

8.5.3 Countermeasures and Improvement Area

Countermeasures for this program will be implemented as a combination of erosion control and reforestation programs. Proposed countermeasures and net improvement area for the master plan are shown in **Table 8.5-3**.

Table 8.5-3 Countermeasures and Improvement Area

Countermeasure	Land use	Net Improvement Area (ha)			Remarks
		Sutil	Duro	Total	
1. Terrace	Pasture	1,500	500	2,000	50% of AP
	Crops	6,000	2,000	8,000	60% of AC
	sub-total	7,500	2,500	10,000	
2. Road and drainage	Pasture & crops	150 km	50 km	200 km	0.02 km/ha
3. No-tillage	Crops	3,000	1,000	4,000	30% of AC
4. Agronomic practice	Crops	3,000	1,000	4,000	30% of AC
5. Forestation	Pasture & crops	1,500	500	2,000	

Source: JICA Study Team

Note: AP = Actual area of artificial pasture, AC = Actual area of upland crops

8.5.4 Project Cost

The result of cost estimation is shown in **Table 8.5-4**. The total cost would be 2.1 million US\$.

Table 8.5-4 Project Cost

Countermeasures	Amount to be covered	Unit cost	Cost (x 1,000US\$)
Terrace	10,000 ha	40 US\$/ha	400
Road and drainage	200 km	4,000 US\$/km	800
No-tillage	4,000 ha	75 US\$/ha	300
Reforestation	2,000 ha	300 US\$/ha	600
Total			2,100
Annual O/M cost (3% of total cost)			63

Source: JICA Study Team

8.5.5 Effect and Benefit

This project is closely related to the agricultural production concerning stability of production and recovery of the productivity. The following effects and benefits are summarized in **Table 8.5-5**.

Table 8.5-5 Effects and Benefits

Item	With Project	Without Project	Improved value	Effect/Benefit
Terraced arable land (ha)	8,713	713	8,000	1) Sustaining of agricultural productivity
Terraced pasture (ha)	2,000	0	2,000	
Total soil loss (ton/year)	2.7×10^6	4.0×10^6	1.3×10^6	
Erosion in arable land (to/ha/yr)	9.1	144.0	134.9	2) Improvement of water quality
Erosion in pasture (to/ha/yr)	5.4	120.8	115.4	
Nutrient loss of nitrogen (kg/ha/yr)	0	20.0	20.0	3) Reduction of production cost
Nutrient loss of potassium (kg/ha/yr)	0	2.3	2.3	
Reforestation area	8,820	6,820	2,000	

Source: JICA Study Team and Parana Rural Program (SEAB, 1989)

8.6 Camaqua River Basin Integrated Management Plan

8.6.1 Objectives

The Camaqua river, having 430 km of length and 16,843 km² of drainage area, is the biggest river in the study area. The marginal areas, having steep slope, is widely used for agriculture. Therefore, land degradation caused by erosion, floods and contamination of agricultural chemicals are of growing anxiety. Moreover, an effective river management had not been executed and no basic data are available for the basin management plan. To prepare an effective river and basin management plan, the integrated master plan should be required.

