

6. ORGANIZATION AND MANAGEMENT

6.1 General Aspects

The organization and management approaches proposed for the implementation of the Project as well as for O&M of the rehabilitated irrigation schemes have been worked out paying full attention to the function and capacity of the existing governmental and non-governmental organizations as well as to the Irrigation Policy 1992. The said policy emphasizes active participation of the farmers in the selection, design and construction of irrigation facilities, especially the construction of tertiary canals. In addition to the above, the policy states that all the Government-developed and managed irrigation schemes which cover up to 500 ha in the hilly region and 2,000 ha in the Terai plain and, if it is found feasible, even bigger projects should be handed over to the farmers (beneficiaries). It also states that all the activities required for O&M and water management for the rehabilitated irrigation schemes (usually, the rehabilitation of the irrigation schemes is carried out using the governmental funds, and farmers are requested to bear 5% of the total rehabilitation cost either by cash or labour contribution according to the policy) should be carried out by the concerned WUAs which will be established under each rehabilitated irrigation scheme. With this background, the organization and management of the rehabilitated irrigation schemes, especially, the organization for implementation of the Project as well as for O&M and water management after its completion are proposed as follows.

6.2 Preparatory Activities Necessary for Establishment of WUAs

It is proposed that 13 WUAs will be newly established under the Project and the farmers who belong to the said WUAs should operate and maintain the irrigation facilities which command 1,727 ha of agricultural lands in total. It is estimated that the total number of members of these WUAs would amount to about 7,000. And it is anticipated that it would be difficult to organize these farmers into 13 WUAs in a short period and that WUAs could not work effectively within a limited time. To solve this, there should be some preparatory period and cooperation as well as deep understanding of the Project by the farmers. Accordingly, each DIO, which is expected to play an important role in implementation of the Project, is requested to start the following preparatory activities for establishing WUAs at least 1.5 years ahead of the project implementation. These activities are also described in Chapter 3 of the O&M Manual.

- (1) AOs who belong to each DIO shall select 5 leading farmers from each target irrigation scheme and AOs shall organize these farmers into a team including AOs themselves. Then, the team, under the leadership of AOs, shall start to disseminate information and explain to the farmers about the Project, project implementation method, activities and duties to be fulfilled by the farmers under the Project, and try to promote closer cooperation of the farmers.
- (2) In parallel with the above activities, AOs of each DIO, with assistance of the technical staff, shall select 10 leading farmers from each target irrigation scheme and give them the orientations (technical training) of which details are given in Clause 3.7, Chapter 3 of the O&M Manual.
- (3) AOs, with assistance of the technical staff, shall repeat this kind of technical training several times and, thereby, they shall make efforts to establish WUAs which will be strongly supported by the majority of farmers.

6.3 Organization for O&M of the Irrigation Facilities

WUAs shall be responsible for O&M of the rehabilitated irrigation facilities. Since all the members of WUAs are farmers, they are also responsible for O&M. As stated repeatedly, the problems with existing WUAs (few in number) are that farmers have not engaged themselves in O&M of the irrigation facilities. Instead, the existing WUAs have sublet the O&M works to a few people. The sublet works have included only cutting grass and desilting in the irrigation canals, which do not satisfy real need for O&M of the irrigation facilities. Paying full attention to the foregoing, O&M of the irrigation facilities by WUAs to be newly established under the Project should be quite different from those of the existing ones. Namely, O&M of the irrigation facilities by the new WUAs should be carried out on the basis of participation of all farmers. To realize this, farmers under the target irrigation schemes are strongly requested to have a consensus that the rehabilitated irrigation facilities shall be maintained for a long period by themselves and not by the government. This means that the farmers are requested to change their way of thinking in O&M of the irrigation facilities. At the same time, in the near future, they are also requested to improve their technique in water management, i.e. operation of the gates according to the irrigation water demand, and reading of water gauges.

With this background and preparatory activities described in Clause 6.2 above, new WUAs (13 WUAs in total) shall be established under each target irrigation scheme and O&M of the irrigation facilities shall be carried out by these WUAs. All the farmers who belong to the target irrigation schemes shall be the members of these WUAs without exception. And the members of these WUAs are requested to faithfully carry out the works specified in Clauses 3.10 to 3.12, Chapter 3 of the O&M Manual. To carry out these works smoothly and effectively, it has been planned to deploy simple equipment at each WUA as described in Annex-5 (Clause 2.3, Chapter 2). The recommended standard organization of a new WUA is given in Chapter 3 of the O&M Manual. In addition to the above, all the members of WUAs shall bear the duty described in Section-8 of Annex-1 of the O&M Manual, i.e. to pay water charge on a monthly basis. The water charge should be collected from the farmers through the turnout leaders and kept at each WUA and it should be deposited immediately in an authorized bank. The accountant in charge shall control this matter. Unless otherwise specified, no payment shall be made to the O&M activities by the farmers as described in the O&M Manual.

6.4 Organization for Implementation of the Rehabilitation Works

For implementation and management of the rehabilitation works of the target irrigation schemes, no additional organization will be established. Instead, DIOs in the Kathmandu, Bhaktapur, and Lalitpur districts, in collaboration with newly established WUAs, will play the role of managing agencies for the implementation of the rehabilitation works. However, since existing DIOs are suffering from a shortage of technical staff and equipment, they do not have enough capacity to undertake the above-mentioned assignment. Accordingly, they should be reinforced under the Project. Concretely speaking, one engineer and two assistants should be additionally assigned to each DIO. And a team shall be organized on the basis of the said three staffs at each DIO and authority shall be given to the team so that it can support the rehabilitation works effectively. In parallel to this, additional equipment will be deployed at each of the DIOs in order to strengthen their function as executing agencies, thus enabling them to properly manage the rehabilitation works. A concrete plan for equipment reinforcement is described in Annex-5 (Clause 2.3, Chapter 2).

6.5 Supporting Organizations and Farmers' Participation

6.5.1 Supporting Organizations

To successfully implement the Project, coordination among the governmental agencies,

like DoI, RID, DIOs, and farmers is essential. Among others, DIOs are requested to take leadership in guiding the farmers. The DIOs' guidance will include timely assistance to the farmers at the initial stage and during the implementation of the Project, as well as assistance in establishing WUAs. In addition, present AOs and MIT attached to DIOs may be reinforced by recruiting available staffs according to the requirement in each DIO. Through this reinforcement, it is expected that DIOs will become one of the most leading organizations to support farmers' activities to be done prior to/during implementation of the Project. Further, to support DIOs, it is recommended that a foreign advisory team consisting of 2 to 3 (maximum) technical staffs be attached to DIOs for 2 years. This team will mainly assist in solving technical and administrative problems which may arise in the course of establishment of WUAs and provide technical training to the staffs of DIOs.

