mg/l | 0.1 | 0.3 | 0.5 |
| Chromium VI (Cr ⁶⁺) | mg/l | 0.05 | 0.1 | 0.1 |
| Cobalt (Co) | mg/l | 0.1 | 0.1 | 0.5 |
| Copper (Cu) | mg/l | 3.0 | 3.0 | 4.0 |
| Iron (Fe) | mg/l | 1.0 | 1.2 | 1.5 |
| Lead (Pb) | mg/l | 0.1 | 0.1 | 0.2 |
| Manganese (Mn) | mg/l | 0.5 | 0.8 | 0.8 |
| Mercury (Hg) | mg/l | 0.001 | 0.001 | 0.005 |
| Nickel (Ni) | mg/l | 0.05 | 0.05 | 0.1 |
| Selenium (Se) | mg/l | 0.05 | 0.05 | 0.5 |
| Silver (Ag) | mg/l | 0.05 | 0.05 | 0.05 |
| Tin (Sn) | mg/l | 0.5 | 0.5 | 0.1 |
| Vanadium (V) | mg/l | 0.005 | 0.005 | 0.1 |
| Zinc (Zn) | mg/l | 0.2 | 0.2 | 1.01 |
| Ammonia + Ammonium (NH ₃ + NH ₄ ⁺) | mg/l | 0.5 | 0.5 | 2.0 |
| Chlorides (Cl ⁻) | mg/l | 200.0 | 200.0 | 400.0 |
| Fluorides (F ⁻) | mg/l | 8.0 | 8.0 | 8.0 |
| Cyanides (Cn) | mg/l | 0.05 | 0.05 | 0.1 |

Table I.3.18 Receiving Water Standards in Tanzania (2/2)

| Physical characteristics | Unit | Maximum permissible concentration | | |
|---|------|--|------------|------------|
| | | category 1 | category 2 | category 3 |
| Inorganic substances | | | | |
| Nitrates (NO ₃) | mg/l | 50.0 | 50.0 | 100.0 |
| Nitrites (NO ₂) | mg/l | As low as is required to prevent eutrophication or excessive weed growth if nitrogen is a limiting. | | |
| Phosphates (PO ₄ ³⁻) | mg/l | Nutrients in waters which are susceptible to eutrophication or excessive weed growth, or in rivers and streams draining into such waters, the lowest possible concentration should be aimed as if phosphorus is a limiting nutrient. | | |
| Sulphates (SO ₄ ²⁻) | mg/l | 600 | 600 | 600 |
| Sulphates (S ²⁻) | mg/l | 0.01 | 0.01 | 0.1 |
| Alkyl benzene sulphonates (ABS) | mg/l | 0.5 | 0.05 | 0.1 |
| Aromatic and aliphatic hydrocarbons | mg/l | 0.5 | 0.05 | 0.1 |
| Aromatic nitrogen containing compounds (e.g. aromatic amines) | mg/l | 0.01 | 0.01 | 0.1 |
| Chloroform extract (CE) | mg/l | 0.5 | 0.5 | .10 |
| Formaldehyde | mg/l | 0.2 | 0.2 | 0.5 |
| Grease & Oils (petroleum ether extract) | mg/l | 0.5 | 1.0 | 5.0 |
| Non - volatile chlorinated compounds | mg/l | 0.005 | 0.005 | 0.01 |
| Volatile chlorinated hydrocarbons (Cl) | mg/l | 0.005 | 0.005 | 0.01 |
| Organochlorine pesticides (Cl) | mg/l | 0.0005 | 0.0005 | 0.001 |
| Other pesticides | mg/l | 0.001 | 0.001 | 0.005 |
| Phenols | mg/l | 0.002 | 0.002 | 0.1 |
| Resins, tar, etc. | mg/l | 0.1 | 0.1 | 0.5 |

Table I.3.19 Recommended Application Rates of Fertilisers in Paddy Farming

| State of Farming | Type of Fertiliser | Rate of Application (kg/ha) | Amount (ton/year) | |
|---------------------|--------------------|--------------------------------|-------------------|-----|
| | | | N | P |
| Nursery | Urea | 0.05 | 0.50 | --- |
| Basel dressing | TSP | 90 | --- | 900 |
| First Top Dresing | N | 37.5 | 375 | --- |
| Second Top Dressing | N | 37.5 | 375 | --- |
| Total | | | 750.5 | 900 |

Table 1.3.20 Results of Impact Assessment and Necessity of Measures and Monitoring(1/2)

| Selected item | Ecological Region 1 (Downstream of the new headworks) | | | Ecological Region 2 (Headworks, mainstem and its direct upstream) | | |
|--|---|--|---|--|--|---|
| | Incremental Negative Impact * Construction St. / Operation St. | Necessity of Additional Measures Construction St. / Operation St. | Necessity of Monitoring Construction St. / Operation St. | Incremental Negative Impacts * Construction St. / Operation St. | Necessity of Additional Measures Construction St. / Operation St. | Necessity of Monitoring Construction St. / Operation St. |
| 1. SOCIAL ENVIRONMENT | | | | | | |
| (1-a) Involuntary resettlement | X | No | No | X | No | No |
| (1-b) Conflict among communities and people | X | No | No | X | No | No |
| (1-c) Population increase and drastic change in population composition | X | Yes | Yes | X | No | No |
| (1-d) Relocation of bases of economic activities and occupational change | X | No | No | X | No | No |
| (1-e) Adjustment of water or fishing rights | X | No | No | X | No | Yes |
| (1-f) Changes in social and institutional structures | X | No | No | X | No | No |
| (1-g) Increased use and residual toxicity of agro-chemicals | X | No | No | X | No | No |
| (1-h) Outbreak of endemic diseases and prevalence of epidemic diseases | X | Yes | Yes | X | No | No |
| (1-i) Increase in domestic and other human wastes | X | No | No | X | No | No |
| 2. NATURAL ENVIRONMENT | | | | | | |
| (2-a) Impacts on important fauna and flora, and degradation of ecosystem | X | No | No | X | No | No |
| (2-b) Proliferation of hazardous species | X | No | No | X | No | No |
| (2-c) Soil erosion | X | No | No | X | No | No |
| (2-d) Soil salinization | X | No | No | X | No | No |
| (2-e) Change in surface water hydrology | X | No | No | X | No | No |
| (2-f) Change in groundwater hydrology | X | No | No | X | No | No |
| (2-g) Riverbed degradation, water pollution and eutrophication | X | No | No | X | No | No |

| Selected item | Ecological Region 4 (Downstream of the new headworks) | | | Ecological Region 5 (Downstream of the Rau river) | | |
|--|---|--|---|--|--|---|
| | Incremental Negative Impact * Construction St. / Operation St. | Necessity of Additional Measures Construction St. / Operation St. | Necessity of Monitoring Construction St. / Operation St. | Incremental Negative Impacts * Construction St. / Operation St. | Necessity of Additional Measures Construction St. / Operation St. | Necessity of Monitoring Construction St. / Operation St. |
| 1. SOCIAL ENVIRONMENT | | | | | | |
| (1-a) Involuntary resettlement | X | No | No | X | No | No |
| (1-b) Conflict among communities and people | X | No | No | X | No | No |
| (1-c) Population increase and drastic change in population composition | X | No | No | X | No | No |
| (1-d) Relocation of bases of economic activities and occupational change | X | No | No | X | No | No |
| (1-e) Adjustment of water or fishing rights | X | No | No | X | No | No |
| (1-f) Changes in social and institutional structures | X | No | No | X | No | No |
| (1-g) Increased use and residual toxicity of agro-chemicals | X | No | No | X | No | No |
| (1-h) Outbreak of endemic diseases and prevalence of epidemic diseases | X | No | No | X | No | No |
| (1-i) Increase in domestic and other human wastes | X | No | No | X | No | No |
| 2. NATURAL ENVIRONMENT | | | | | | |
| (2-a) Impacts on important fauna and flora, and degradation of ecosystem | X | No | No | X | No | No |
| (2-b) Proliferation of hazardous species | X | No | No | X | No | No |
| (2-c) Soil erosion | X | No | No | X | No | No |
| (2-d) Soil salinization | X | No | No | X | No | No |
| (2-e) Change in surface water hydrology | X | No | No | X | No | No |
| (2-f) Change in groundwater hydrology | X | No | No | X | No | No |
| (2-g) Riverbed degradation, water pollution and eutrophication | X | No | No | X | No | No |

Note : * O = Significant negative impacts, even with the built-in plans or measures friendly to environment which have been already proposed in the Report of the JICA study team ;
X = No or minor negative impacts, with the built-in plans or measures friendly to environment which have been already proposed in the Report of the JICA study team

Environmental items having significant negative impacts, and/or needing counter-measures and monitoring

