- The project will increase crop yield and farm income.
- The project will create better living condition.
- The project will increase the prices of vegetables.
- The project will reduce women's work load.

In consideration of these, the Project should be formulated in order to promote the women's participation in economic activities, together with providing packages particularly for women covering marketing, food processing and storage, and institutional development.

5 Conclusion

The development concept and plan proposed in the Interim Report were explained and discussed with the prospective beneficiaries of the Project. Almost all attendants at the public consultation meetings showed good understanding and general acceptance on the presented plan. However, a considerable number of the farmers suggested their opinion for further improvement of the development concept and plans. These opinions were carefully examined to make the development concept more realistic, attractive and acceptable to the prospective beneficiaries.

The major opinions given to the Study Team and the Team's considerations on them are summarized in the following table.

Consideration on Major Opinions of the Beneficiaries

Major Opinions of the Beneficiaries	Considerations of the JICA Study Team
1 Irrigation development	
- Too small service area on irrigation development.	Irrigation area is planned based on water resources assessment. To maximize the irrigation area, water-saving irrigation method is recommended and hence no further expansion is possible.
- Need for training on irrigation practices.	"Upland Horticulture and Irrigation Technology Center" is planned to perform training programs on irrigation and horticultural technologies.
- Irrigation facilities should be constructed in the Public Forest land.	Irrigation is proposed in the area within A&D lands and the existing upland fields alone within the Public Forest lands.
- Right-of-way problem.	Water distribution facility is pipeline installed under ground to minimize right-of-way problem.
2 Improvement of marketing activities	
- Municipalities should support transactions of vegetables at trading posts.	Principal operational works are performed with technical collaboration of the Municipal Agricultural Offices.
- Right-of-way problem for the construction of secondary roads.	Secondary roads and skyline cables are deleted for this reason as well as for nature preservation in the mountain.
3 Agricultural research and training	
- Far from the proposed site of the Center on agricultural research and extension.	The Center is along the Barangay road to be improved, considering accessibility.
- Need to increase the number of extension workers.	Training of agricultural extension workers on the new technologies is one of its major functions.
- Right-of-way for the construction of the Center.	The area of the Center is only 2 ha.
- The Center should emphasize extension services rather than research works.	The main activity of the Center is training and extension but not for research.
4 Soil conservation	
- No perception of necessity on soil conservation.	Upland fields are located at higher and steeper lands where soil erosion is inevitable without countermeasures.
- Farmers want to get materials from the government to adopt measures.	"Soil Conservation Extension Center" is planed to be established and provide tree nursery.
- Location of demonstration farm is important to make them effective.	Demo fields are located close to Barangay road to easily show soil conservation measures and effects.
- The financial support to the demo farms is necessary from governmental agencies.	Nursery for establishment of demo farm is provided as a component of the Project.
5 Rehabilitation of domestic water supply system	
- The Project should not limit to the rehabilitation of the existing system, but include the construction of additional water system.	Water diversion works and conduits are rehabilitated for efficient use of water.
- Concern if they could get water during the rehabilitation works.	Water supply is secured by temporary works during the rehabilitation period.
- Increase in the quantity of water supply is needed.	Water diversion works and conduits are rehabilitated for efficient use of water.

Table VI.2.1 Profile of Barangays and Number of Participants

Municipality	Barangay	Total Household	No. of Farm Household	Attendance to Public Consultation Meeting	No. of Respondent
Nagcarlan					
	Abo	132	124	126	10
	Bukal	112	106	60	10
	Kanluran Lazaan	104	90	120	8
	San Francisco	228	121	94	10
	Silangan Lazaan	195	153	115	6
	Silangan Napapatid	125	56	54	5
	Balimbing	63	32	45	5
	Malinao	150	130	187	8
	Sub-total	1,109	812	801	62
Liliw					
	Ilayang San Roque	59	56		5
	Ilayang Sungi	55	52		5
	Luquin	116	110		11
	Novaliches	193	183		15
	Sun-total	423	401	240	36
Majayjay					
	Bukal	83	45	23	6
	Malinao	81	63	28	6
	Oobi	31	29	13	3
	Pangil	199	48	12	3
	Sub-total	394	185	76	18
Total		1,926	1,398	1,117	116

Source: Public Consultation Survey by the JICA Study Team

Table VI.2.2 Profile of Respondents by Barangay

Municipality/ Barangay	No. of Respondent			Family Size	Land Holding and Tenure (ha)						
	Total	Male	Female		Owned Farm Land				Leased/ Rented	Others	Total
					Titled Land	Free Patent	Home-stead Patent	Sub-total			
Nagcarlan											
Abo	10	10	0	4.1	0.43	0.00	0.41	0.83	0.00	0.00	0.83
Bukal	10	9	1	4.5	0.30	0.00	0.56	0.86	0.00	0.00	0.86
Kanluran Lazaan	8	7	1	4.5	0.13	0.00	0.85	0.98	0.00	0.00	0.98
San Francisco	10	10	0	4.7	1.45	0.00	0.70	2.15	0.33	0.10	2.58
Silangan Lazaan	6	5	1	4.5	0.32	0.00	0.08	0.40	0.08	0.06	0.54
Silangan Napapatid	5	5	0	3.4	0.35	0.00	0.20	0.55	0.10	0.00	0.65
Balimbing	5	5	0	6.2	1.15	0.20	0.00	1.35	0.00	0.00	1.35
Malinao	8	8	0	4.4	0.75	0.00	1.16	1.91	0.06	0.00	1.97
Sub-total/Average	62	59	3	4.7	0.62	0.02	0.55	1.18	0.08	0.02	1.28
Liliw											
Ilayang San Roque	5	4	1	5.2	0.15	0.00	0.00	0.15	0.60	0.10	0.85
Ilayang Sungi	5	5	0	10.0	1.30	0.00	0.40	1.70	0.00	0.20	1.90
Luquin	11	6	5	4.4	0.66	0.05	0.09	0.80	0.14	0.07	1.00
Novaliches	15	11	4	5.4	0.73	0.12	0.07	0.92	0.40	0.07	1.38
Sub-total/Average	36	26	10	5.7	0.71	0.06	0.11	0.88	0.29	0.09	1.26
Majayjay											
Bukal	6	6	0	5.0	1.08	0.17	0.00	1.25	1.83	0.00	3.08
Malinao	6	6	0	6.7	0.58	0.00	0.17	0.75	0.46	0.00	1.21
Oobi	3	3	0	6.3	0.50	0.00	0.17	0.67	0.50	0.00	1.17
Pangil	3	3	0	4.3	1.08	0.00	0.00	1.08	0.33	0.00	1.42
Sub-total/Average	18	18	0	5.7	0.82	0.06	0.08	0.96	0.90	0.00	1.86
Total/Average	116	103	13	5.1	0.17	0.01	0.02	0.19	0.16	0.04	1.37

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.1 Acceptance of the Project by Municipality

Component/Plan	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Irrigation								
Accept	89	77%	46	74%	32	89%	11	61%
More or Less Accept	14	12%	7	11%	2	6%	5	28%
Do not Accept	13	11%	9	15%	2	6%	2	11%
No Answer	0	0%	0	0%	0	0%	0	0%
Improvement of marketing Activities								
Accept	106	91%	55	89%	34	94%	17	94%
More or Less Accept	5	4%	2	3%	2	6%	1	6%
Do not Accept	5	4%	5	8%	0	0%	0	0%
No Answer	0	0%	0	0%	0	0%	0	0%
Agricultural Research and Extension Plan								
Accept	96	83%	53	85%	29	81%	14	78%
More or Less Accept	13	11%	7	11%	3	8%	3	17%
Do not Accept	7	6%	2	3%	4	11%	1	6%
No Answer	0	0%	0	0%	0	0%	0	0%
Soil Conservation Plan								
Accept	103	89%	53	85%	34	94%	16	89%
More or Less Accept	7	6%	4	6%	2	6%	1	6%
Do not Accept	5	4%	4	6%	0	0%	1	6%
No Answer	1	1%	1	2%	0	0%	0	0%
Rehabilitation of Domestic Water Supply								
Accept	98	84%	51	82%	34	94%	13	72%
More or Less Accept	9	8%	5	8%	2	6%	2	11%
Do not Accept	7	6%	6	10%	0	0%	1	6%
No Answer	0	0%	0	0%	0	0%	0	0%

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.2 Farmers' Concerns on Irrigation Development Plan by Municipality

(1) First Three Priorities

Concerns	Overall (N=348)		Nagcarlan (N=186)		Liliw (N=108)		Majayjay (N=54)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Needed for training on irrigation practices	69	20%	40	22%	18	17%	11	20%
Irrigation facilities should be constructed in the Public Forest land	49	14%	31	17%	8	7%	10	19%
Cannot afford to pay amortization fee	48	14%	35	19%	10	9%	3	6%
Right-of-way problem	42	12%	18	10%	20	19%	4	7%
Irrigation facilities should not be constructed in the Public Forest land	23	7%	16	9%	6	6%	1	2%
Irrigators Association is difficult to organize	18	5%	9	5%	6	6%	3	6%
Coverage of irrigation area is too small	16	5%	9	5%	4	4%	3	6%
Others	10	3%	2	1%	7	6%	1	2%
No Answer	73	21%	26	14%	29	27%	18	33%

(2) First Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Needed for training on irrigation practices	13	11%	2	3%	8	22%	3	17%
Irrigation facilities should be constructed in the Public Forest land	23	20%	11	18%	6	17%	6	33%
Cannot afford to pay amortization fee	5	4%	3	5%	0	0%	2	11%
Right-of-way problem	21	18%	16	26%	5	14%	0	0%
Irrigation facilities should not be constructed in the Public Forest land	17	15%	12	19%	5	14%	0	0%
Irrigators Association is difficult to organize	2	2%	1	2%	1	3%	0	0%
Coverage of irrigation area is too small	13	11%	8	13%	2	6%	3	17%
Others	8	7%	2	3%	6	17%	0	0%
No Answer	14	12%	7	11%	3	8%	4	22%

(3) Second Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Needed for training on irrigation practices	37	32%	27	44%	6	17%	4	22%
Irrigation facilities should be constructed in the Public Forest land	19	16%	15	24%	1	3%	3	17%
Cannot afford to pay amortization fee	14	12%	4	6%	9	25%	1	6%
Right-of-way problem	11	9%	2	3%	5	14%	4	22%
Irrigation facilities should not be constructed in the Public Forest land	4	3%	3	5%	0	0%	1	6%
Irrigators Association is difficult to organize	5	4%	1	2%	3	8%	1	6%
Coverage of irrigation area is too small	1	1%	1	2%	0	0%	0	0%
Others	1	1%	0	0%	1	3%	0	0%
No Answer	24	21%	9	15%	11	31%	4	22%

(4) Third Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Needed for training on irrigation practices	19	16%	11	18%	4	11%	4	22%
Irrigation facilities should be constructed in the Public Forest land	7	6%	5	8%	1	3%	1	6%
Cannot afford to pay amortization fee	29	25%	28	45%	1	3%	0	0%
Right-of-way problem	10	9%	0	0%	10	28%	0	0%
Irrigation facilities should not be constructed in the Public Forest land	2	2%	1	2%	1	3%	0	0%
Irrigators Association is difficult to organize	11	9%	7	11%	2	6%	2	11%
Coverage of irrigation area is too small	2	2%	0	0%	2	6%	0	0%
Others	1	1%	0	0%	0	0%	1	6%
No Answer	35	30%	10	16%	15	42%	10	56%

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.3 Farmers' Concerns on Marketing Improvement Plan by Municipality

(1) First Three Priorities

Concerns	Overall (N=348)		Nagcarlan (N=186)		Liliw (N=108)		Majayjay (N=54)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Municipalities should support tansactions of vegetables at trading post	62	18%	43	23%	12	11%	7	13%
Right-of-way problem for the construction of secondary road	56	16%	39	21%	12	11%	5	9%
Others	26	7%	13	7%	9	8%	4	7%
Skyline cables are not necesarry	26	7%	8	4%	18	17%	0	0%
Construction of secondary roads may cause environmental destruction	23	7%	11	6%	9	8%	3	6%
O&M of skyline cables is difficult	19	5%	16	9%	3	3%	0	0%
Sites of trading posts are not appropriate	17	5%	9	5%	1	1%	7	13%
Organizing marketing cooperatives is difficult	16	5%	4	2%	2	2%	10	19%
Secondary roads should not be constructed in Public Forest land	16	5%	5	3%	9	8%	2	4%
Concrete pavement of secondary roads is not necessary	13	4%	5	3%	8	7%	0	0%
Need nore trading posts	11	3%	1	1%	4	4%	6	11%
No Answer	63	18%	32	17%	21	19%	10	19%

(2) First Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Municipalities should support tansactions of vegetables at trading post	11	9%	4	6%	3	8%	4	22%
Right-of-way problem for the construction of secondary road	37	32%	29	47%	7	19%	1	6%
Others	24	21%	12	19%	9	25%	3	17%
Construction of secondary roads may cause environmental destruction	6	5%	2	3%	3	8%	1	6%
Skyline cables are not necesarry	3	3%	2	3%	1	3%	0	0%
O&M of skyline cables is difficult	0	0%	0	0%	0	0%	0	0%
Sites of trading posts are not appropriate	3	3%	1	2%	0	0%	2	11%
Organizing marketing cooperatives is difficult	3	3%	2	3%	0	0%	1	6%
Secondary roads should not be constructed in Public Forest land	8	7%	3	5%	5	14%	0	0%
Concrete pavement of secondary roads is not necessary	7	6%	1	2%	6	17%	0	0%
Need nore trading posts	5	4%	0	0%	1	3%	4	22%
No Answer	9	8%	6	10%	1	3%	2	11%

(3) Second Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Municipalities should support tansactions of vegetables at trading post	35	30%	27	44%	6	17%	2	11%
Right-of-way problem for the construction of secondary road	15	13%	9	15%	3	8%	3	17%
Others	2	2%	1	2%	0	0%	1	6%
Skyline cables are not necesarry	10	9%	1	2%	9	25%	0	0%
Construction of secondary roads may cause environmental destruction	11	9%	7	11%	3	8%	1	6%
O&M of skyline cables is difficult	2	2%	0	0%	2	6%	0	0%
Sites of trading posts are not appropriate	6	5%	4	6%	0	0%	2	11%
Organizing marketing cooperatives is difficult	8	7%	2	3%	1	3%	5	28%
Secondary roads should not be constructed in Public Forest land	4	3%	2	3%	2	6%	0	0%
Concrete pavement of secondary roads is not necessary	4	3%	2	3%	2	6%	0	0%
Need nore trading posts	3	3%	0	0%	1	3%	2	11%
No Answer	16	14%	7	11%	7	19%	2	11%

(4) Third Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Municipalities should support tansactions of vegetables at trading post	16	14%	12	19%	3	8%	1	6%
Right-of-way problem for the construction of secondary road	4	3%	1	2%	2	6%	1	6%
Others	0	0%	0	0%	0	0%	0	0%
Skyline cables are not necesarry	13	11%	5	8%	8	22%	0	0%
Construction of secondary roads may cause environmental destruction	6	5%	2	3%	3	8%	1	6%
O&M of skyline cables is difficult	17	15%	16	26%	1	3%	0	0%
Sites of trading posts are not appropriate	8	7%	4	6%	1	3%	3	17%
Organizing marketing cooperatives is difficult	5	4%	0	0%	1	3%	4	22%
Secondary roads should not be constructed in Public Forest land	4	3%	0	0%	2	6%	2	11%
Concrete pavement of secondary roads is not necessary	2	2%	2	3%	0	0%	0	0%
Need nore trading posts	3	3%	1	2%	2	6%	0	0%
No Answer	38	33%	19	31%	13	36%	6	33%

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.4 Farmers' Concerns on Agricultural Research and Extension Plan by Municipality

(1) First Three Priorities

Concerns	Overall (N=348)		Nagcarlan (N=186)		Liliw (N=108)		Majayjay (N=54)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Right-of-way problem for the construction of the "Center"	68	20%	44	24%	17	16%	7	13%
Need to increase the number of extension workers	54	16%	30	16%	15	14%	9	17%
The "Center" should emphasize extension services rather than research works	48	14%	18	10%	19	18%	11	20%
Others	31	9%	11	6%	12	11%	8	15%
Proposed location of the "Center" is not appropriate	26	7%	12	6%	8	7%	6	11%
It is not clear if the "Center" provides benefits to farmers	23	7%	12	6%	6	6%	5	9%
Size of the "Center" is not appropriate	17	5%	11	6%	3	3%	3	6%
No Answer	81	23%	48	26%	28	26%	5	9%

(2) First Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Right-of-way problem for the construction of the "Center"	51	44%	40	65%	7	19%	4	22%
Need to increase the number of extension workers	10	9%	3	5%	5	14%	2	11%
The "Center" should emphasize extension services rather than research works	16	14%	4	6%	9	25%	3	17%
Others	18	16%	6	10%	6	17%	6	33%
Proposed location of the "Center" is not appropriate	4	3%	1	2%	2	6%	1	6%
It is not clear if the "Center" provides benefits to farmers	2	2%	0	0%	1	3%	1	6%
Size of the "Center" is not appropriate	4	3%	2	3%	1	3%	1	6%
No Answer	11	9%	6	10%	5	14%	0	0%

(3) Second Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Right-of-way problem for the construction of the "Center"	9	8%	3	5%	4	11%	2	11%
Need to increase the number of extension workers	31	27%	21	34%	5	14%	5	28%
The "Center" should emphasize extension services rather than research works	11	9%	4	6%	5	14%	2	11%
Others	9	8%	3	5%	4	11%	2	11%
Proposed location of the "Center" is not appropriate	19	16%	10	16%	5	14%	4	22%
It is not clear if the "Center" provides benefits to farmers	12	10%	9	15%	2	6%	1	6%
Size of the "Center" is not appropriate	7	6%	5	8%	2	6%	0	0%
No Answer	18	16%	7	11%	9	25%	2	11%

(4) Third Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Right-of-way problem for the construction of the "Center"	8	7%	1	2%	6	17%	1	6%
Need to increase the number of extension workers	13	11%	6	10%	5	14%	2	11%
The "Center" should emphasize extension services rather than research works	21	18%	10	16%	5	14%	6	33%
Others	4	3%	2	3%	2	6%	0	0%
Proposed location of the "Center" is not appropriate	3	3%	1	2%	1	3%	1	6%
It is not clear if the "Center" provides benefits to farmers	9	8%	3	5%	3	8%	3	17%
Size of the "Center" is not appropriate	6	5%	4	6%	0	0%	2	11%
No Answer	52	45%	35	56%	14	39%	3	17%

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.5 Farmers' Concerns on Soil Concervation Plan by Municipality

(1) First Three Priorities

Concerns	Overall (N=348)		Nagcarlan (N=186)		Liliw (N=108)		Majayjay (N=54)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Farmers want to get materials from the government to adopt measures	85	24%	47	25%	24	22%	14	26%
Location of demonstration farm is important to make them effective	82	24%	50	27%	23	21%	9	17%
The financial support to the demo farms is necessary from governmental agencies	70	20%	45	24%	16	15%	9	17%
Others	30	9%	8	4%	10	9%	12	22%
Need credits to adopt soil erosion control measures	24	7%	14	8%	8	7%	2	4%
No Answer	30	9%	14	8%	11	10%	5	9%

(2) First Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Farmers want to get materials from the government to adopt measures	12	10%	2	3%	8	22%	2	11%
Location of demonstration farm is important to make them effective	65	56%	42	68%	17	47%	6	33%
The financial support to the demo farms is necessary from governmental agencies	15	13%	10	16%	1	3%	4	22%
Others	13	11%	1	2%	8	22%	4	22%
Need credits to adopt soil erosion control measures	0	0%	0	0%	0	0%	0	0%
No Answer	11	9%	7	11%	2	6%	2	11%

(3) Second Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Farmers want to get materials from the government to adopt measures	24	21%	11	18%	9	25%	4	22%
Location of demonstration farm is important to make them effective	10	9%	6	10%	3	8%	1	6%
The financial support to the demo farms is necessary from governmental agencies	49	42%	34	55%	10	28%	5	28%
Others	8	7%	3	5%	0	0%	5	28%
Need credits to adopt soil erosion control measures	6	5%	1	2%	5	14%	0	0%
No Answer	19	16%	7	11%	9	25%	3	17%

(4) Third Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Farmers want to get materials from the government to adopt measures	49	42%	34	55%	7	19%	8	44%
Location of demonstration farm is important to make them effective	7	6%	2	3%	3	8%	2	11%
The financial support to the demo farms is necessary from governmental agencies	6	5%	1	2%	5	14%	0	0%
Others	9	8%	4	6%	2	6%	3	17%
Need credits to adopt soil erosion control measures	18	16%	13	21%	3	8%	2	11%
No Answer	27	23%	8	13%	16	44%	3	17%

Source: Public Consultation Survey by the JICA Study Team

Table VI.3.6 Farmers' Concerns on Rehabilitation Plan of Domestic Water Supply System by Municipality

(1) First Three Priorities

Concerns	Overall (N=348)		Nagcarlan (N=186)		Liliw (N=108)		Majayjay (N=54)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Increase in the quantity of water sypply	75	22%	45	24%	20	19%	10	19%
The project should not limit to the rehabilitation of the existing system, but include the construction of additional water system	73	21%	37	20%	23	21%	13	24%
Concern if they could get water during the rehabilitation works	62	18%	37	20%	15	14%	10	19%
Others	31	9%	13	7%	11	10%	7	13%
Don't know if the system is constructed separately from the irrigation water supply system	16	5%	10	5%	6	6%	0	0%
No Answer	91	26%	44	24%	33	31%	14	26%

(2) First Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Increase in the quantity of water sypply	40	34%	26	42%	8	22%	6	33%
The project should not limit to the rehabilitation of the existing system, but include the construction of additional water system	26	22%	12	19%	10	28%	4	22%
Concern if they could get water during the rehabilitation works	10	9%	2	3%	7	19%	1	6%
Others	26	22%	12	19%	8	22%	6	33%
Don't know if the system is constructed separately from the irrigation water supply system	4	3%	2	3%	2	6%	0	0%
No Answer	10	9%	8	13%	1	3%	1	6%

(3) Second Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Increase in the quantity of water sypply	29	25%	18	29%	10	28%	1	6%
The project should not limit to the rehabilitation of the existing system, but include the construction of additional water system	26	22%	11	18%	11	31%	4	22%
Concern if they could get water during the rehabilitation works	26	22%	16	26%	3	8%	7	39%
Others	3	3%	1	2%	1	3%	1	6%
Don't know if the system is constructed separately from the irrigation water supply system	2	2%	1	2%	1	3%	0	0%
No Answer	30	26%	15	24%	10	28%	5	28%

(4) Third Priority

Concerns	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Increase in the quantity of water sypply	6	5%	1	2%	2	6%	3	17%
The project should not limit to the rehabilitation of the existing system, but include the construction of additional water system	21	18%	14	23%	2	6%	5	28%
Concern if they could get water during the rehabilitation works	26	22%	19	31%	5	14%	2	11%
Others	2	2%	0	0%	2	6%	0	0%
Don't know if the system is constructed separately from the irrigation water supply system	10	9%	7	11%	3	8%	0	0%
No Answer	51	44%	21	34%	22	61%	8	44%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.1 Willingness to Participate in Marketing Cooperatives

	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Willingness to Participate in Marketing Cooperatives								
Yes	106	91%	57	92%	35	97%	14	78%
No	7	6%	3	5%	1	3%	3	17%
No Answer	3	3%	2	3%	0	0%	1	6%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.2 Willingness to Agricultural Research and Extension Plan

	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Willingness to Participate in Training Program								
Yes	97	84%	49	79%	31	86%	17	94%
No	12	10%	7	11%	5	14%	0	0%
No Answer	7	6%	6	10%	0	0%	1	6%
Expectation from the "Center"	(N=539)		(N=212)		(N=223)		(N=104)	
New development of vegetable cultivation technologies suitable to the area	101	19%	50	24%	34	15%	17	16%
Training of beneficiary farmers	95	18%	44	21%	34	15%	17	16%
Introduction of new vegetables to the area	84	16%	36	17%	32	14%	16	15%
Multiplication of better seeds	83	15%	34	16%	34	15%	15	14%
Development and dissemination of post-harvest technologies	74	14%	27	13%	31	14%	16	15%
Development and dossemination of soil erosion control technologies	63	12%	18	8%	30	13%	15	14%
Propagation of irrigation technologies	39	7%	3	1%	28	13%	8	8%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.3 Farmers' Perception of Soil Erosion Control Measures

	Overall (N=116)		Nagcarlan (N=62)		Liliw (N=36)		Majayjay (N=18)	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Perception of Extent of Soil Erosion								
Severe	7	6%	5	8%	2	6%	0	0%
Moderate to a certain extent	33	28%	20	32%	11	31%	2	11%
Light	50	43%	31	50%	9	25%	10	56%
None	24	21%	6	10%	12	33%	6	33%
No Answer	2	2%	0	0%	2	6%	0	0%
Application of Soil Erosion Control Measures (Present)								
Yes	77	66%	42	68%	26	72%	9	50%
No	28	24%	15	24%	6	17%	7	39%
No Answer	11	9%	5	8%	4	11%	2	11%
Applied Soil Erosion Control Measures (Present)								
Hedgerow	40	34%	11	18%	22	61%	7	39%
Dumping along Contour	17	15%	9	15%	7	19%	1	6%
Paddy Dikes	12	10%	10	16%	2	6%	0	0%
Contour Cultivation	5	4%	0	0%	5	14%	0	0%
Planting Cover Crops	1	1%	0	0%	0	0%	1	6%
Perception of Need to Adopt Soil Erosion Control Measures								
Yes	85	73%	50	81%	21	58%	14	78%
No	25	22%	8	13%	13	36%	4	22%
No Answer	6	5%	4	6%	2	6%	0	0%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.4 Duties of Women

	Overall		Nagcarlan		Liliw		Majayjay	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Womwn's Duties	(N=721)		(N=326)		(N=205)		(N=122)	
Cooking for the family	93	27%	47	14%	30	15%	16	13%
Child care	79	23%	42	13%	25	12%	12	10%
Laundry	89	26%	46	14%	29	14%	14	11%
Planting crops	71	20%	35	11%	24	12%	12	10%
Harvesting crops	63	18%	35	11%	16	8%	12	10%
Washing crops before selling	63	18%	30	9%	19	9%	14	11%
Negotiating the price of crops with buyers	60	17%	28	9%	18	9%	14	11%
Cultivating the farm	49	14%	26	8%	14	7%	9	7%
Transporting the crops to trading posts	40	11%	14	4%	16	8%	10	8%
Transporting water for daily use	21	6%	12	4%	5	2%	4	3%
Others	18	5%	7	2%	7	3%	4	3%
Working for govenment agency or company	7	2%	4	1%	2	1%	1	1%
Work Load	(N=105)		(N=57)		(N=32)		(N=16)	
Heavy	52	50%	30	53%	11	34%	11	69%
Not heavy	53	50%	27	47%	21	66%	5	31%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.5 Women's Opinions for the Project

	Overall		Nagcarlan		Liliw		Majayjay	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Acceptance for the proposed project	(N=105)		(N=57)		(N=32)		(N=16)	
Accept	93	89%	48	46%	30	29%	15	14%
Not Accept	6	6%	6	6%	0	0%	0	0%
No Answer	9	9%	6	6%	1	1%	2	2%
Reasons why women like the project	(N=280)		(N=126)		(N=103)		(N=51)	
The project will increse crop yield and farm income	70	25%	34	27%	24	23%	12	24%
The project will create better living condition	68	24%	30	24%	26	25%	12	24%
The project will increase the prices of vegetables	66	24%	31	25%	23	22%	12	24%
The project will reduce women's work load	57	20%	24	19%	24	23%	9	18%
Others	19	7%	7	6%	6	6%	6	12%

Source: Public Consultation Survey by the JICA Study Team

Table VI.4.6 Areas for Women's Participation in the Project

	Overall		Nagcarlan		Liliw		Majayjay	
	Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)
Areas for Women's Participation	(N=105)		(N=50)		(N=38)		(N=17)	
Marketing	48	46%	23	46%	17	45%	8	47%
Processing/Storage	31	30%	22	44%	5	13%	4	24%
Crop classification/grading	12	11%	1	2%	11	29%	0	0%
Participation in organization/cooperatives as members or officers	5	5%	0	0%	3	8%	2	12%
Support to economic activities	2	2%	2	4%	0	0%	0	0%
Participate in cooperatives development	2	2%	2	4%	0	0%	0	0%
Training/information dissemination	2	2%	0	0%	2	5%	0	0%
Cooperative marketing	2	2%	0	0%	0	0%	2	12%
Womwn's association activities	1	1%	0	0%	0	0%	1	6%

Source: Public Consultation Survey by the JICA Study Team

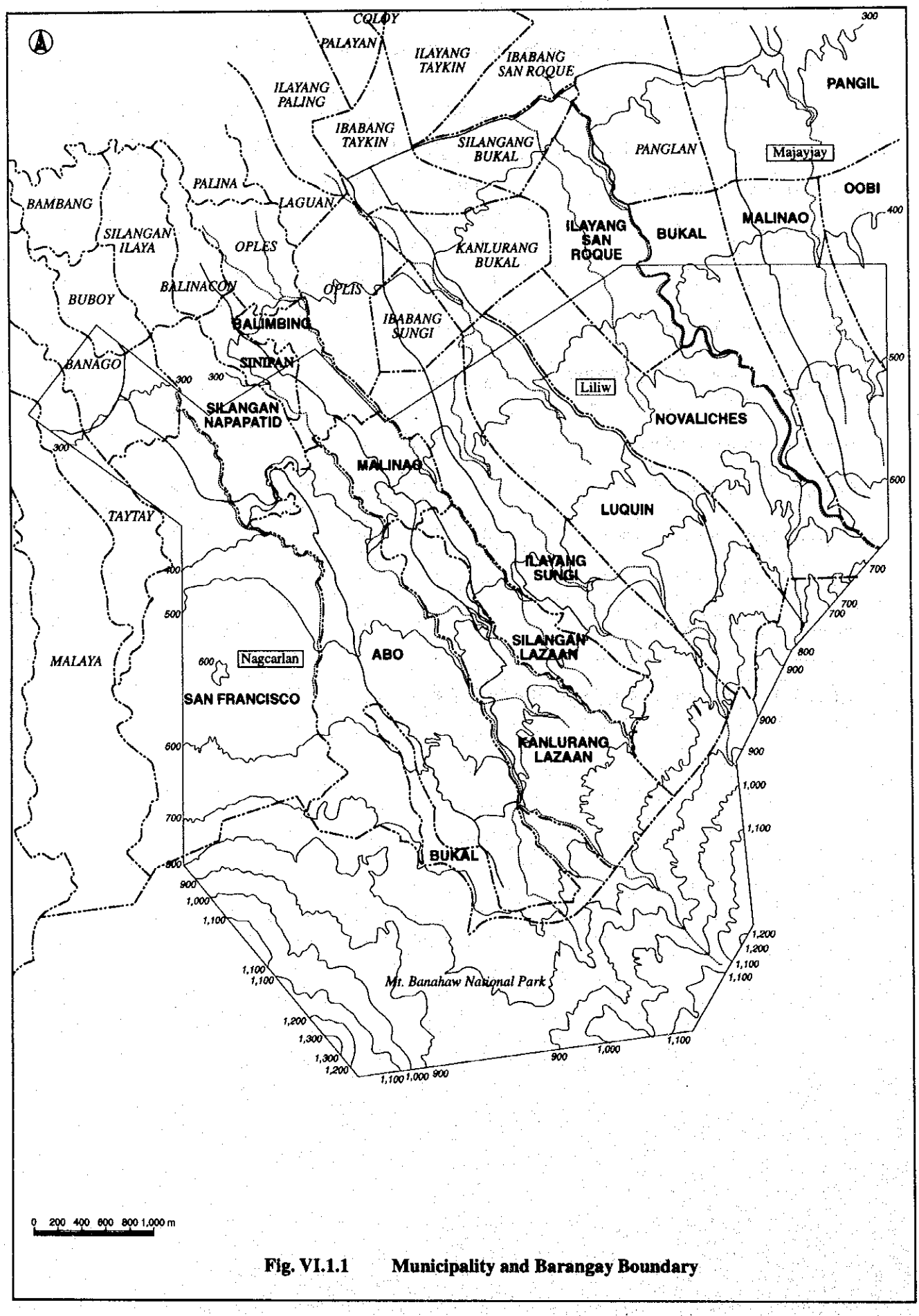

Fig. VI.1.1 Municipality and Barangay Boundary

Attachment VI.1 Questionnaire (for Nagcarlan)

stionnaire (

PUBLIC CONSULTATION SURVEY

FEASIBILITY STUDY
ON
THE UPLAND IRRIGATION AND RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

Date : _____
Enumerator : _____

A. GENERAL INFORMATION

1. Name of Respondent _____
2. Sex ( ) Male ( ) Female
3. Name of Barangay _____
4. Family Size (nos. of family members living in same house) _____persons
5. Land holding and tenure
   a. Own farm land _____ ha
      Status: Titled land _____ ha
      Free patent _____ ha
      Homestead patent _____ ha
   b. Farm land in unreleased public land including the national park _____ ha
   c. Leased/Rented farm land _____ ha
   d. Others _____ ha
   e. Total (a+b+c+d) _____ ha

B. RESPONDENTS' OPINIONS ON THE PROPOSED PROJECT

To Enumerators:
Followings are the summary description of the preliminary development plans and questions regarding respondents' opinions on the plans. Explain the plans and then get their answer to the questions. Emphasize their answers and opinions are important to finalize the development plans and would not be used in any way that would affect them individually.