6.5.2 Farmers' Participation in the Project

Farmers' participation in the Project is considered as one of the most important components of the Project. Especially, farmers' participation at the initial stage of the Project, including the preparatory stage, is considered very important. This is also mentioned more concretely in the O&M Manual. At the preparatory stage of establishment of WUAs, farmers should be well informed of the Project, their expected roles in O&M of the rehabilitated irrigation facilities, as well as in water management so that farmers can get prior understanding on the Project.

Farmers' participation in the Project will include the following:

- (1) Participation in the improvement or construction of on-farm canals below the tertiary canals during the implementation stage of the Project. In irrigation development projects in developing countries, whether they are new or rehabilitation projects, farmers are usually requested to participate in the construction of tertiary canals and below the tertiary canals. If they cannot participate in the above, then they are requested to make cash or other kinds of contributions. It has been planned under the Project that canals will be lined with concrete up to the tertiary canals for which skilled labour and a higher technical standard than those used in the construction of earth canals, may be needed. Accordingly, it is recommended under this Project that farmers' participation in the construction of the canals should be limited to the part below the tertiary canals, i.e., improvement of on-farm canals. It is considered that farmers' participation in the improvement of on-farm canals will not include such works which are costly. Accordingly, such improvement works should be carried out by the farmers themselves under the technical guidance of DIO's staff, without any budgetary support from the Government or WUAs which will be established.
- (2) Participation in the discussions with the officials of DIOs on decision of the locations of turnouts on the tertiary canals.
- (3) Faithful fulfilment of duties as WUA's members in O&M of the irrigation facilities as described in the O&M Manual.
- (4) Regular payment of the water charge according to the mode specified in the O&M Manual in order to maintain WUAs properly.
- (5) Immediate repair of damaged portions of the irrigation canal systems, if these are manageable within their own budget. The collected water charge from the farmers shall be utilized for that purpose.

The above-mentioned farmers' participation should be carried out in an organized manner and not by force but by willingness of the farmers, with proper guidance of DIOs, in accordance with the Irrigation Policy of HMGN.

7. BENEFITS AND JUSTIFICATION

7.1 General

The Project was evaluated assessing the feasibility of the 13 selected schemes in the economic, financial, and socio-economic aspects. The economic feasibility was assessed on the basis of the economic internal rate of return (EIRR), benefit-cost ratio (B/C), and the net present value (NPV or B-C).

The financial evaluation was carried out by analyzing the effect of the Project on a typical farm budget in each of the 13 schemes. The indirect benefits and socio-economic impacts of the Project were also briefly studied.

7.2 Economic Evaluation

7.2.1 Basic Assumptions

The economic evaluation was carried out based on the following assumptions:

- 1) The Project implementation period is three years for the Thika Bhairaw-I scheme; two and half years for the Boshan, Shali Nadi, Kotkhu, and Thika Bhairaw-II schemes; and two years for other 8 schemes; Biswambhara, Dakshinkali, Indrayani, Bidol, Katunje, Kutudhal, Mahadev Kholo, and Lubhu schemes, including one year for the detailed design and preparatory works.
- 2) The economic useful life of the Project is 30 years.
- 3) All prices are constant 1994 prices.
- 4) The exchange rate of US\$ 1.00 = NRs.49.0 = ¥100.0 as of July 1994 is applied.

7.2.2 Evaluation of Economic Factors

The economic prices and costs were evaluated according to the following criteria:

- 1) The standard conversion factor (SCF) is fixed at 0.89.
- 2) Transfer payments are excluded from the Project cost in the economic evaluation.
- 3) Economic prices for agricultural outputs and inputs are determined considering the international prices, SCF, etc.
- 4) The economic opportunity cost of farm labour and unskilled construction labour is priced at NRs.63/man-day by adopting the shadow wage factor of 0.7, considering the actual employment opportunity in the area.
- 5) The economic construction cost for major project facilities is estimated by applying construction conversion factor (CCF).

7.2.3 Economic Benefits

Crop budget data per unit area were used to estimate the production cost and benefit in the Project area at the full development stage as detailed in Annex-6. The irrigation benefit will be generated and increased from year to year, depending on the progress of the Project rehabilitation and the supply of irrigation water. It is expected that the total irrigation benefit will attain the expected level five years after the completion of rehabilitation of the irrigation facilities, and the generation of benefit will be continuously sustained afterwards.

At the full development stage, the economic irrigation benefits under the "without" and

"with" Project conditions are estimated as shown in Table 7-1 and summarized below:

(Unit : NRs.1,000)

Schemes	Farm land area (ha)	Without Project	With Project	Increment Benefit	Increment per ha
Kathmandu District					
AK-04 Biswambhara	92	4,141	13,112	8,971	97.5
AK-05 Boshan	122	5,427	15,548	10,121	83.0
AK-07 Dakshinkali	67	2,612	9,549	6,937	103.5
AK-14 Indrayani	101	5,019	14,395	9,376	92.8
AK-25 Shali Nadi	157	8,859	24,227	15,368	97.9
Bhaktapur					
AB-02 Bidol	32	1,510	4,078	2,568	80.3
AB-10 Katunje	40	1,890	4,823	2,933	73.3
AB-12 Kutudhal	23	2,084	4,522	2,438	106.0
AB-14 Mahadev Khola	112	5,047	12,388	7,341	65.5
Lalitpur					
AL-10 Kotkhu	246	10,845	31,351	20,506	83.4
AL-13 Lubhu	130	5,470	16,228	10,758	82.8
AL-19 Thika Bhairaw-I	497	21,501	63,340	41,839	84.2
AL-20 Thika Bhairaw-II	88	3,940	12,542	8,602	97.8

7.2.4 Economic Costs

(1) Economic Construction Cost

The economic costs were derived from the financial costs, shown in Table 5-1, by applying CCFs for each of the major components as described in Annex-7. A summary of the economic construction cost is shown below:

(Unit : NRs.1,000)