Table 1.3.20 Results of Impact Assessment and Necessity of Measures and Monitoring(2/2)

| Selected Item | Ecological Region 3 (Construction site of diversion channel) | | | |
|--|--|----------------------------------|-------------------------|---------------|
| | Incremental Negative Impacts * | Necessity of Additional Measures | Necessity of Monitoring | |
| | Construction St. | Operation St. | Construction St. | Operation St. |
| 1. SOCIAL ENVIRONMENT | | | | |
| (1-a) Involuntary resettlement | O | X | No | Yes |
| (1-b) Conflict among communities and people | X | No | No | Yes |
| (1-c) Population increase and drastic change in population composition | O | Yes | No | Yes |
| (1-d) Relocation of bases of economic activities and occupational change | X | No | No | No |
| (1-e) Adjustment of water or fishing rights | X | No | No | No |
| (1-f) Changes in social and institutional structures | X | No | No | No |
| (1-g) Increased use and residual toxicity of agro-chemicals | X | No | No | Yes |
| (1-h) Outbreak of endemic diseases and prevalence of epidemic diseases | X | No | No | Yes |
| (1-i) Increase in domestic and other human wastes | X | No | No | Yes |
| 2. NATURAL ENVIRONMENT | | | | |
| (2-a) Impacts on important fauna and flora, and degradation of ecosystem | X | No | No | No |
| (2-b) Proliferation of hazardous species | X | No | No | Yes |
| (2-c) Soil erosion | X | No | No | No |
| (2-d) Soil salinization | X | No | No | No |
| (2-e) Change in surface water hydrology | X | No | No | No |
| (2-f) Change in groundwater hydrology | X | No | No | No |
| (2-g) Riverbed degradation, water pollution and eutrophication | X | No | No | No |

| Selected Item | Ecological Region 6 (In and around the Nyumba ya Mungu dam reservoir) | | | |
|--|---|----------------------------------|-------------------------|---------------|
| | Incremental Negative Impacts * | Necessity of Additional Measures | Necessity of Monitoring | |
| | Construction St. | Operation St. | Construction St. | Operation St. |
| 1. SOCIAL ENVIRONMENT | | | | |
| (1-a) Involuntary resettlement | X | X | No | No |
| (1-b) Conflict among communities and people | X | No | No | No |
| (1-c) Population increase and drastic change in population composition | X | No | No | No |
| (1-d) Relocation of bases of economic activities and occupational change | X | No | No | No |
| (1-e) Adjustment of water or fishing rights | X | No | No | Yes |
| (1-f) Changes in social and institutional structures | X | No | No | No |
| (1-g) Increased use and residual toxicity of agro-chemicals | X | No | No | Yes |
| (1-h) Outbreak of endemic diseases and prevalence of epidemic diseases | X | No | No | No |
| (1-i) Increase in domestic and other human wastes | X | No | No | No |
| 2. NATURAL ENVIRONMENT | | | | |
| (2-a) Impacts on important fauna and flora, and degradation of ecosystem | X | X | No | No |
| (2-b) Proliferation of hazardous species | X | No | No | No |
| (2-c) Soil erosion | X | No | No | No |
| (2-d) Soil salinization | X | No | No | No |
| (2-e) Change in surface water hydrology | X | No | No | No |
| (2-f) Change in groundwater hydrology | X | No | No | No |
| (2-g) Riverbed degradation, water pollution and eutrophication | X | No | No | Yes |

Note : * O = Significant negative impacts, even with the built-in plans of measures friendly to environment which have been already proposed in the Report of the JICA study team ;

X = No or minor negative impacts, with the built-in plans of measures friendly to environment which have been already proposed in the Report of the JICA study team

Environmental items having significant negative impacts, and/or needing counter-measures and monitoring

Table I.4.1 Compensation Rate for Seasonal Crop Land

(Unit : Tsh. / ha)

| Crop | Rate as of 1992/93 | Crop | Rate as of 1992/93 |
|---------------------------|--------------------|-------------------------------------|---------------------|
| 1. Cereals | | 4. Oils | |
| Maize | 33,000 | Black sunflower | 35,100 |
| Rice | 47,100 | Jupiter sunflower | 35,100 |
| Sorghum | 11,000 | Mired sunflower | 35,100 |
| Wheat | 38,000 | Groundnuts | 45,000 |
| Finger millet | 13,400 | Castor | 18,000 |
| Bull rush millet | 9,000 | Sim sim / sesame | 20,750 |
| 2. Bean-like Crops | | 5. Rhizomes / Tubers / Roots | |
| Green gram | 45,150 | Cocoyam | 18,800 |
| Beans | 35,000 | Cassava | (20 / plant) 22,680 |
| Pigeon peas | 19,600 | Sweet potato | 16,000 |
| Other beans | 27,600 | Yam | 35,580 |
| Bambara nuts | 37,450 | Irish potato | 42,000 |
| 3. Vegetables | | 6. Others | |
| Okra (Lady's finger) | 58,583 | Cotton | 35,000 |
| Egg plant | 78,000 | Tabacco (steamed) | 171,500 |
| Cabbage | 78,000 | Tabacco (smoked) | 109,200 |
| Spinach | 31,245 | Tabacco (burley) | 43,165 |
| Tomato | 195,000 | | |
| Onion | 156,000 | | |
| Carrot | 78,000 | | |
| Pumpkin | 87,800 | | |
| Water melon | 93,700 | | |
| Sweet pepper | 93,700 | | |

Source : New Compensation Rates for Planted Agricultural Crops & Forest Products (Trees) - effective from July 1992 (translated from Swahili), Regional Valuation Office, Kilimanjaro

Table I.4.2 Compensation Rate for Trees (Group I : Logs *)

(Unit : Tsh. / m³)

| Tree Species ** | Rate as of 1992/93 | Tree Species ** | Rate as of 1992/93 |
|-----------------|--------------------|-----------------|--------------------|
| Class I | 2,600 | Class IV | 500 |
| Class II | 1,400 | Class V | 400 |
| Class III | 800 | | |

Source : New Compensation Rates for Planted Agricultural Crops & Forest Products (Trees) - effective from July 1992 (translated from Swahili), Regional Valuation Office, Kilimanjaro

Notes : * Detailed description on the other Groups (poles, withies, firewood, charcoal, raffia fibres, seeds, etc.) is also included in the above source.

** Detail lists of species by Class are shown in the Second Schedule of "The Forest Rules (Amendment), 1995 made under section 30, The Forest Ordinance (Cap. 385)"

Table I.4.3 Compensation Rate for Permanent Crop and Land

(Unit : Tsh.)

| Crop | Rate as of 1992 / 93 | |
|------------------------------|----------------------|-------------|
| | per Plant | per Hectare |
| 1. Commercial Crops | | |
| Katani (Sisal) | 526 | 1,841,000 |
| Mibuni (Arabica) | 5,260 | 6,995,800 |
| Mibuni (Robusta) | 5,260 | 5,680,800 |
| Michai (Tea) | 658 | 6,580,000 |
| Minazi (Coconut) | 6,576 | 822,000 |
| Mikakao (Cocoa) | 6,576 | 3,945,600 |
| Mikorosho (Cashewnut) | 6,576 | 657,600 |
| Miwa (Sugar cane) | 263 | 3,287,500 |
| Pareto (Pyrethrum) | 526 | 526,000 |
| 2. Fruits | | |
| Parachichi (Avocado) | 4,224 | 394,500 |
| Michenza (Tangarine) | 2,112 | 657,500 |
| Michungwa (Oranges) | 4,224 | 1,315,000 |
| Miembe (Mangoes) | 4,224 | 394,500 |
| Mifenesi (Jack fruit) | 4,224 | 394,500 |
| Migomba (Banana) | 2,112 | 1,972,500 |
| Mikweme (Oyster nut) | 2,112 | 394,500 |
| Mikongomanga (Pommegranat) | 2,112 | 657,500 |
| Minanasi (Pineapple) | 105 | 1,320,000 |
| Mipapai (Pawpaw) | 1,056 | 1,052,000 |
| Mipera (Guava) | 1,056 | 197,250 |
| Mistafeli (Custard apple) | 1,056 | 460,250 |
| Mitende (Date palm) | 5,280 | 822,000 |
| Ndimu, Malimao (Lime, Lemon) | 2,112 | 657,500 |
| 3. Spices | | |
| Iliki (Cardamom) | 2,112 | 2,104,000 |
| Pilipilimanga (Black pepper) | 528 | 987,000 |
| Mdalasini (Cinnamon) | 528 | 987,000 |
| Tangawizi (Ginger) | 211 | 3,945,000 |
| 4. Others | | |
| Mchikichi (Oil palm) | 4,221 | 789,600 |
| Mianzi (Bamboo) | 211 | 5,786 |
| Mizabibu (Grapes) | 2,112 | 4,786,600 |
| Misufi (Kapok) | 1,056 | 263,000 |
| Miozi (Indian almond) | 1,056 | 147,280 |
| Mizeituni (Mafura) | 4,224 | 2,367,000 |
| Nikungmanga (Nutmeg) | 2,112 | 1,783,500 |

Source : New Compensation Rates for Planted Agricultural Crops & Forest Products (Trees) - effective from July 1992 (translated from Swahili), Regional Valuation Office, Kilimanjaro

Table I.4.4 Compensation Rate for Houses

| House Condition | Rate as of July 1995 |
|---|----------------------|
| (1) Mud-wattle walls, CIS roof, wooden doors and windows, earth floor, no ceilingboard, no services | 15,000 |
| (2) As (1) but tinned roof, bati doors and windows | 11,250 |
| (3) As (1) but grass-thatched | 7,500 |
| (4) As (1) but CSS floor finish | 19,500 |
| (5) Mud bricks, grass-thatched, earth floor, poor workmanship, no services | 15,750 |
| (6) Mud bricks, rendered, plastered and painted, CIS roof CSS floor, wooded doors and windows | 27,000 |
| (7) Walls partly mud-wattle and partly mud bricks CIS roofing, CSS floor, no ceiling poor workmanship | 30,000 |
| (8) Concrete block walls rendered, plastered and painted CIS roof, CSS floor, ceiling board, wooden doors and windows, services provided, good workmanship | 100,000 |
| (9) As (8) but glazed and grilled windows | 112,500 |
| (10) Single-storey flat roof, concrete foundation, block walling rendered, plastered and painted, wooden doors and glazed windows with mosquito gauze, full services provided | 180,000 |
| (11) As (10) but with high standard finishes, e.g. terrazo, flush doors, louvred and grilled windows | 225,000 |
| (12) Single-storey, tiled roof, other details as (10) | 135,000 |
| (13) Multi-storey flat roof * | 270,000 |
| (14) As (13) but terrazzo / parquet floor | 360,000 |
| (15) Multi-storey CIS roofing, details as (13) | 150,000 |
| (16) Burnt bricks pointed, plastered and painted, CIS roof CSS floor, ceilingboard, windows with glazed shutters, timber doors, full services | 97,500 |
| (17) Primary school classrooms * | 37,500 |
| (18) As (17) but windows provided and good workmanship | 52,500 |
| (19) Secondary school classrooms * | 67,500 |
| (20) Framed structures of substantial construction, e.g. modern godowns, factory buildings and power houses * | 150,000 ~ 360,000 |
| (21) Out buildings (gate house, servant quater, store, garage, etc.) * | 75,000 ~ 180,000 |

Source : Cost Rates, Moshi Municipality

Note : * More details are excluded because of their complication.