B-1. IRRIGATION PLAN

1. Proposed Irrigation Area:	160 ha (about a half of the existing vegetable farms in Nagcarlan municipality)
2. Location:	Approximately at EL.500 m and above (for the both alternatives) Alt-1 includes the area of public forest land. Alt-2 excludes the area of public forest land.
3. Water Source:	Bukal spring at EL.900 m
4. Facilities:	An intake, pipelines, farm ponds and distribution pipes
5. Irrigation methods:	By using hoses and hand-carried watering pots
6. Construction	Carried out under the supervision of NIA
7. Responsibility of O&M:	An Irrigators' Association (IA) to be organized by beneficiaries
8. Other requirement:	Beneficiaries must pay amortization fee to NIA according to the contract between NIA and IA

Questions

1. Do you accept the plan? (tick one)
   ( ) Accept
   ( ) More or less accept
   ( ) Do not accept
2. Do you have any concerns for the plan? You can select at most three (3) with priority
   1st _____
   2nd _____
   3rd _____
   a. Coverage of irrigation area is too small.
   b. Irrigation facilities should not be constructed in the public forest land.
   c. Irrigation facilities should be constructed in the public forest land. Right-of-way problem for the construction of irrigation facilities is difficult to solve.
   e. Training of irrigation practices is needed.

f. Irrigators' Association is difficult to organize.

g. Can not afford to pay the amortization fee, if it is too expensive.

h. Others (please specify) : _____

3. Please write down your opinion(s) and/or desire(s) for the plan. (Do not mind if it is overlapped with the items you selected above.)

_____

B-2. PLAN FOR IMPROVEMENT OF MARKETING ACTIVITIES

1. Road Improvement: Following barangay roads will become concrete-paved roads.

San Francisco - Bukal	6.5 km
Oples - Silangan Lazaan	5.7 km
Malinao - Kanlurang Lazaan	1.2 km
Kanlurang Lazaan - Bukal	2.8 km
Total	16.2 km

2. New road construction: Following new roads will be planned if they are justified from the economic, social and environmental stand points.

	Alt-1	Alt-2
San Francisco	2.0 km	(2.0 km)
Bukal (1)	0.6 km	(0.3 km)
Bukal (2)	0.9 km	(0.4 km)
Bukal (3)	1.0 km	(-)
Kanlurang Lazaan	1.0 km	(1.0 km)
Total	5.5 km	(3.7 km)

The length of the roads in ( ) excludes the portion extended in the public forest land.

3. Skyline cables The construction of skyline cables will be planned where the construction of secondary roads (new roads) are not economically and environmentally viable.

4. Trading posts: The number of trading posts to be constructed along the following barangay roads is as follows:

San Francisco - Bukal	4
Opels - Silangan Lazaan	2
Kanlurang Lazaan - Bukal	2
Total	8

Facilities: Office, weighting, washing, bagging and storage facilities. (100 m^2 per post)

5. Responsibility of O&M:

Roads:	Nagcarlan Municipality
Skyline cables:	Management cooperatives (new)
Trading posts:	Marketing cooperatives (new)

Questions

1. Do you accept the plan? (tick one)
   - ( ) Accept
   - ( ) More or less accept
   - ( ) Do not accept

2. Are you willing to participate in marketing cooperatives to be organized?
   ( ) Yes ( ) No

If No, why?

_____

3. Do you have any concerns for the plan? You can select at most three (3) with priority

1st _____
2nd _____
3rd _____

a. Secondary roads should not be constructed in the public forest land.
b. Right-of-way problem for the construction of secondary roads is difficult to solve.
c. Construction of secondary roads may cause environmental destruction.
d. Concrete pavement of secondary roads is not necessary.
e. Skyline cables are not necessary.
g. Sites of trading posts are not appropriate.
h. Need more trading posts.
i. Municipalities should support the transaction of vegetables at trading posts.
j. O&M of skyline cable is difficult.
k. Organizing marketing cooperatives is difficult.
l. Others (please specify) : _____

4. Please write down your opinion(s) and/or desire(s) for the plan. (Do not mind if it is overlapped with the items you selected above.)

_____

B-3. AGRICULTURAL RESEARCH AND EXTENSION PLAN

1. Facility:	"Upland Horticulture and Irrigation Technology Center" (1.0 ha in total) - Experimental and demonstration farm - A green house - Irrigation facilities - A Meteorological station - Center building (including laboratory and rooms for accommodation, lecture and office) - A warehouse
2. Location:	To be established near the existing pilot demonstration farm at barangay Bukal
3. Objectives:	- To carried out applied research and/or experiments on vegetable cultivation, - To train agricultural extension workers and beneficiary farmers on new technologies, - To multiply promising vegetable seeds, and - To demonstrate appropriate technologies to farmers.
4. Responsibility of O&M:	Department of Agriculture (Region IV) in close coordination with the Nagcarlan municipality, UPLB and NIA.

Questions

1. Do you accept the plan? (tick one)

( ) Accept
( ) More or less accept
( ) Do not accept

2. Are you willing to participate the training programs to be offered by the Center?

( ) Yes ( ) No

If No, why?

_____

3. Do you have any concerns for the plan? You can select at most three (3) with priority

1st _____
2nd _____
3rd _____

a. Right-of-way problem for the construction of the Center is difficult to solve.
b. It is not clear if the Center provides benefits to farmers.
c. Proposed location of the Center is not appropriate.
d. Size of the Center is not appropriate.
e. The Center should emphasize extension services rather than research works.

f. Need to increase the number of extension workers to enhance the effectiveness of the Center.

g. Others (please specify) : _____

4. What do you expect most from the Center? (tick one)

( ) Training of beneficiary farmers

( ) New development of vegetable cultivation technologies suitable to the area.

( ) Multiplication of better seeds.

( ) Development and dissemination of post-harvest technologies.

( ) Development and dissemination of soil erosion control technologies.

( ) Propagation of irrigation technologies.

( ) Introduction of new vegetables to the area.

B-4. SOIL CONSERVATION PLAN

1. Facilities:	Demonstration farms of soil erosion control measures (more or less five (5) sites with about 1.0 ha each)
2. Location:	To be selected in the Phase-2 study
3. Purposes:	- To conduct field trials of soil erosion control measures - To popularize the measures in the area. - To transfer the measures through learning by showing
4. Conservation measures:	Contour hedgerow, wattling, SALT and contour ditches and drainage canals are selected as promising ones in the area. More than two measures will be demonstrated in a farm.
5. O&M:	To be done by the owners of the farm under the technical assistance of DENR. The farmers will be trained beforehand to manage the farms.

Questions

1. Do you accept the plan? (tick one)
   ( ) Accept
   ( ) More or less accept
   ( ) Do not accept
2. What do you think of the extent of soil erosion in your farm? (tick one)
   ( ) Severe
   ( ) Moderate or to a certain extent
   ( ) Light
   ( ) None
3. Do you apply some soil erosion control measures in your farm now? (tick one)
   ( ) Yes ( ) No

   If Yes, briefly describe the measures, please.

   _____
4. Do you think you need to adopt some soil erosion control measures in your farm?

   ( ) Yes ( ) No
5. Do you have any concerns for the plan? You can select at most three (3) with priority

   1st _____
   2nd _____
   3rd _____

   a. Location of demonstration farms is important to make them effective.
   b. The financial support to the demo farms is necessary from the governmental agencies.
   c. Farmers want to get materials from the government to adopt the measures in their farm.

d. I need credits to adopt the soil erosion control measures in my farm.
e. Other-1 (please specify) : _____
f. Other-2 (please specify) : _____

B-5. PLAN FOR REHABILITATING DOMESTIC WATER SUPPLY SYSTEM

To enumerators:
Emphasize this plan is only for the rehabilitation of the existing water supply system and does not involve a new construction and/or extension of the existing system.

1. Works:	Rehabilitation of the existing water supply system (i.e., replacement of water conduits, the construction of water distribution tanks and the installation of flow control valves)
2. Location:	To be determined during the Phase-2 study period.
3. Responsibility of O&M:	BWSAs (Barangay Water Works and Sanitation Associations)

Questions

1. Do you accept the plan? (tick one)
   ( ) Accept
   ( ) More or less
   ( ) Do not accept

2. Do you have any concerns for the plan? You can select at most three (3) with priority
   1st _____
   2nd _____
   3rd _____

   a. Increase in the quantity of water supply is needed.
   b. I have a concern if I get water during the rehabilitation works.
   c. The project should not limit to the rehabilitation of the existing system, but include the construction of additional water supply system.
   d. I don't know if the system is constructed separately from the irrigation water supply system.
   e. Other-1 (please specify) : _____
   f. Other-2 (please specify) : _____

3. Please write down your opinion(s) and/or desire(s) for the plan. (Do not mind if it is overlapped with the items you selected above.)

   _____

C. WOMEN'S OPINIONS FOR THE PROJECT

To Enumerators:
Following questions are only for women.

Question

1. Please tick all of your duties mentioned below.

   ( ) Cooking for your family
   ( ) Transporting water for daily use
   ( ) Laundry
   ( ) Child care
   ( ) Planting crops
   ( ) Cultivating farm
   ( ) Harvesting crops
   ( ) Transporting crops to trading posts
   ( ) Washing crops before selling
   ( ) Negotiating the price of crops with buyers
   ( ) Working for a government agency and a company
   ( ) Others (please specify) _____

2. Do you think your work load is heavy? (tick one)

   ( ) Yes ( ) No

3. Do you like the proposed project?

   ( ) Yes ( ) No

   If Yes, why? (tick appropriate ones)

   ( ) The project will increase crop yield and farm income.
   ( ) The project will create better living condition.
   ( ) The project will reduce my work load.
   ( ) The project will increase the prices of vegetables.
   ( ) Others (please specify)

   _____

   If No, why?

   ( ) The project will increase my work load.
   ( ) Others (please specify)

   _____

4. Do you want to participate more in economic activities (i.e., marketing, processing crops, etc.)

   ( ) Yes ( ) No

   If Yes, please specify what you want to do.

   _____

Thank you for your time!

To Enumerators:
Finish interview by thanking the respondents for his/her help and repeat that the project plans will be finalized based on their opinions.

FEASIBILITY STUDY ON
THE UPLAND IRRIGATION AND
RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

APPENDIX-VII

IRRIGATION DEVELOPMENT PLAN

FEASIBILITY STUDY
ON
THE UPLAND IRRIGATION AND RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

APPENDIX-VII

IRRIGATION DEVELOPMENT PLAN

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APPENDIX-VII IRRIGATION DEVELOPMENT PLAN

1 Introduction

The farmers in the Study area have been practicing irrigation using such tools as hand-carried water pot, sprayer and small bucket for the maintenance of the soil moisture around the main root zone of crops at a high level with minimum water application during the period of seeding and planting for the promotion of germination, rooting and growing.

Such irrigation practice seems to be suitable for areas where the water resources potential is low. In agricultural development project, it is common to integrate the development of farmlands and upland irrigation facilities as a comprehensive unit. However, it is a difficult task to obtain water for the Study area because amount of water for the irrigation use is insufficient.

It should be also noted that the availability of groundwater is unreliable in the Study area. Thus, an effective farming system in terms of the use of limited water resources is in important demand. In this regard, the drip irrigation system is expected to be the most reliable water-saving system, and hence recommended as the future on-farm development in the proposed irrigation areas.

The study on the irrigation water requirements is made based on the empirical prediction method using climatological data available in and around the Study area. Such predicted water requirements are cross-checked with the actual field measurements of water consumption which were conducted in the pilot demonstration farm located at Barangay Bukal.

2 Data Collection and Field Experiments

In order to provide necessary data for the formulation of irrigation development plans, the present condition on the following subjects was investigated during Phase 1 and Phase 2 stages together with relevant experts and counterpart personnel despatched from NIA.

(1) Collection of meteorological data and information, including a) Temperature, b) Rainfall, c) Evaporation, d) Humidity, e) Wind velocity, and f) Solar radiation.

(2) Collection of river runoff data and further measurements of discharge of the major rivers in the Study area.

(3) Checking of topographic conditions of the Study area.

Topographic map scaled 1/4,000 with contour interval of 1 m was checked by topographic survey of irrigation facilities including two intake structure sites in the Nagcarlan and Liliw rivers, several reservoir or impounding sites and farm pond sites.

(4) Checking of soil and land use data.

(5) Investigation of cylinder intake rate.

In Phase 2, measurement of cylinder intake rate was carried out in collaboration with the DCIEP personnel and NIA counterparts at the pilot demonstration farm in Nagcarlan Municipality.

(6) Geotechnical investigation.

Geotechnical investigation was conducted to obtain basic data for the irrigation facility plan including a) bearing capacity of the foundation of the farm ponds, and b) permeability of soil to estimate seepage of water in reservoirs and/or impounding sites.

(7) Soil moisture investigation by using tensiometer method

Measurement of evapotranspiration in the tomato field was performed by courtesy of DCIEP at the demonstration farm in Nagcarlan Municipality from April 13 to June 14, 1994.

3 Water Requirements

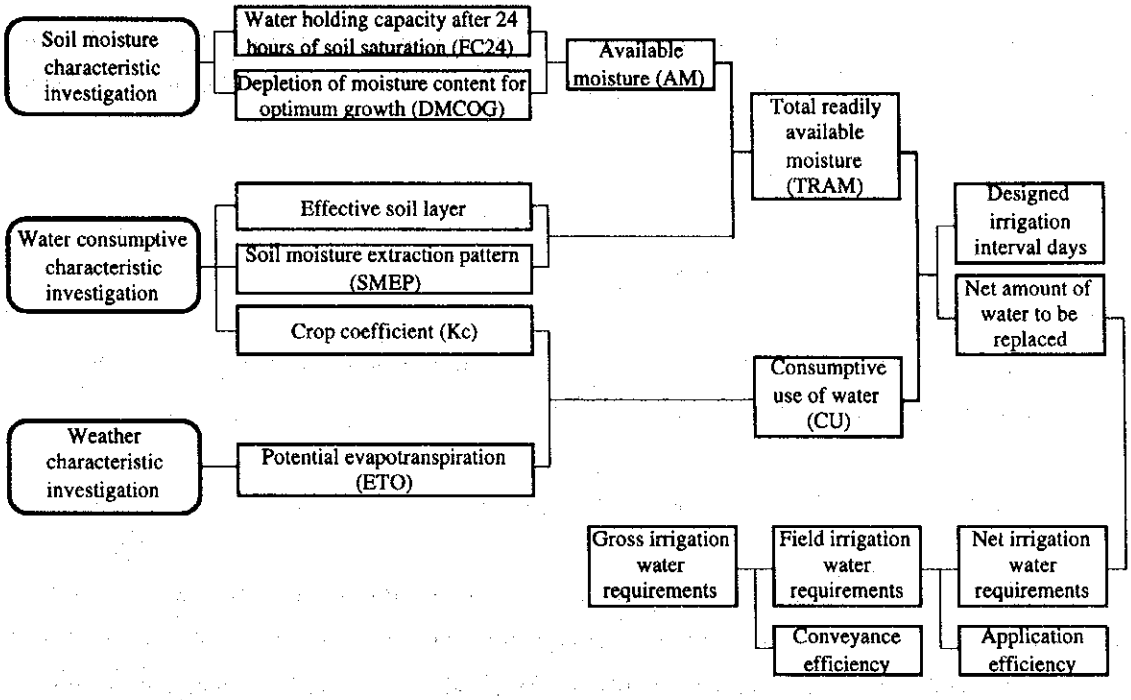
3.1 Criteria for Water Requirements

Water requirements are decided with reference to the ***Irrigation Engineering Manual for Diversified Cropping*** prepared in 1991 by the Diversified Crops Irrigation Engineering Project (DCIEP), which has been undertaken by NIA with the support of JICA through technical cooperation and grant-aid programs. Investigation on basic data for upland irrigation was conducted by courtesy of DCIEP at the pilot demonstration farm in Barangay Bukal , Nagcarlan and the results are used for estimating water requirements.

3.2 Procedure for Calculation of Water Requirements

The calculation of water requirements shall be proceeded by the determination of total readily available moisture (TRAM), daily consumptive use of water (CU), irrigation intervals and net amount of water to be replaced, and these items are important values in establishing the irrigation plan.

The procedure in estimating water requirement for upland irrigation is shown below:



Procedure of water requirement calculation

3.3 Decision of Total Readily Available Moisture (TRAM)

3.3.1 Soil moisture characteristics

The critical soil moisture characteristics on upland irrigation plan are water holding capacity after 24 hours (FC24) and depletion of moisture content for optimum growth (DMCOG). Both of them are analyzed directly from the soil sampled at the investigation sites in Barangay Bukal.

(1) Water holding capacity after 24 hours (FC24)

The upper limit of available moisture is the water holding capacity when 24 hours passed after a sufficient rainfall or irrigation. Water holding capacity after 24 hours is defined to be the moisture amount corresponding with pF 1.5 according to the DCIEP Manual.

(2) Depletion of moisture content for optimum growth (DMCOG)

The moisture amount of the point which obstructs normal crop growth is called the depletion of moisture content for optimum growth, and it is corresponding with more or less pF 3.0.

(3) Available moisture (AM)

Available moisture is the moisture content which is used effectively for normal crop growth, the range of which is defined between water holding capacity after 24 hours (FC24) and depletion of moisture content for optimum growth (DMCOG).

3.3.2 Water consumptive characteristics

Water consumptive characteristics are represented by effective soil layer, important soil layer for growth, soil moisture extraction pattern, and crop coefficient.

(1) Effective soil layer and important soil layer for growth

Effective soil layer indicates the depth of soil in which moisture is consumed by surface evaporation or moisture absorption and capillary replenishment of crop roots after the water holding of 24 hours is attained. Important soil layer for growth is included in effective soil layer, and dominates moisture consumption. It is the layer with the smallest total readily available moisture to be calculated from available moisture and soil moisture extraction pattern.

(2) Soil moisture extraction pattern (SMEP)

SMEP represents the ratio of moisture decrease in each layer of the whole effective soil layers. SMEP is regarded to be nearly uniform, and water consumption in four divided root zones is 40, 30, 20, and 10 % respectively, in the descending order from the surface layer.

3.3.3 Total readily available moisture (TRAM)

The total moisture consumed in the effective soil layer when the average moisture in the important soil layer for growth falls from water holding capacity after 24 hours (FC24) to depletion of moisture content for optimum growth (DMCOG) is called total readily available moisture(TRAM).

TRAM is calculated by following equation:

$$TRAM = (FC24 - DMCOG) \times D \times \frac{1}{Cp}$$

where: *TRAM*: Total readily available moisture (mm)

FC24: Water holding capacity after 24 hours (volume ratio %)

DMCOG: Depletion of moisture content for optimum growth (volume ratio %)

D: Thickness of important soil layer (mm)

Cp: SMEP in the important soil layer (%)

Based on the result of soil analyses with the soil sampled at the pilot demonstration farm in Barangay Bukal, TRAM is calculated as follows:

Soil Layer	Depth (mm)	pF 1.5 Water holding capacity after 24hours (%)	pF 3.0 Depletion of moisture for optimum growth (%)	Available moisture (mm)	Soil Moisture extraction pattern (%)	Moisture decrease in each layer (mm)	Important soil layer for growth (mm)
		(i) FC	(ii) DMCOG	(iii) AM	(iv) SMEP	(v)	TRAM
1	0-10	47.93	28.96	18.97	40	47.4	48
2	10-20	45.82	25.64	20.18	30	67.3	
3	20-30	47.98	30.24	17.74	20	88.7	
4	30-40	51.19	30.83	20.36	10	203.6	

Remarks: (iii) = (i) - (ii)
(v) = (iii) ÷ (iv) x 100

3.4 Designed Daily Consumptive Use of Water

3.4.1 Comparative study on decision

Consumptive use of water (CU) is the amount of moisture in the effective soil layer consumable under the conditions where normal growing of crops are expected. It will be decided synthetically through the comparative study among modified Penman method, evapotranspiration ratio method, and soil moisture depletion method.

Potential evapotranspiration is calculated by using available meteorological data of temperature, relative humidity, wind velocity, and sunshine hours as enumerated below:

Temperature:	Demonstration farm (from October 1993 to June 1994) and Los Baños (for 44 years). Data at Los Baños are corrected into those at demo farm based on a coefficient of correlation.
Relative humidity:	Los Baños (for 40 years)
Wind velocity:	Los Baños (for 35 years)
Sunshine hours:	Los Baños (for 35 years) × 80 %. Coefficient of correlation is derived from number of fine and rainy days in the Study area and Los Baños.

Measurement of pan evaporation was conducted using class A-pan at the pilot demonstration farm in Barangay Bukal from October 1993 to June 1994. Pan evaporation represents many meteorological factors relating to evapotranspiration.

It is seen in the table below that there is no notable difference between the pan evaporation actually measured and potential evapotranspiration estimated by modified Penman method. However, since the measurement value of pan evaporation cannot be obtained in cumulative years in the Study area as seen the table below, it is preferable to adopt modified Penman method in estimating potential evapotranspiration.

Pan evaporation and evapotranspiration by Penman method

(Unit: mm/day)

	Year	Month												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Pan evaporation	1993	-	-	-	-	-	-	-	-	-	2.68	3.82	n.a.	-
(Actual measurement)	1994	n.a.	3.33	2.55	3.36	2.85	2.87	-	-	-	-	-	-	-
Evapotranspiration (Penman method)		2.06	2.59	3.26	3.88	3.69	3.04	2.85	2.76	2.69	2.58	2.33	2.02	2.81

Note: n.a. Not available.

Investigation of soil moisture depletion in the upland field (tomato field) was conducted by courtesy of DCIEP using tensiometers at the pilot demonstration farm in Barangay Bukal from April 13 (transplanting) to June 14, 1994 (harvesting). Due to the rains which fell almost everyday, it was not possible to obtain accurate data throughout the entire growing period. No data were obtained, especially, during the crop development stage and mid-season stage covering April 28 to June 9, 1994 when the maximum consumptive use of water is expected to have been occurred. Out of 62 days of growing period only two days in April and five days in June, when the moisture content became lower than the water-holding capacity. Therefore, it is concluded that modified Penman method is the most reliable one at this study.

3.4.2 Crop coefficient (Kc)

Crop coefficient (Kc) at each growth stage is estimated on the basis of the *Crop water requirements, Paper 24* published by FAO in 1977. Following table shows Kc values of each vegetable proposed in the Study area by four growth stages.

Kc values and growth stage days of each vegetable

Stage	Period	Crop coefficient (Kc)				Each growth stage (days)			
	(days)	1	2	3	4	1	2	3	4
Tomato	105	0.60	0.83	1.05	0.60	25	30	30	20
Celery	90	0.60	0.80	1.00	0.90	15	30	35	10
Cabbage	105	0.60	0.78	0.95	0.80	25	40	25	15
	90	0.60	0.78	0.95	0.80	20	35	25	10
Cauliflower	105	0.60	0.78	0.95	0.80	25	40	25	15
Lettuce	105	0.60	0.78	0.95	0.90	30	40	25	10
Carrot	105	0.60	0.80	1.00	0.70	25	30	35	15
Radish	90	0.60	0.83	1.05	0.90	25	30	25	10
Sito	105	0.60	0.83	1.05	0.30	15	20	40	30
Baguio Beans	105	0.60	0.83	1.05	0.30	15	20	40	30
Chinese Cabbage	120	0.60	0.78	0.95	0.90	35	45	30	10
	105	0.60	0.78	0.95	0.90	30	40	25	10
Sweet Potato	105	0.60	0.83	1.05	0.70	25	30	30	20

Stage1: Initial stage
Stage2: Crop development stage
Stage3: Mid-season stage
Stage4: Late season stage

Proposed cropping pattern is classified into six(6) types as shown in Appendix-IV. Kc values are calculated by averaging the Kc values estimated at five(5) days intervals according to each proposed cropping pattern type (see Table.VII-3.1).

Kc values of each proposed cropping pattern type

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Type1	0.90	1.05	0.62	0.60	0.71	1.02	0.87	0.60	0.70	0.97	0.90	0.60
Type2	0.94	0.98	0.60	0.67	0.88	0.90	-	0.60	0.74	0.93	0.93	0.66
Type3	0.69	0.89	0.94	0.60	0.71	1.02	0.86	0.60	0.71	1.02	0.91	0.60
Type4	0.90	1.05	0.62	0.60	0.71	0.93	0.88	0.60	0.67	0.88	0.90	0.60
Type5	1.04	0.93	0.43	0.61	0.89	1.01	0.60	0.67	0.88	0.90	-	0.69
Type6	0.74	0.93	0.93	0.62	0.84	0.91	-	0.60	0.71	1.02	0.91	0.60

3.4.3 Design daily consumptive use of water (CU)

Daily consumptive use of water (CU) is obtained by multiplying potential evapotranspiration (ETo) by crop coefficient (Kc).

$$CU = Kc \times ETO$$

where: *CU*: Daily consumptive use of water (mm/day)

Kc: Crop coefficient

ETo Potential evapotranspiration (mm/day)

Daily consumptive use of water of each proposed cropping pattern

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ETo	2.06	2.59	3.26	3.88	3.69	3.04	2.85	2.76	2.96	2.58	2.33	2.02
Type1	1.9	2.7	2.0	2.3	2.6	3.1	2.5	1.7	2.1	2.5	2.1	1.2
Type2	1.9	2.5	2.0	2.6	3.2	2.7	-	1.7	2.2	2.4	2.2	1.3
Type3	1.4	2.3	3.1	2.3	2.6	3.1	2.5	1.7	2.1	2.6	2.1	1.2
Type4	1.9	2.7	2.0	2.3	2.6	2.8	2.5	1.7	2.0	2.3	2.1	1.2
Type5	2.1	2.4	1.4	2.4	3.3	3.1	1.7	1.8	2.6	2.3	-	1.4
Type6	1.5	2.4	3.0	2.4	3.1	2.8	-	1.7	2.1	2.6	2.1	1.2

3.5 Design Irrigation Interval Days

This project adopts drip irrigation or irrigation by hand-carried watering pot as irrigation method. It forms a partial wet zone in contrast with sprinkler irrigation. Therefore, TRAM is handled in the plan as depth of water on the assumption of homogenous watering coverage the whole area of the field, and it is called "Assumptive surface-calibrated total TRAM". Assumptive surface-calibrated total TRAM is obtained by multiplying TRAM by the rate of the wetted area.