Schemes	Financial Cost			Economic Cost		
	Local	Foreign	Total	Local	Foreign	Total
Kathmandu District						
AK-04 Biswambhara	11,737	9,873	21,610	9,404	9,573	18,977
AK-05 Boshan	14,225	11,802	26,027	11,066	11,339	22,405
AK-07 Dakshinkali	10,723	9,191	19,914	8,592	8,911	17,503
AK-14 Indrayani	11,050	9,216	20,266	8,853	8,936	17,789
AK-25 Shali Nadi	18,515	14,534	33,049	14,403	13,988	28,369
Bhaktapur						
AB-02 Bidol	8,926	4,978	13,904	7,029	4,836	11,865
AB-10 Katunje	5,492	4,697	10,189	4,400	4,554	8,954
AB-12 Kutudhal	7,525	6,278	13,803	6,029	6,087	12,116
AB-14 Mahadev Khola	19,233	16,239	35,472	15,409	15,745	31,154
Lalitpur						
AL-10 Kotkhu	32,312	25,943	58,255	25,072	24,914	49,986
AL-13 Lubhu	19,457	15,889	35,346	15,587	15,408	30,998
AL-19 Thika Bhairaw-I	84,558	64,929	149,487	64,319	61,944	126,263
AL-20 Thika Bhairaw-II	21,030	16,900	37,930	16,447	16,258	32,705

(2) Annual O&M Cost

Annual O&M costs include repair and maintenance cost of the facilities, administration cost, fuel and operation cost of O&M equipment, and office operation cost. The average annual O&M cost was estimated at NRs.3,170/ha as shown in Table 7-2. Annual O&M costs for the respective schemes were converted to the economic O&M costs by applying CCFs.

(3) Replacement Costs

In general, some of the facilities such as gates for intake and canal structures and O&M equipment have a shorter useful life than the civil works and, therefore, require replacement at a certain time within the Project life. In this Project, no heavy O&M equipment is included. And most of important equipment such as vehicles, motorcycles, survey equipment, portable concrete mixers, and so on would be procured for strengthening DIOs in order to support O&M activities of the farmers. Accordingly, replacement cost of the O&M equipment is included in the annual O&M cost, and only the replacement cost of gates for intake and canal structures is considered with an assumed useful life of 20 years.

Economic replacement costs were estimated by adopting a salvage value of 10% and CCFs as shown in Table 7-2.

7.2.5 EIRR, B/C, and NPV

The EIRR, B/C, and NPV (in terms of B-C) of each scheme were calculated on the basis of the flows of economic benefits and costs mentioned above, as shown below:

Schemes	EIRR (%)	B/C *	NPV * (NRs.10 ⁶)
Kathmandu District			
AK-04 Biswambhara	31.4	3.41	43.5
AK-05 Boshan	25.1	3.00	41.1
AK-07 Dakshinkali	28.2	2.93	31.7
AK-14 Indrayani	33.2	3.75	46.7
AK-25 Shali Nadi	27.7	3.56	66.6
Bhaktapur			
AB-02 Bidol	15.7	1.54	6.1
AB-10 Katunje	22.2	2.27	11.0
AB-12 Kutudhal	14.0	1.38	4.4
AB-14 Mahadev Khola	16.9	1.68	19.8
Lalitpur			
AL-10 Kotkhu	24.0	2.77	80.7
AL-13 Lubhu	24.4	2.54	44.4
AL-19 Thika Bhairaw-I	21.0	2.30	144.4
AL-20 Thika Bhairaw-II	17.3	1.78	23.4

Remarks : * Calculating at a discount rate of 10%

7.2.6 Sensitivity Analysis

Sensitivity analysis is made with respect to changes in yield of farm products, market price of products and the Project cost, as shown in Table 7-8 in Annex-7. The proposed development for respective schemes shows EIRR over 10% except for Kutudhal (AB-12) scheme of 9.6% for the case of 15% increase in the construction cost and 20% decrease in economic benefit.

7.3 Financial Evaluation

In order to assess the irrigation rehabilitation Project from the farmers' economic viewpoint, an analysis of the farm budget for typical farmers was made under the both "with" and "without" Project conditions. The analysis result indicates that the farm income of typical farms under the "with" Project condition is expected to be much higher than that under the "without" project condition. Farm budgets of the typical farm size in each model scheme area are described in Table 7-3 and the average annual net reserve or capacity to pay is summarized below:

(Unit : NRs.1,000)

Schemes	Farm Size (ha)	No. of Families	Without Project	With Project	
				Intensive	Remote
Kathmandu District					
AK-04 Biswambhara	0.41	5.9	13	74	40
AK-05 Boshan	0.28	5.6	3	44	21
AK-07 Dakshinkali	0.28	5.9	6	47	24
AK-14 Indrayani	0.37	5.7	16	69	39
AK-25 Shali Nadi	0.27	6.4	12	47	25
Bhaktapur District					
AB-02 Bidol	0.19	6.0	1	26	10
AB-10 Katunje	0.24	5.9	9	34	18 *
AB-12 Kutudhal	0.30	5.6	6	38	18 *
AB-14 Mahadev Khola	0.26	5.9	1	26	9 *
Lalitpur District					
AL-10 Kotkhu	0.19	5.3	1	25	9
AL-13 Lubhu	0.23	6.2	4	29	18
AL-19 Thika Bhairaw-I	0.25	5.8	1	35	15
AL-20 Thika Bhairaw-II	0.13	5.9	1	16	5

Note * : For conservative estimation, the typical farmer's budget in remote areas is taken as that in the downstream area where no irrigation water will be available in the dry season due to the shortage of available water.

Judging from the analysis result, each scheme can be justified financially from the beneficiaries' viewpoint.

A standard farm in remote type area in Thika Bhairaw-II scheme of which standard size is the smallest as 0.13ha among 13 model schemes, will get about NRs.4,000/year of incremental capacity-to-pay, or about NRs.30,000/ha/year. It is considered that this amount will be quite sufficient to pay not only water charge but also contribution for construction of field ditches as well as necessary facilities for vegetable collection centres as recommended in Chapter 9.

7.4 Indirect Benefits and Socio-economic Impacts

(1) Increase of Employment Opportunities

The Project will create a demand for farm labour which will be accrued from increased farming activities as a result of the increase in irrigation area as well as intensive use of the land. The incremental farm requirement was estimated to reach 574 million man-days annually.

(2) **Increase of Crop Production and Stable Supply of Products to Kathmandu**

The Project will increase the production of vegetables (30,710 tons), which will bring about considerable profit to the beneficiaries in the Project area. These products will be marketed in Kathmandu City for domestic use. People in Kathmandu City will enjoy those fresh and stable supply of the products from the project area due to the locational advantage.

(3) **Increase of Farmers' Income**

The farmers' income will be expected to improve considerably due to the increase of crop production, as described in the previous chapter. This increase in income will contribute to the improvement of their living standards.

8. ENVIRONMENTAL ASPECTS

8.1 Present Environmental Condition

8.1.1 Natural Environment

The Project areas are located in the Kathmandu Valley and their land is used mainly for agricultural purposes except for scattered settlements and other lands as shown in Table 3-6, although urbanization has been progressing in some scheme areas. There are no forests in the areas of the selected irrigation schemes. Paddy is the main crop under irrigation and maize follows without irrigation in the rainy season. Wheat and such winter crops as potatoes, vegetables, mustard, millet, and legumes are cultivated in the dry season with limited irrigation. Although there is no pasture land in the Project areas, livestock farming has developed considerably. Goat, cattle, buffalo, and poultry are the common livestock. There are neither natural vegetation nor natural wildlife habitats in the areas of the selected model schemes.