Table I.4.5 Tentative Free-Market Price of Land as of December, 1997

| Village | Unit Price (Tsh. / Acre) | Nature of Land |
|----------------------|--------------------------|--------------------------------|
| Kanaya | 50,000 ~ 100,000 | Less productive |
| Mkalame | 100,000 ~ 200,000 | Moderate productive |
| Kikavu-Chini | 300,000 ~ 500,000 | Most productive |
| Chekereni / Mabogini | < 500,000 | Most productive and developed |
| Mvuleni / Mtakuja | 100,000 ~ 300,000 | Moderate productive and upland |

Source : Local people through the Project counterparts

Table I.4.6 Annual Cost of Administration and Operation for EMMP Group

| Item | Unit Cost (US\$/year) | Numbers | Total (US\$/year) |
|----------------------|-----------------------|-------------|-------------------|
| Personnel | | | |
| - Professional staff | 12,000 | 1 person | 12,000 |
| - Assistant staff | 10,000 | 2 persons | 20,000 |
| - Others | 5,000 | 1 person | 5,000 |
| Office Cost | | | |
| - Vehicle | 30,000 | 1 field car | 30,000 |
| - Others | --- | 1 set | 30,000 |
| Grand Total | | | 97,000 |

Table I.4.7 Cost for Environmental Management and Monitoring Activities

| Target Aspect | Unit Price (per M/M in US \$) | M/M DC | M/M PC | Total cost US \$ |
|--|--|-------------------|-------------------|-----------------------------|
| 1. Water Quality (Residual toxicity) | | | | |
| - Local expert | 3,000 | 0.5 | 3 | 10,500 |
| - Others (50% of the above) | | | | 5,250 |
| Sub-total | | | | 15,750 |
| 2. Soil Salinization | | | | |
| - Local expert | 3,000 | 0.5 | 2 | 10,500 |
| - Others (50%) | | | | 5,250 |
| Sub-total | | | | 15,750 |
| 3. Crocodile Proliferation | | | | |
| Local expert | 3,000 | 0.5 | 2 | 10,500 |
| - Others (50%) | | | | 5,250 |
| Sub-total | | | | 15,750 |
| 4. Dangerous water plant (Eichhornia) | | | | |
| - Others (50%) | | | | 10,500 |
| Local expert | 3,000 | 0.5 | 2 | 5,250 |
| Sub-total | | | | 15,750 |
| 5. Fauna, flora and ecosystem | | | | |
| -Local expert | 3,000 | 1 | 2 | 9,000 |
| - Others (50%) | | | | 4,500 |
| Sub-total | | | | 13,500 |
| 6. Surface water hydrology | | | | |
| -Local expert | 3,000 | 0 | 2 | 6,000 |
| - Others (50%) | | | | 3,000 |
| Sub-total | | | | 9,000 |
| Grand total | | | | 85,500 |

Note: DC = During construction stage
PC = During operation stage

Figures

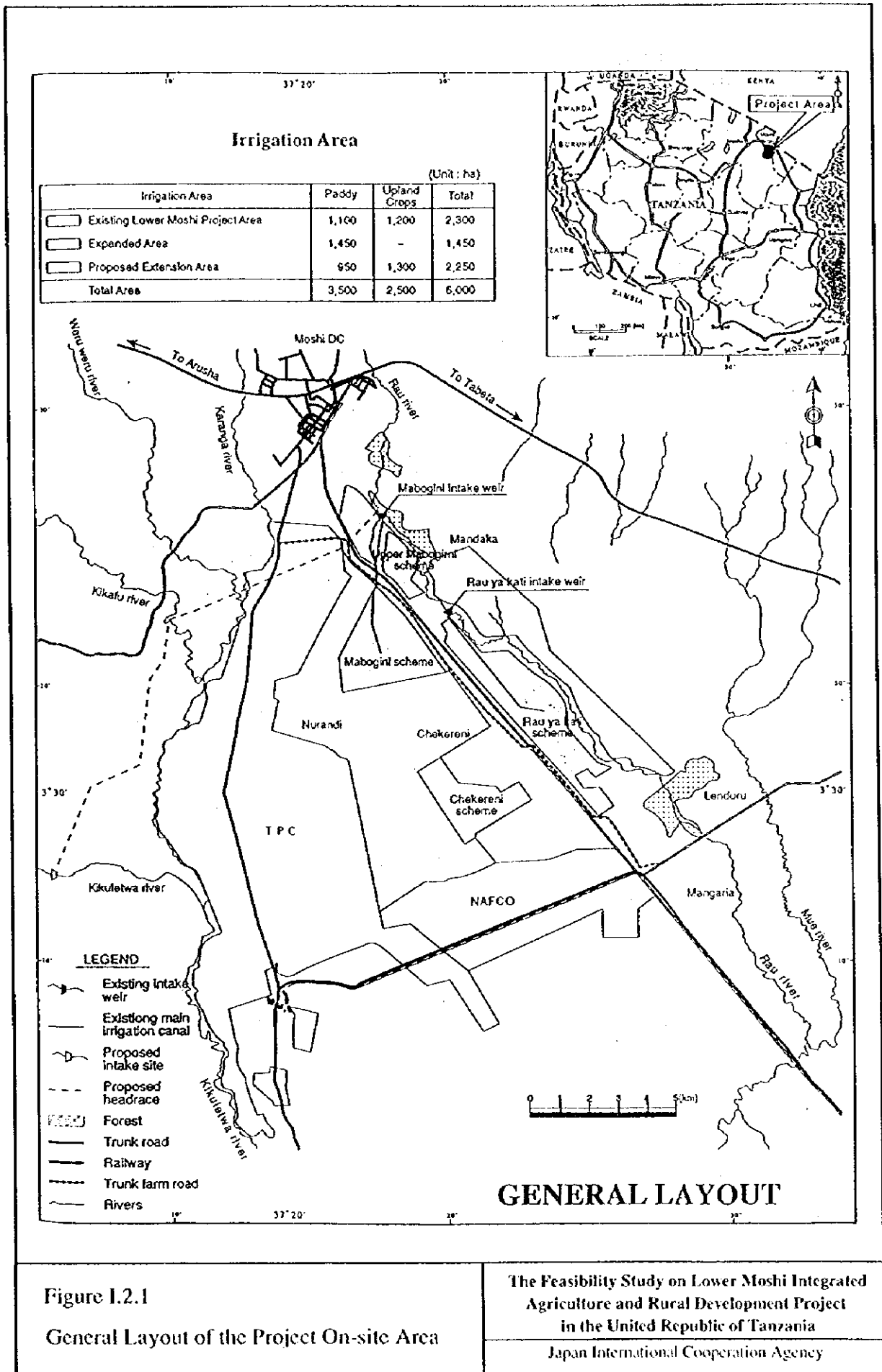


Figure I.2.1
General Layout of the Project On-site Area

The Feasibility Study on Lower Moshi Integrated
Agriculture and Rural Development Project
in the United Republic of Tanzania
Japan International Cooperation Agency