Assuming that P (the rate of the wetted area) is 0.5, assumptive surface-calibrated total TRAM will be calculated as follows.

$$\textit{Assumptive surface-calibrated total TRAM} = TRAM \times P$$
$$= 48 \times 0.5 = 24 \quad \text{mm}$$

The design irrigation interval is obtained by dividing assumptive surface-calibrated total TRAM by maximum daily consumptive use of water with decimal points discarded.

$$Designed\ irrigation\ interval\ days = \frac{Assumptive\ surface - calibrated\ total\ TRAM\ (mm)}{CUmax\ (mm/day)} \quad (days)$$

$$= \frac{24}{3.3} = 7 \quad (days)$$

3.6 Net Amount of Water to be Replaced

Net amount of water to be replaced is generally obtained by multiplying designed irrigation interval days by daily consumptive use of water for each season.

It is noted that total amount of irrigation water is not sufficient in the Study area. If net amount of water to be replaced can be set at lower level, it will lead to decrease water requirement and increase irrigation area. It is, however, necessary to confirm that the soil moisture is maintained above the depletion of moisture content for optimum growth (DMCOG) under the condition that small net amount of water to be replaced.

Simulation of soil moisture was conducted for three years from 1979 to 1981, of which daily rainfall record is available at Liliw in the Study area, based on the assumption that maximum net amount of water to be replaced is 2.0 mm/day.

Fig.VII.3.1 shows the results of the simulation for each proposed cropping pattern. It proves that soil moisture can be kept mostly above the depletion of moisture content for optimum growth (DMCOG) except for a few days at the end of the dry season in 1979.

As stated above, daily rainfall record available in the Study area is limited to only three years. Thus, it is desirable that soil moisture content is cross-checked by using daily rainfall record for at least ten years. Following records in the vicinity area of the Study area were collected with assistance of National Power Corporation (NAPCOR).

Daily rainfall data near to the Study area

Station	Years	Period (years)	Altitude (m)	Annual rainfall (mm)
Caliraya	1965 - 1983	19	292	3032.6
Sta.Cruz	1956 - 1993	38	0	1820.7
Lumot	1955 - 1984	30	294	2808.2

Correlation between Liliw and three(3) observation stations was examined by the method of least squares using daily rainfall records in 1979. The result indicates that the data of Caliraya have the highest correlation with those of Liliw and its correlation expression was obtained as follows.

$$Y = 0.56125X + 2.20643$$

Where: Y: Daily rainfall at Liliw (mm)

X: Daily rainfall at Caliraya (mm)

In estimating the net irrigation water requirements, the effective rainfall is calculated in such a manner as stated below:

(1) Multiply each record of rainfall (R) by 0.8

$0.80 \times R$ (when $R<5$ mm, $R=0$ mm)

(2) The value of the upper limit of effective rainfall (Ro) can be calculated by subtracting the soil moisture maintained within TRAM immediately after rainfall from TRAM.

Ro = (TRAM - soil moisture maintained within TRAM immediately before rainfall occurs)

(3) Determination of effective rainfall

(a) when $Ro \geq 0.80 \times R$

Effective rainfall = $0.80 \times R$

(b) when $Ro < 0.80 \times R$

Effective rainfall = Ro

Simulation of soil moisture was conducted for ten years of which daily rainfall records are available from 1965 to 1980 at Caliraya, based on the assumption that maximum net amount of water to be replaced is 2.0 mm/day.

Fig.VII.3.2 shows the results of the simulation for the proposed cropping pattern type 3 which is regarded to be the worst case in the aspect of soil moisture content. It proves that soil moisture can be kept mostly above the depletion of moisture content for optimum growth (DMCOG) except two years of 1969 and 1970.

On the other hand, the consumptive use of water at partially wetted fields tends to show slightly lower value than that at completely wetted fields. The difference is mainly attributed to lower evaporation on the soil surface, one of the two components constituting evapotranspiration, transpiration and evaporation.

Furthermore, data measured at Amami district in Japan shows that evapotranspiration at drip irrigation decreases to 84 % of sprinkler irrigation. Adoption of these data contribute to keep the soil moisture higher at the stated simulation.

It follows from what has been studied that 2.0 mm/day is recommended as maximum net amount of water to be replaced. It means that water-saving irrigation will be adopted in the Study area.

4 Cylinder Intake Rate

Measurement of cylinder intake rate was conducted by the Study team with assistance of DCIEP using three cylinders with diameter of 28 cm, 29 cm and 30 cm at the pilot demonstration farm in Barangay Bukal on August 10, 1994. The result of measurement is summarized as follows:

Cylinder intake rate

Diameter of cylinder	28 cm	29 cm	30 cm
Integrated infiltration (mm)	$D = 6.66T^{0.705}$	$D = 9.05T^{0.625}$	$D = 5.41T^{0.714}$
Infiltration speed (mm/hr)	$I = 281T^{-0.295}$	$I = 339T^{-0.375}$	$I = 231T^{-0.286}$
Time to reach the basic infiltration (mm)	T = 177.0	T = 225.0	T = 171.6
Basic intake rate (mm/hr)	$I_b = 61.0$	$I_b = 44.5$	$I_b = 53.0$

As seen in the above, central values of the three cylinders are the measurement done using Dia. 30 cm cylinder. Therefore, the time to reach the basic infiltration is 171.6 minutes, and the basic intake rate is estimated at 53.0 mm/hr.

5 Gravity Irrigation

5.1 Nagcarlan Irrigation System

Bukal spring in the Nagcarlan river is located at El. 890 m, which yields 0.04 cu.m/sec of water in the dry season. By taking water at this elevation, it is possible to irrigate these present upland crop land by means of gravity. Because the amount of spring yield is the limiting factor, benefited area is estimated at 155 ha. Since this water source is used for present rural water supply through existing pipelines, intake works are designed so as to serve both for irrigation and rural water supply.

5.2 Liliw Irrigation System

A spring exists at El. 900 m with yield of 0.003 - 0.005 cu.m/sec in the dry season. All the yields of this spring is taken by the existing intake facility which was constructed by local people. These is no possibility for further development of this water source. Luquin Springs in the Liliw river are located at El. 620 m with yield of 0.07 cu.m/sec and at El. 540 m with yield of 0.23 cu.m/sec. By taking water from these springs, it is possible to irrigate present upland crop lands located lower elevation of 550 m by means of gravity. Since the area of crop lands in the limiting factor, benefited area is estimated at 165 ha.

6 Storage Reservoirs and/or Ponds (Relation between Capacity of Storage Reservoir and Irrigable Area)

A farm pond is planned to cover each irrigation block so as to cope with hourly fluctuation of water demand within a day. Farm pond itself, however, can not serve to increase irrigable area. Since maximum net amount of water to be replaced is not consecutively required throughout the year, it is concluded that capacity of the storage reservoir can be effectively utilized for additional irrigable area.

The relation between the capacity of storage reservoir and irrigable area is examined in this study. Water level of the storage reservoir is simulated within the regulating capacity limits of 5,000 cu.m to 20,000 cum at 5,000 cu.m interval. Irrigable area is decided on trial as maximum value which water level of the storage reservoir is maintained above low water level throughout the year. The simulation is conducted based on the assumptions as follows:

1) Daily rainfall record: 1979, Liliw

2) Water resources

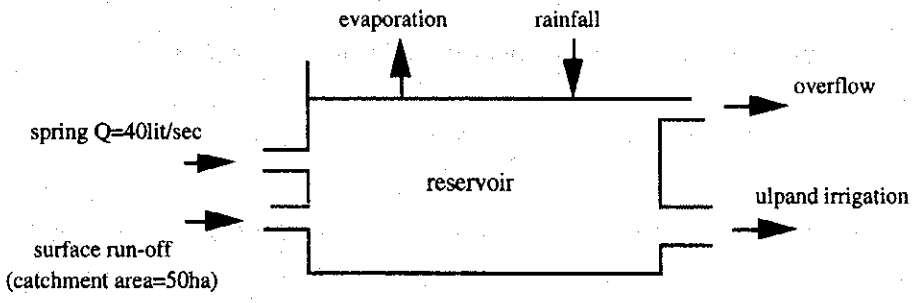
Spring: Yield=40lit/sec

Surface run-off from catchment area:

- Catchment area=50ha
- Run-off coefficiency=60%

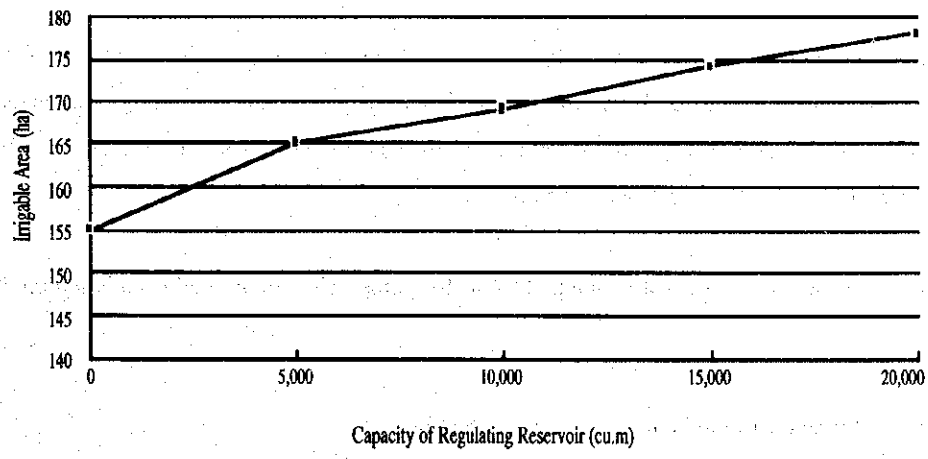
3) Gross irrigation water requirement: Outputs of Soil moisture simulation in 1979

4) Rainfall and evaporation on the surface of reservoir is involved in the simulation.



Concept of water balance on regulating reservoir

Fig.VII.6.4 shows the results of the simulation. Irrigable area corresponding to each storage capacity is illustrated below according to the results. On an average, the capacity of around 870 cu.m is required to increase an irrigable area of one (1) ha.



Relation curve between reservoir capacity and irrigable area

Reservoir capacity-construction cost graph is presented in Fig.VII.6.1. The construction cost of ₱1,000 to obtain one (1) cu.m water is required in the case that the reservoir with 5,000 cu.m capacity is constructed. The excessively high cost is caused by the water proof works using rubber sheet or concrete, and transportation cost of excavated soil materials to the outside of the area considering negative environmental impacts. Standard sections of the respective reservoirs with rubber sheet and concrete wall are shown in Figs.VII.6.2 and VII.6.3, respectively.

The following are construction quantities for storing reservoir:

Principal construction quantity of storing reservoir

Pond capacity	5,000 cum	10,000 cu.m	15,000 cu.m	20,000 cu.m
Rubber sheet reservoir				
Excavated soil	8,000 cu.m	16,000 cu.m	23,000 cu.m	31,000 cu.m
Sheet area	2,600 sq.m	4,400 sq.m	6,000 sq.m	7,600 sq.m
Concrete wall reservoir				
Excavated soil	6,000 cu.m	12,000 cu.m	17,000 cu.m	23,000 cu.m
Concrete	700 cu.m	1,100 cu.m	1,600 cu.m	2,000 cu.m

7 Pump Irrigation

With regard to the irrigation water supply to the farm lands located at highly elevated area in the Barangays Sungi, Luquin and Novaliches in Liliw (see Fig.VII.7.1), economic viability of the lift irrigation using pumps is examined in this section.

Two alternatives, as illustrated in Fig.VII.7.2 and Fig.VII.7.3, are selected to examine the costs of construction and O&M in terms of difference of pump head. In Case 1, all the existing farm lands (145 ha) are irrigable with pump head of 300 m, and in Case 2, existing farm lands (79 ha) located between El. 600 m and El. 700 m are irrigable with pump head of 150 m.

The cost estimation of construction and O&M for pump irrigation is conducted based on the conditions as below:

1) Pump operation hours : 4,563 hrs
This is calculated based on simulation result of gross water requirement (4,228 cu.m/ha) throughout the year in 1979

2) Pump capacity (Qp) : $Qp = 2.78 \times Dm \times A / Ef \times To$ (lit/sec)

$= 0.257 \times A$(lit/sec)$=0.925 \times A$ (cu.m/hr)

A : served area by pump (ha)

Dm : water requirement=2 mm/day

Ef : irrigation efficiency=0.9

To : pump operation hours a day=24 hrs

3) Motor power (P) : $P = 0.163 \times Qp \times H \times (1+R) / pe$ (kW)

Qp: pump capacity (cu.m/min)

H : total head (m)

R : surplus efficiency=0.15

pe : pump efficiency=50 %

4) Specifications of pump unit

Item	unit	Case 1				Case 2	
		Left NO.1	Left NO.2	Right NO.1	Right NO.2	Left NO.1	Right NO.2
Pump capacity	cu.m/min	1.08	0.66	1.16	0.35	0.42	0.80
Pump head	m	100	200	150	100	100	150
Pump diameter	mm	100	80	100	65	65	80
Motor power	kW	45	55	75	15	18	45
Number of pump unit	set	1	1	1	1	1	1

Proposed facilities for pump irrigation are summarized as follows;

		Case 1	Case 2
Pump station		4 stations	2 stations
Conduit pipe	ø150	1,700 m	-
	ø125	1,310 m	800 m
	ø100	930 m	600 m
Farm pond	(360 cu.m)	4 sites	2 sites
Pipeline (on-farm)		(145 ha)	(79 ha)

The costs of construction and annual O&M per hectare are estimated as follows;

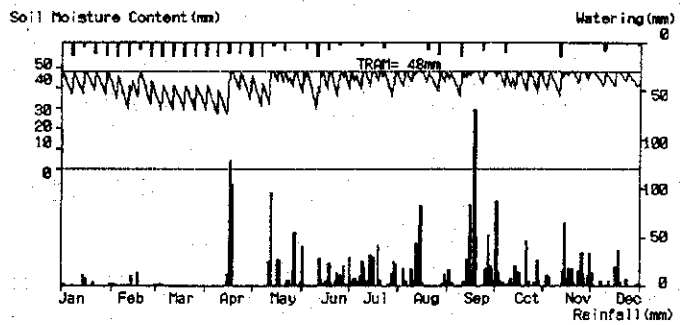
Construction and annual O&M costs

(unit: ₱'000)

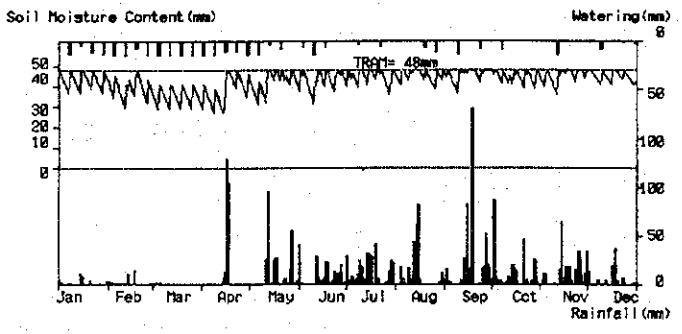
Item		Case 1	Case 2
Construction cost			
Pump station	Left No.1	2,550	1,685
	Left No.2	2,693	-
	Right No.1	3,024	2,475
	Right No.2	1,619	-
Sub-total		9,886	4,160
Conduit pipeline		4,286	1,606
Farm pond		6,080	3,040
On farm facilities		14,790	8,058
Direct construction cost		35,042	16,864
Over head expenses (30%)		10,513	5,059
Construction cost		45,555	21,923
(per hectare)		**314**	**277**
Annual O&M cost			
Fuel(diesel)		3,482	1,163
Salary		218	109
Replacement cost		294	112
Total		3,994	1,384
(per hectare)		**28**	**10**

Table VII.3.1 Kc Value of Each Proposed Cropping Pattern

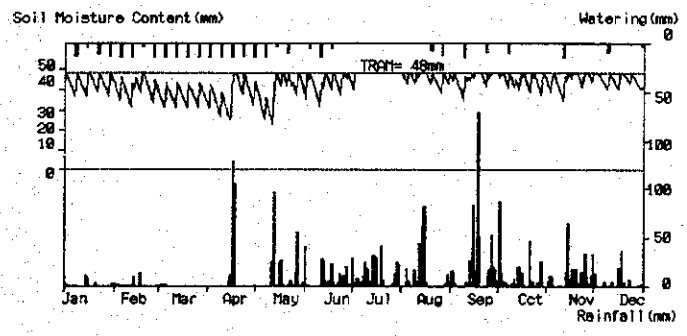
		Type 1				Type 2				Type 3				Type 4				Type 5				Type 6			
		Sito	Tomato	Carrot	Average	Celery	Cabbage	Lettuce	Average	Chincse	Tomato	Potato	Average	Beans	Cabbage	Cauliflower	Average	Sitao	Radish	Cabbage	Average	Chinese	Cabbage	Potato	Average
	1	0.69				0.83				0.60				0.69				0.96				0.64			
	2	0.78				0.89				0.64				0.78				1.05				0.68			
	3	0.87				0.94				0.67				0.87				1.05				0.72			
Jan.	4	0.96				1.00				0.71				0.96				1.05				0.76			
	5	1.05				1.00				0.74				1.05				1.05				0.79			
	6	1.05			**0.90**	1.00			**0.94**	0.78			**0.69**	1.05			**0.90**	1.05			**1.04**	0.83			**0.74**
	1	1.05				1.00				0.81				1.05				1.05				0.87			
	2	1.05				1.00				0.85				1.05				1.05				0.91			
	3	1.05				1.00				0.88				1.05				1.05				0.95			
Feb.	4	1.05				1.00				0.92				1.05				0.93				0.95			
	5	1.05				0.95				0.95				1.05				0.80				0.95			
	6	1.05			**1.05**	0.90			**0.98**	0.95			**0.89**	1.05			**1.05**	0.68			**0.93**	0.95			**0.93**
	1	0.93								0.95				0.93				0.55				0.95			
	2	0.80								0.95				0.80				0.43				0.93			
	3	0.68								0.95				0.68				0.30				0.90			
Mar.	4	0.55					0.60			0.95				0.55											
	5	0.43					0.60			0.93				0.43											
	6	0.30			**0.62**		0.60		**0.60**	0.90			**0.94**	0.30			**0.62**				**0.43**				**0.93**
	1						0.60												0.60				0.60		
	2						0.60												0.60				0.60		
	3						0.64												0.60				0.60		
Apr.	4		0.60				0.68				0.60				0.60				0.60				0.60		
	5		0.60				0.72				0.60				0.60				0.60				0.64		
	6		0.60		**0.60**		0.76		**0.67**		0.60		**0.60**		0.60		**0.60**		0.66		**0.61**		0.69		**0.62**
	1		0.60				0.79				0.60				0.60				0.73				0.73		
	2		0.60				0.83				0.60				0.64				0.79				0.78		
	3		0.66				0.87				0.66				0.69				0.86				0.82		
May	4		0.73				0.91				0.73				0.73				0.92				0.86		
	5		0.79				0.95				0.79				0.78				0.99				0.91		
	6		0.86		**0.71**		0.95		**0.88**		0.86		**0.71**		0.82		**0.71**		1.05		**0.89**		0.95		**0.84**
	1		0.92				0.95				0.92				0.86				1.05				0.95		
	2		0.99				0.95				0.99				0.91				1.05				0.95		
	3		1.05				0.95				1.05				0.95				1.05				0.95		
Jun.	4		1.05				0.90				1.05				0.95				1.05				0.95		
	5		1.05				0.85				1.05				0.95				0.98				0.88		
	6		1.05		**1.02**		0.80		**0.90**		1.05		**1.02**		0.95		**0.93**		0.90		**1.01**		0.80		**0.91**
	1		1.05								1.05				0.95										
	2		1.05								1.05				0.88										
	3		0.94								0.94				0.80										
Jul.	4		0.84								0.83									0.60					
	5		0.71								0.71									0.60					
	6		0.60		**0.87**						0.60		**0.86**				**0.88**			0.60	**0.60**				
	1							0.60												0.60					
	2							0.60												0.60					
	3							0.60												0.64					
Aug.	4			0.60				0.60				0.60				0.60				0.68				0.60	
	5			0.60				0.60				0.60				0.60				0.72				0.60	
	6			0.60	**0.60**			0.60	**0.60**			0.60	**0.60**			0.60	**0.60**			0.76	**0.67**			0.60	**0.60**
	1			0.60				0.64				0.60				0.60				0.79				0.60	
	2			0.60				0.68				0.60				0.60				0.83				0.60	
	3			0.66				0.72				0.66				0.64				0.87				0.66	
Sep.	4			0.71				0.76				0.73				0.68				0.91				0.73	
	5			0.77				0.79				0.79				0.72				0.95				0.79	
	6			0.83	**0.70**			0.83	**0.74**			0.86	**0.71**			0.76	**0.67**			0.95	**0.88**			0.86	**0.71**
	1			0.89				0.87				0.92				0.79				0.95				0.92	
	2			0.94				0.91				0.99				0.83				0.95				0.99	
	3			1.00				0.95				1.05				0.87				0.95				1.05	
Oct.	4			1.00				0.95				1.05				0.91				0.90				1.05	
	5			1.00				0.95				1.05				0.95				0.85				1.05	
	6			1.00	**0.97**			0.95	**0.93**			1.05	**1.02**			0.95	**0.88**			0.80	**0.90**			1.05	**1.02**
	1			1.00				0.95				1.05				0.95								1.05	
	2			1.00				0.93				1.05				0.95								1.05	
	3			1.00				0.90				0.96				0.95								0.96	
Nov.	4			0.90								0.88				0.90								0.88	
	5			0.80								0.79				0.85								0.79	
	6			0.70	**0.90**				**0.93**			0.70	**0.91**			0.80	**0.90**							0.70	**0.91**
	1					0.60				0.60								0.60				0.60			
	2					0.60				0.60								0.60				0.60			
	3					0.60				0.60								0.60				0.60			
Dec.	4	0.60				0.66				0.60				0.60				0.69				0.60			
	5	0.60				0.71				0.60				0.60				0.78				0.60			
	6	0.60			**0.60**	0.77			**0.66**	0.60			**0.60**	0.60			**0.60**	0.87			**0.69**	0.60			**0.60**



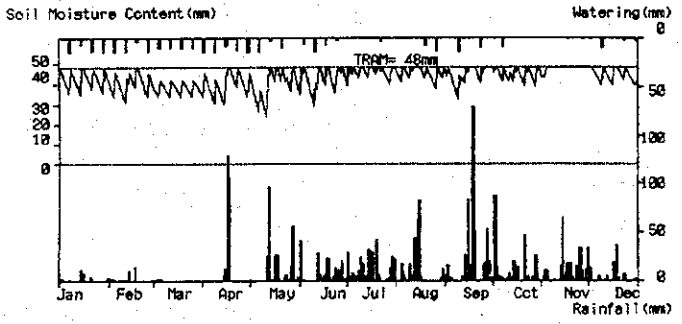
<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 1



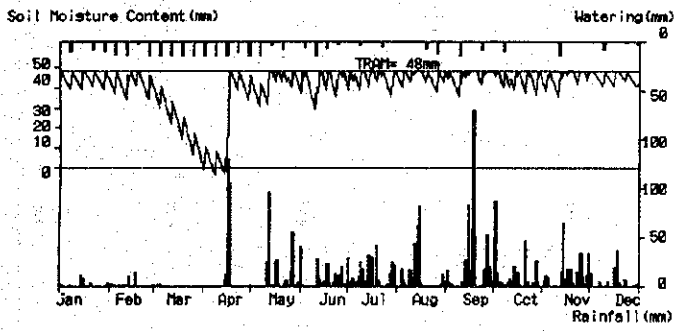
<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 4



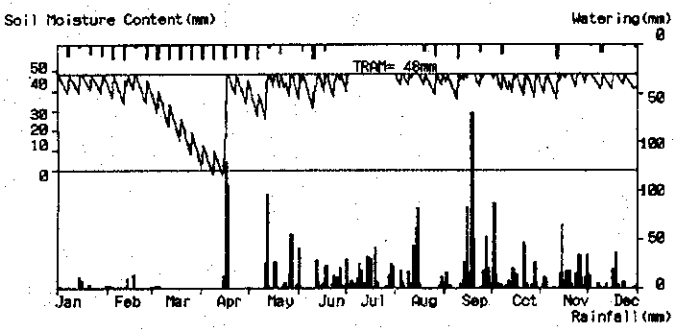
<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 2



<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 5



<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 3



<< Simulation of Soil Moisture >> Liliw 1979
Proposed Cropping Pattern Type : 6

Fig. VII.3.1(1) Soil Moisture Simulation, Liliw, 1979

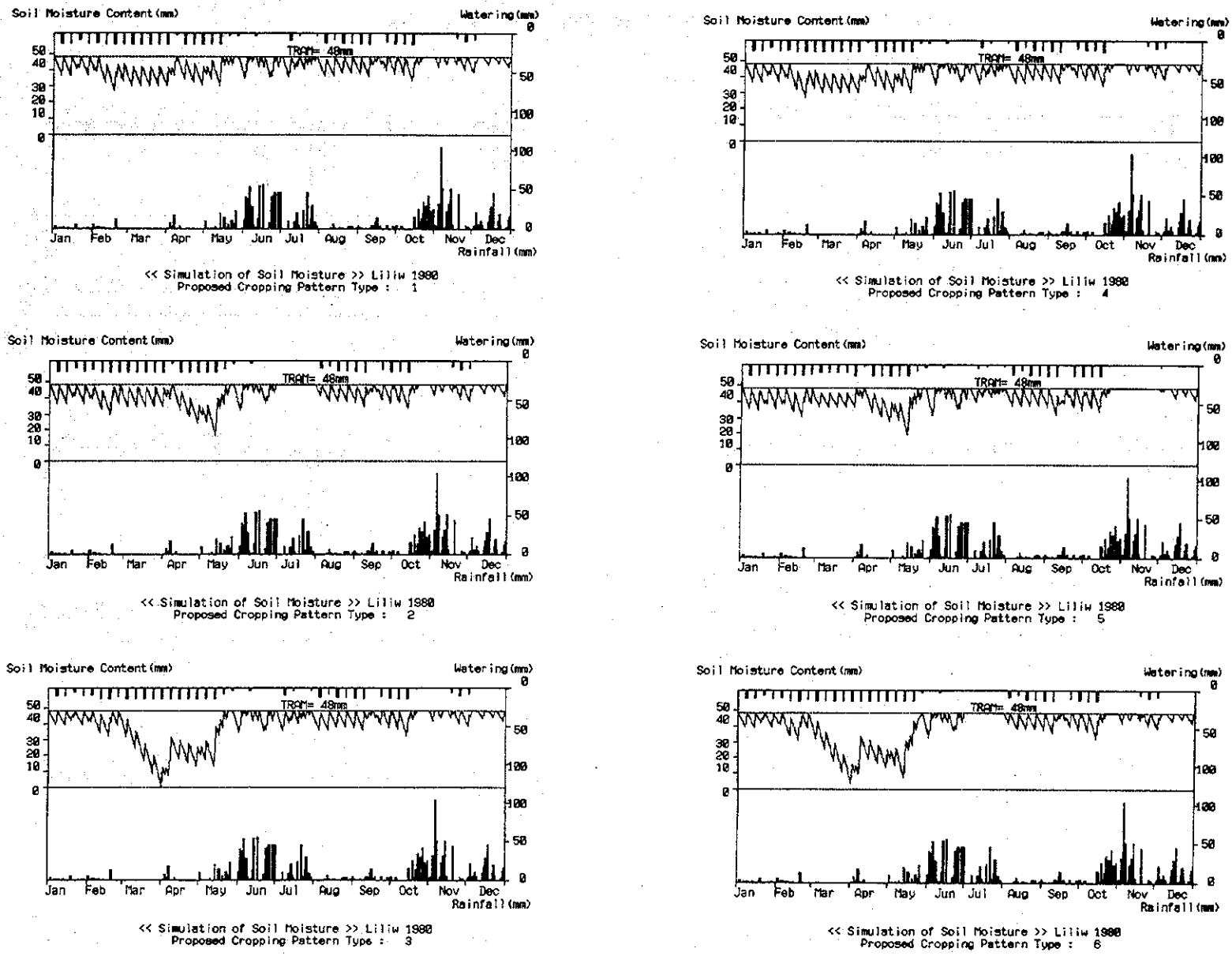


Fig. VII.3.1(2) Soil Moisture Simulation, Liliw, 1980

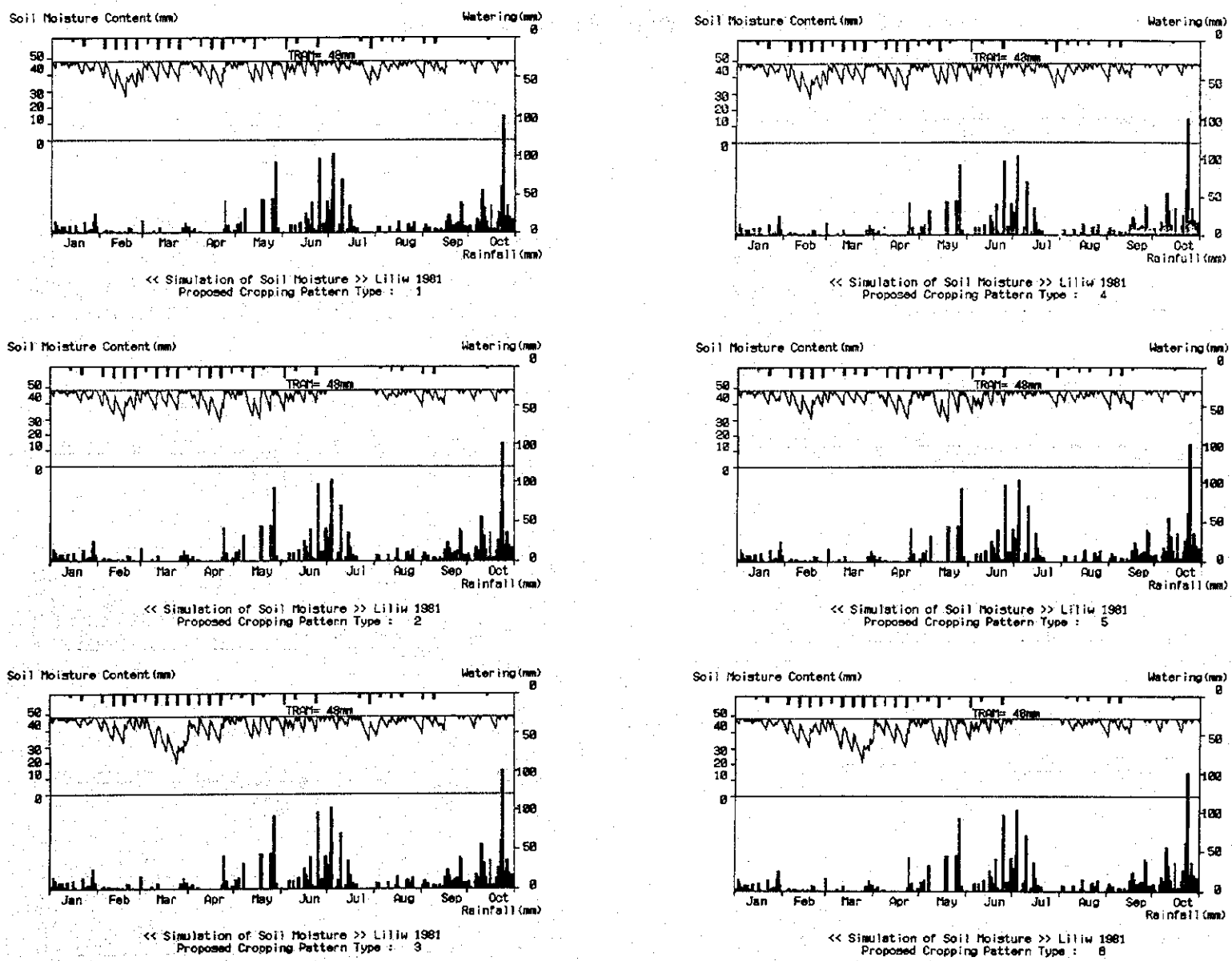
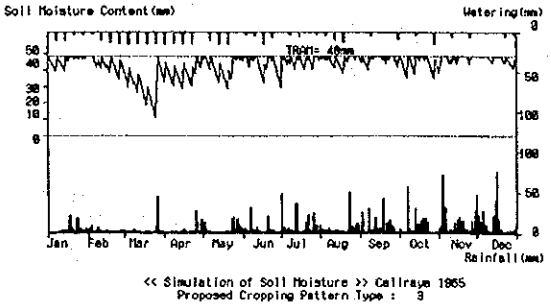
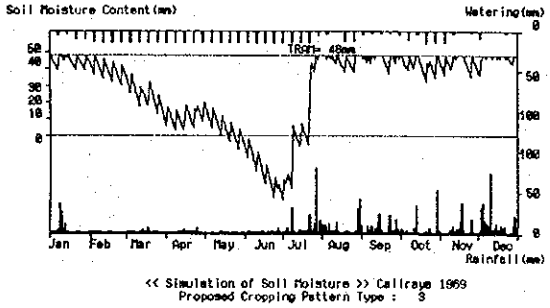