8.1.2 Socio-economic Environment

The population in the Kathmandu Valley increased at an average annual growth rate of 3.7% (5.1% for urban area and 2.3% for rural area) during the last decade. The cultivated area decreased from about 49,800 ha or 76% of the Valley area in 1981/82 to about 30,000 ha or 46% in 1991/92, mainly due to the expansion of the Kathmandu metropolitan area and urbanization of rural area.

Most of the irrigation facilities in the Valley are old and do not function well. Although most of the agricultural support systems are fairly well organized and operate intensively, the major constraints on agricultural development in the Project areas are i) unstable production which basically depends on the rainfed condition, ii) shortage of irrigation water due to superannuation and damage of the existing irrigation facilities and increasing demand for domestic water supply, and iii) decreasing farmland due to urbanization as well as industrial development such as brick making.

In the Project Areas, there are about 7,200 farm households occupying about 3,070 ha in gross area and about 1,730 ha of net cultivated land with an average of 0.24 ha per farm. The average family size is 5.8. 38% of the farmers are owner cultivators, 36% are owner cum tenant farmers, and 26% are tenant farmers. The prevailing cropping patterns are:

Paddy - Wheat	69%
Paddy - other winter crops (potatoes, vegetables, maize, etc.)	25%
Maize - winter crops (wheat, mustard, millet, barley, legume, etc.) or fallow	6%

The average unit yields of major crops are higher than those for the whole of Nepal, especially the unit yield of paddy is almost twice (4.2 tons/ha compared to the average of 2.28 tons/ha for the whole of Nepal). The average amount of applied chemical fertilizers far exceeds that used in other areas of the country; it is estimated at 608 kg/ha/year while the average in Nepal is 70 kg/ha/year as referred to in Table 1-39 in Annex-1.

41% of the farm households in the Kathmandu Valley raise cattle mainly for milk production, and 34% keep goats and poultry of which meat fetches good prices in the market. The Fishery Office recommended to apply the "Paddy cum Fish Culture" pattern, but the area of the ponds operated under this type of fish culture is only 7 ha in the Valley and most of them are for home consumption purposes.

The majority of farmers in the areas of the selected irrigation schemes have huge amounts of non-farm income, which are estimated at 50% to 75% of their total annual household income of about NRs.35,000.

The Project areas are located in the Kathmandu Valley where basic rural infrastructure

such as settlement yards, roads, schools, postal and medical facilities, etc. as well as various agricultural support services facilities like sub-centres for agricultural extension services, branch offices and dealers of AIC for supply of agricultural inputs and branch offices of ADB/N for agricultural credit, is fairly developed.

The economic circumstances change rapidly, but the rural people in the scheme areas could not adapt themselves quickly and still keep traditional practices to some extent, such as in cereal production, using no draught animals and measuring by traditional measurements. One of the main causes of the traditional practices is ethnic groups. Main ethnic groups in the scheme areas are the Newar (56%), Chhetri (29%) and Brahmin (10%). Among those ethnic groups, the Newar tends to cluster in one community. Newar farmers who own their farmland in other villages are not willing to live in other villages where most of their farmland is located. Females of the Chhetri tribe are known to be hard workers, therefore although labour charge of females is generally about half that of males, labour charge of females of the Chhetri tribe is the same as that of males.

One of the demographic characteristics of the Project areas is that the male population exceeds the female population (51.4% against 48.6%), even though in the whole of Nepal the male population is less than the female population (49.9% against 50.1%).

8.2 Beneficial Environmental Impact of the Project

The Project is designed to upgrade irrigation facilities in the respective model schemes of approximately 3,000 ha in gross command area in total. About 10,000 farm families who are living in the Project areas will increase their farm income through improved irrigation water supply and crop diversification.

The local transportation system will be greatly improved by the construction of O&M roads along the irrigation canals, which will enhance economic activity and contribute to inter-regional accessibility and communication in the Project areas.

The rehabilitation and improvement of the irrigation canal system with washing steps provided in the main and secondary canals will substantially contribute to the domestic water supply. Sufficient domestic water supply through the canals would greatly improve the sanitary conditions of the people in and around the Project areas. In addition, farmers will be able to use water to wash harvested vegetables, which is expected to increase the value of vegetables in the market.

The economic value of land will surely increase with the implementation of the Project. This means that the economic activities in the areas will be promoted. After completion of the Project, changes in land use in the Project areas will have to be controlled by HMG/N in order to maintain the agricultural land.

Implementation of the rehabilitation project will help accumulate experience, technical knowledge, and skills of agencies and people concerned in irrigated agricultural projects. These knowledge and skills will spread to the surrounding areas in which HMG/N is promoting a number of small-scale irrigation projects.

With the implementation of the rehabilitation Project, supply of irrigation water will be stabilized and it is much expected to diversify the crops into high value crops and to increase the cropping intensity. Furthermore, the Project areas will be maintained as superior farm and to serve as a base of supply of fresh vegetables to the Kathmandu metropolitan area with promising higher income to the farmers, as well as a green belt zone.

8.3 Negative Environmental Impact and Mitigation Measures

As the majority of the works proposed under the Project involve the improvement of existing schemes, no significant negative environmental impacts are expected, except the following.

Although water quality of the rivers at the intake points of the irrigation schemes is sufficiently suitable for cultivation, water pollution was observed in the lower reaches of the Bagmati due to the sewerage water and wastes thrown in the river from the urban area and urbanized rural area. Due to the improvement of intake facilities, the river runoff will be taken for irrigation with less losses at intake sites. This means that the river water in the lower reaches will be reduced, especially in the dry season. It is necessary, therefore, to establish a rule to increase the flushing capacity in order to maintain the water quality in the lower reaches.

The Bagmati river is a tributary of the Ganges and is a holy river in Hindu beliefs. Along the Bagmati and its tributary, there exist many temples and places of historical and religious importance, including women's ritual bathing places. If those religious values will be hindered by the improvement of intake facilities or by new canal alignment in some schemes, these impacts shall be mitigated with socially acceptable measures such as relocation or compensation, and alternative spaces and facilities shall be provided, though these problems were not reported by DIO during the field survey by questionnaire for screening and scoping of environmental issues.