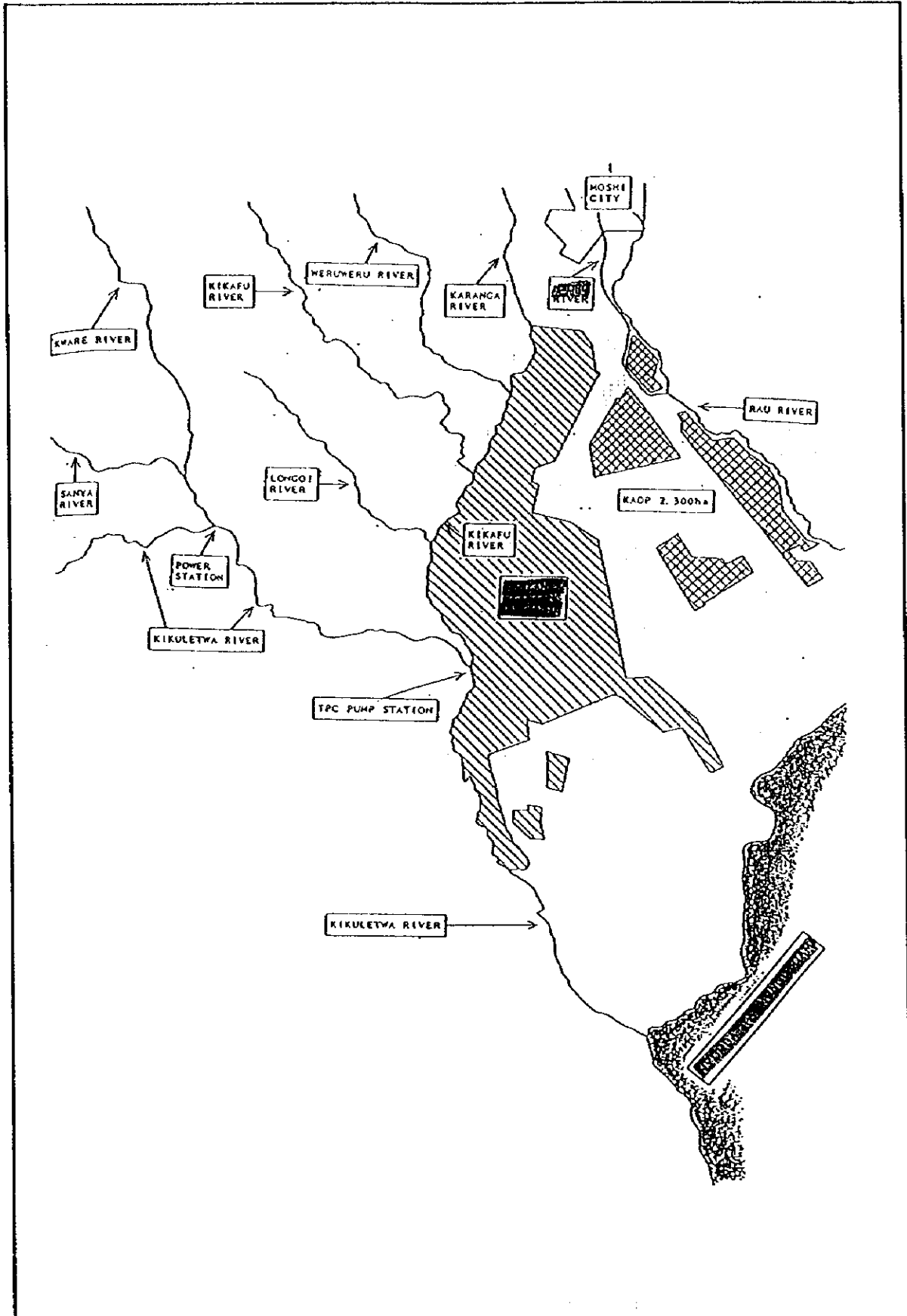


Figure I.2.2
 Sketch of Rivers around the Proposed Project Area

The Feasibility Study on Lower Moshi Integrated
 Agriculture and Rural Development Project
 in the United Republic of Tanzania
 Japan International Cooperation Agency

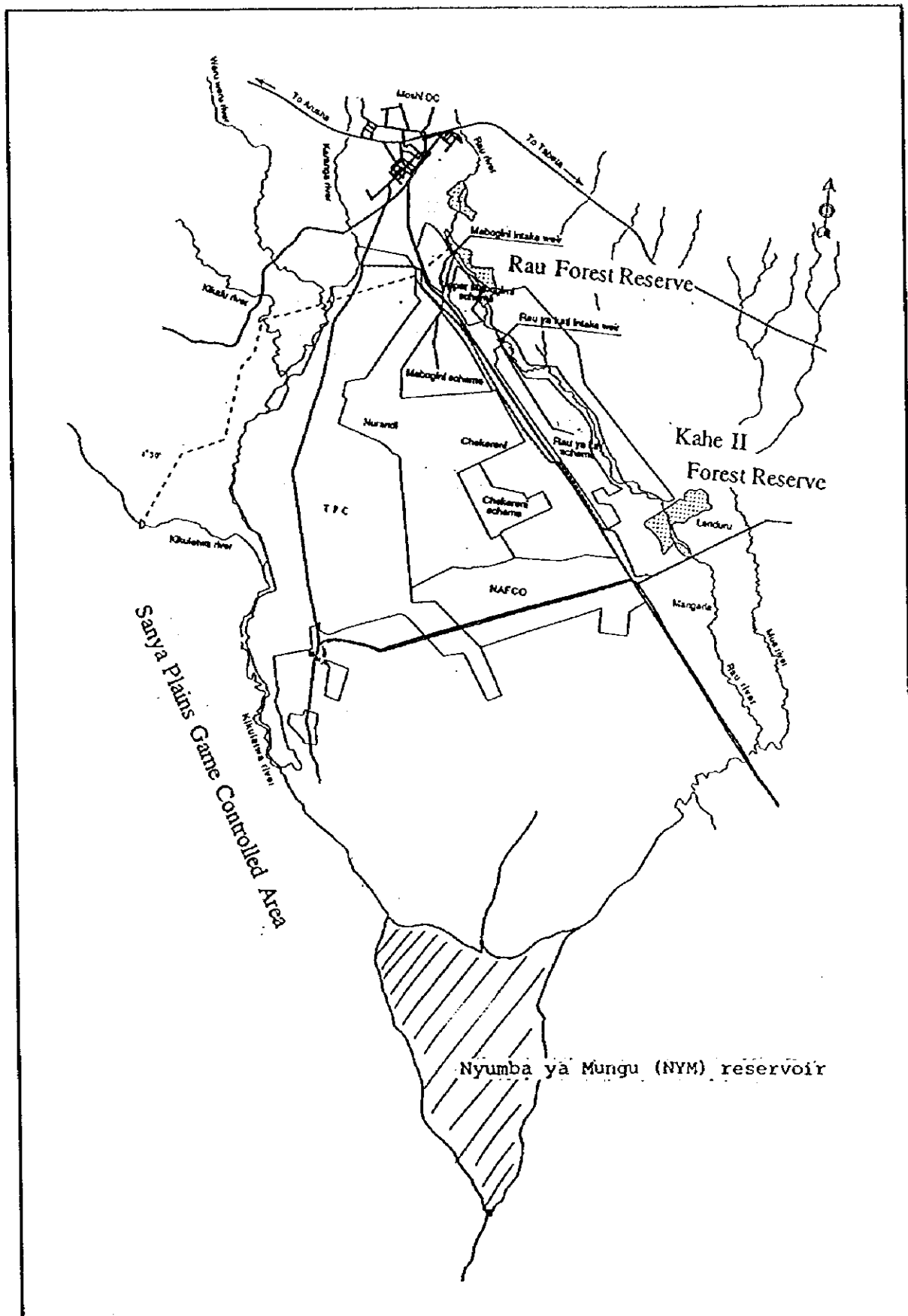


Figure I.2.3
 Sketch of Reserves in and around the Proposed Project Area

The Feasibility Study on Lower Moshi Integrated
 Agriculture and Rural Development Project
 in the United Republic of Tanzania
 Japan International Cooperation Agency