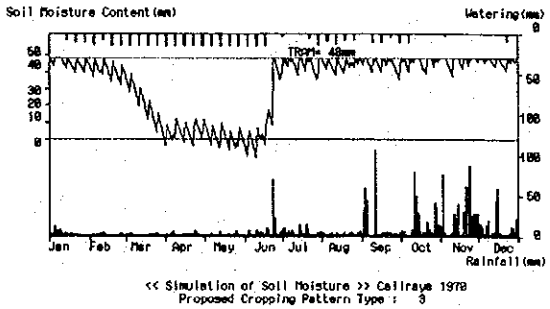
Fig. VII.3.1(3) Soil Moisture Simulation, Liliw, 1981



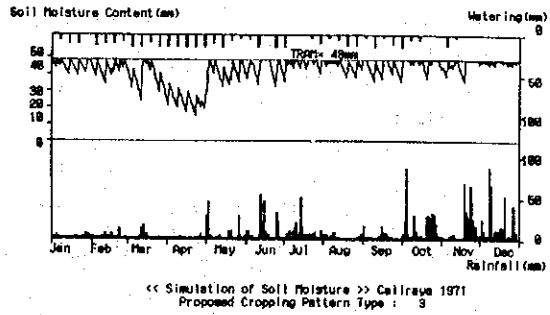
<< Simulation of Soil Moisture >> Caliraya 1965
Proposed Cropping Pattern Type : 3



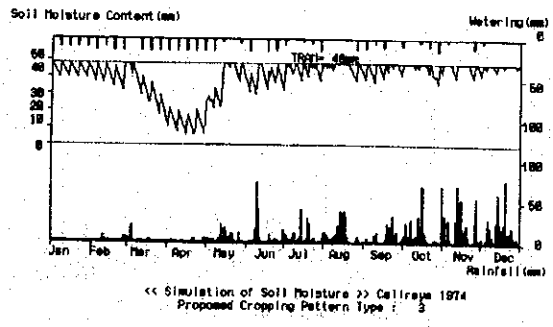
<< Simulation of Soil Moisture >> Caliraya 1969
Proposed Cropping Pattern Type : 3



<< Simulation of Soil Moisture >> Caliraya 1970
Proposed Cropping Pattern Type : 3



<< Simulation of Soil Moisture >> Caliraya 1971
Proposed Cropping Pattern Type : 3



<< Simulation of Soil Moisture >> Caliraya 1974
Proposed Cropping Pattern Type : 3

Fig. VII.3.2(1) Soil Moisture Simulation, Caliraya, 1965-1980

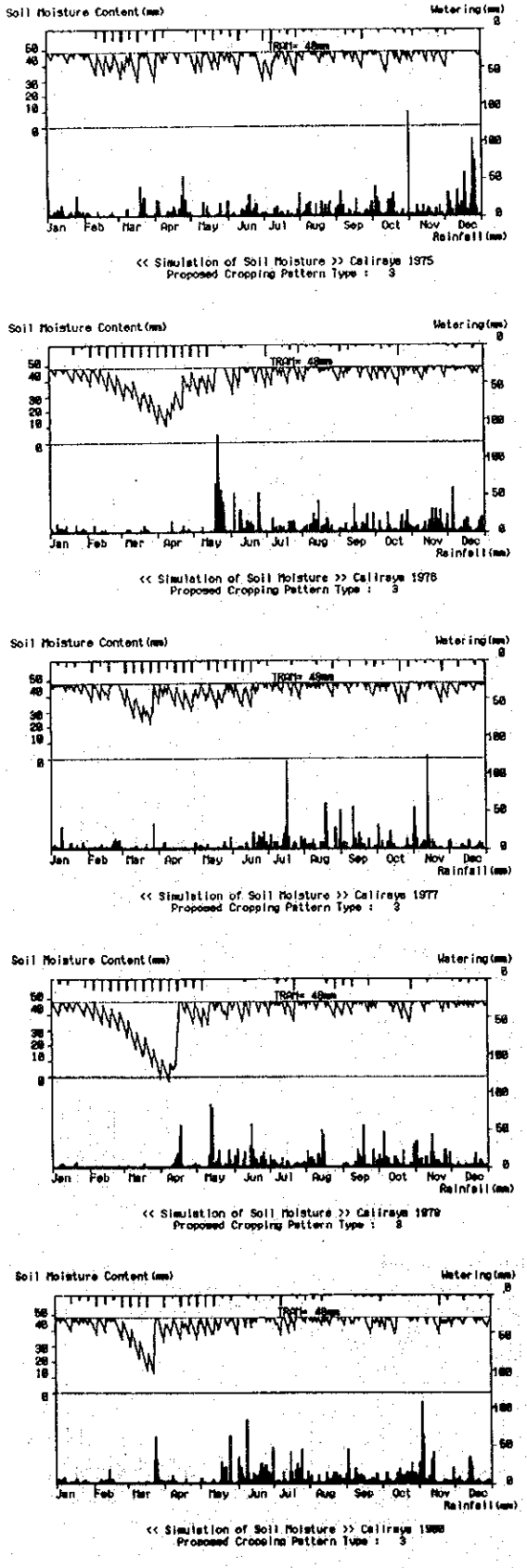


Fig. VII.3.2(2) Soil Moisture Simulation, Caliraya, 1965-1980

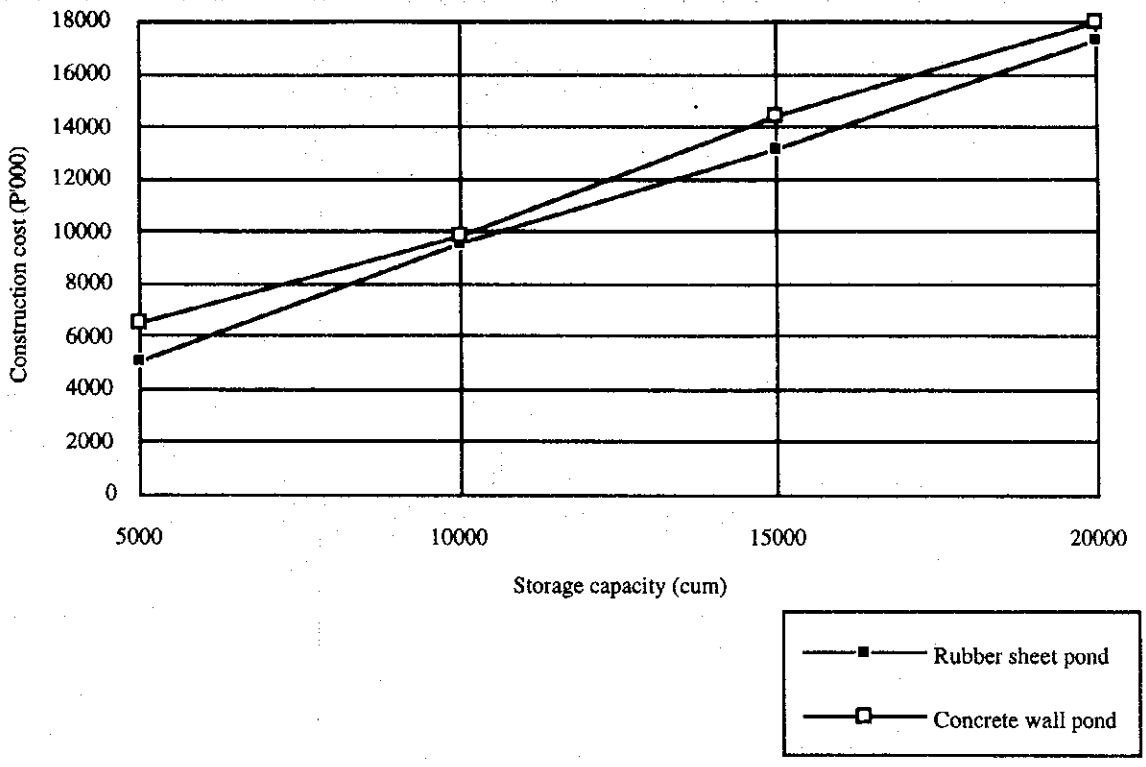


Fig. VII.6.1 Reservoir Capacity - Construction Cost

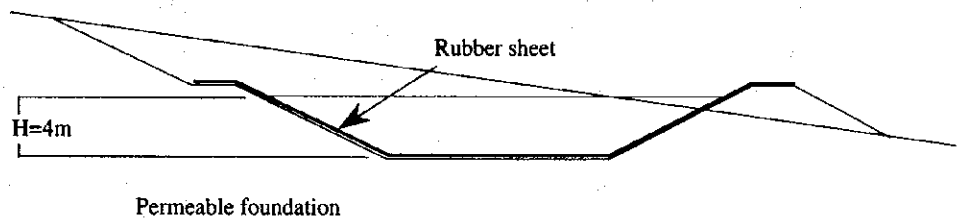


Fig. VII.6.2 Standard Section of Rubber Sheet Reservoir

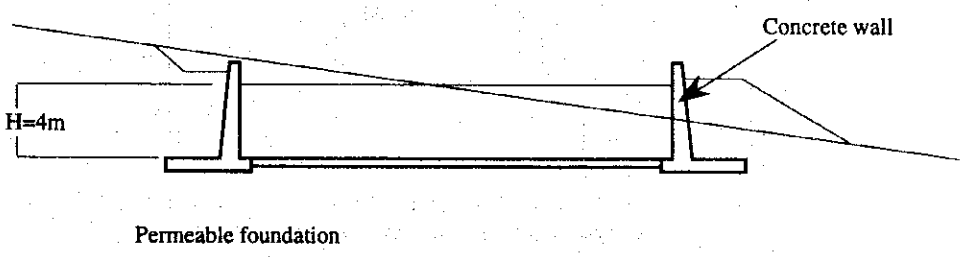


Fig. VII.6.3 Standard Section of Concrete Wall Reservoir

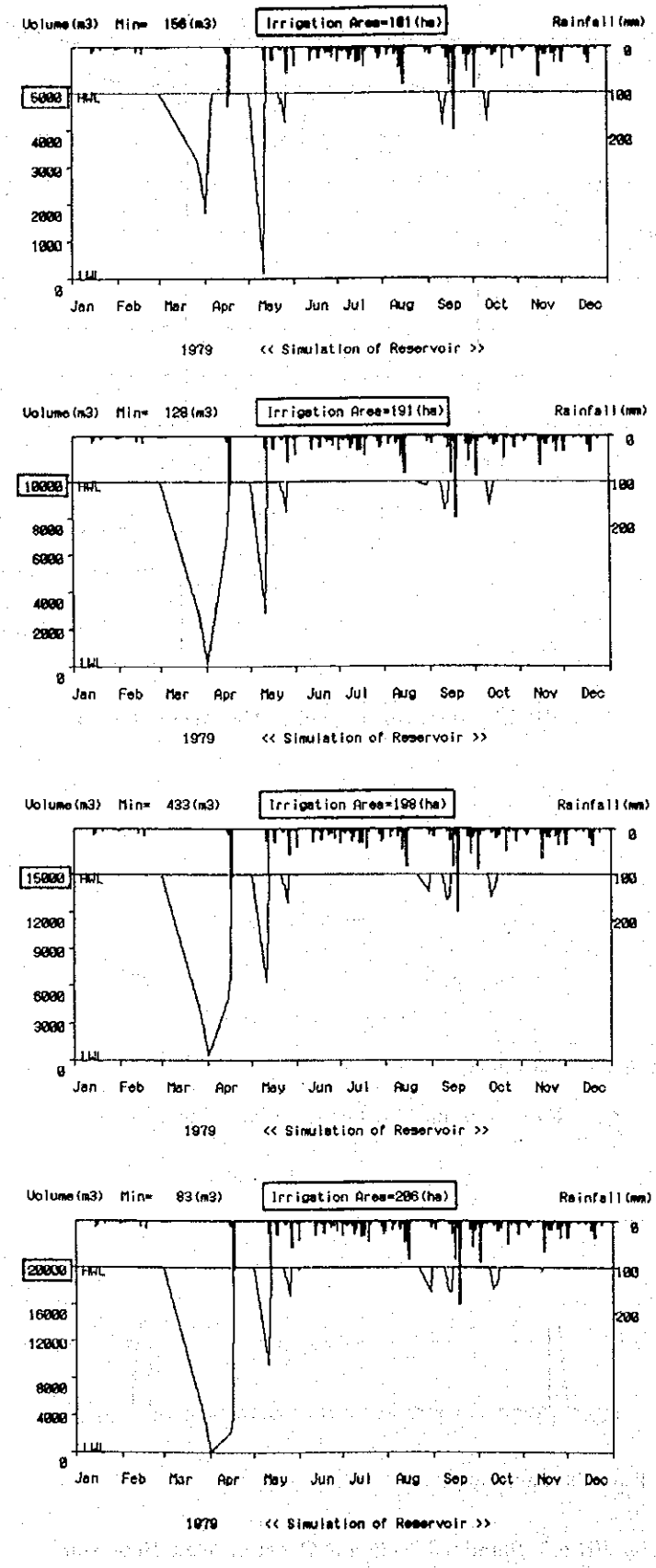


Fig. VII.6.4 Simulation of Storage Reservoir

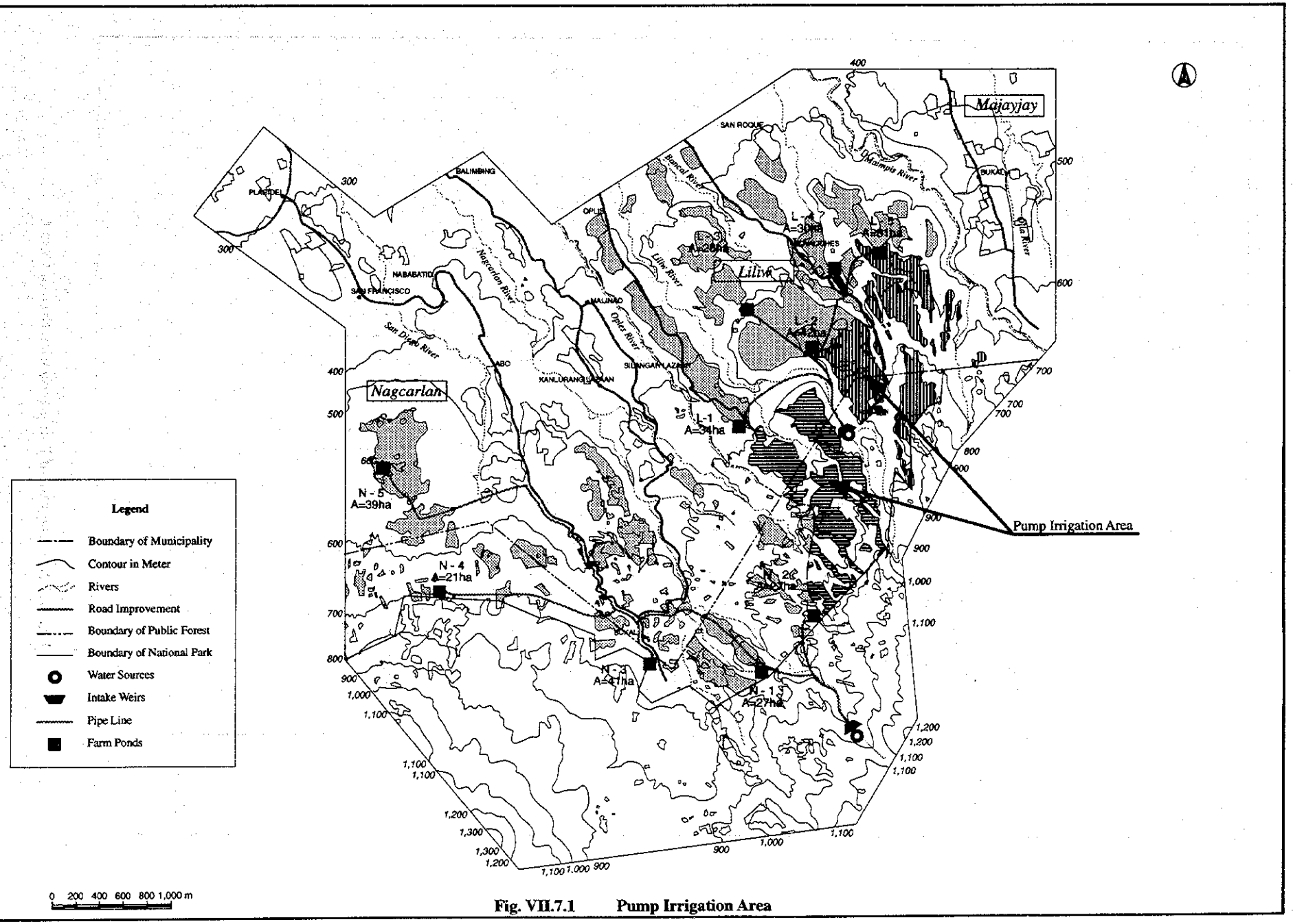


Fig. VII.7.1 Pump Irrigation Area

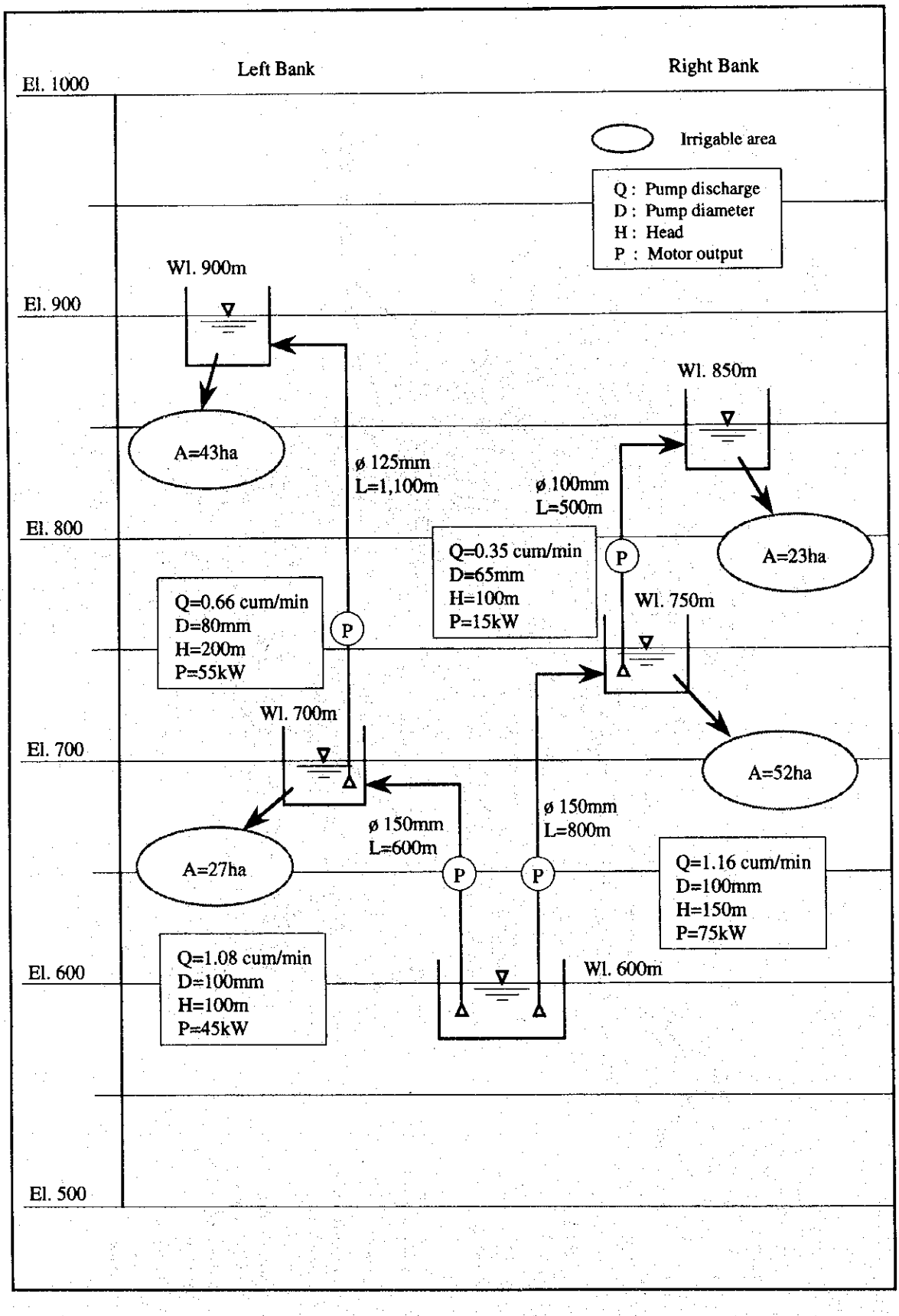


Fig. VII.7.2 Diagram of Pump Irrigation System Case 1

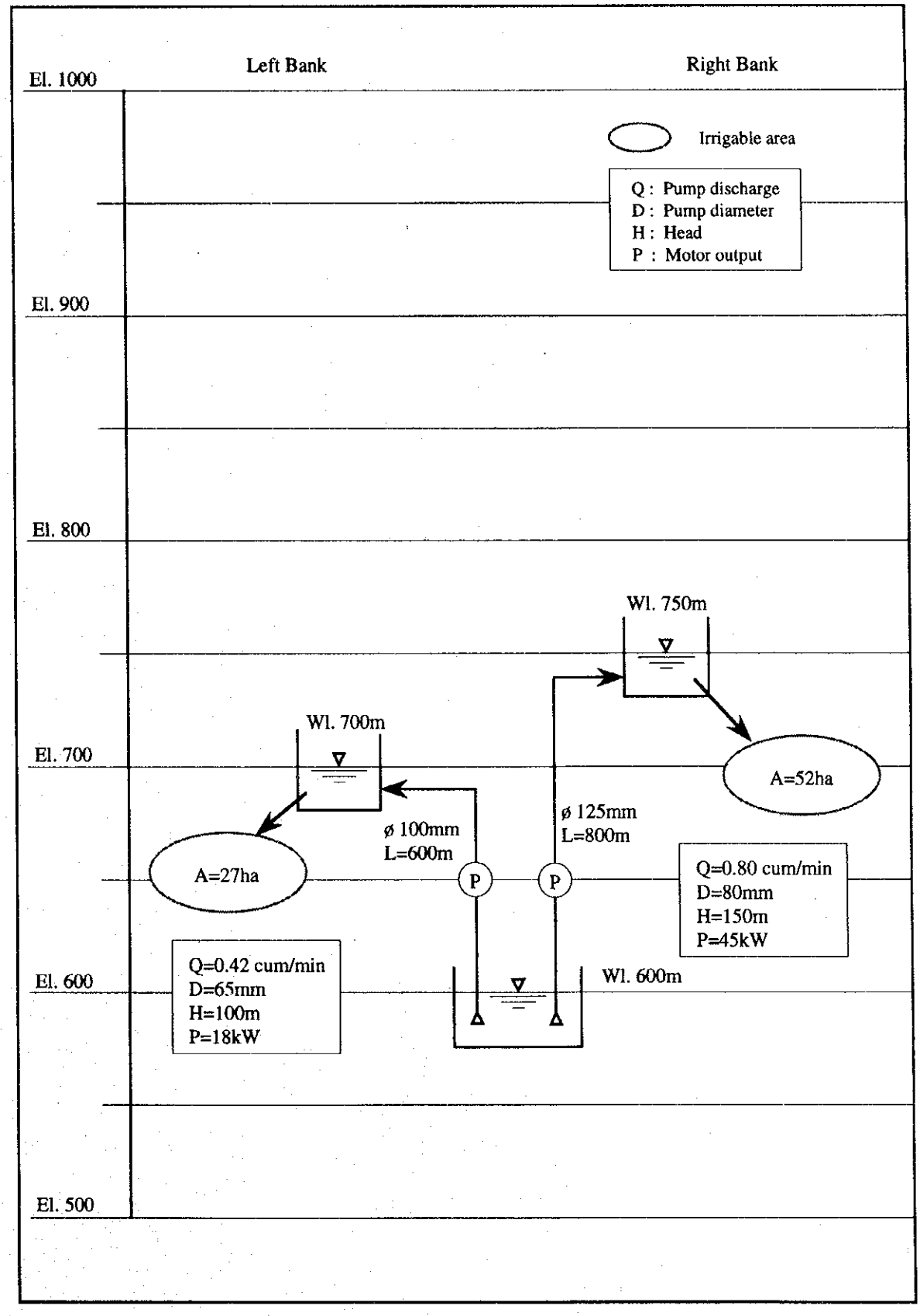


Fig. VII.7.3 Diagram of Pump Irrigation System Case 2

FEASIBILITY STUDY ON
THE UPLAND IRRIGATION AND
RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

APPENDIX-VIII

FACILITY PLANNING AND DESIGNS

FEASIBILITY STUDY

ON

THE UPLAND IRRIGATION AND RURAL DEVELOPMENT PROJECT

IN SOUTHERN LUZON

APPENDIX-VIII

FACILITY PLANNING AND DESIGNS

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APPENDIX VIII FACILITY PLANNING AND DESIGNS

1 Irrigation Facilities

1.1 Basic Irrigation System

Upland Irrigation system consists of water conveyance system, water distribution system, and on-farm irrigation system as illustrated below.

Water conveyance system is a general term for a series of facilities from intake work to farm ponds. Water distribution system is a general term for a series of facilities from farm pond aiming at the regulation of water demand within a day to on-farm irrigation facilities. On-farm irrigation system is a general term for a series of facilities from the valves covering watering blocks to other secondary facilities.

As discussed in establishing irrigation development plan, gravity irrigation is employed for entire irrigation system, which is the method best suited to the Project area in terms of easy operation and low maintenance cost.