It is not expected that the increased use of agro-chemicals under the Project will have a significant adverse impact on the natural environment and human health, since the quantities of agro-chemicals applied would be small. As for the chemical fertilizers, since the average amount consumed in the Kathmandu Valley far exceeds that used in other areas of the country, no increased use but optimum use is proposed under the Project.

9. CONCLUSION AND RECOMMENDATIONS

(1) Conclusion

As a result of economic evaluation in terms of EIRR, B/C, and NPV, it is concluded that the 13 model irrigation schemes to be rehabilitated under the Project are technically sound and economically feasible, although the priority of some schemes will be changed.

(2) Stagewise Implementation

Basically, the implementation of the Project should be carried out based on the priorities determined through the economic evaluation. However, considering the nature of the Project which require that the selected model schemes in Kathmandu, Bhaktapur, and Lalitpur districts will benefit equally as much as possible, at least one to two target irrigation schemes with a high EIRR, which are to be selected from each district, should be implemented at the same time. This is considered very important, because the Project also intends to strengthen the functions of the three DIOs in Kathmandu, Bhaktapur, and Lalitpur districts, which are expected to be the main executing agencies of the Project.

It is suggested that the Project be implemented stage-wisely, by dividing the target irrigation schemes into several groups as suggested below:

	First Stage	Second Stage	Third Stage
<u>Kathmandu District</u>	AK-04 Biswambhara AK-14 Indrayani	AK-25 Shali Nadi AK-05 Boshan	AK-07 Dakshinkali*
<u>Bhaktapur District</u>	AB-14 Mahadev Khola AB-10 Katunje	AB-02 Bidol AB-12 Kutudhal	
<u>Lalitpur District</u>	AL-10 Kotkhu ** AL-13 Lubhu	AL-19 Thika Bhairaw-I AL-20 Thika Bhairaw-II	

Note * : Regarding to Dakshinkali irrigation scheme, it is proposed to be implemented in the third stage due to the difficulty of access to the areas to be irrigated, as well as the difficulty of transportation of construction materials especially for canals, although the scheme has a high EIRR of 28.2%

** : Notwithstanding the above stagewise order, the implementation priority of the Kotkhu irrigation scheme is subject to the progress of the Kotkhu Water Supply Project with the construction of a dam at the same location as the existing intake of the irrigation scheme, although the Kotkhu irrigation scheme has high potential among the 13 model irrigation schemes.

(3) Executing Agency and Implementation Period

It is recommended that the implementation agencies of the Project shall be the three DIOs in Kathmandu, Bhaktapur and Lalitpur districts. Construction of the Project shall be carried out on the contract basis under the supervision of the said agencies, in close collaboration with other governmental agencies concerned and the farmers who will benefit from the Project.

The following implementation periods should be considered, depending mainly on the scale of the agricultural areas to be irrigated under the Project, the volume of engineering works required for each target irrigation scheme, etc.:

- (a) 2 years for the Biswambhara, Indrayani, Mahadev Khola, Katunje, Lubhu, Bidol, Kutudhal, and Dakshinkali irrigation schemes,
- (b) 2.5 years for the Shali Nadi, Boshan, Thika Bhairaw-II, and Kotkhu irrigation schemes, and
- (c) 3 years for the Thika Bhairaw-I irrigation scheme.

(4) Strengthening of the Function of DIOs

It is expected that each DIO in the Kathmandu, Bhaktapur and Lalitpur districts will play a leading role in the implementation of the Project through various stages: preparatory stage including establishment of WUAs, detailed design stage, construction stage, handing-over stage, and O&M stage. However, it has been observed through the studies that the present capacity of the said three DIOs, particularly in the aspects of manpower and equipment, is not sufficient to enable them to carry out efficiently their expected roles under the Project. Accordingly, to cope with this situation, the manpower and equipment of the said three DIOs need to be strengthened under the Project. It is therefore recommended that at least three assistant technical engineers be attached to each DIO and additional equipment such as jeeps, pickup trucks, motor cycles, and audio visual set for the training of farmers, etc. be provided. The equipment to be provided is listed in Section 2.3, Chapter 3 of Annex-5.

For monitoring and evaluation the performance of O&M and water management activities under the Project, as mentioned in Section 3.20 of O&M Manual, it is recommended to establish a monitoring and evaluation team (MET) in each DIO. MET shall execute monitoring and evaluating the performance of O&M and water management activities by the farmers during one year after the rehabilitated facilities have been handed over to the farmers and then preferably once in every two years, and DIO may give timely suggestions to each WUA for necessary improvement of various activities in O&M and water management.

(5) Training of WUAs

Since all the farmers who belong to any rehabilitated irrigation schemes, shall be members of WUAs to be established, training of WUAs actually means training of farmers who are expected to undertake very important tasks under the Project. Accordingly, this training is considered very important because the rehabilitated irrigation schemes will be handed-over to the farmers and be maintained by themselves for a long time without expecting much assistance from the Government. Evidently, this situation calls for a drastic change in the way of thinking of the farmers as well as their adequate technical training for O&M of the said facilities. Since the success of the Project largely depends on the degree of performance of the farmers in O&M and water management for the rehabilitated irrigation schemes, it is strongly recommended that as many farmers as possible take part in the training programs, of which details are given in the O&M Manuals (Sections 3.7 to 3.9, Chapter 3). To attain this, each DIO is requested to guide the farmers, taking every possible opportunities at different stages of the Project implementation, in collaboration with OAs and MITs.

(6) Organization of Vegetable Growers Group

Individual farmers in the Project areas have little experience on vegetable farming for commercial purposes. In order to introduce intensive agricultural farming, it is vitally important for them to learn and understand the cultivation technology and to cooperate in farm operation and marketing by groups, such as planting, irrigation, harvesting, storage, packaging, transportation, selling, and purchase of seeds and equipment.

Under the present extension services by ADO, the farmers who are interested in

vegetable farming in the service area of the centre are organized and provided guidance on the farming techniques. At present such growers' groups have not been organized yet in each scheme area.

After completion of the Project, all farmers in the scheme areas will be able to introduce the vegetable cultivation. Accordingly all the farmers in the terminal unit of WUA in each scheme should be organized as a Vegetable Growers' Group (VGG) under the supervision of ADO and DIO, in order to manage the vegetable farming, marketing and cooperation, such as transfer/exchange of technical know-how of vegetable farming, procurement of farm inputs and equipment, and production marketing together with proper O & M of irrigation facilities.

As mentioned in the previous chapter, the terminal unit of WUA will be organized for the purpose of O&M of an irrigation scheme on the basis of a tertiary irrigation block, which covers 5 ha. This unit organization of WUA will also function as VGG.