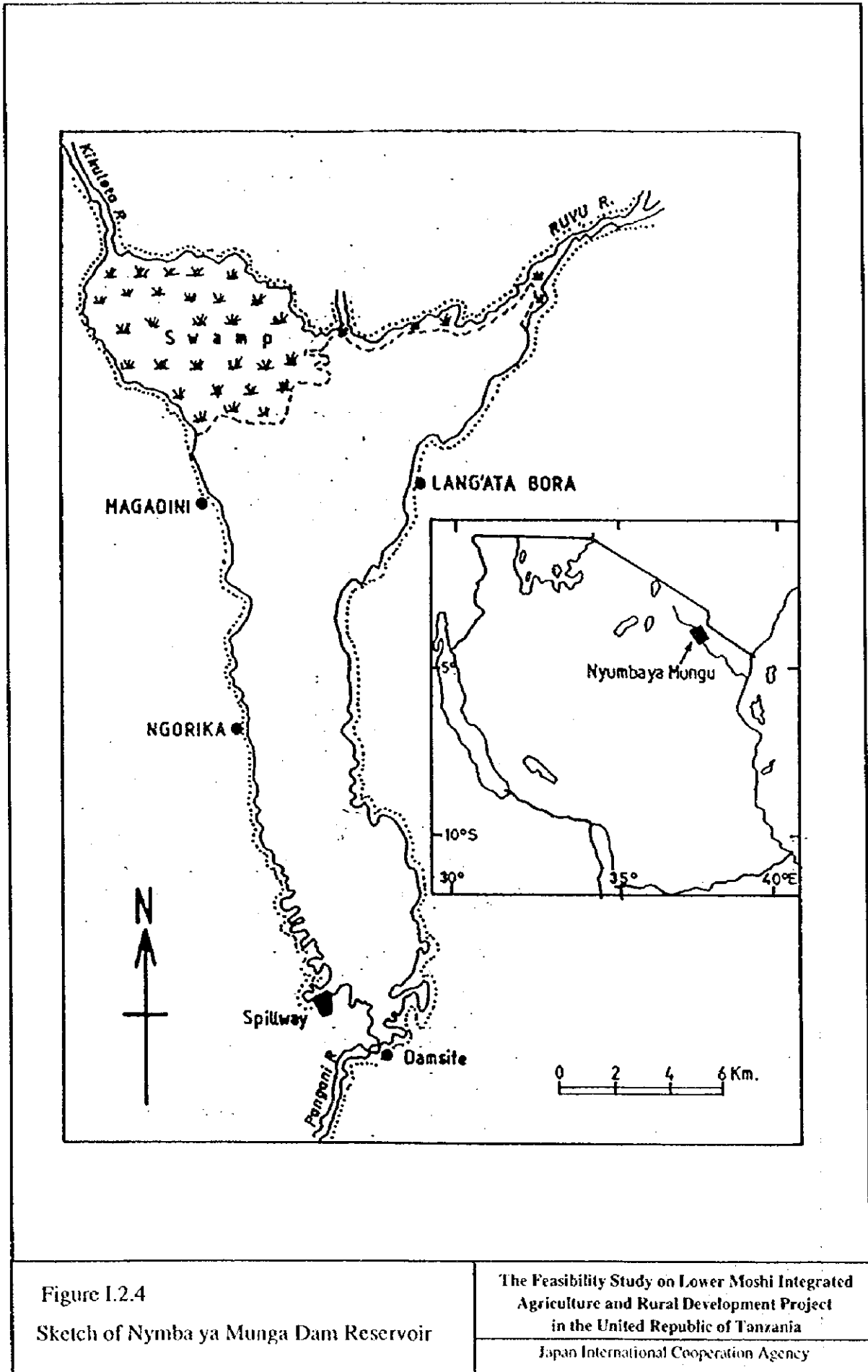
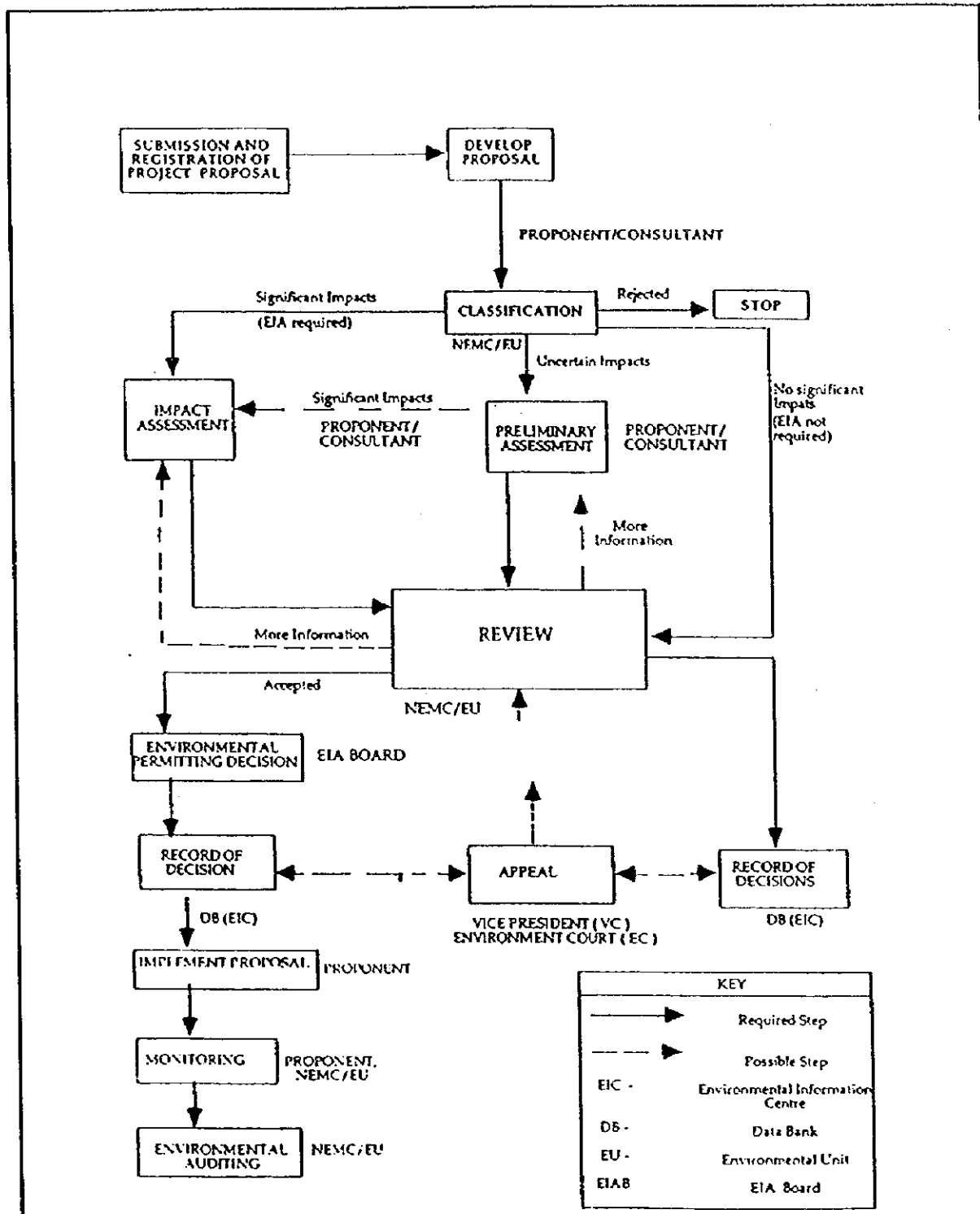


Figure I.2.4
 Sketch of Nyumba ya Munga Dam Reservoir

The Feasibility Study on Lower Moshi Integrated
 Agriculture and Rural Development Project
 in the United Republic of Tanzania
 Japan International Cooperation Agency



Source : Environmental Impact Assessment Guidelines for Tanzania (Draft), p.18

Figure 1.2.5
Environmental Impact Assessment Procedure

The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania
 Japan International Cooperation Agency

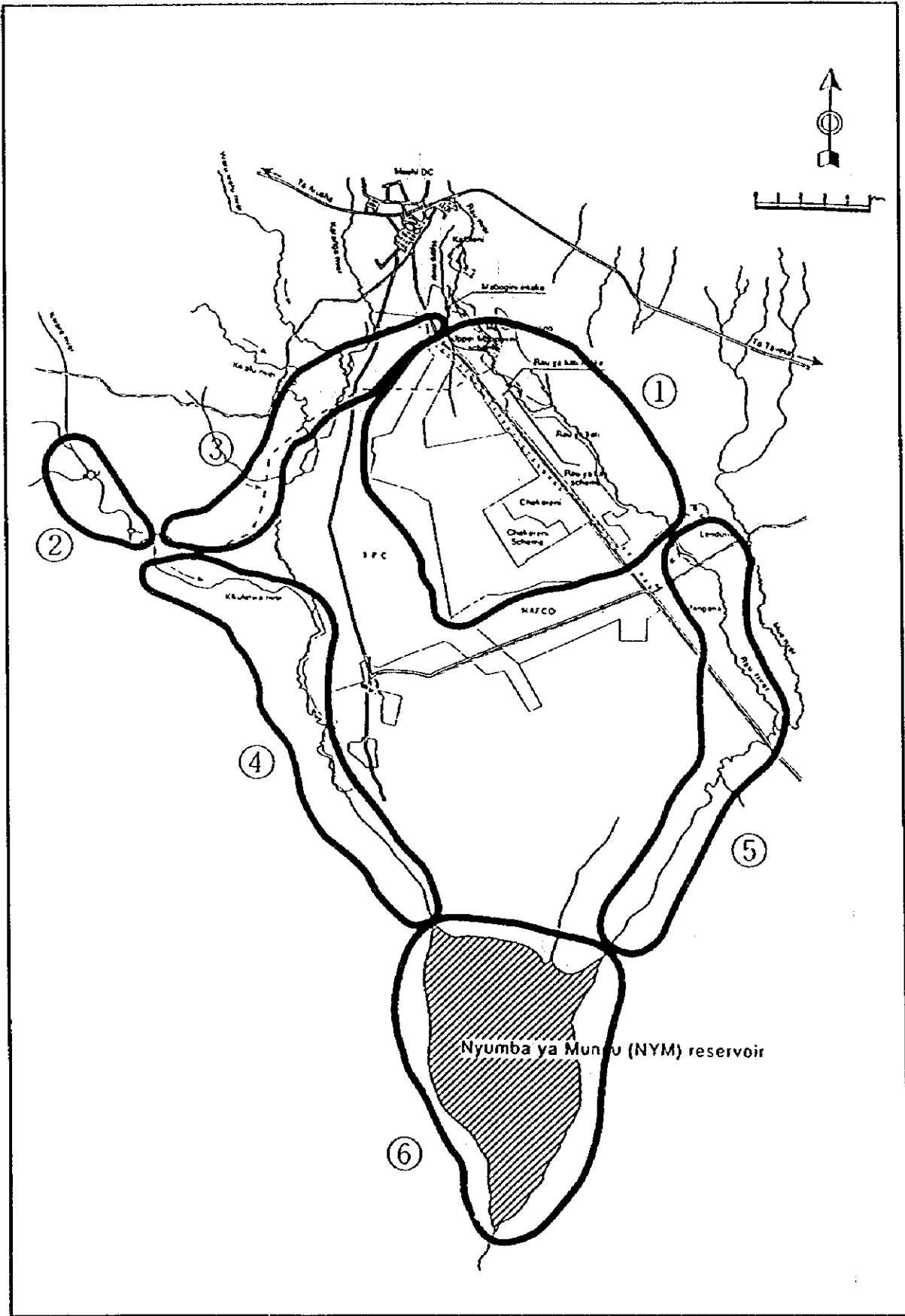


Figure I.2.6
Ecological Regions

The Feasibility Study on Lower Moshi Integrated
Agriculture and Rural Development Project
in the United Republic of Tanzania
Japan International Cooperation Agency