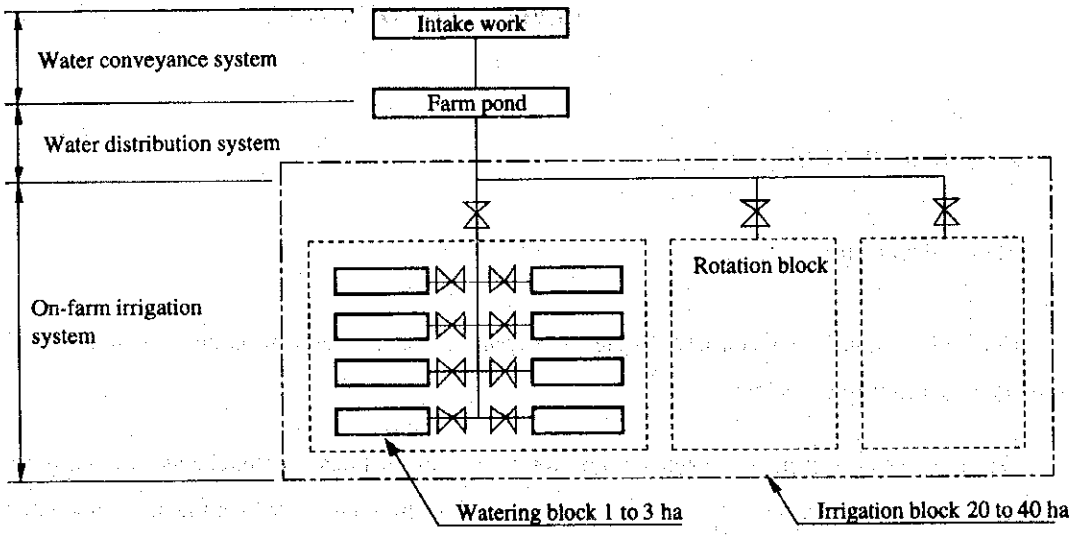
Water operation system in the lower stream of farm pond is classified into three blocks according to field acreage:

1) Watering block: The field area covered by one irrigation control valve (common hydrant) is called a watering block. It is the smallest unit of irrigation, which is determined depending on farming system, cropping pattern, and situation of water management.

2) Rotation block: The whole field to be projected is divided into several blocks, in each one of which irrigation order is decided. Such blocks are called rotation blocks.

3) Irrigation block: It is the field area managed by one water distribution system, and is composed of one or more rotation blocks. Connecting several rotation blocks to one distribution system is convenient to adjust the fluctuation in water demand within the irrigation block.

Fig. VIII.1.1 is the schematic diagram which represents the arrangement of main irrigation facilities such as intake works, farm ponds, pipelines, and common hydrants.



Schematic Diagram of Whole Irrigation System

Taking account of the condition of the Project area and basic concept stated below, whole benefited area is divided into ten (10) irrigation blocks with an area ranging from 21 ha to 42 ha as shown in Fig.VIII.1.2.

1) The area covered by each irrigation block is desirable to be uniform, at best, in terms of operation and maintenance.

2) Since the benefited areas of Nagcarlan and Liliw irrigation systems are estimated at around 160 ha, the number of irrigation blocks at both irrigation systems are desirable to be equal.

Beneficial Area by Irrigation Block

Municipality	Irrigation block No	Area (ha)	Remarks
Nagcarlan	N-1	27	Water resource: Bukal spring
	N-2	27	
	N-3	41	
	N-4	21	
	N-5	39	
	(Sub-total)	(155)	
Liliw	L-1	34	Water resource: Luquin spring
	L-2	42	
	L-3	28	
	L-4	30	
	L-5	31	
	(Sub-total)	(165)	
Total		320	

1.2 Intake Works

To divert spring water, a mountain stream diversion work is provided on the stream in a mountainous region where riverbed slope is steep and voluminous stone flows down by floods. Special attention stated below should be paid in designing the intake works so as to fit for the proposed sites.

(1) The required amount of water can be taken through separating the deposits of sand and gravel from the water.

(2) The structure is strong enough against suspended stones, and free from maintenance.

(3) The works should not impair the scenery and the flow conditions, etc.

There are several intake types as enumerated below according to the intake method of water and the structural feature of intake work.

1) Natural intake type
2) Intake weir type
3) Water cushion intake type
4) Bar screen intake type
5) Collecting conduit type

The descriptions of the intake types and merits and demerits of those are briefed in Table. VIII.1.1. Out of these intake types, water cushion intake type is recommended because it meets the requirement under the proposed sites. Plan of water cushion intake type is shown in Fig. VIII.1.3.

Dimensions of the proposed intake works are summarized as follows:

Dimensions of the Proposed Intake

Name	Design intake Discharge (lit/sec)	Intake water level (m)	Intake weir length (m)	Catchment area (sq.km)	Benefited area (ha)	Irrigation block (nos)
Bukal	40	880	5	1.68	155	5(N1 - N5)
Luquin	42	620	5	2.28	165	5(L1 - L5)

1.3 Farm Ponds

(i) Capacity

Irrigation time in the on-farm commonly lasts 16 to 20 hours, the flow period of the conduit pipeline, on the other hand, is the whole day because of the convenience of water management and flow capacity. The time-lag between on-farm and conduit pipeline is regulated by farm pond. The required capacity of farm pond is obtained by following expression.

$$V = \frac{10 \times Dm}{Ef} \times \frac{Ts}{24} \times A$$

where: V : Farm pond capacity (cum)

Dm : Net amount of water to be replaced (= 2 mm/day)

Ef : Irrigation efficiency (Drip irrigation= 0.9)

Irrigation method	Irrigation efficiency
Surface irrigation	60 - 65 %
Sprinkler irrigation	70 - 85 %
Drip irrigation	85 - 95 %

Source: Engineering Manual for Irrigation and Drainage "Upland Irrigation", "Drip Irrigation" 1990 The Japanese Institute of Irrigation and Drainage

Ts : Water storing time (= 12 hrs)
Since maximum value of capacity will be produced when net irrigation time is 12 hours, water storing time is assumed at 12 hours.

A : Irrigation area commanded by one (1) farm pond (ha)

Assuming that one (1) farm pond covers an average irrigation area of 32 ha, the capacity of that is calculated at 360 cu.m.

(2) Location

Proposed farm ponds shall be located in higher portion of each irrigation block to distribute irrigation water by gravity.

(3) Structure / Foundation

Concrete water tank type is proposed as the structure of farm pond taking account of high permeability of soils in the Study area. Based on the standard penetration test conducted in Phase2 field work, bearing capacity of foundation bed was calculated by using the modified Terzarghi formula to judge the suitability of foundation for construction of farm ponds. Allowable bearing capacity is more than bouble of the design load of farm pond (=5ton/sq.m).

Fig. VIII.1.4 shows the plan of the proposed farm pond.

1.4 Pipeline/Common Hydrants

(1) System Capacity of Pipeline

Pipelines are classified into two categories, namely conduit pipelines and distribution pipelines

according to their function. Conduit pipelines are defined to be the pipelines connecting between the intake works and farm ponds, and distribution pipelines are placed from farm ponds to on-farm facilities.

The capacity of pipeline is obtained by the following expression.

$$Q = 2.78 \times \frac{Dm \times A}{Ef \times To}$$

Here Q : System capacity (lit/sec)

A : Irrigation area (ha)

Dm : Net amount of water to be replaced (= 2 mm/day)

Ef : Irrigation efficiency = 0.9

To : Operation time (hrs)

Capacity of Pipeline

Category	Operation Time (hrs)	Capacity (lit/sec/ha)	Remarks
Conduit pipes	24	0.26	Water conveyance time
Distribution pipes	16	0.39	Net irrigation time

(2) Design of Pipeline

Galvanized Iron pipe (schedule 40) is proposed in terms of rot-proof and durability, and it will be laid more than 30 cm under the ground. Diameter of pipes shall be determined within the range between minimum allowable velocity 0.3m/sec and economical velocity 1.0m/sec corresponding to the discharge variations. The following table indicates the range of discharge for the selection of pipe diameter.

Selection Table of Pipe Diameter

Pipe Diameter	Discharge in Pipeline (lit/sec)		
(inch)	V=0.3m/sec	to	V=1.0m/sec
ø3	1.3	-	4.4
ø4	2.4	-	7.9
ø5	3.7	-	12.3
ø6	5.3	-	17.7
ø8	9.4	-	31.4
ø10	14.7	-	49.1

Hydraulic computation was done at the conduit pipelines of Nagcarlan irrigation system and Liliw irrigation system to check if enough water pressure is maintained at each farm pond. Friction loss of pipeline is calculated by Hazen - Williams formula, and the results of hydraulic computation are shown in Fig VIII.1.6 and 7.

Hazen - Williams formula

$$H = 1.2 \times 10.67 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

where H: head loss(m)
C: coefficient of velocity C=100 (Steel pipe)
D: diameter of pipe (m)
Q: discharge (cu.m/sec)
L: pipe length (m)

(3) Appurtenant Structure of Pipeline

Sluice valves, air valves, and blow off valves should be properly equipped for smooth operation and periodical maintenance of pipelines. Sluice valves will be utilized for repairing and restoring in case of accident. The purpose of air valves is to blow off the air from the pipeline because the entrapped air causes irregular pressure surge and deterioration of flow capacity. Blow off valves are provided so as to blow off the water including the soil which gives rise to pipe clogging.

Pressure dissipating water tanks with a volume of 10 cu.m will be also placed properly to keep water pressure less than 15 kg/sq.m.

Standard section of pipeline and the appurtenant structure are shown in Fig. VIII.1.5.

(4) Common Hydrant

One common hydrant is installed to supply water to the irrigation area covering approximately one (1) ha to three (3) ha which can be irrigated within a day. Irrigation water is sprinkled by using farmer's own hoses joined with outlet of common hydrants or hand-carried watering pot. Arrangement of common hydrants is indicated in Fig. VIII.1.5 as an example.

The proposed pipeline and common hydrants are summarized as follows:

Proposed Pipeline and Common Hydrants

Municipality	Category/Irrigation block		Pipeline Length (m)	Number of common hydrants
Nagcarlan	Conduit pipe ø10'-ø4"		8,600	
	Distribution pipe ø6'-ø3"	N-1	3,090	18
		N-2	5,870	22
		N-3	4,710	25
		N-4	3,770	16
		N-5	2,640	14
		(Sub-total)	(20,080)	(95)
Liliw	Conduit pipe ø10'-ø4"		3,950	
	Distribution pipe ø6'-ø3"	L-1	3,950	12
		L-2	3,100	16
		L-3	3,370	14
		L-4	3,460	14
		L-5	3,240	22
		(Sub-total)	(17,120)	(78)

1.5 On-farm Water Management

As described in Section 3 of Appendix-VII, it is noted that the Project adopts slight and water-saving irrigation that maximum net amount of water to be replaced is assumed to be 2.0 mm/day.

In such a circumstance, arbitrary use of water at the upper stream causes the shortage of water at the down stream, so that some considerations are needed to attain an impartial water distribution.

The rules and facilities to be proposed for proper on-farm water management are as follows;

1) Rotational irrigation is employed, and the date and time of water supply shall be based on the planned rotation schedule.

- In principal, one (1) rotation block is composed of seven (7) common hydrants covering the farm lands with one (1) to three (3) ha. Watering of each hydrant shifts in turn at an interval of one (1) day, and hence after seven (7) days, watering turn will return to the first hydrant.

- Maximum operation time of each hydrant is 16 hours in a day, and the discharge of water supply shall be kept at the following quantity according to the covering area.

Discharge of hydrant

Covering area of each hydrant	Discharge
1ha	2.7 lit/sec
2	5.5
3	8.2

note: unit discharge=0.39 lit/sec/ha, interval day=7 days

2) Water pressure control shall be done so as to obtain the impartial pressure at every hydrants.

- Excessive water pressure at the conduit pipeline will be depressed by the pressure dissipating water tanks.

- Water pressure can be depressed on a small scale by the sluice valves installed at the conduit and distribution pipeline.

- Several sizes of round rings inserted into the riser pipe of the hydrants are effective for the pressure control at the outlet point.

2 Farm-to-Market Roads

2.1 Basic Design Criteria of the Proposed Roads

(1) Selection of the proposed routes

Total of seven (7) routes, connecting between farm lands and market and contributing to shipping of farm products are proposed for road improvement plan among the existing roads within the Project area. Fig. VIII.2.1 shows the proposed routes, being composed of four (4) routes in Nagcarlan, two (2) routes in Liliw, and one (1) route in Majayjay.

(2) Road width

Minimum width of roads is determined on the basis of the kind of expected traveling vehicle, taking account of the following items.

1) Target vehicle for road design is jeepney which has been using as main transportation mean.

2) The road shall have enough width for the jeepneys to pass each other.

3) Shoulder of the proposed roads can be omitted because L-shape gutter provided at both sides will function as well as the shoulder.

Four (4) meters width will be given as a minimum value from following expression.

$$LW = JW \times 2 + C$$
$$= 1.75 \times 2 + 0.50 = 4.0m$$

where LW: Road width (m)
JW: Width of jeepney = 1.75m
C: Passing margin between vehicles = 0.50m

Therefore, four (4) meters width is employed for the proposed Barangay roads, and five (5) m width is employed for the unpaved Provincial roads between the parts which have been already cemented with five (5) meters width.

(3) Mode of pavement

The mode of pavement for farm-to-market roads is specified into gravel, asphalt, and concrete pavement. Out of those, concrete pavement is proposed due to the following reasons.

1) The roads within the Project area are very susceptible to surface erosion owing to the seasonal heavy rainfall.

2) Slope gradient of the roads is considerable steep including short and steep slope of 15 - 20% partially.

3) Maintenance cost shall be minimized.

Considering that existing unpaved roads are so ragged, road bed with fifteen (15) cm in thickness and concrete pavement with twenty (20) cm in thickness are proposed as pavement mode.

(4) Gutter

To avoid the collapse of side slope and to keep structural stabilization of the road itself, L-shape gutter shall be equipped at both sides of the proposed roads and the existing concrete roads without gutter. Small amount of surface runoff can be flashed out by alone L-shape gutter, and at flooding the roads including L-shape gutter will function as waterway for drainage. Flume type gutter can be, as an exception, adopted at the portion with wide right of way.

(5) Standard section

Fig. VIII 2.2 shows the standard section of the proposed roads. Type 1 and Type 2 are applied to the roads with five (5) m width and four (4) m width, respectively.

(6) Vertical alignment of the roads

Vertical alignment of the proposed roads follows the present alignment taking the topographic restriction and the construction cost into account.

The proposed roads are summarized as tableted below on the base of topographic survey results conducted in Phase 2 field works.

Length of the proposed roads

(unit: m)

Municipality/Road name	Pavement with gutter		Gutter	Total
	W=5m	W=4m		
Nagcarlan				
SanFrancisco-Bukal	1,521	4,515	581	6,620
Silanga Lazaan		764	5,267	6,031
Malinao-Kanlurang Lazaan		1,523	127	1,650
Kanlurang Lazaan-Bukal		2,144		2,144
Liliw				
Ibabang Sugi-Ilayang Sugi		976	3,424	4,400
Novaliches-Luquin	1,607	1,603	2,490	5,700
Majayjay				
Pangil-Bukal		3,883	397	4,280
Total	3,131	15,408		
	18,539		12,286	30,825

2.2 Drainage Facilities

The proposed roads are mainly developed along the ridge of the mountain slope of Mt.Banahaw and Mt.San Cristobal, so that few crossing point of main river are founded.

Box-culvert type bridges are employed at the sites where the proposed roads cross the main rivers, one (1) site at the San Diego river and three (3) sites at the Nagcarlan river. Cross drains shall be properly arranged to introduce the surface runoff water into the vicinal drainage smoothly. The capacity of the cross drains will be determined according to their own catchment areas, referring to the following table.

Relation between Catchment Area and Dimension of Culvert

Dimension of culvert (mm)	Cathment area (ha)
ø300	0.304
ø450	0.810
ø600	2.024
ø750	3.239
ø900	5.668
900*1500	11.117
1200*1500	16.136

The proposed drainage facilities are summarized as follows:

Proposed drainage facilities

(unit: nos)

Municipality/Road name	Box culvert	Cross drain
Nagcarlan		
SanFrancisco-Bukal	1	40
Silanga Lazaan		16
Malinao-Kanlurang Lazaan		5
Kanlurang Lazaan-Bukal	3	12
Liliw		
Ibabang Sugi-Ilayang Sugi		18
Novaliches-Luquin		19
Majayjay		
Pangil-Bukal		22
Total	4	132

3 Trading Posts

The location of fifteen (15) trading posts shall be planned along the existing main roads taking its accessibility and the present location of existing trading posts into account. Fig. VIII.3.1 shows the location of the proposed trading posts, eight (8) in Nagcarlan, five (5) in Liliw, and two (2) in Majayjay.

The floor area of one (1) trading post is required at around 100 sq.m based on the following assumption.

1) The amount of the vegetable production in future with project is estimated at 31,215 ton, and it will be evenly handled at fifteen (15) trading posts.

2) Workable days are estimated at 240 days, two third of one (1) year.

3) One (1) container which can be packed the vegetable products of 35 kg occupies around 0.4 sq.m.

Fig. VIII.3.2 shows general plan of the proposed trading post equipped with the following facilities corresponding to various uses.

Parking lot:	Parking lot has five (5) m in width for two (2) or three (3) jeepneys which are main transportation means for farm products.
Working space:	Working space has a floor area of 100 sq.m for the purpose of weighing, packing and storage of farm products. The structure is a steel frame with shade. Floor is set up at 80 cm higher than parking lot to make the loading and unloading of the farm products easier.
Washing basin:	Washing basin is provided so as to wash the farm products such as radish and carrot. Water is distributed from the existing domestic water supply conduits laying along the road, and two (2) faucets are installed at the both sides of the washing basin.
Office space:	Office serves to exchange the information on whole sale prices and manage the trading post.
Office equipment:	Weighing machines, and office tools

4 Upland Horticulture and Irrigation Technology Center

The Upland Horticulture and Irrigation Technology Center is composed of demonstration farm and center building, of which whole layout is shown in Fig. VIII.4.1.

4.1 Demonstration Farm

Consolidated farm will be created in order to demonstrate standard horticultural technologies and on-farm irrigation practices. It has a total area of about one (1) ha, being divided into ten (10) farming lots. Demonstration and research of farming practice during the wet season will be made at the greenhouse which is made of steel flame and transparent plastic roofing. On-farm Irrigation practices are also demonstrated by using several kinds of irrigation instruments such as sprinkler, micro-jet, micro-sprinkler, and drip tube. Arrangement of the irrigation instruments placed on the demonstration farm is shown in Fig. VIII.4.2. Besides, the irrigation system is provided so as to operate the irrigation instruments.

Demonatration and training farm:

Trainig for irrigation methods;	5 methods × 1 lot = 5 lots
Trainig for new farming;	1 lot
Trainig for environment protection;	1 lot
Demonstration of new varieties;	1 lot
Multiplication for seeds;	1 lot
Green house;	1 lot

Water tank: Concrete water tank has the capacity of 20cu.m corresponding to the amount of consumptive water for two (2) days.

Pump station: Numder of pump unit = 1 set
Pump capacity = 162 lit/min
Pump diameter = 50 mm
Pump head = 30 m
Motor power = 2.2 kw

Pipeline: Galvanized Iron pipes ø3" are installed connecting the pump station with the hydrants provided at each farming lot.

Access roads between the center building and the demonstration farm will be also constructed for the O&M of the demonstration farm.

4.2 Center Building

Center building serves to train the farmers in and around the Project area on horticulture and irrigation technologies, and manage the demonstration farm.

The size of each room in the center building is determined on the assumption that around 30 participants attend the seminar at one time.

Main farm labors;	1,340 households × 2 persons / household = 2,700 persons
Farmers to be trained;	2,700 persons × 1/2 = 1,350 persons
Annual trained farmers;	1,350 persons / 5 years = 280 persons
Trained farmers per seminar;	280 persons / 10 times = 28 persons

Accommodation including dining room is provided for the lecturers and farmers who join the seminar. Laboratory is also included in the center building for the purpose of soil test and seed production.

Fig. VIII.4.3 shows the layout of the proposed center building equipped with the following facilities and equipments.

Seminar room: One room (35 sq.m) with educational equipment.

- 28 participants × 1/2 (turning rate) × 2.5 m^2 = 35 m^2

Laboratory: One room (30 sq.m) with laboratory equipment.

- 35 m^2 × 0.85 = 30 m^2

Office: One room (24 sq.m) with office tools

- 7 staff × 3.5 m^2 = 24 m^2

Accommodation: Three rooms (36 sq.m) with furniture.

- for Lectures; 2 persons × 6 m^2 = 12 m^2
- for Farmers; 4 persons × 3 m^2 × 2 = 24 m^2

Dining hall (54 sq.m) with kitchen.

- Canteen; 14 persons × 3 m^2 = 42 m^2
- Kitchen; 12 m^2 × 1 room = 12 m^2

Garage/storage: One garage and two storages (56 sq.m).

- Garage; 6 cars × 6 m^2 = 36 m^2
- Storage; 20 m^2

Experiment instrument: Soil test equipment, seed production instrument, etc.

Meteorological observation station: Rainfall recorder, wind velocity/direction meter, sunshine duration meter, evaporation pan, temperature, humidity meter, etc.

O&M equipment: Office tools, computers, copy machine tractors, 2 ton trucks, 4 wheel jeeps, pickup cars, motor bikes, etc.

Others: Security fence, water supply facilities, etc.

5 Soil Conservation

Soil conservation is proposed as one of the project components, of which the countermeasures are to create demonstration fields for soil conservation technologies at several sites in the Project area, and to establish "Soil Conservation Extension Center" aiming at the extension of said technologies.

5.1 Demonstration Fields

The objectives of demonstration fields are field trial and easy understanding of soil conservation technologies by farmers themselves through learning by showing. The technologies to be performed will be selected among ones of contour hedgerow, SALT (Sloping Agricultural Land Technology), and wattering

according to the site condition. Initial works such as transplanting will be implemented at the demonstration fields by the Project.

Fig. VIII.5.1 shows the location of the proposed demonstration fields, and of which number and area are as follows:

Proposed Demonstration Farms

Municipality	Number	Total area
Nagcalran	3 sites	3.6ha
Liliw	5 site	7.3ha
Majayjay	1 sites	1.2ha
Total	9 sites	12.2ha

5.2 Soil Conservation Extension Center

Soil Conservation Extension Center serves to supply the seedlings for counter hedgerow and/or SALT, and train the farmers on soil conservation technologies. The center should be located along the Novaliches road within the area covered by the proposed irrigation system in Liliw.

Center building and a permanent nursery will be created with a total area of 3,000 sq.m as main facilities of "Soil Conservation Extension Center". Fig. VIII.5.2 shows the proposed layout of Center building equipped with the following facilities and equipment. The size of seminar rooms is determined on the assumption of around 30 participants as same as Upland Horticulture and Irrigation Technology Center.

Center building: 156 sq.m

Seminar rooms: Two (2) rooms (72 sq.m) with educational equipment

- 28 persons × 2.5 m^2 = 72 m^2

Office: One (1) room (35 sq.m) with office tools

- Working space; 3 persons × 3.5 m^2 = 10.5 m^2
- Resting space for participants; 28 persons × 1/2 (using rate) × 1.5 m^2 = 24.5 m^2

Garage/Storage: One (1) garage and two (2) storages (56 sq.m) with farming tools

- Garage; 6 cars × 6 m^2 = 36 m^2
- Storage; 20 m^2

O&M equipments: 2 ton trucks, pickup cars, 4 wheel jeeps, etc.

The following facilities are normally founded in a permanent nursery , and typical arrangement of those are illustrated in Fig. VIII.5.3. The size of the permanent nursery is estimated at 2,000 sq.m which can supply 100,000 seedlings to be planted for the area of 33 ha per year. (Source: The Philippines Recommends for Reforestation, Page 58)

- seed beds
- soil sterilization bed
- compost shed
- potting shed
- rearing beds
- hardening beds
- multiplication plots
- irrigation facilities (water tank, pump, pipelines, and hydrants)

6 Rural Water Supply System

Based on the inventory survey of existing rural water supply facilities, the following rehabilitation works are planned at Bukal of Nagcarlan and Gawanan springs of Liliw.

6.1 Bukal Spring of Nagcarlan

In Nagcalran, Bukal spring alone is water source available for rural water supply of related barangaies, namely Bukal, Abo, Kanlirang Lazaan, Silangan Lazaan, Malinao, and San Francisco. The intakes of all barangaies except Abo are located at the upper stream of the proposed intake work for irrigation purpose.

At Abo intake site, domestic water is taken primitively with bamboo being laid at the riverbed on the down stream of the proposed intake work. Therefore, Abo intake shall be unifiled into the proposed intake work in terms of the stable supply of domestic water.

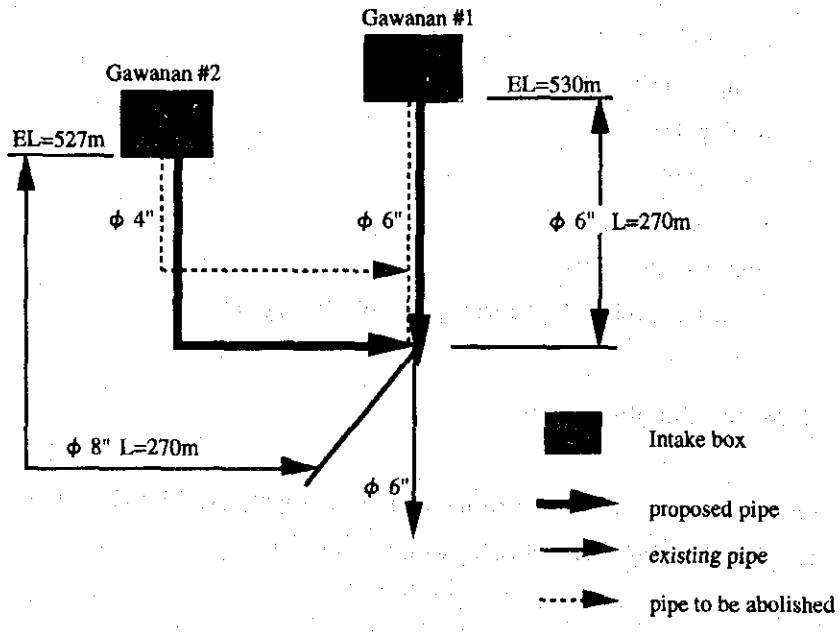
6.2 Gawanan Springs of Liliw

Rural water of Liliw is derived from Serian and Gawanan #1 and Gawanan #2 springs. Gawanan springs exist at an elevation between 500m and 550m at the tributary of the Liliw river. Gawanan intake boxes and their distribution pipeline were built in 1926, since then no rehabilitation was done. Water being taken by intake box of Gawanan #1 is conveyed by conduit pipe with the sizes ranging from ø6" to ø4". Besides, ø4" conduit pipe connected with Gawanan #2 intake box is interconnected to ø6"conduit pipe of Gawanan #1 spring at the lower portion .

The field reconnaissance conducted revails the necessity of urgent rehabilitation stated below.

1) Renewal of the existing decrepit intake boxes.

2) Replacement of the conduit pipeline installed between intake boxes and the junction of pipelines so as to improve the hydraulic defect. (Water is going back at Gawanan #2 intake box.)



Schematic Diagram of Gawanan Spring Site

Diameter and length of the pipelines to be replaced are determined based on the following basic data and idea.

1) Intake discharge of both intake boxes is assumed to be 17.5 lit/sec in accordance with the plan proposed by Liliw Municipal Goverment.

2) Discrepancy in elevation between Gawanan #1 intake box and Gawanan #2 intake box is estimated at three (3) meters.

3) Hydraulic defect can be settled if water level is kept equal at the junction of two conduit pipes.

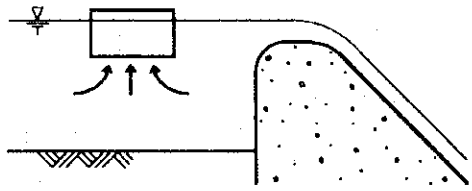
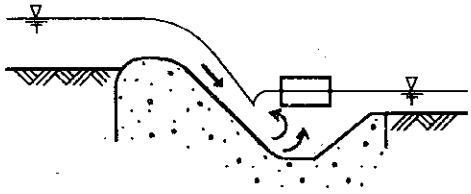
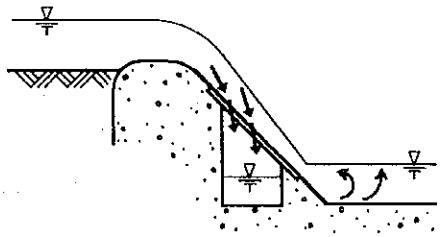
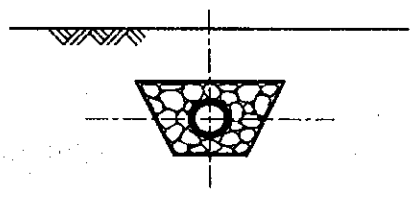
Assuming that diameter of Gawanan #1 pipe and Gawanan #2 pipe are ø6" and ø8" respectively, length of the pipes to be replaced is estimated at 270 m by Hazen-william's formula.

The rehabilitation works are summarized as follows:

Rehabilitation of Rural Water Supply Systems

System name	Spring name	Rehabilitation works	Quantity	Remarks
Abo RWSS in Nagcarlan	Bukal	Intake pipe	1 LS	ø4" steel pipe
Gawanan RWSS in Liliw	Gawanan #1 4.0m 3.5m 2.5m	intake box	1 no	
		conduit pipe ø6"	270 m	steel pipe
	Gawanan #2 4.0m 3.5m 2.5m	intake box	1 no	
		conduit pipe ø8"	270 m	steel pipe

Table VIII.1.1 Feature of Intake Types

Type	Description of each intake type	Diagram of each intake type
Natural intake	Natural intake type is recomendable at the sites where there is a stable pond or a basin of waterfall. Water is taken from the inlet installed on the side.	—
Intake weir	The design intake water level is secured by constructing the fixed weir at the point where the riverbed slope is relatively gentle . This type tends to cause the sedimentation of sand and/or gravel, so that it is said that the maintenance is commonly difficult.	
Water cushion	Water cushion intake type consists of the inclined trap and the water cushion. Water is taken through the inlet installed on the side wall of the inclined trap while maintaining the subcritical flow condition within water cushion. Water cushion side intake type suits to the place with more and less two meters head available and less than one cu.m/sec in discharge.	
Bar screen intake	There are two kinds of bar screen intake. One is bar screen bottom intake type and the other is bar screen back stream intake type. Bar screen bottom intake is called "Tyrolean type". The bar screen is installed on the downstream side of the overflow section of the fixed weir, and the water dropping through the interval in the screen is gathered on the collecting channel. In case of bar screen back stream intake type, water is taken at the backside of the overflow. This type overcomes the disadvantage of "Tyrolean type" which tends to clog with foreign materials.	
Collecting conduit	Collecting conduit type takes water through the pipes with holes being buried under the riverbed. Since collecting conduit is subject to clogging with riverbed materials, it brings about problems such as deterioration of the collecting function.	