(7) Establishment of the Vegetable Collection Centre

In order to strengthen the activities of VGG, marketing facilities such as the vegetable collection centre should be established in each terminal unit irrigation block area. The vegetable collection centre is a place where farmers in the unit area gather their products for joint shipment.

After harvesting, the farmers clean, select, and package their products for marketing. After that, they carry their products to the place located near the access road to the market in early morning. The typical mode of transportation used by the farmers to carry vegetables to the markets is minibus. Normally, a minibus is hired by a group of farmers but it also happens that individual farmers use their own transportation means.

The main constraints for vegetable marketing in the production area are the time to carry the products to and sell them in the market. Due to the perishable nature of the vegetables, a large part of products is lost. The prices of vegetables mostly fluctuate by harvesting period and are decided by directly between sellers and buyers.

The joint shipment by the members of VGG will be advantageous to the farmers. They can hire minibuses regularly, and the vegetables which are gathered from members' farms to the vegetable collection centre are carried to the market place by the representative members. Also, through discussions, they can coordinate the cropping schedule according to the market demand. Because of regularly and timely supply, they will be able to get the best prices for the products through price negotiations.

The vegetable collection centre will play an important role for VGG activities, not only as a place where farmers gather their products but also as a place where farmers discuss VGG activities such as farming schedule including irrigation period, extension of new cultivation techniques, and present constraints and countermeasures in the area. Therefore, for the successful implementation of the Project and achievement of the target in the Project areas, establishment of the vegetable collection centre is recommended although it may depend on the availability of land. The conditions of the vegetable collection centre are outlined below:

Location and area :

- The centre should have space for parking of minibuses along the premises, if space is inadequate, along the main or approach roads.
- For easy cleaning of vegetables, the centre should be located near a water source such as a river or an irrigation canal.
- Considering the volume of products to be gathered at the collection centre in the peak period, the space of collection centre is recommended to be 30 m².

Facilities :

The recommended facilities include a cemented floor with a two-side roof, and a storage room for keeping equipment such as packaging materials.

Operation & Maintenance :

Operation and management of the collection centre is undertaken by VGG. The management system should be decided by VGG members.