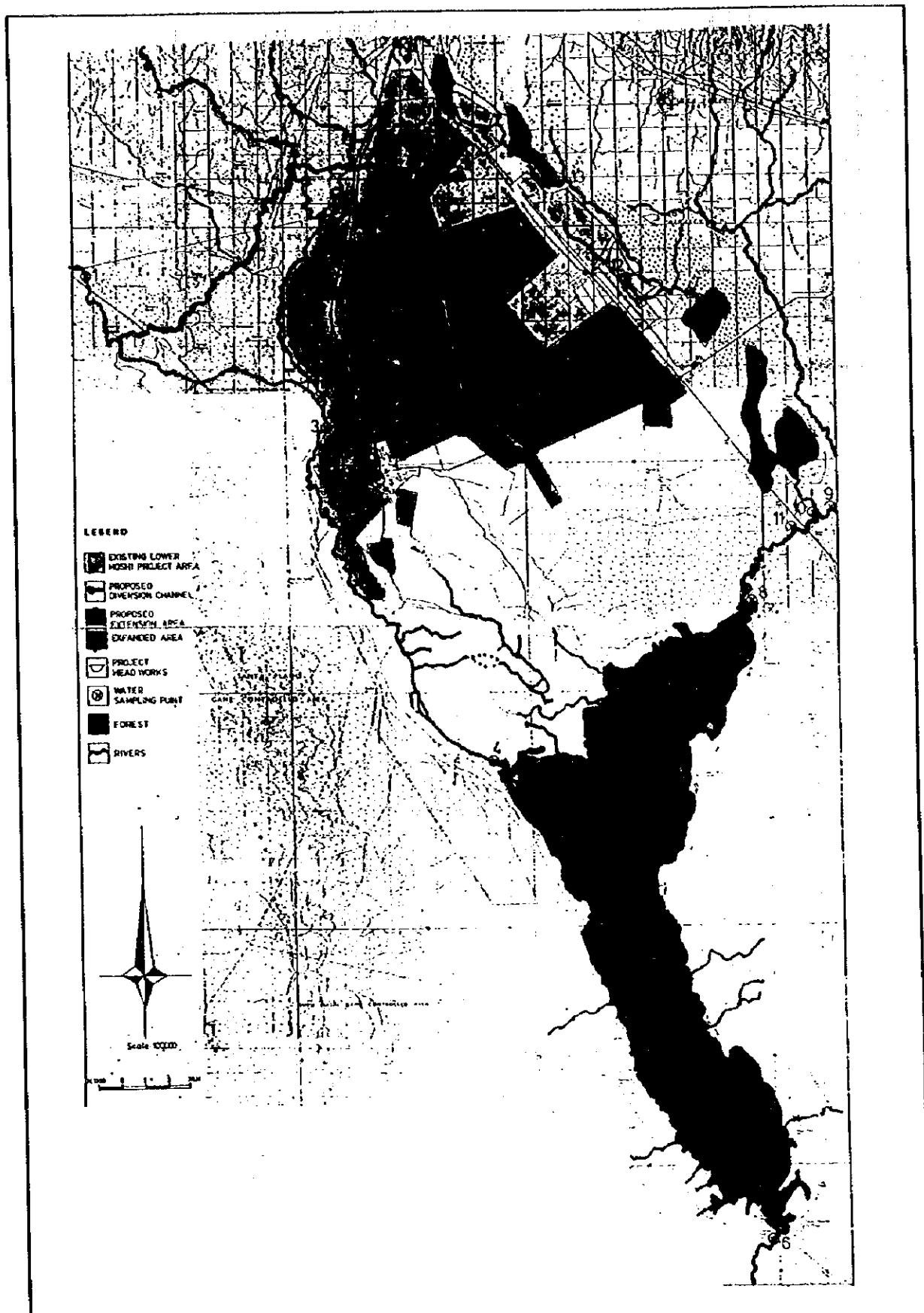


Figure I.3.1
 Sampling Points (SPs) for Water Quality Test

The Feasibility Study on Lower Moshi Integrated
 Agriculture and Rural Development Project
 in the United Republic of Tanzania
 Japan International Cooperation Agency

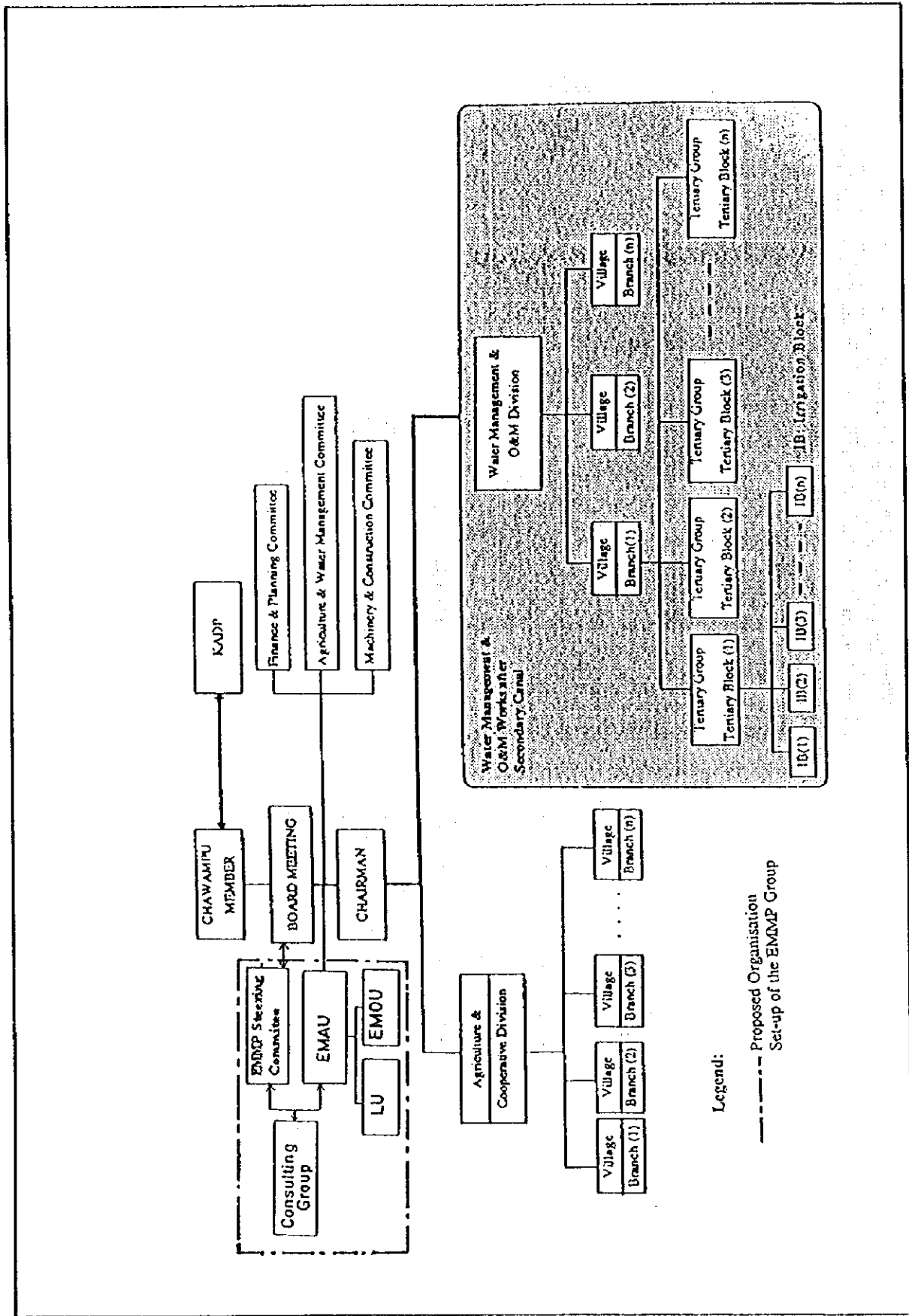


Figure I.4.1
Organization of EMMP Group during Construction Stage

The Feasibility Study on Lower Moshi Integrated
Agriculture and Rural Development Project
in the United Republic of Tanzania
Japan International Cooperation Agency

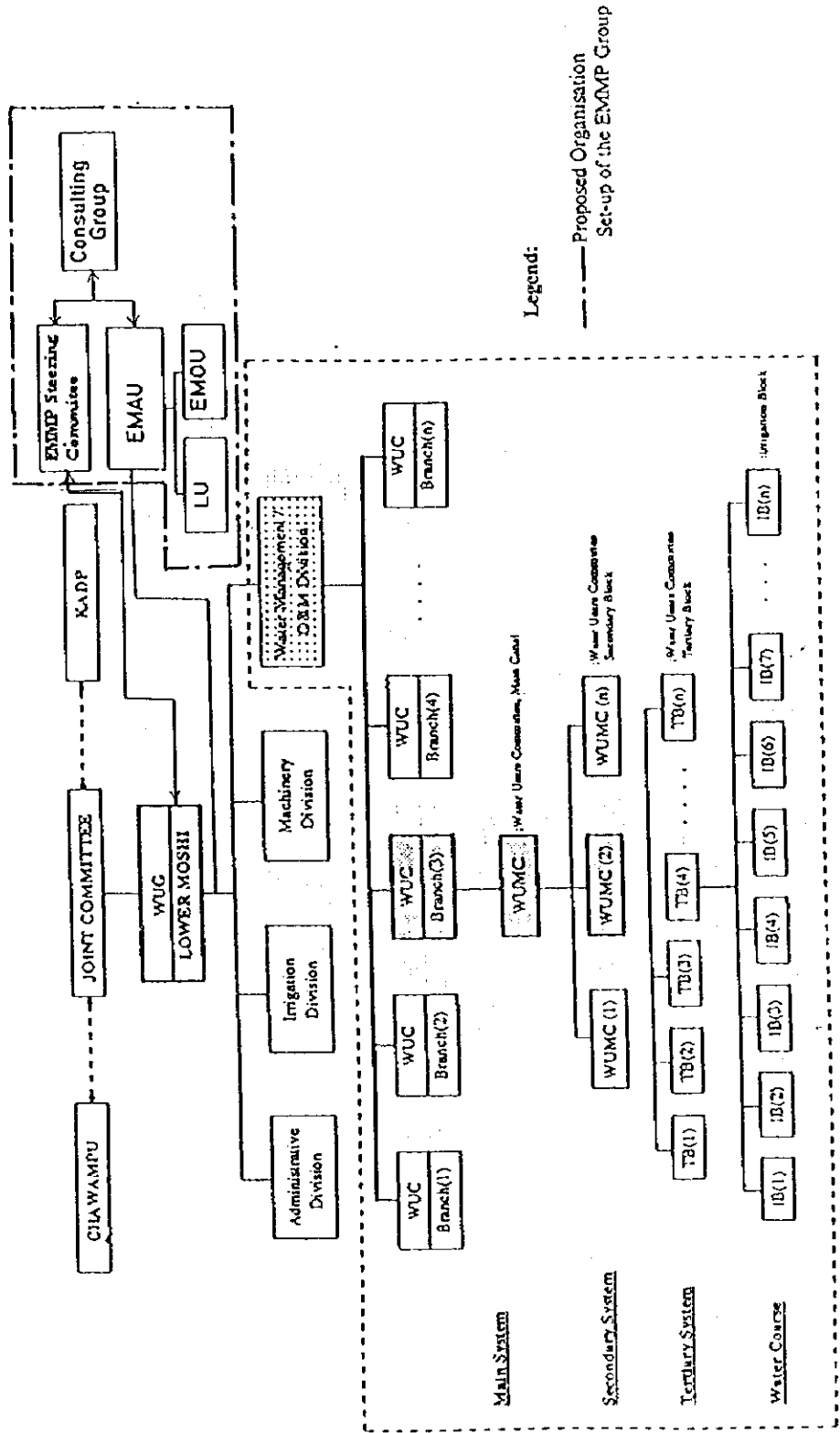


Figure I.4.2
 Organization of EMMP Group during Operation Stage

ATTACHMENT-I.1

OFFICIAL ADVISORY LETTER ON EIA

FROM

NATIONAL ENVIRONMENT

MANAGEMENT COUNCIL (NEMC)