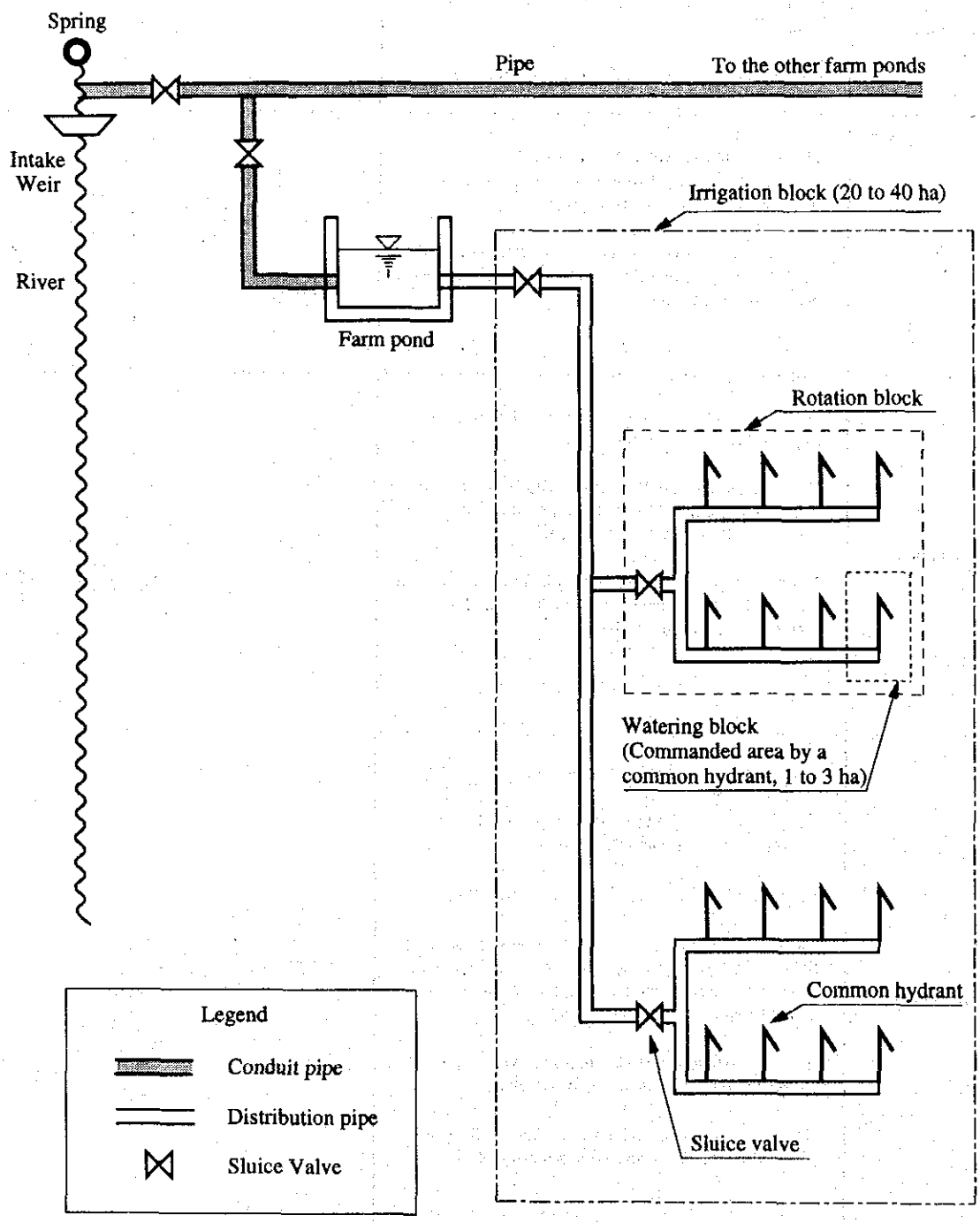


Fig. VIII.1.1 Schematic Diagram of Proposed Irrigation System

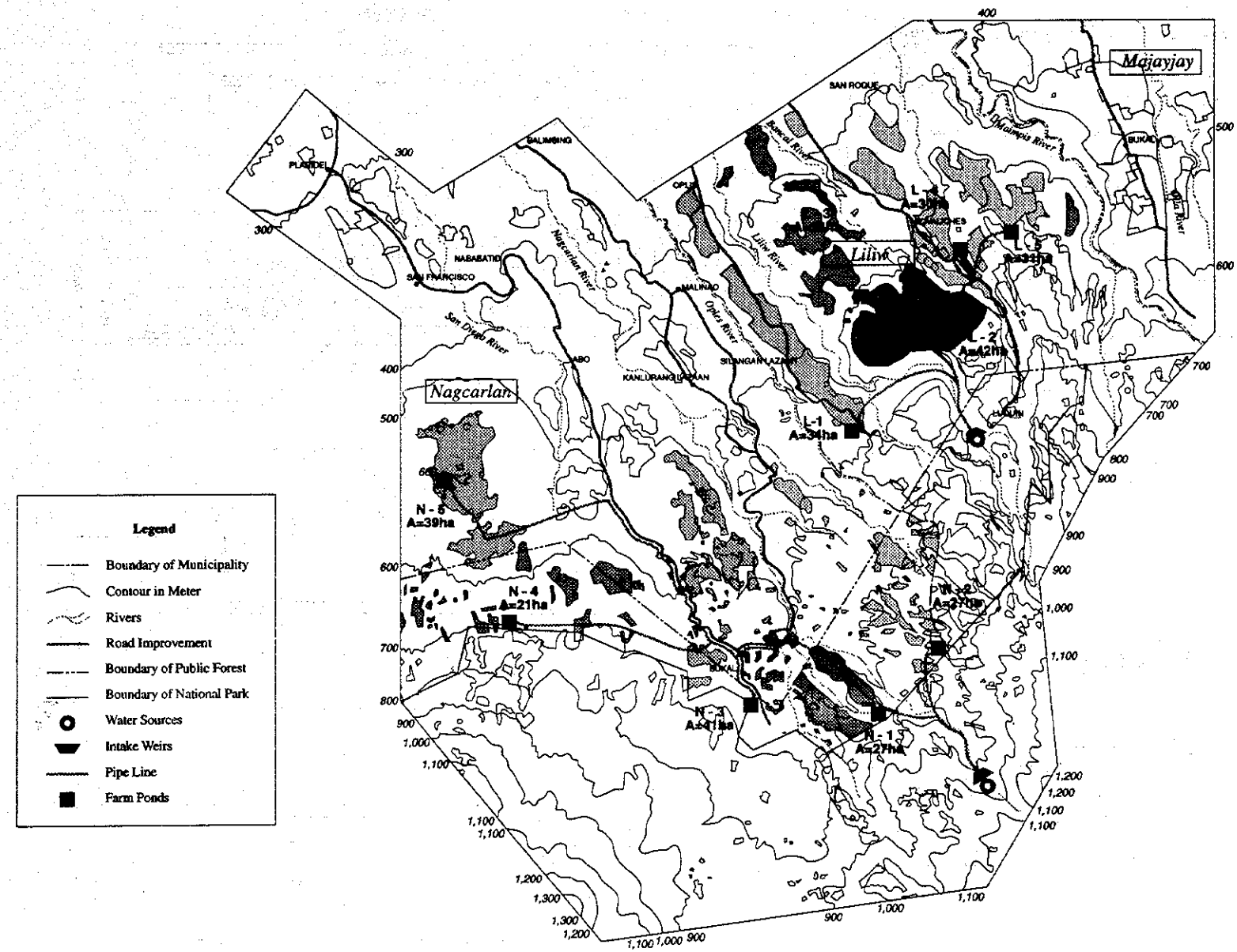


Fig. VIII.1.2 Irrigation Blocks

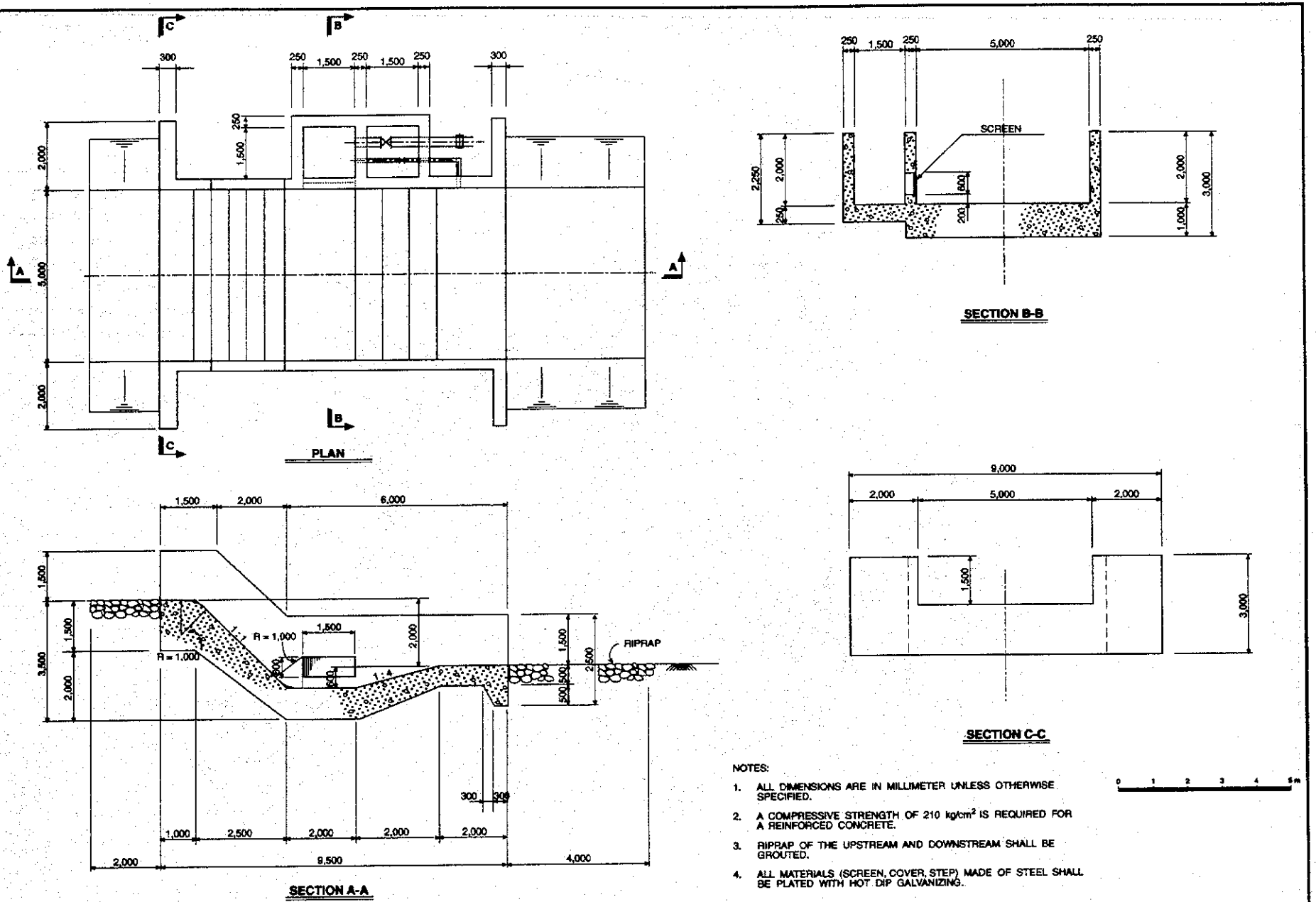
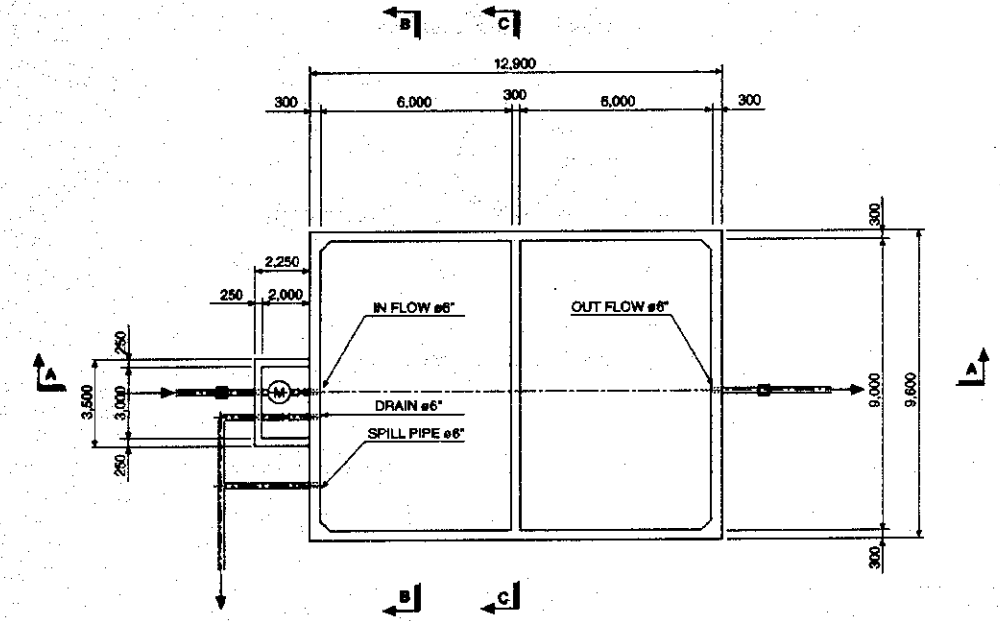
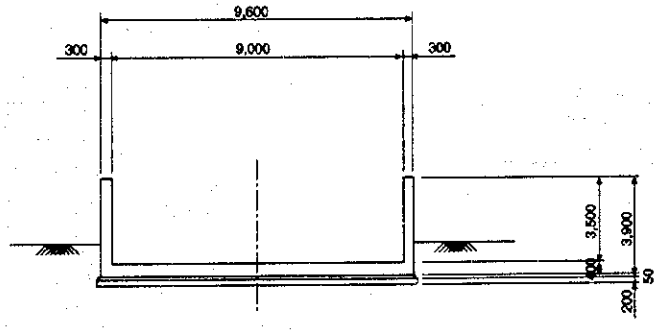


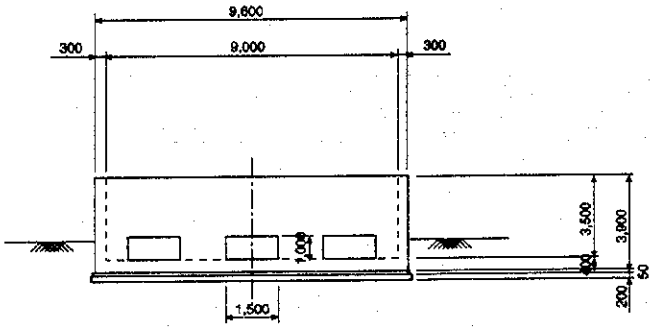
Fig. VIII.1.3 Plan of Intake Work (Water Cushion Intake Type)



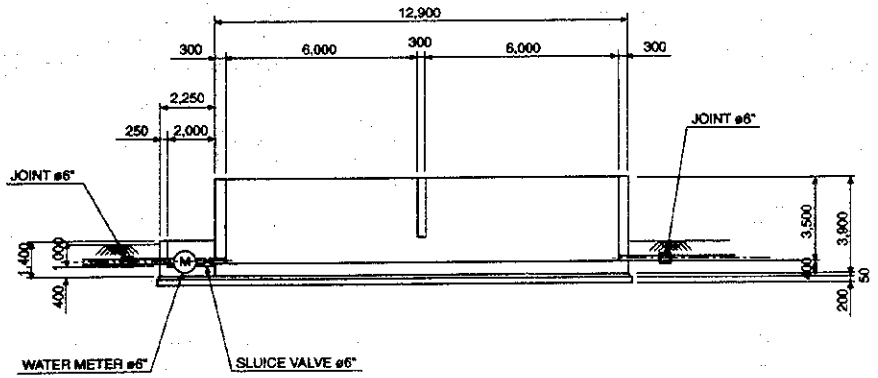
PLAN



SECTION B-B



SECTION C-C



SECTION A-A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SPECIFIED.
2. A COMPRESSIVE STRENGTH OF 210 kg/cm^2 IS REQUIRED FOR A REINFORCED CONCRETE, 135 kg/cm^2 FOR LEVELLING CONCRETE.
3. THE MAXIMUM SIZE OF AGGREGATES FOR CAST-IN-PLACE CONCRETE SHALL NOT BE LARGER THAN 25 MILLIMETERS.
4. ALL MATERIALS (SCREEN, COVER, STEP) MADE OF STEEL SHALL BE PLATED WITH HOT DIP GALVANIZING.