Tables

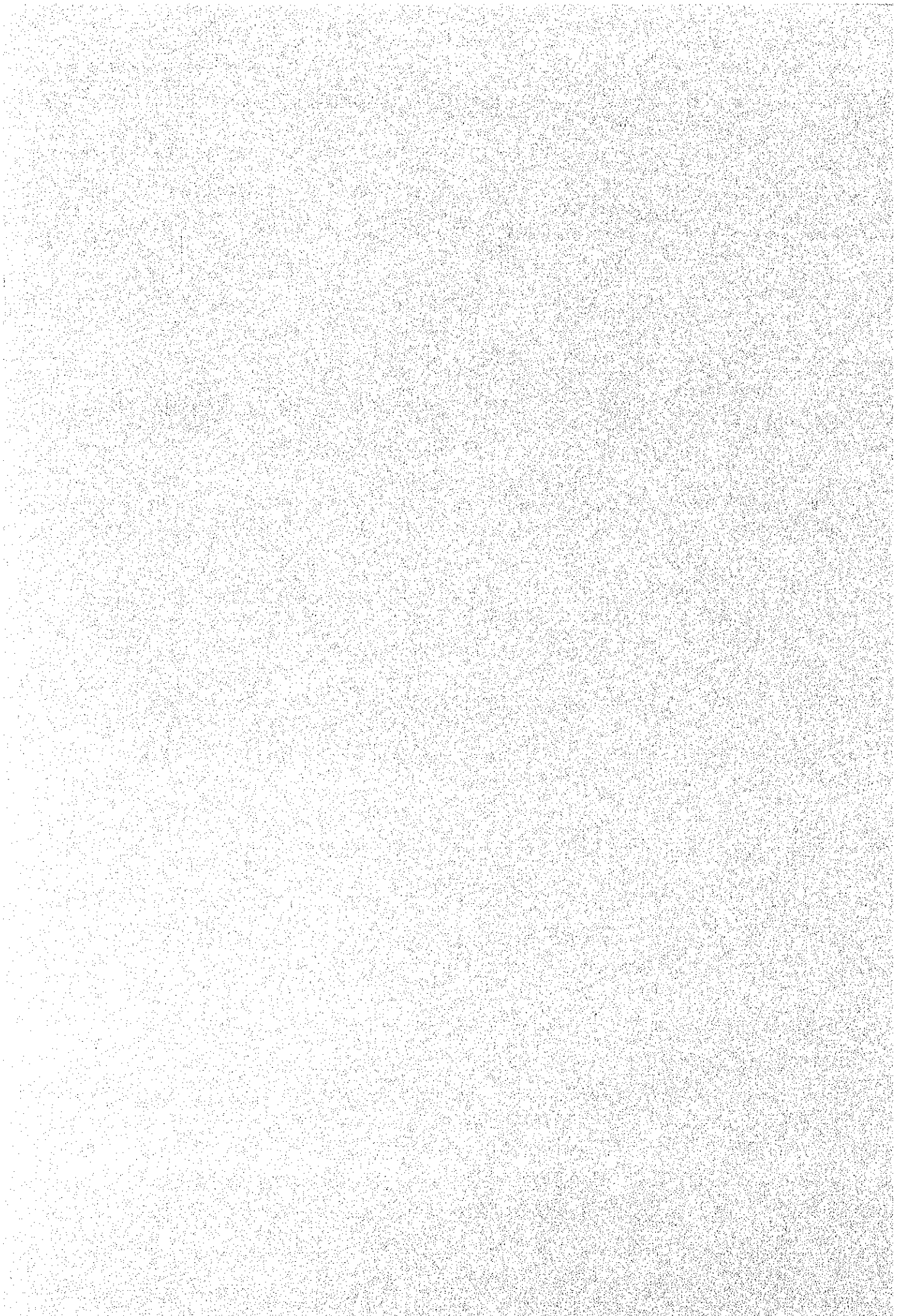


Table 2-1

Evaluation of Priority Schemes

No.	Code No.	Sub No.	Name of Schemes	Evaluation Items							Evaluation by JICA Study Team
				ISP	Farm land condition	Water sources	Farmer's intention	Urbanization	Priority by DOI	Accessibility	
1	AK-01	K-09	Balaju	○	X	△	X	X	X	○	X
2	AK-02	K-20	Balambu	X	--	--	--	--	--	--	ISP
3	AK-03	----	Balkhu	○	X	△	X	X	X	○	X
4	AK-04	K-07	Biswambhara	○	○	○	⊙	○	○	○	○
5	AK-05	K-3	Boshan	○	○	○	⊙	○	○	△	○
6	AK-06	K-8	Budhanikantha	○	○	○	△	△	X	△	△
7	AK-07	K-1	Dakshinkali	○	○	○	⊙	○	△	○	○
8	AK-09	K-17	Dhulopuro	X	--	--	--	--	--	--	ISP
9	AK-10	K-13	Gogal Indrayani Kulo	○	○	△	○	○	X	△	△
10	AK-12	K-6	Gokarna	○	△	X	△	X	○	○	X
11	AK-13	K-5	Ichadol	○	X	△	○	△	X	△	X
12	AK-14	K-11	Indrayani	○	○	○	⊙	○	○	△	○
13	AK-24	K-2	Pharping Dhunge Dhara	○	△	X	○	○	X	△	X
14	AK-25	K-14	Shali Nadi	○	○	○	⊙	○	○	○	○
15	AK-26	K-18	Sundarijal	○	X	○	○	○	X	△	X
16	AK-27	K-10	Tokha	○	○	△	⊙	○	○	○	○
17	AB-01	B-05	Balakhu	○	△	△	△	X	X	△	X
18	AB-02	B-07	Bidol	○	○	○	⊙	○	△	△	○
19	AB-03	B-04	Chakhu Khola	○	△	○	○	○	X	△	△
20	AB-04	B-10	Dhunge Dhara	○	⊙	○	⊙	○	○	△	○
21	AB-07	----	Ghatte Kulo	○	○	△	○	△	X	△	△
22	AB-08	B-08	Hanumante	○	○	△	△	△	X	○	△
23	AB-10	B-02	Katunje	○	○	○	⊙	△	○	△	○
24	AB-12	B-09	Kutudhal	○	○	○	⊙	○	○	△	○
25	AB-13	----	Lapsetar	○	△	△	○	○	X	○	△
26	AB-14	B-01	Mahadev Khola	○	⊙	○	⊙	△	○	△	○
27	AB-17	B-11	Nil Barahi	○	△	○	○	○	X	△	△
28	AB-18	B-03	Sipadol Katunje	○	○	△	○	○	X	△	△
29	AB-20	B-06	Sweety (shishaugari)	○	X	○	○	○	X	△	X
30	AL-02	L-06	Bhorle	X	--	--	--	--	--	--	ISP
31	AL-03	L-09	Champi	X	--	--	--	--	--	--	ISP
32	AL-05	L-03	Godawari	○	○	△	○	△	○	○	△
33	AL-08	L-07	Khokana	○	○	○	⊙	○	○	△	○
34	AL-10	L-04	Kotkhu	○	⊙	○	⊙	△	○	○	○
35	AL-13	L-05	Lubhu	○	○	○	⊙	△	○	△	○
36	AL-18	L-08	Saibu / Makal Kulo, Sara Kulo	X	--	--	--	--	--	--	ISP
37	AL-19	L-01	Thika Bhairaw-I	○	⊙	○	⊙	△	○	○	○
38	AL-20	L-02	Thika Bhairaw-II	○	⊙	○	⊙	△	○	△	○

Table 2-2 Selection of Priority Schemes

Code Scheme No.	Less Urbanization *1	Farmland Conditions *1	Availability of Irrigation Water *1	Accessibility *1	Economic Viability (EIRR) *1	Over-all Judgment *2	Selected Area (ha) as 1st priority		Selected Area (ha) as 2nd priority		Selected Area (ha) for Further Study	
							Gross	Net	Gross	Net	Gross	Net
Kathmandu District												
AK-04 Birwanchan	○	○	△	○	△	○	210	168	125	100	125	100
AK-05 Boshan	○	○	◎	△	○	◎					210	168
AK-07 Dakhinkali	○	△	◎	○	△	○			100	80	100	80
AK-14 Indrayani	○	○	◎	△	△	○			140	112	140	112
AK-25 Shali Nadi	○	○	◎	○	○	◎	300	240			300	240
AK-27 Tokha	○	△	×	○	△	×						
Sub-total							510	408	365	292	875	700
Bhaktapur District												
AB-02 Bidol	○	△	◎	△	△	○			60	48	60	48
AB-04 Dhunge Dhara	○	○	×	△	×	×						
AB-10 Kasuki	△	△	△	△	△	○			90	72	90	72
AB-12 Kumbhal	○	○	△	△	○	◎	147	118			147	118
AB-14 Mahadevi Khola	△	◎	△	△	○	◎	450	360			450	360
Sub-total							597	478	150	120	747	598
Lalitpur District												
AL-08 Khokana	○	○	○	△	×	×						
AL-10 Kothmi	△	◎	○	○	○	◎	445	356			445	356
AL-13 Labhu	△	○	○	△	○	◎	165	132			165	132
AL-19 Thika Bharaw (1)	△	◎	◎	○	○	◎	600	480			600	480
AL-20 Thika Bharaw (2)	△	◎	○	△	△	○			400	320	400	320
Sub-total							1,210	968	400	320	1,610	1,288
Total							2,317	1,854	915	732	3,232	2,586

Note *1 : Judged with the following criteria.

- Urbanization : ○ almost nil △ a little progressed in a part of the comand area X progressed or most of area located in the urban extend area.
- Farmland Conditions : ◎ over 300ha ○ 300-100 ha △ 100-40 ha X less than 40 ha of net command area.
- Availability of Water : ◎ in dry season, 100% of area can be irrigated with 80% dependable discharge ○ also 100% of area is irrigable with average discharge : △ about 40-50% of area can be irrigated in dry season X irrigable area in dry season is less than 20% for proposed cropping pattern.
- Accessibility : ○ relatively good △ poor X bad
- Economic viability : ○ over 18% △ between 10 - 18% X less than 10%
- *2 : If there are any X in EIRR or Water Availability, scheme was judged as the lowest priority and first priority was given for scheme which has EIRR over 18%.
- : selected schemes as model areas for feasibility study.