**ATTACHMENT-I.1 : OFFICIAL ADVISORY LETTER ON EIA FROM
NATIONAL ENVIRONMENT MANAGEMENT
COUNCIL (NEMC)**



NATIONAL ENVIRONMENT MANAGEMENT COUNCIL

BARAZA LA TAIFA LA HIFADHI NA USIMAMIZI WA MAZINGIRA

Telegrams: MAZINGIRA DAR ES SALAAM
Phone: 34603 / 27815 -7
Telox: 41959 NEMACO TZ
Fax: 34603

P. O. BOX 63154
DAR ES SALAAM
TANZANIA

In reply please quote:

Ref:..... NEMC/179/1/Vol.6/22

Date..... 17.11.97

Lower Moshi Integrated
Agriculture and Rural Development Project
P.O. Box 972
Moshi

**RE: ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR THE
PROPOSED LOWER MOSHI INTEGRATED AGRICULTURE
AND RURAL DEVELOPMENT PROJECT**

We acknowledge receipt of your letter Ref. No. A.20/4/V/60 dated 5th November 1997 on the above subject.

Based on initial Environmental Examination (IEE) section on your Progress report 1, some negative environment impacts and their mitigation measures has been sited from the project implementation. We advise a full EIA Study should be carried out, which will consider the effect on the downstream users, like Electric production at Nyumba ya Mungu dam and other activities.

The initial Environmental Examination (IEE) commanded to the feasibility study should be used as scoping procedures of impacts within the EIA frame work.

Yours sincerely


D. MWAIPOPO
for Ag DIRECTOR GENERAL



ATTACHMENT-1.2

TERMS OF REFERENCE FOR EIA

ATTACHMENT-1.2 : TERMS OF REFERENCE FOR EIA

TOR of EIA on Lower Moshi Integrated Agriculture & Rural Development Project

- **Members of EIA Study Team**
- **Schedule of EIA Study**
- **Methodology of EIA Study**

1. Summary

2. Project Description (PD)

(* This PD is to be mentioned in more detail than that of the IEE report)

3. Site Description (SD)

(* This PD is to be mentioned in more detail than that of the IEE report)

4. Targets of Environmental Conservation

4-1. Selected Environmental Items for EIA (based on the IEE results)

(1) Social environment

- Involuntary resettlement
- Conflict among communities and peoples
- Population increase and drastic change in population composition
- Relocation of bases of economic activities and occupational change
- Adjustment of water or fishing rights
- Changes in social and institutional structures
- Increased use and residual toxicity of agro-chemicals
- Outbreak of endemic diseases and prevalence of epidemic diseases

(2) Natural environment

- Impacts on important fauna and flora, and degradation of ecosystem
- Proliferation of hazardous species
- Soil erosion
- Soil salinization
- Changes in surface water hydrology
- Changes in groundwater hydrology
- Riverbed degradation, water pollution and eutrophication

4-2. Tanzanian Targets Available for the Selected Environmental Items

- Environmental / emission standards
- Ecological criteria

4-3. Finalized Targets

- Short-term targets for the selected environmental items
- Long-term targets for the selected environmental items

5. Prediction and Assessment of Environmental Impacts

5-1. Present Conditions of the Selected Environmental Items

5-2. Selection of Prediction Methods / Models

- Justification of selection
- Suitable and prerequisite conditions for application

- Re-testability of the selected methods
- 5-3. Prediction of Environmental Impacts
 - Process of prediction (qualitatively or quantitatively)
 - Results and limitation of prediction
- 5-4. Assessment of Environmental Impacts
 - Criteria for assessment
 - Results of assessment

6. Preventive / Mitigative Countermeasures against Environmental Impacts

- 6-1. Technical Aspects
- 6-2. Institutional Aspects
- 6-3. Financial Aspects
- 6-4. Effects of Countermeasures
 - Extent of achievement of the targets
 - Phase-wise approaches
 - Relation with local infrastructure
- 6-5. Relations with Other Existing / Planned Environmental Conservation Schemes

7. Environmental Monitoring

- 7-1. Environmental Items to be Monitored
- 7-2. Technical Specification
- 7-3. Structural Organization
- 7-4. Indicative Cost for Environmental Monitoring

8. Conclusions and Recommendations

- 8-1. Overall Evaluation for Project Implementation from Environmental Point of View
 - Clarification of environmental feasibility / infeasibility
- 8-2. Recommendations to Counterpart Agency
(When the project is environmentally feasible)
 - Enforcement of legislative and institutional frameworks
 - Man-power training
 - Consolidation of equipment and facilities
 - Other measures

ATTACHMENT-1.3

MAIN REFERENCE FOR EIA

ATTACHMENT-1.3 : MAIN REFERENCES FOR EIA

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ATTACHMENT-I.4

QUESTIONNAIRE RESULTS

ATTACHMENT-I.4 : QUESTIONNAIRE RESULTS

Questionnaire Results for Irrigated and Extended Areas

PART A: Irrigated area

1. Main problems experienced in the irrigated cultivation of paddy *

| | Responded | % |
|-----------------------------|-----------|------|
| i) Scarcity of water | 71* | 32.0 |
| ii) Expensive agrochemicals | 52 | 23.4 |
| iii) Poor water quality | 34 | 15.3 |
| iv) Lack of reliable market | 55 | 24.8 |
| v) Others | 10 | 4.5 |

2. Sufficiency of water flowing in the channel response

| Yes | No |
|------|------|
| 31 | 50 |
| 38.3 | 61.7 |

2.1 Changes expected in activities in case water supply is increase

| | | |
|--|----|------|
| i) Cultivating more than a season 9 year | 69 | 43.9 |
| ii) Increased yield per plot | 40 | 25.5 |
| iii) Reduced conflicts | 45 | 28.7 |
| iv) others | 03 | 1.9 |

3. Fairness in the water distribution arrangement Respondents %

| Yes | No |
|------|------|
| 37 | 44 |
| 45.7 | 54.3 |

3.1.1 Reason for unfairness*

| | | |
|---|----|------|
| i) Illegal topping | 27 | 46.6 |
| ii) Non-compliance to the distribution arrangements | 31 | 53.4 |
| iii) Others | 0 | 0.0 |

4. Presence of conflicts with the paddy-plot neighbour respondents %

| Yes | No |
|------|------|
| 47 | 34 |
| 58.0 | 42.0 |

4.1 Reason for conflicts respondents %

| | | |
|--------------------------|----|------|
| i) water uses | 45 | 95.7 |
| ii) Solid waste disposal | 2 | 4.3 |
| iii) Other | 0 | 0.0 |

5. Trend of population growth response %

| Increasing | Decreasing | Constant |
|------------|------------|----------|
| 80 | 0 | 1 |
| 98.8 | 0.0 | 1.2 |

5.1 Reason for the existing population - trend *

| Natural growth | Immigration | Emigration |
|----------------|-------------|------------|
| 65 | 41 | 0 |
| 61.3 | 38.7 | 0.0 |

PART B : For both the Irrigated and Extended areas

6. Awareness of the plan to change the landuse into irrigation scheme and/or increase the amounts of water for irrigation

| Irrigated area (Existing) | | Extended area | |
|---------------------------|------|---------------|-----|
| Yes | No | Yes | No |
| 60 | 21 | 68 | 6 |
| 74.1 | 25.9 | 91.9 | 8.1 |

6.1 (If Yes), Source of Information *

| | Irrigated area | | Extended area | |
|------------------------------|----------------|------|---------------|------|
| | Responses | % | Responses | % |
| Through meeting | 19 | 31.7 | 38 | 51.4 |
| From village/CHAWAMPU Office | 16 | 26.7 | 20 | 27.0 |
| Hearsay | 23 | 38.3 | 10 | 13.5 |
| Others | 3 | 5 | 0 | 0.0 |

7.

| | Irrigated area | | Extended area | |
|--|----------------|------|---------------|------|
| | Respondents | % | Responses | % |
| No serious problem if water is enough | 78 | 57.8 | 43 | 50.0 |
| Increased incidence/prevalence of diseases | 29 | 21.5 | 23 | 26.7 |
| Increased land/water -use conflicts | 22 | 16.3 | 12 | 14.0 |
| Other | 6 | 4.4 | 8 | 9.3 |

8. Expected benefits from the extension/expansion *

| | Irrigated area | | Extended area | |
|-------------------------|----------------|------|---------------|------|
| | Responses | % | Responses | % |
| Increased field | 54 | 35.1 | 64 | 57.1 |
| Higher living standards | 46 | 29.9 | 20 | 17.9 |
| Decreased conflicts | 51 | 33.1 | 27 | 24.1 |
| Other | 3 | 1.9 | 1 | 0.9 |

* A respondent may give more than one answer. The % refers to the portion of the total responded given by respondents of that question.