Fig. VIII.1.4 Plan of Farm Pond

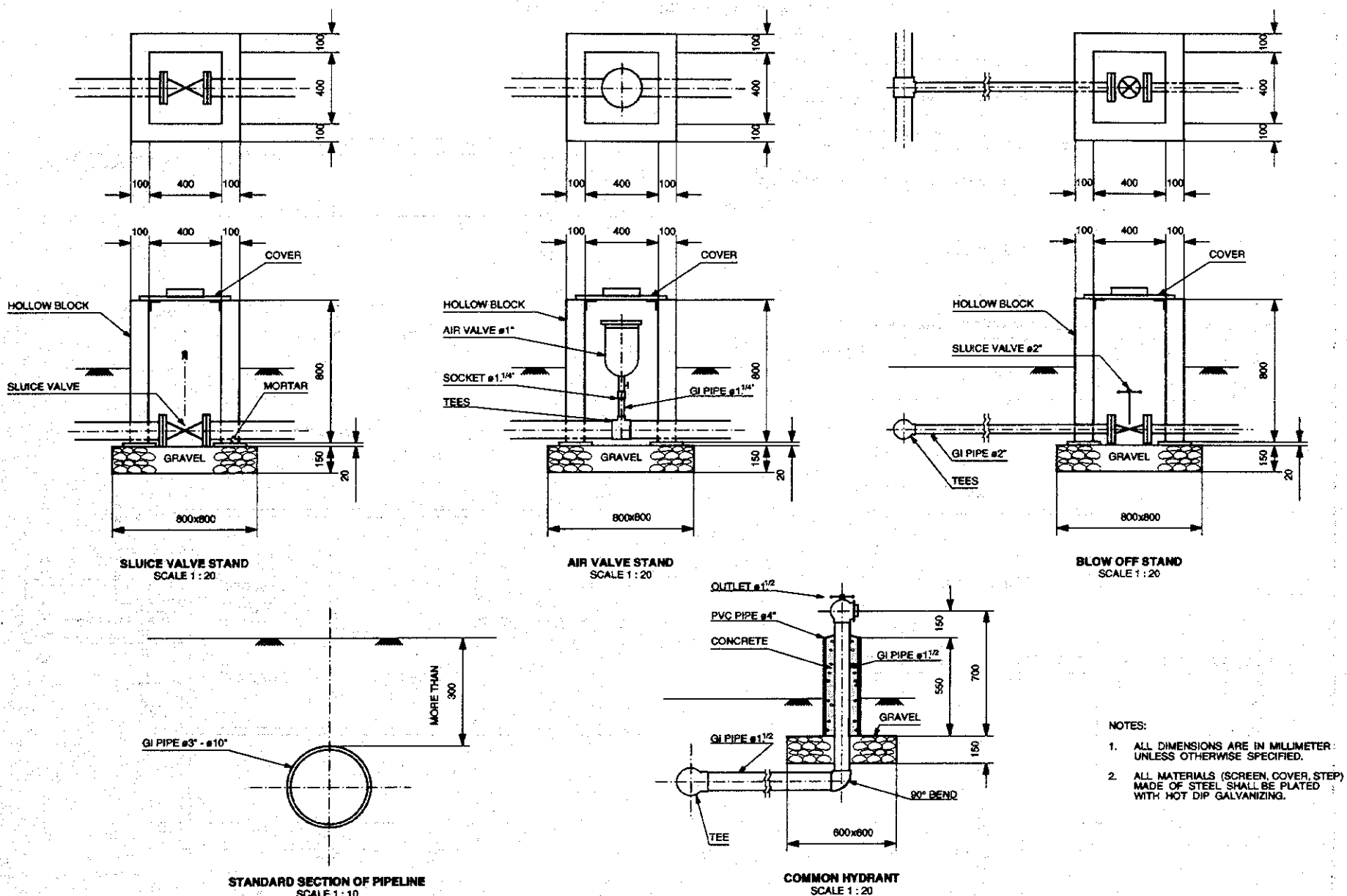


Fig. VIII.1.5 Standard Section of Pipeline and Plan of Appurtenant Structure

Nagcarlan

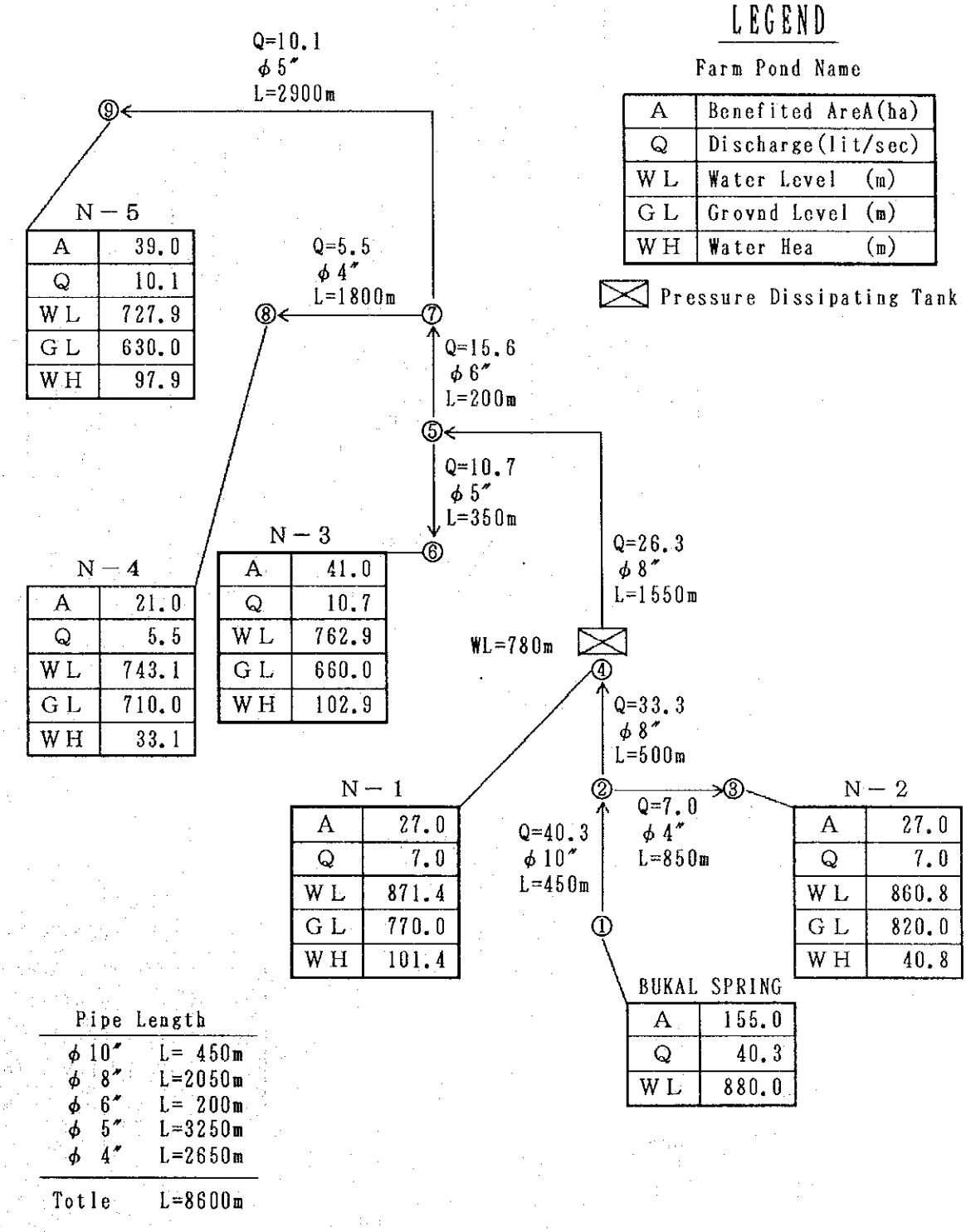


Fig. VIII.1.6 Hydraulic Condition of Nagcarlan Irrigation System

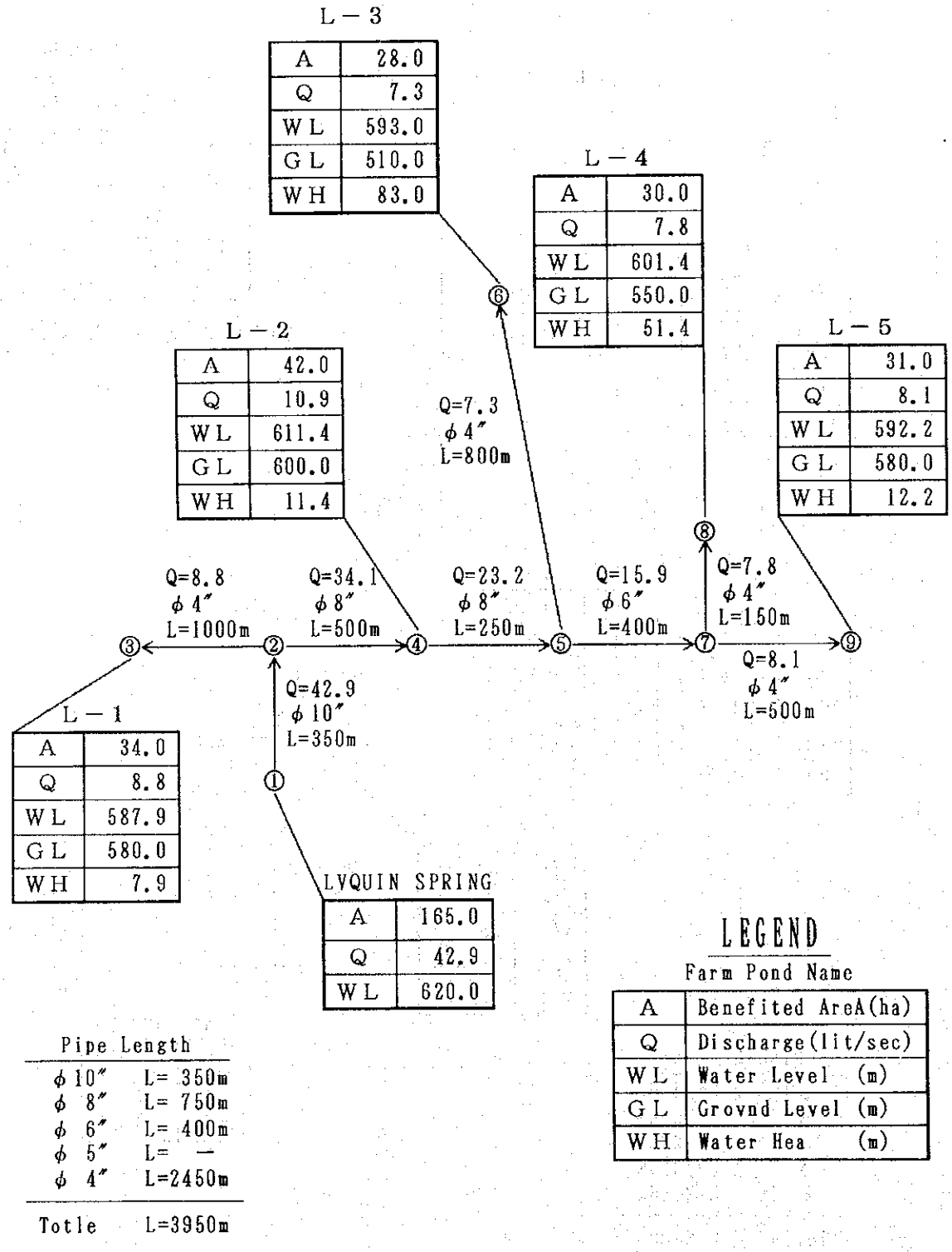


Fig. VIII.1.7 Hydraulic Condition of Liliw Irrigation System

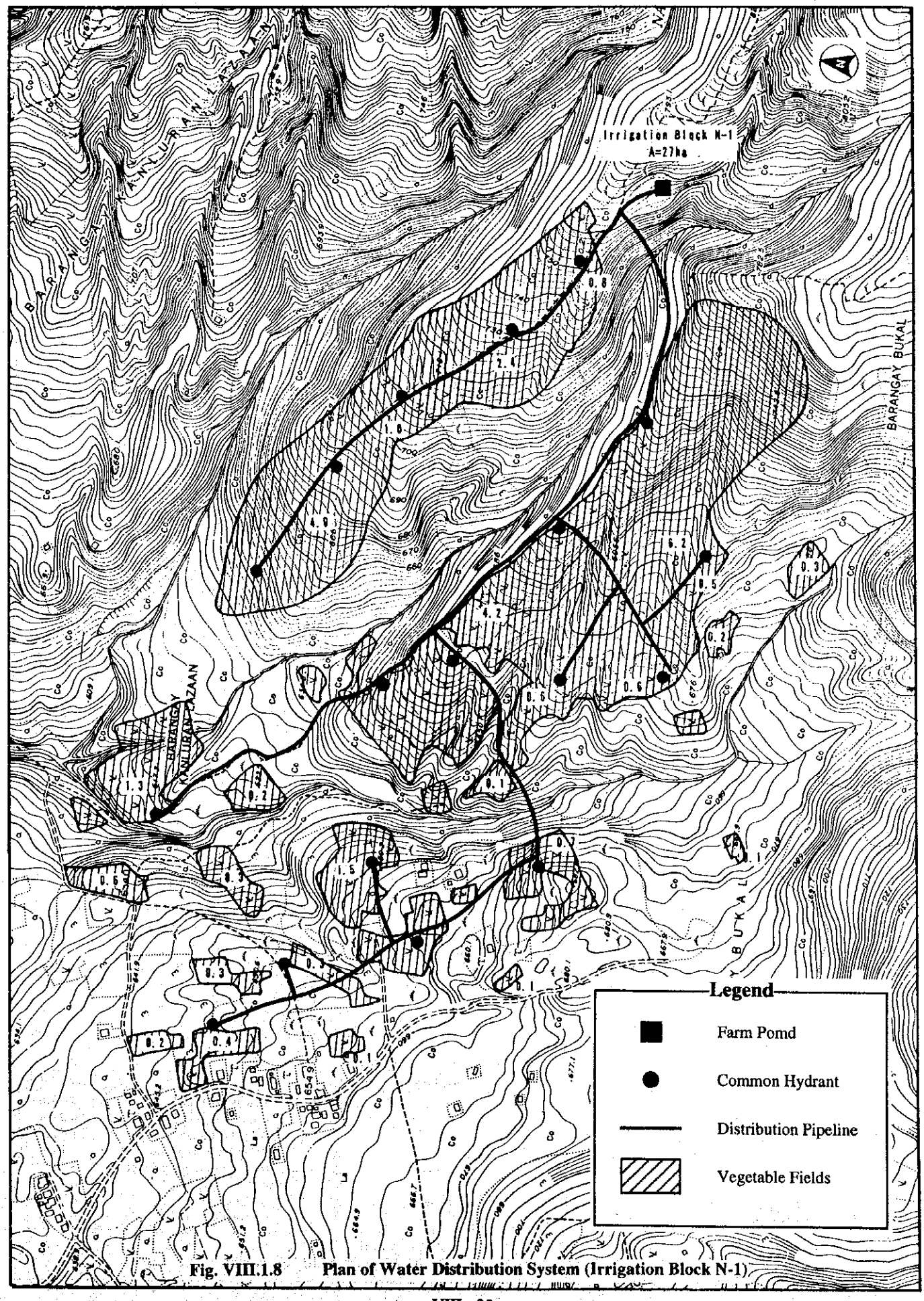
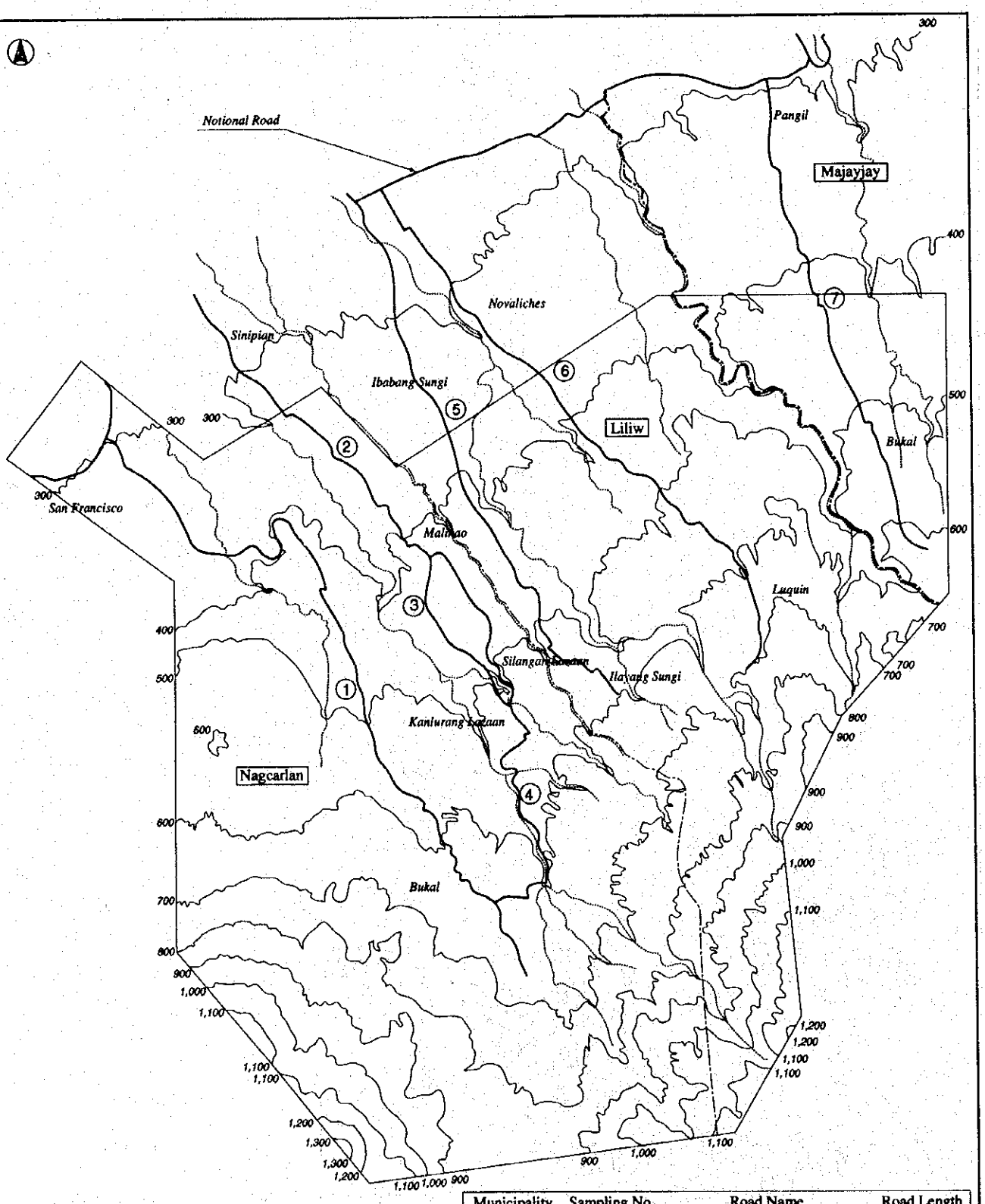
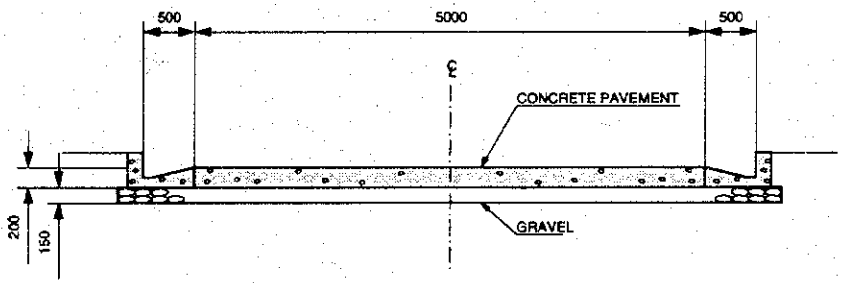


Fig. VIII.1.8 Plan of Water Distribution System (Irrigation Block N-1)

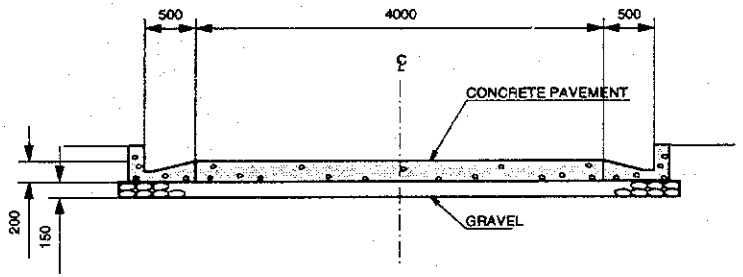


Municipality	Sampling No.	Road Name	Road Length
Nagcarlan	①	San Francisco - Bukal	6.6 km
	②	Sinipian - Silangan Lazaan	6.0 km
	③	Malinao - Kanlurang Lazaan	1.7 km
	④	Kanlurang Lazaan - Bukal	2.1 km
Liliw	⑤	Ibabang Sungi - Ilayang Sungi	5.7 km
	⑥	Novaliches - Luquin	4.4 km
Majayjay	⑦	Pangil - Bukal	4.3 km
		Total	30.8 km

Fig. VIII.2.1 Route Map of Road Networks



TYPE.1
SCALE 1 : 50



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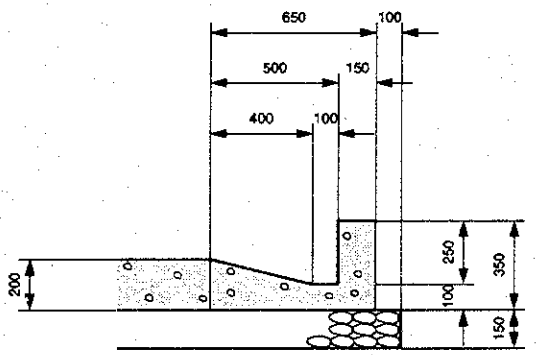
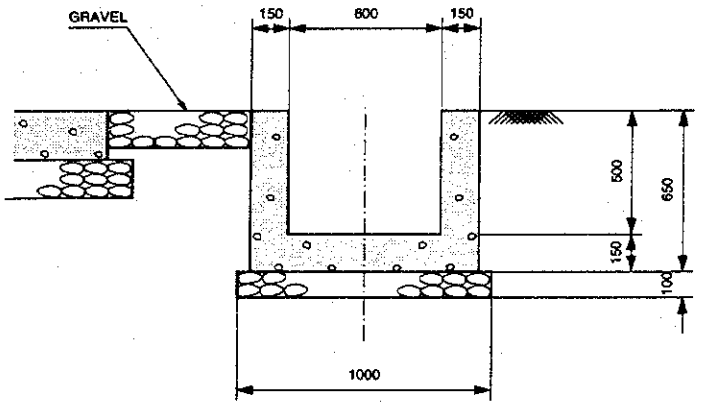
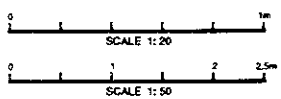


TYPE.1



TYPE.2

DETAIL OF DRAINAGE
SCALE 1 : 20



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SPECIFIED.
2. CONTRACTION JOINT SHALL BE PLANNED. THE INTERVAL OF CONTRACTION JOINT SHALL BE LESS THAN 10 METERS. EXPANSION JOINT SHALL BE PLANNED WITH INTERVAL OF LESS THAN 30 METERS.

Fig. VIII.2.2 Standard Section of Road

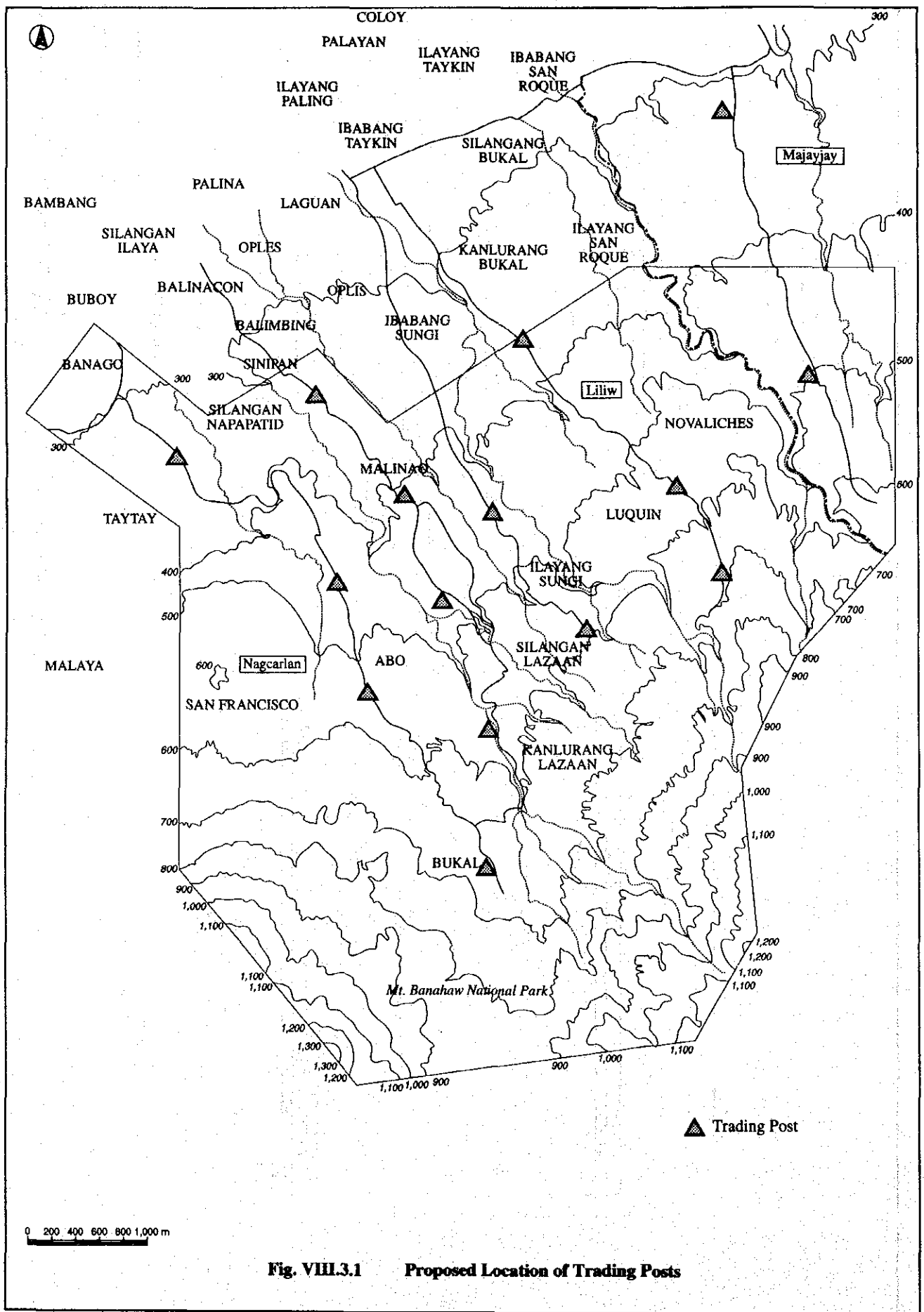
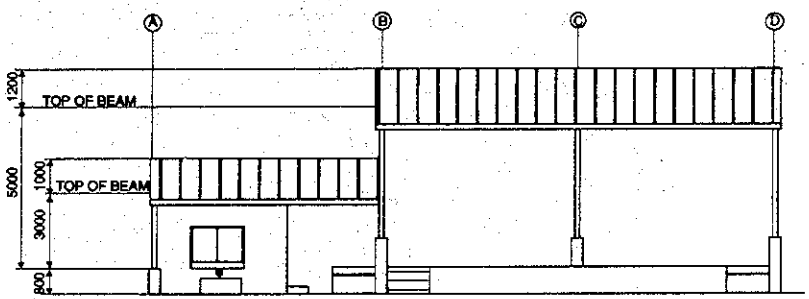
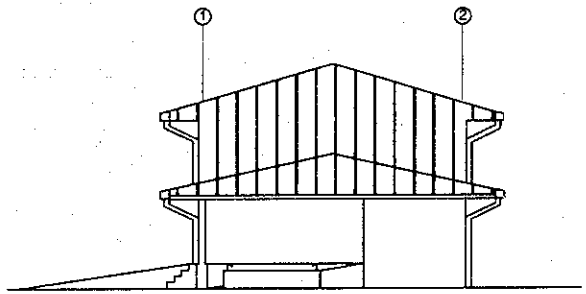


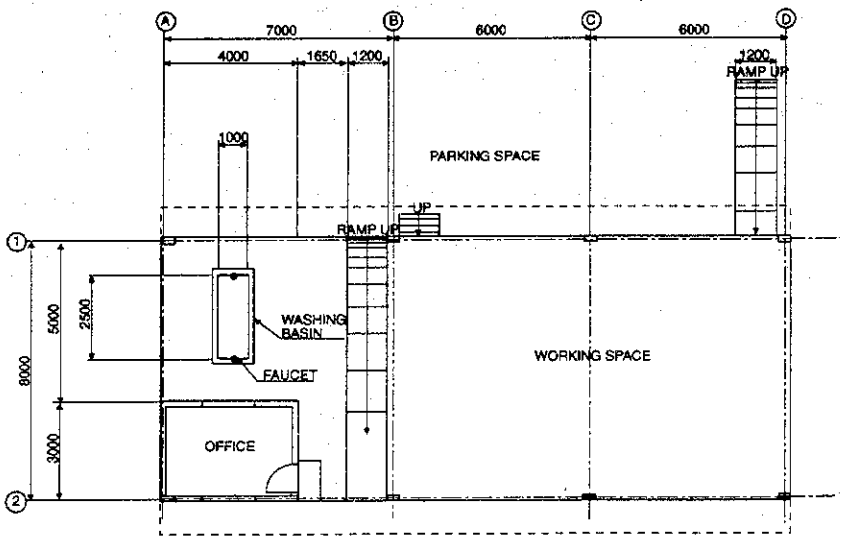
Fig. VIII.3.1 Proposed Location of Trading Posts



FRONT ELEVATION
MTS



LEFT SIDE OF ELEVATION
MTS



TRADING POST FLOOR PLAN
MTS

Fig. VIII.3.2 Plan of Trading Post

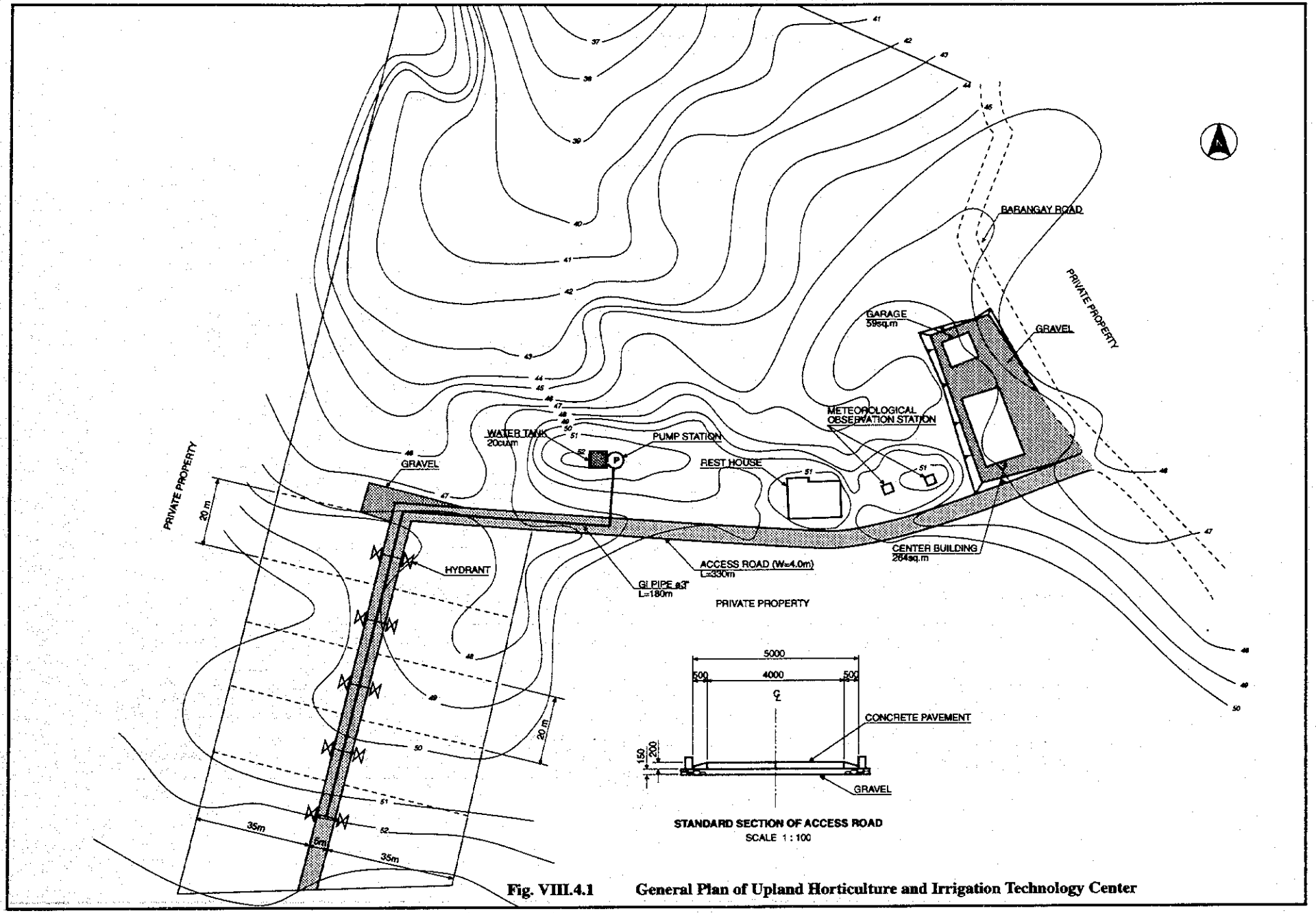
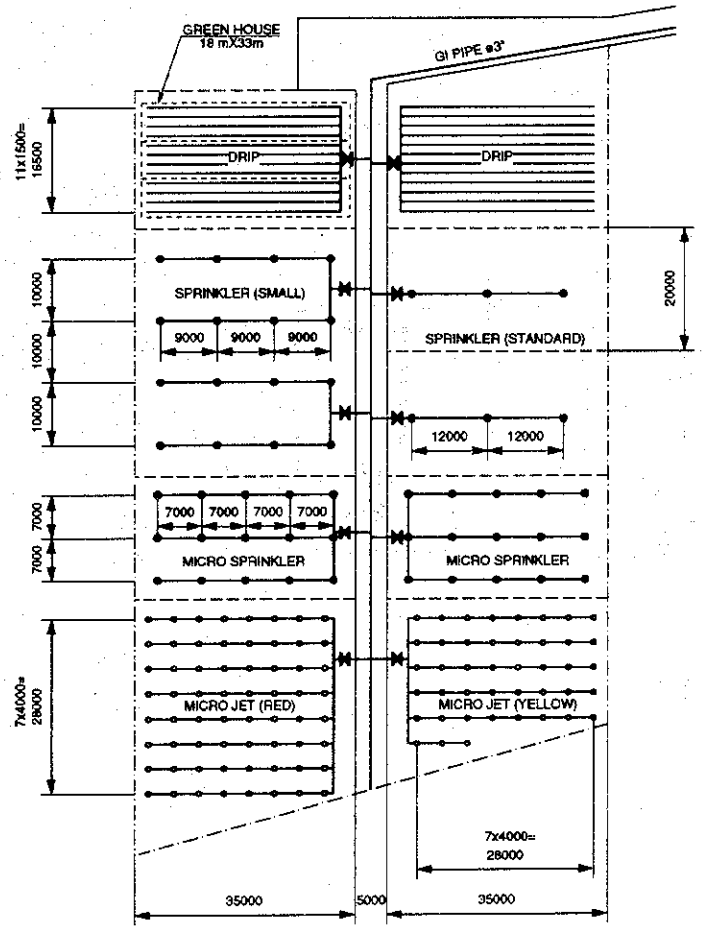
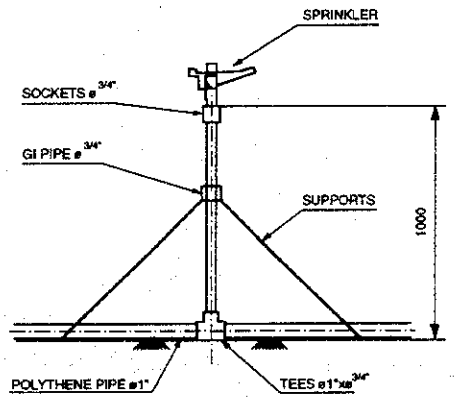


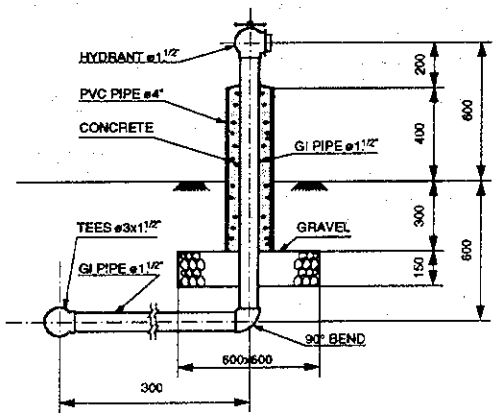
Fig. VIII.4.1 General Plan of Upland Horticulture and Irrigation Technology Center