8.6.2 Contents

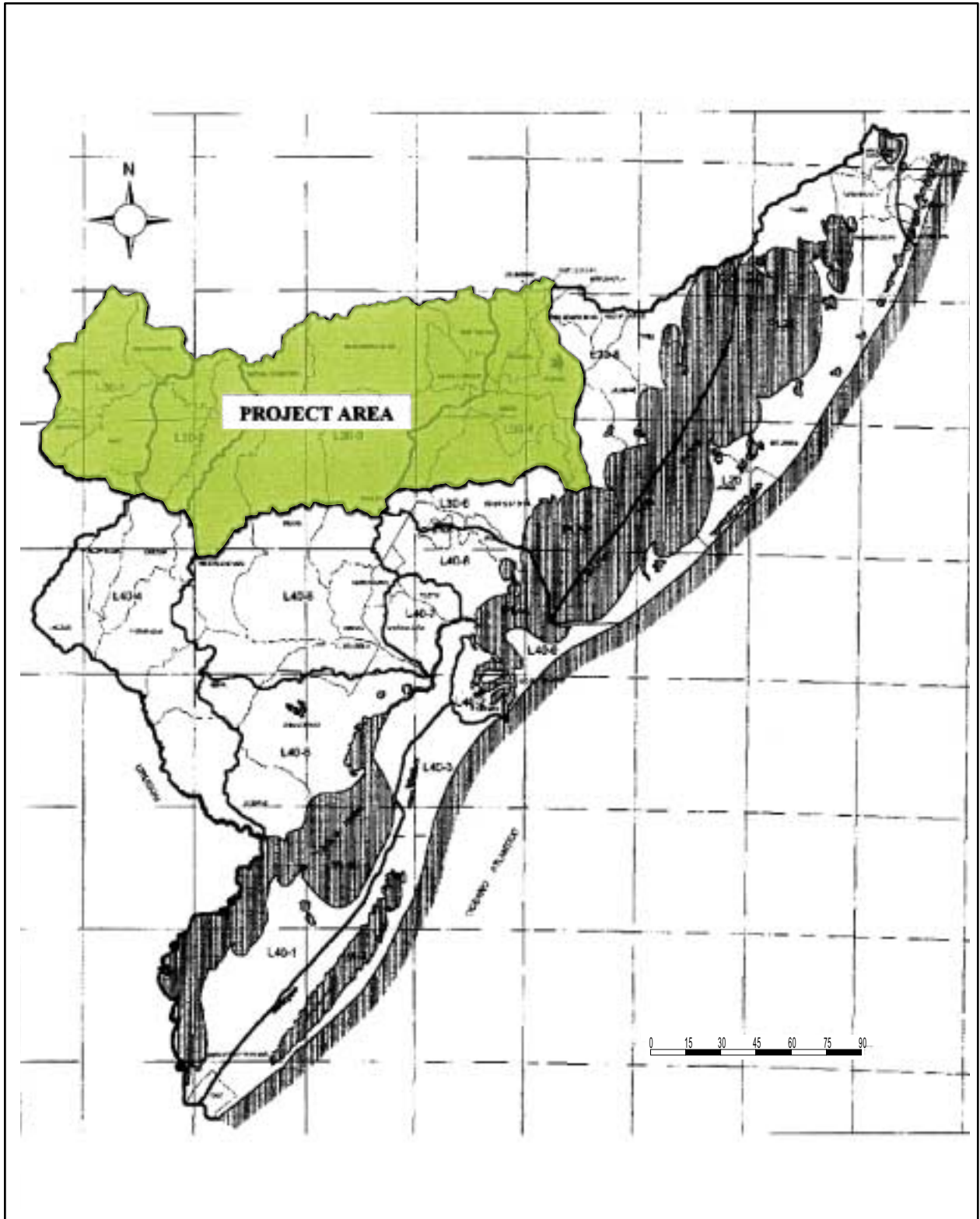
As shown in **Fig.8.6-1**, the study area for this master plan is the whole of drainage area of the Camaqua river. The study contents are as follows.

- 1) Review of national and/or federal plan related to river and basin management;

- 2) Collection and analysis of meteorological and hydrological data;
- 3) Water quality survey;
- 4) Topographic survey (cross and longitudinal) of the Camaqua river from estuary to the junction of Arr. Hilario and Arr. Camaqua Chico;
- 5) Preparation of land use map by remote sensing;
- 6) Study of natural and socio-economical conditions (geology, soil, land use, agriculture, livestock, forest, environment and socio-economy etc.);
- 7) Flood analysis, sand/earth production and transportation survey, flow capacity survey, and flood damage survey;
- 8) Water resources development survey (irrigation, domestic and industrial water supply etc.);
- 9) Preparation of the data base and GIS for above-mentioned data;
- 10) Sabo dam River and erosion control survey;
- 11) Preparation of hazardous map for flood and land degradation;
- 12) Preparation of the master plan for medium and long terms, alternative plan for river and basin management;
- 13) Preparation of emergency works for short term river and basin management;
- 14) Environmental evaluation for emergency works;
- 15) Preparation of execution plan and project evaluation for emergency works;
- 16) Recommendation for institutional strengthening program, and advice on river management and basin conservation for the environmental conservation.

8.6.3 Execution Method

The study must be realized by a international organization or other developed country in close cooperation with counterparts of the concerned Brazilian organizations. The study team member must be constituted by (1) team leader, (2) river engineer, (3) erosion control expert, (4) hydrologist, (5) geologist (6) soil and land use expert, (7) agronomist, (8) livestock expert, (9) forestry expert, (10) topographic survey supervisor, (11) environmental specialist, (12) institutional expert, and (13) socio-economist. The study period will be 24 months.



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KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL

Fig. 8.6-1

**Project Area for
the Camaqua River
Basin Integrated
Management Plan**