C. For Extension Area Ownership of the occupied land Responses %

| Yes | No |
|------|-----|
| 73 | 1 |
| 98.6 | 1.4 |

9.1 Period of using the land Response %

| Years | 1 - 3 | 3 - 5 | Over 5 |
|----------|-------|-------|--------|
| Response | 6 | 20 | 48 |
| % | 8.1 | 27.0 | 64.9 |

9.2 Economic activities engaged in *

| Livestock keeping | Cultivation | Others |
|-------------------|-------------|--------|
| 7 | 73 | 0 |
| 8.8 | 91.2 | 0.0 |

9.3 Average of the farm

| Areas | 1-2 | 2-5 | over 5 |
|-----------|-----|------|--------|
| Responses | 16 | 36 | 22 |
| % | 8.8 | 48.6 | 29.7 |

10. Willingness to shift to other place in case of resettlement

| Areas | Yes | No |
|-----------|------|------|
| Responses | 53 | 21 |
| % | 71.6 | 28.4 |

10.1 Anticipated losses to be incurred in case of resettlement *

| | | | |
|----|-----------|----|------|
| i) | decreased | 20 | 34.5 |
|----|-----------|----|------|

| | | |
|------------------|----|------|
| acreage | | |
| ii) Poor housing | 29 | 50 |
| iii) Other | 9 | 15.5 |

Relocation of Economic Activities and Occupational Change

For Ecological Region 6 only

1. Time started fishing

| | Before 1987 | 1987 onwards |
|----------|-------------|--------------|
| Response | 49 | 51 |
| % | 49% | 51% |

2. Type of fish *

| | Pelegc | Kambale | Ngogogo | Ningu | Dagaa | Asilia | Others |
|----------|--------|---------|---------|-------|-------|--------|--------|
| Response | 94 | 57 | 25 | 11 | 4 | 22 | 4 |
| % | 43.3 | 26.35 | 11.5% | 5.1% | 1.8% | 10.1% | 1.8% |

Others: Kuyu, Changu, Mkunga

3. Daily fish catch

| | Less than 1 basket | 1-3 baskets | More than 3 baskets |
|----------|--------------------|-------------|---------------------|
| Response | 21 | 72 | 7 |
| % | 21% | 72% | 7% |

4. Comparison of fish catch between the year of starting fishing and now

| Increase | Decreased | Constant | I don't know |
|----------|-----------|----------|--------------|
| 19 | 64 | 15 | 2 |
| 19% | 64% | 15% | 2% |

5. Scarcity of fish species which were plenty

| Yes | No |
|-----|-----|
| 60 | 40 |
| 60% | 40% |

NB: A respondent may give more than one option. % age is computed from the total number of responses and not from the number of respondents.

5.1 Type of scarce species

- Asilia
- Ningu

5.2 Reasons for scarcity *

| | % Responses | % | % |
|-----------------------------------|-------------|----------------------------|-------|
| Over fishing | 28 | | 43.8% |
| Siltation | 0 | | |
| Pollution from irrigation project | 4 | | 6.2% |
| Others | 17 | Predation by other species | 26.6% |
| Use of Kokoros | 15 | | 23.4% |

6. Tools used in fishing

| Fishing tool | Responses | % |
|-----------------------------|-----------|----|
| Gillnets | 90 | 90 |
| Kokoros "Seeine nets" | 2 | 2 |
| Others: "Mgono wa Kikerewe" | 8 | 8 |

7. Alternative activities in case of fish scarcity

| | Responses | % |
|-----------------------|-----------|----|
| I don't know | 54 | 54 |
| I will do farming | 36 | 36 |
| I will do pastoralism | 2 | 2 |
| Others: Trade | 8 | 8 |

8. Duration engaged in fishing in a year

| | Responses | % |
|------------------------|-----------|----|
| Throughout the year | 76 | 76 |
| Half a year | 22 | 22 |
| Three months | 2 | 2 |
| Less than three months | 0 | 0 |

NB: A respondent may give more than one option % age is computed from the total number of responses and not from the number of respondents.

9. Other Economic activities engage in *

| Farming | Pastoralism | I don't have | Others |
|---------|-------------|--------------|--------|
| 27 | 5 | 36 | 34 |
| 26.4% | 4.9% | 35.3% | 33% |

10. Occupation on which daily livelihood depend on

| Employment | Fishing | Farming | Trade |
|------------|---------|---------|-------|
| 0 | 95 | 12 | 0 |
| 0% | 88.8% | 11.2% | 0% |

11. Problems faced in fishing activity *

| Problem | Response | % |
|---|----------|------|
| Decrease of fish | 51 | 33.8 |
| Fish market | 56 | 37.1 |
| Others: Poor; Gillnet, fishing gear theft, crocodiles, hippopotamus | 44 | 29.1 |

12. Staple food *

| Staple food | Response | % age |
|-------------|----------|-------|
| Fish | 100 | 75.8 |
| Meat | 32 | 24.2 |

13. Problem affecting fishing activities which are associated with the reservoir

| Problem | Response | % age |
|------------------------------|----------|-------|
| No problems | 73 | 73 |
| Presence of crocodile | 1 | 1 |
| Decrease of water in the dam | 26 | 26 |

NB: A respondent may give more than one option % age is computed from the total number of responses and not from the number of respondents.

14. Average monthly income

| Monthly income | Responses | % age |
|------------------|-----------|-------|
| Less than 10,000 | 0 | 0 |
| 10,000 - 25,000 | 12 | 12 |
| 25,000 - 40,000 | 47 | 47 |
| Over 40,000 | 41 | 41 |

15. Average monthly living expenses

| Living expense | Responses | % age |
|------------------|-----------|-------|
| Less than 10,000 | 8 | 8 |
| 10,000 - 25,000 | 25 | 25 |
| 25,000 - 40,000 | 46 | 46 |
| Above 40,000 | 21 | 21 |

16. Amount paid for the fishing licence

| | Responses | % age |
|----------------|-----------|-------|
| Less than 1000 | 35 | 35 |
| 1000 - 2000 | 23 | 23 |
| Above 2000 | 25 | 25 |
| I don't have | 17 | 17 |

Social infrastructure and home facilities

| | Yes | | No | |
|--------------------------|----------|-------|----------|-------|
| | Response | % age | Response | % age |
| 1. Supply of electricity | 15 | 15 | 85 | 85 |
| 2. Domestic water supply | 14 | 14 | 86 | 86 |

Alternative water supply sources

| | River | Well | Canal | Pond | Others (Reservoir) |
|-----------|-------|------|-------|------|--------------------|
| Responses | 19 | 0 | 0 | 3 | 68 |
| % age | 19% | 0% | 0% | 3% | 68% |

| | Yes | | No | |
|--------------------|-----------|----|-----------|-----|
| | Responses | % | Responses | % |
| 3. Oil cooker | 17 | 17 | 83 | 83 |
| 4. Cooker | 0 | 0 | 100 | 100 |
| 5. Refrigerators | 0 | 0 | 100 | 100 |
| 6. Electric fan | 0 | 0 | 100 | 100 |
| 7. Bicycle | 55 | 55 | 45 | 45 |
| 8. Motorcycle | 0 | 0 | 100 | 100 |
| 9. Television | 0 | 0 | 100 | 100 |
| 10. Radio | 57 | 57 | 43 | 43 |
| 11. Radio cassette | 22 | 22 | 78 | 78 |
| 12. Sewing machine | 1 | 1 | 99 | 99 |
| 13. Firewood | 78 | 78 | 22 | 22 |

Questionnaire Forms

(For Ecological Region 1, Ecological Region 3 and Ecological Region 6)

Interviewer:

Date:

Location: () () ()

Location:
ER 1 ER 3 ER 6

Observe house: Wall: () mud () Block/brick () Timber

Roof: () Thatched () CI sheet
() Others (specify)

Respondent name (optional)
Occupation

Gender () () () () Age: () () ()
 () () M () F 0-17 18-25 26-35 Over 35

Position in the family () () ()
 Parent Child Other (specify)

Size of household

| Age | Male | Female |
|---------|------|--------|
| 0 - 17 | | |
| 18 - 40 | 1 | |
| Over 40 | 1 | |

A. Population Changes (For ER. 1 only)

1. When did you start living here?

() Before 1987 () In 1987 () After 1987

() Illegal tapping () Non-compliance to the distribution arrangement

() Others (specify)

2. Is the water flowing in the channel enough?

() Yes () No

3. Are there any conflicts with your paddy plot (boda) neighbours?

() Yes () No

If yes, what are they?

() Water use () Solid waste disposal

() Others (specify)

What do you think is the solution?

4. Do you own the paddy plot (boda) permanently?

() yes () No

If no, who is the owner?

() Communal farm () School () Individuals farm

() Others (specify)

5. Are there any conflict about the paddy plots (boda) ownership?

Yes No

If yes, what is the reason?

Land tenure (originally private now public or vice versa)

Allocation

Others (specify)

2. Where did you live before?

In the project area Outside the project area

3. What prompted you to come here?

Employment Relocated Others (specify)

4. Do you have plans to return to your original place?

Yes No

5. In your own views, what is the trend of the population?

Increasing Decreasing

What do you think is the reason for this?

Natural growth Immigration Emigration

6. What has been the effect of the change in population?

B. Conflicts Among Communities and People (For ER 1 And ER 3)

1. Do you have a paddy plot (Boda)?

Yes No

If yes, is there any arrangement for water distribution in paddy plot (bodas)

Yes No

What is the arrangement

Rationing Others (specify)

Is it fair? Yes No

If no, what are the reasons for unfairness?

Involuntary Resettlement (For ER 1 and ER 3)

1. Suppose new paddy plots (bodas) are to be established, some relocation may be needed. Will you be willing to shift to other area

() Yes () No

What are the possible losses you may incur in case of relocation?

JICA