ARRANGEMENT OF IRRIGATION INSTRUMENTS
MTS



DETAIL OF SPRINKLER INSTALLATION
SCALE 1 : 20



DETAIL OF HYDRANT INSTALLATION
SCALE 1 : 20

Fig. VIII.4.2 Plans of Demonstration Farm

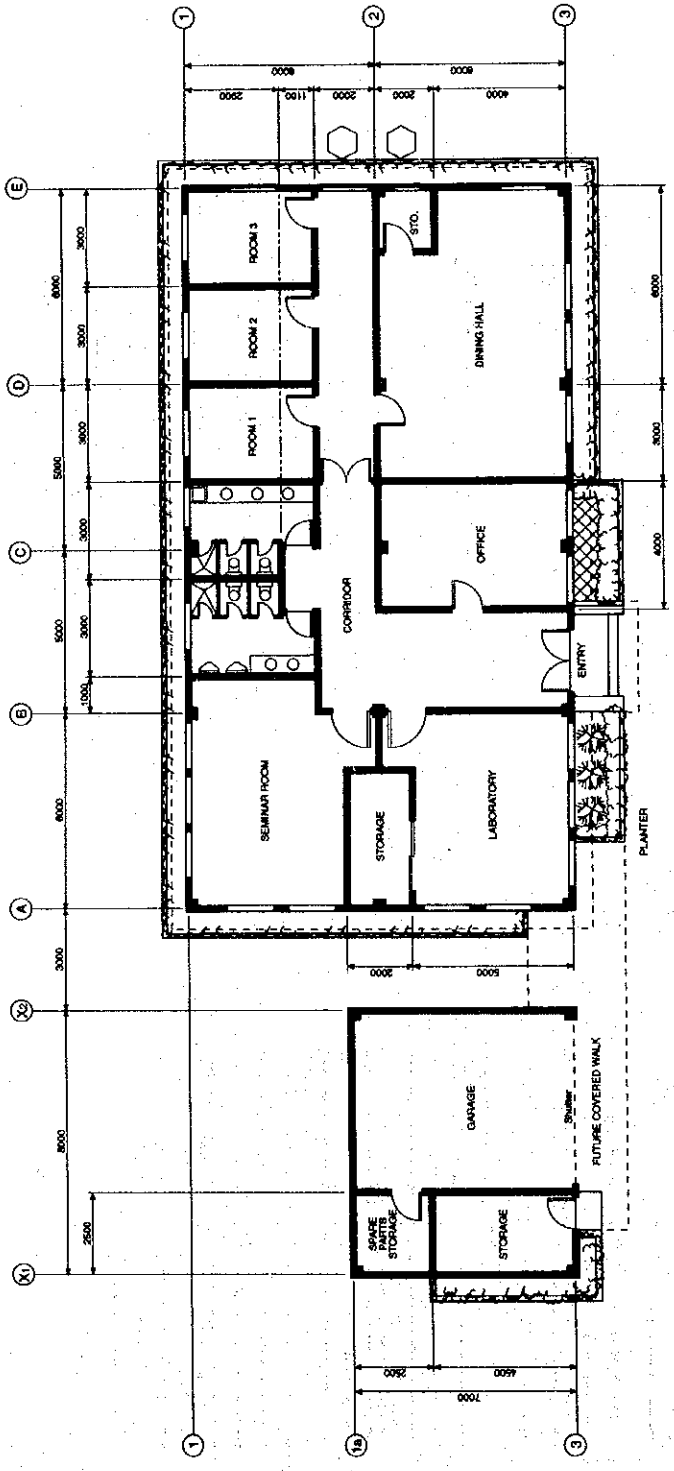


Fig. VIII.4.3 Plan of Technology Center of Building

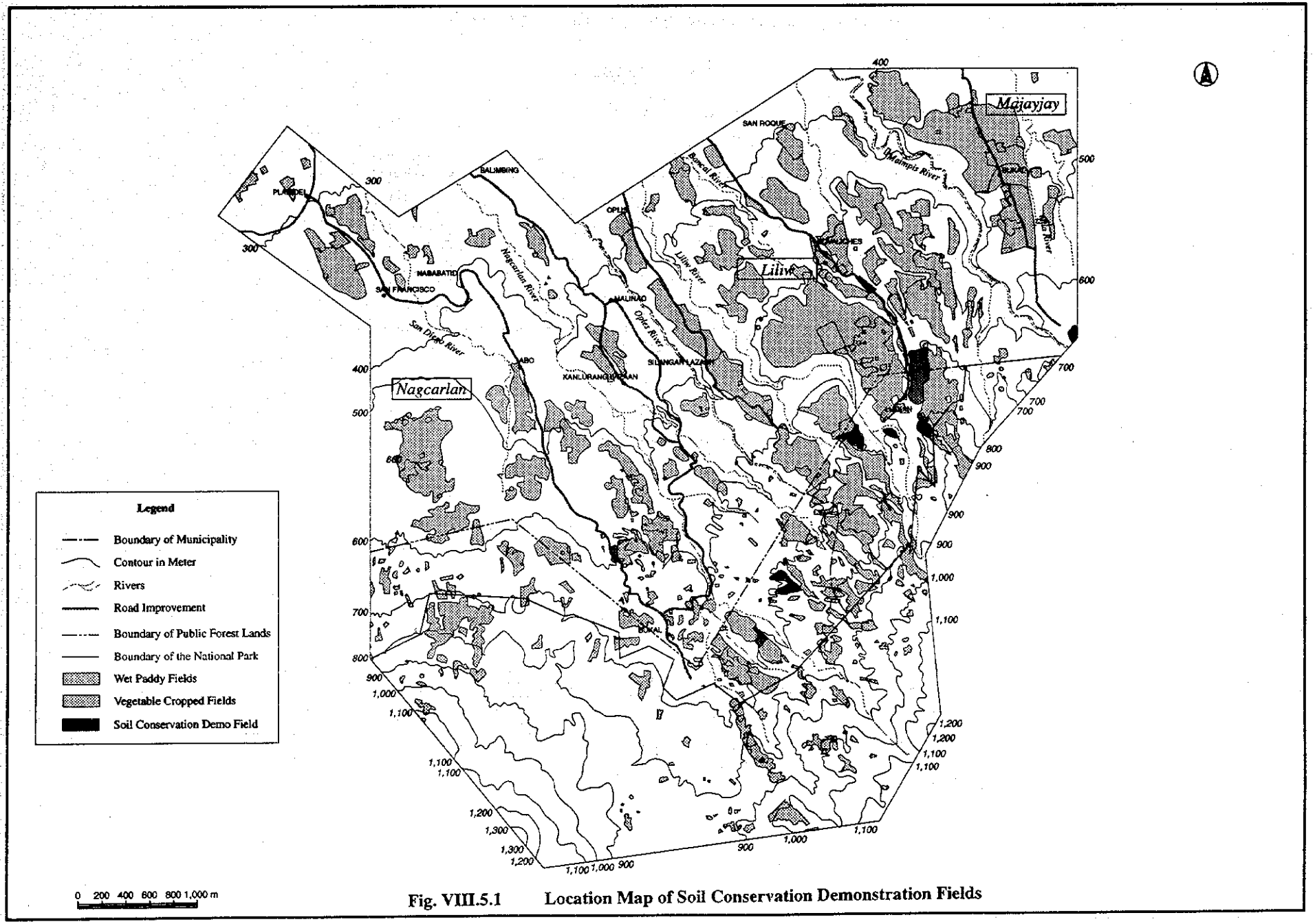
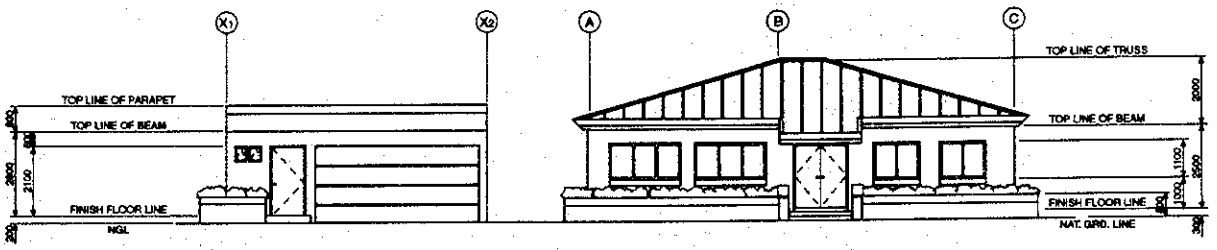
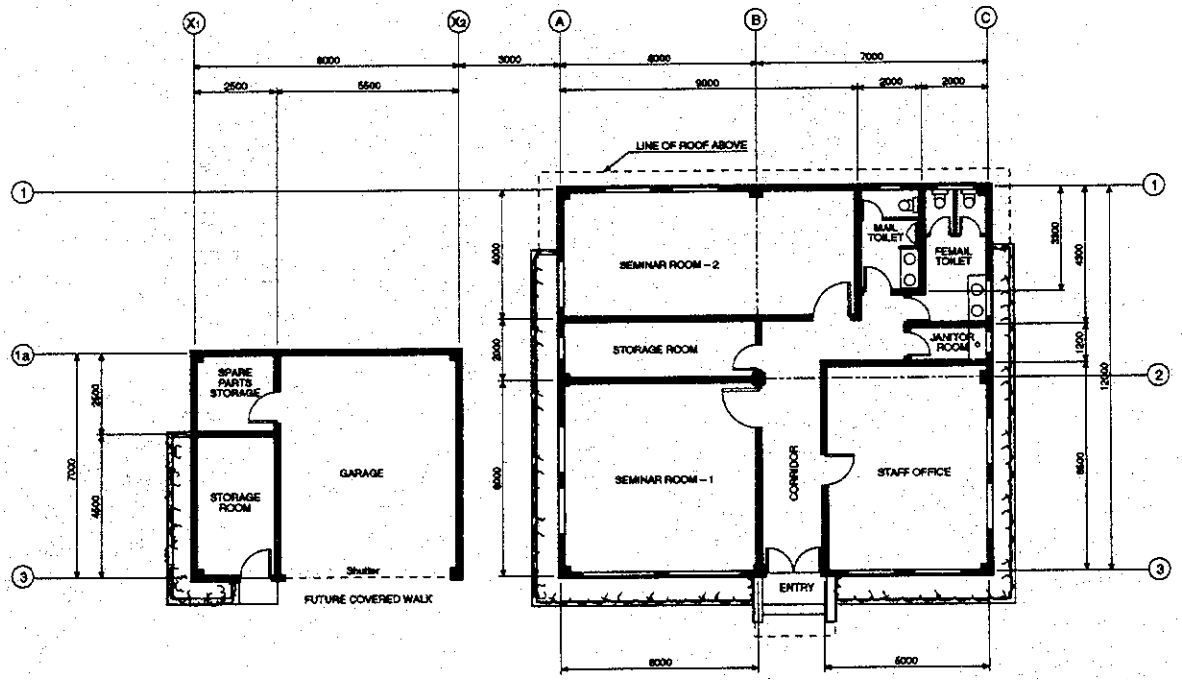


Fig. VIII.5.1 Location Map of Soil Conservation Demonstration Fields



FRONT ELEVATION
MTS.



GROUND FLOOR PLAN
MTS.

Fig. VIII.5.2 Plan of Soil Conservation Extension Center

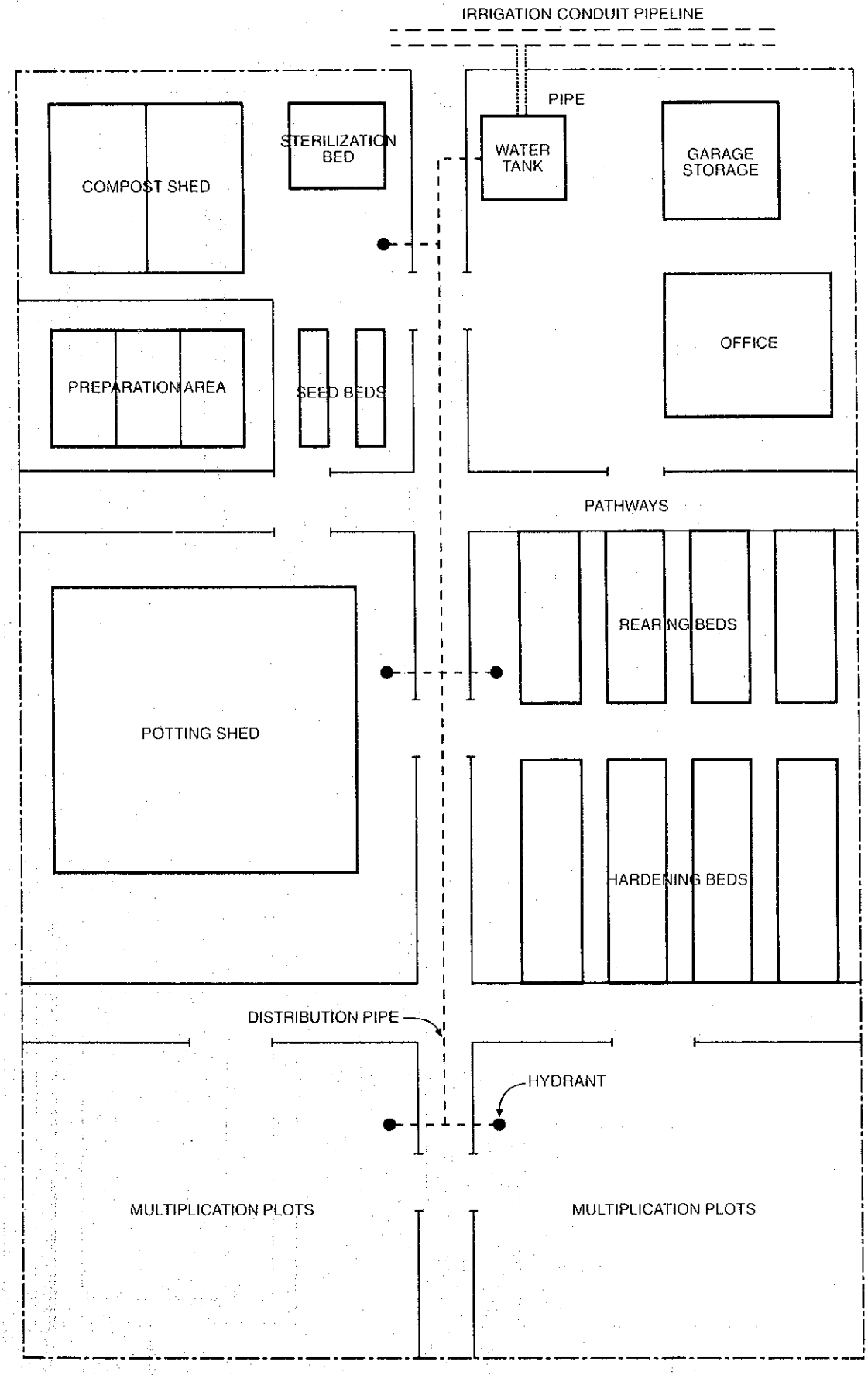
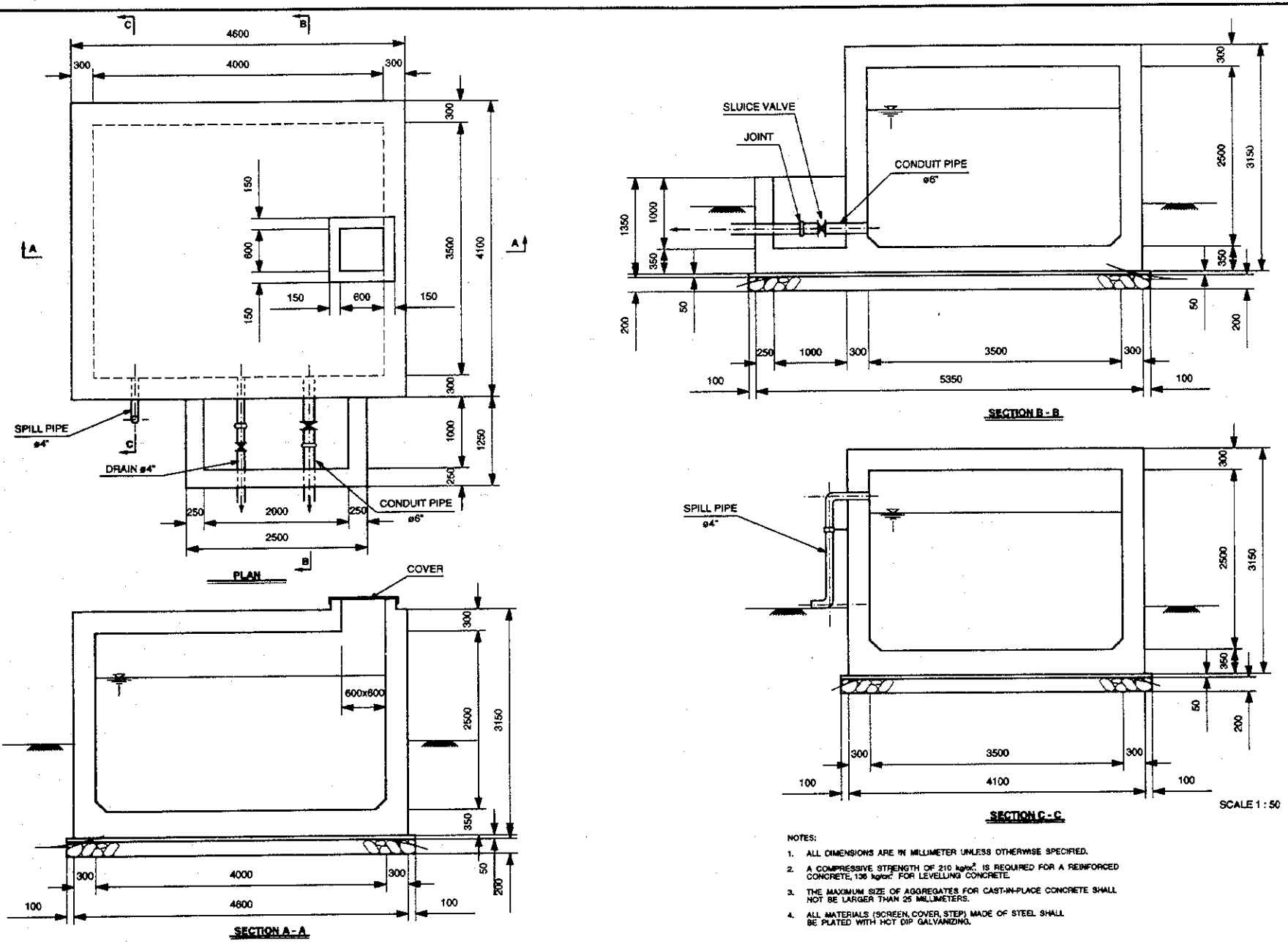


Fig. VIII.5.3 Typical Nursery Layout



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE SPECIFIED.
2. A COMPRESSIVE STRENGTH OF 210 kg/cm^2 IS REQUIRED FOR A REINFORCED CONCRETE, 136 kg/cm^2 FOR LEVELLING CONCRETE.
3. THE MAXIMUM SIZE OF AGGREGATES FOR CAST-IN-PLACE CONCRETE SHALL NOT BE LARGER THAN 25 MILLIMETERS.
4. ALL MATERIALS (SCREEN, COVER, STEP) MADE OF STEEL SHALL BE PLATED WITH HOT DIP GALVANIZING.

Fig. VIII.6.1 Plan of Rehabilitation Work for Rural Water Supply Intake Boxes at Gawanan Springs

FEASIBILITY STUDY ON
THE UPLAND IRRIGATION AND
RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

APPENDIX-IX

IMPLEMENTATION SCHEDULE AND COST ESTIMATES

FEASIBILITY STUDY
ON
THE UPLAND IRRIGATION AND RURAL DEVELOPMENT PROJECT
IN SOUTHERN LUZON

APPENDIX-IX

IMPLEMENTATION SCHEDULE AND COST ESTIMATES

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APPENDIX-IX IMPLEMENTATION SCHEDULE AND COST ESTIMATES

1 Implementation Schedule

1.1 Project Components

Project components consist of 1) irrigation facilities, 2) road construction, 3) trading posts construction, 4) Upland Horticulture and Irrigation Technology Center construction, 5) Soil Conservation works comprising of Soil Conservation Extension Center and demonstration fields construction, and 6) rehabilitation works on domestic water supply facilities. The major features of the proposed facilities are as follows:

Work Volume of Construction Works

Items	Description	Q'ty	Unit	Remarks
1 Irrigation Facilities	Irrigation Blocks	10	blocks	Total irrigable area: 320 ha
	Intakes	2	sites	Water source: Spring yield
	Farm ponds	10	sites	Concrete structure (V = 360 cum)
	Pipeline	49,750	m	(ø80 - ø250mm)
	On-farm facilities	173	units	(Hydrant valves)
2 Road Construction	Concrete pavement	18,539	m	W = 5.0 m: 3,131 m W = 4.0 m:15,408 m w/ L-shape drainage ditch
	Drainage culvert	132	sites	RC pipe/box culverts type
	Bridge	4	bldgs	Box type
3 Trading Posts		15	bridges	Storage space/office (Floor area: 152 sq.m)
4 Upland Horticulture & Irrigation Technology Center	Center building	1	bldg	(Floor area: 264 sq.m)
	Demo-farm	1	site	(Area: 1.0 ha)
	Green house, etc.	3	houses	(Floor area: 630 sq.m)
	Storage/garage	1	bldg	(Floor area: 56 sq.m)
5 Soil Conservation Works	Center building	1	bldg	(Floor area: 156 sq.m)
	Storage/garage	1	bldg	(Floor area: 56 sq.m)
	Demo-field	1	site	(Area: 0.2 ha)
	Contour hedgerow, SALT	12.2	ha	
6 Rehabilitation works on Domestic Water Supply	Intake box	2	sites	
	Pipeline rehabilitation	1	LS	

1.2 Work Volume of the Construction Works

Construction works are composed of earth works, concrete works, piping works, steel works and building works, etc. Total amount of 27,060 cu.m of concrete materials comprising of 23,500 cu.m plain concrete and 3,560 cu.m reinforced concrete are predominant in the construction works. Furthermore, pipe installation works for irrigation attain its total length of 49,750 m. Major construction materials of each construction work are tabulated below:

Major Work Volume

Items	Materials	Q'ty	Unit	Remarks
1 Irrigation Facilities	Excavation	17,000	cu.m	(excluding surface smoothing)
	Reinforced concrete	1,400	cu.m	
	Reinforcing bar	90	ton	
	Gravel foundation	300	cu.m	
	Pipeline	49,750	m	ø250mm: 800 m
	(ø80 - ø250mm)			ø200mm: 2,800 m
				ø150mm: 1,950 m
				ø125mm: 4,460 m
				ø100mm: 11,110 m
				ø 80mm: 28,630 m
	On-farm facilities	173	units	(Hydrant valves)
2 Road Construction	Plain concrete	23,500	cu.m	
	Reinforced concrete	1,200	cu.m	
	Gravel sub-grade	25,000	cu.m	
	RC pipes	550	m	ø300mm: 20m
				ø450mm: 145m
				ø600mm: 275m
				ø750mm: 60m
				ø900mm: 50m
3 Trading Posts	Reinforced concrete	670	cu.m	Other works:
	Reinforcing bar	25	ton	Electric works
	Roofing (G.I. sheet)	3,000	sq.m	Plumbing works
	Structural steel	60	ton	Gravel pavement
4 Upland Horticulture & Irrigation Technology Center	Reinforced concrete	170	cu.m	Other works:
	Reinforcing bar	9	ton	Electric works
	Roofing (G.I. sheet)	420	sq.m	Plumbing works
	Structural steel	0.5	ton	Gravel pavement
	Structural lumber	7	cu.m	Fencing works
	Plain concrete (road)	400	cu.m	
5 Soil Conservation Works	Reinforced concrete	100	cu.m	Other works:
	Reinforcing bar	5	ton	Electric works
	Roofing (G.I. sheet)	250	sq.m	Plumbing works
	Structural steel	0.3	ton	Gravel pavement
	Structural lumber	4	cu.m	Fencing works
6 Rehabilitation works on Domestic Water Supply	Reinforced concrete	20	cu.m	
	Reinforcing bar	2	ton	
	Conduit	540	m	ø200mm: 270 m
				ø150mm: 270 m

Note: Quantities of above indicate major items, and exclude minor quantities.
Quantities of above exclude amount of loss.

1.3 Construction Planning

(1) Workable days

Workable days are estimated as follows, taking into account of daily rainfall in the Study area. Construction works are broadly composed of i) concrete works (road pavement, concrete tank, etc.), ii) earth works, iii) piping works, iv) building works. Amongst these works, concrete works volume occupies the majority of whole construction volume. In relation to the fact, workable days are estimated primarily aiming at the concrete works. The following are estimated assuming that concrete works are discontinued in the case a daily rainfall is 15 mm or above on condition that sheet protection is carried out during an initial curing time of concrete. Earth works, especially compaction works, is not continued in the case that the daily rainfall reaches above 4 mm. Major earth works of the construction works are comprised of excavation works of existing road sub-base and excavation works for irrigation farm pond foundation as listed below. Compaction works such as embankment, however, are not planned in the earth works so that the workable days restricted by daily rainfall amount of above 15 mm for concrete works will be considered to make a construction schedule.

Workable Days

(unit: days)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Workable days	25	24	25	23	23	18	20	20	20	16	18	22	254

Note: Construction works are discontinued in the case daily rainfall is 15 mm or above.
Source: Rainfall data at Liliw (1979 - 1983)

(2) Temporary works

Temporary works shall be planned to achieve the appropriate quality control, to minimize construction cost, to secure the safety of labors and machinery/equipment, to maintain appropriate construction schedule, etc. The following are the temporary works required for the construction works:

a) Mobilization of concrete batching plant (quality control of concrete and minimization of construction period)

b) Establishment of stock yards for construction materials and motor pool for construction equipment (quality control)

c) Installation of electric and water supply system (quality control)

d) Maintenance work of material transportation roads and foot-pass (safety control of labors and construction machinery/equipment)

e) Set up of temporary strut retaining wall (safety of labors)

f) Establishment of soil disposal yards with proper erosion protection (environmental preservation)

g) Installation of drainage canals/culverts (environmental preservation and maintenance of construction schedule)

h) Installation of scaffold and staging (safety of labors)

Because construction of temporary roads is restricted in the critical environmental area, the Public Forest lands and the National Park area, adequate maintenance works of temporary roads and foot-pass for material transportation remarkably influence whole construction schedule. Scaffolding and staging composed of lumber material is adopted for the material transportation at the steep sites in the mountainous areas. Concrete batching plants are also properly distributed in the project area with due consideration of concrete requirements, transportation time, as well.

(3) Construction plan

Construction plan of the major proposed facilities are as follows:

a) Irrigation facilities

Irrigation facilities are composed of the intakes, farm ponds and pipeline installation works. Construction works broadly consist of earth work, concrete work and pipeline work. Transportation of the construction materials (cement, aggregates, steel bar, steel pipes, wooden forms, etc.), concrete mixing and earth works are carried out by man-power due to its prohibition of temporary road construction in due consideration of the environmental preservation in the Project area. Construction planning shall be established taking transportation capacity (labor force) and construction schedule. All of the excess materials, e.g., excavated earth materials, form lumber, steel materials and temporary structures shall be properly disposed outside of the critical environmental area. Conduit pipe shall be lain under the ground surface. Regarding intakes, concrete structures are recommended so as to mitigate surface wearing by flow, and to ensure impermeability through foundation. Also confronting to the difficulty of access due to prohibition of O&M road construction in the critical environmental areas, in addition, another exploration relating to stability of intake structures and impermeability shall be conducted prior to the construction works.

b) Rural Road

Road works are composed of concrete pavement, drainages, and bridges construction works. Regarding quality control and construction control maintenance, all concrete shall be produced at the batching plant and transported by agitator-body trucks or dump trucks. Proper mixing capacity and transportation cycle time shall be examined to achieve effective concrete casting works. Transportation time including mixing works is restricted within 1.5 hours and 1.0 hour for the agitator-body truck and dump truck, respectively. Drainage culverts and bridges construction shall be completed during the dry season to minimize flood damages. Furthermore, detailed planning for the route selection of concrete pavement shall be decided in consideration of transportation of farm products and common traffic in the Project area. Gravel sub-base with its thickness of 15 cm shall be constructed to protect concrete pavement from traffic load including construction machinery/equipment. Replacement method shall be adopted provided bearing capacity is too small against load.

c) Trading posts

Construction works of trading posts are composed of foundation, floor, steel structure and roofing works. Appropriate distribution of man power to proposed 15 trading posts and effective manufacture of steel structures result in minimization of the construction period.

d) Upland Horticulture and Irrigation Technology Center

The Center is comprised of the center building, storage/garage, green house and demonstration farm, etc. Procurement schedule of heavy equipment for earth work, concrete delivery schedule from batching plant and delivery of electric and plumbing materials shall be planned before the construction works. Condition of the foundation shall be also exploded by excavation of test pits for the preparation of prospective specific foundation treatment.

e) Soil Conservation Extension Center and demonstration fields

The Center is comprised of the center building, storage/garage and nursery. Procurement schedule of heavy equipment and foundation exploration shall be carried out before the construction works to secure the construction schedule.

Transplanting in the demonstration fields selected amongst existing farmlands shall be carried out with participation of the beneficiaries. Technical assistance of PENRO is simultaneously expected during the construction works.

f) Rehabilitation works of domestic water supply system

The rehabilitation works are composed replacement of intake tanks and timeworn conduits in proposed two sites in Nagcarlan and Liliw. Temporary diversion works which contribute for present water supply shall be attained before the commencement of the works.

1.4 Construction schedule

Construction schedule is planned as shown in Fig. IX.1.1 on each project component. Construction schedule is calculated in terms of the workable days, concrete mixing capacity, number of laborers, working hours a day, as well as temporary works. As a result of the calculation, the construction works could be completed within eighteen (18) months including mobilization/demobilization.

Monthly rainfall amount is fluctuated in a year, and most of rainfall is concentrated during the wet season from May to December. Earth works shall be conducted during the dry season because earth works are severely affected by consistency of soil. Meanwhile, the existing road in the Project area will hardly be utilized for passing of the transportation of construction materials, equipment and labor force to the scattered sites due to the rough and irregular surface condition. In this connection, concrete pavement works of these existing roads shall be commenced prior to the other construction works. Concrete pavement works shall be continued even during the wet season with proper drainage works and surface protection works of pavement from heavy rainfall during concrete curing.

The indispensable equipment for project implementation, agricultural and soil conservation extension

services shall be provided immediately after the completion of each proposed facility to expect an earliest appearance of the input procurement effect of the equipment.

1.5 Implementation Schedule

The project implementation schedule including one (1) year for pre-construction activities, such as submission of the Project Description (PD) and Project Proposal, as well as establishment/strengthening of beneficiaries' organizations, is presented in Fig. IX.1.1. As described in Appendix XI in detail, the Project Description shall be submitted to DENR Regional office to get Environmental Compliance Certificate (ECC) prior to the commencement of the construction works because the project implementation in the critical environmental area can not be proceeded without ECC. Furthermore, establishment and strengthening of beneficiaries' organization, such as IAs and marketing cooperatives are inevitable to attain smooth project implementation. Land acquisition and land compensation for temporary works will be simultaneously proceeded with dissemination of the project implementation.

2 Project Cost Estimates

2.1 Assumptions

The construction cost of the Project is estimated based on the following assumptions:

(1) Unit prices are analyzed on the basis of average prices as of mid-1994.

(2) The exchange rate used in estimate is as follows:

US$ 1.00 = ₱ 27.00 = J¥ 100.00

(3) All construction works will be undertaken under the contract basis. Contractor(s) will be selected by international competitive bidding. All construction machinery and equipment are to be provided by the contractor(s).

(4) Taxes on the construction materials, machinery and equipment imported from abroad are to be exempted and are not included in the cost estimate.

(5) The construction cost based on unit cost is divided into foreign and local currency portions. Local currency portion is estimated on the basis of the current price in Laguna Province and foreign currency is estimated based on the CIF prices at Manila.

(6) The construction costs are estimated with paying attention to the protection of the nature resources, e.g., estimate of protection of soil disposal areas from soil erosion, transportation of construction materials by man-power without temporary roads construction, disposal of excess construction material to outside of critical environmental area, proper temporary drainage system to prevent water contamination, expenses for monitoring and inspection works on negative impacts of natural resources, etc.

(7) As the project sites are located in the critical environmental area, construction works which affect negative impact, as well as maintenance road, shall be restricted. Assuming a difficulty of maintenance works for proposed facilities, durability corresponding to each facility is considered in the proper selection of materials and in the structural designing.

(8) Construction period is estimated at 18 months taking account of proper quality control, construction schedule maintenance and minimization of construction cost, etc., as described in 7.1.2 (2) "Temporary works".

(9) The physical contingency of ten (10) percent of the total costs of detailed design, construction, O&M equipment, administration/engineering and land acquisition is included in the Project cost.

(10) Price contingency is also taken into account at an annual escalation rate of four (4) percent for the foreign currency portion and eight (8) percent for local currency portion. Inflation rates has decided referred to that of Casecnan Multi-Purpose Project funded by IBRD.

2.2 Project Cost

Financial Project cost is comprised of the following items:

1) Construction cost

Construction cost is composed of direct construction cost, cost for temporary and preparatory works, contractor's expenses. The cost for the temporary and preparatory works are assumed at about 5 to 10 % of the direct construction cost. The contractor's expenses are assumed at about 20 % of the direct construction cost. Total construction cost is estimated at around ₱ 214.6 million. Construction cost is summarized in Table IX.2.3 to Table IX.2.8.

2) Procurement Cost of O&M

The costs of O&M machinery and equipment are estimated based on the current price in Manila. Total O&M cost is estimated at around ₱ 12.2 million. Procurement cost of O&M is tabulated in Table IX.2.9.

3) Administration cost

Detailed design, construction works including pre-construction works, are undertaken by the governmental staff with assistance and advice of the consultants. Administration cost is estimated based on the required number of governmental staff for pre-construction works, detailed deign and construction supervisory works. Total administration cost of ₱ 4.7 million comprising of ₱ 0.4 million for pre-construction works, ₱ 1.4 million for the detailed design works and ₱ 2.9 million for the construction supervisory works is estimated. Administration cost for each stage are given in Table IX. 2.11.

4) Engineering service cost

The cost for engineering is approximately calculated at about ₱ 38.9 million, comprising of