Table 2-3 Selection of Priority Schemes

Code Scheme No.	Less Urbanization *1	Farmland Conditions *1	Availability of Irrigation Water *1	Accessibility *1	Economic Viability (EIRR) *1	Over-all Judgment *2	Selected Area (ha) as 1st priority		Selected Area (ha) as 2nd priority		Selected Area (ha) for Further Study	
							Gross	Net	Gross	Net	Gross	Net
Kathmandu District												
AK-04 Birewambhara	○	○	△	○	△	○			125	100	125	100
AK-05 Bishnu	○	○	◎	△	○	◎	210	168	100	80	210	168
AK-17 Dakshinatal	○	△	◎	○	△	○			100	80	100	80
AK-14 Indrayan	○	○	◎	△	△	○			140	112	140	112
AK-25 Shah Nadi	○	○	◎	○	○	◎	300	240			300	240
AK-27 Tokha	○	△	×	○	△	×						
Sub-total							510	408	365	292	875	700
Bhaktapur District												
AB-02 Bishu	○	△	◎	△	△	○			60	48	60	48
AB-04 Dhunge Dhara	○	○	×	△	×	×			90	72	90	72
AB-10 Krungu	△	△	△	△	△	○	147	118			147	118
AB-12 Kumbhal	○	○	△	△	○	◎	450	360			450	360
AB-14 Mahadev Khola	△	◎	△	△	○	◎	597	478	150	120	747	598
Sub-total												
Lalitpur District												
AL-08 Khokana	○	○	○	△	×	×						
AL-10 Kotahi	△	◎	○	○	○	◎	445	356			445	356
AL-13 Lobhu	△	○	○	△	○	◎	165	132			165	132
AL-19 Thaka Bharav (1)	△	◎	◎	○	○	◎	600	480			600	480
AL-20 Thaka Bharav (2)	△	◎	○	△	△	○			400	320	400	320
Sub-total							1,210	968	400	320	1,610	1,288
Total							2,317	1,854	915	732	3,232	2,586

Note *1 : Judged with the following criteria.

Urbanization : ○ almost nil

Farmland Conditions : ◎ over 300ha

Availability of Water : ◎ in dry season, 100% of area can be irrigated with 80% dependable discharge

Accessibility : △ about 40-50% of area can be irrigated in dry season

Economic viability : ◎ relatively good

Over-all Judgment : ◎ over 18%

Selected schemes as model areas for feasibility study.

△ a little progressed in a part of the command area

○ almost nil

◎ over 300ha

△ about 40-50% of area can be irrigated in dry season

◎ relatively good

◎ over 18%

Selected schemes as model areas for feasibility study.

△ progressed or most of area located in the urban extend area.

○ less than 40 ha of net command area.

△ 100-40 ha

△ a little progressed in a part of the command area

◎ over 300ha

△ between 10 - 18%

Selected schemes as model areas for feasibility study.

△ progressed or most of area located in the urban extend area.

○ less than 40 ha of net command area.

△ 100-40 ha

△ a little progressed in a part of the command area

◎ over 300ha

△ between 10 - 18%

Selected schemes as model areas for feasibility study.

△ progressed or most of area located in the urban extend area.

○ less than 40 ha of net command area.

△ 100-40 ha

△ a little progressed in a part of the command area

◎ over 300ha

△ between 10 - 18%

Selected schemes as model areas for feasibility study.

Table 3-1 Monthly Rainfall at Kathmandu Airport and Changu Narayan

Station : Kathmandu Airport (No. 1030)													Unit : mm
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1968	30.1	8.5	45.3	25.5	109.6	305.7	379.5	228.2	86.9	160.4	0.0	0.0	1,379.7
1969	8.6	1.4	47.6	27.4	86.9	166.1	299.7	323.9	175.3	40.3	2.0	0.0	1,179.2
1970	29.1	27.6	26.6	34.4	93.6	193.7	494.3	229.7	163.9	58.2	11.2	0.0	1,362.3
1971	3.0	6.3	28.4	180.8	109.7	608.1	204.6	252.6	36.4	81.2	0.2	0.0	1,511.3
1972	1.4	25.5	80.4	23.8	56.6	157.3	480.9	155.3	174.5	86.1	19.6	0.0	1,261.4
1973	23.7	32.4	48.5	25.3	81.1	340.4	456.0	336.5	321.1	119.3	15.5	0.0	1,799.8
1974	16.9	5.8	23.3	30.9	108.0	74.8	339.6	364.2	204.6	45.6	0.0	11.4	1,225.1
1975	30.6	25.4	8.0	36.1	69.1	138.5	436.1	379.0	267.5	34.2	0.0	0.0	1,424.5
1976	30.2	14.5	0.0	68.6	153.4	387.4	335.0	307.3	169.9	24.3	0.0	0.0	1,490.6
1977	11.5	12.1	17.1	103.9	90.1	265.6	322.7	338.3	78.9	29.1	14.4	13.6	1,297.3
1978	4.7	11.1	69.4	41.7	143.3	298.9	323.6	392.5	159.8	108.6	0.2	2.2	1,556.0
1979	5.6	39.3	0.7	42.1	37.3	258.1	447.3	320.3	99.1	35.7	5.6	65.3	1,356.4
1980	1.0	17.7	45.7	10.1	124.4	349.3	296.1	238.5	183.5	69.0	0.0	5.6	1,340.9
1981	14.5	0.0	60.4	100.9	216.2	140.7	304.0	266.9	225.1	0.0	42.0	0.0	1,370.7
1982	14.2	21.9	35.5	48.8	39.7	200.5	238.2	384.3	155.4	9.0	18.3	3.4	1,169.2
1983	18.2	4.0	30.2	78.7	110.1	81.4	499.9	194.2	287.7	129.9	0.0	15.3	1,449.6
1984	13.9	17.4	13.5	60.1	96.0	275.0	250.1	301.9	260.2	18.4	0.1	7.4	1,314.0
1985	9.7	3.2	4.0	24.8	132.5	160.8	418.3	434.4	375.6	167.2	0.0	54.6	1,785.1
1986	0.0	22.5	15.8	93.4	96.9	315.6	380.8	218.6	221.3	79.5	0.0	49.4	1,493.8
1987	3.2	43.3	35.9	34.4	57.6	116.4	498.8	256.3	171.2	159.3	0.0	18.8	1,395.2
1988	0.6	19.1	68.0	42.3	152.9	239.5	397.3	278.7	134.4	17.6	11.7	78.9	1,441.0
1989	47.4	10.7	12.1	4.0	148.7	135.5	328.0	206.0	196.5	42.4	0.0	0.7	1,132.0
1990	0.0	42.2	59.5	116.2	108.3	285.5	345.6	308.5	188.2	78.7	0.0	2.8	1,535.5
1991	20.7	11.4	45.2	26.3	145.3	114.4	190.3	280.7	137.7	0.4	0.2	24.9	997.5
1992	6.4	17.2	0.2	44.5	69.7	232.7	230.4	219.9	209.3	51.6	15.5	3.1	1,100.5
Average	13.8	17.6	32.9	53.0	105.5	233.7	355.9	288.7	187.4	65.8	6.3	14.3	1,374.7

Station : Changu Narayan (No. 1059)													Unit : mm
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1974						151.9	439.9	454.4	239.4	36.5	0.0	10.6	
1975	27.1	24.5	10.1	50.9	66.1	143.4	492.4	458.2	309.2	62.6	0.0	0.0	1,644.5
1976	28.4	18.5	0.0	83.4	169.9	370.6	314.2	490.5	239.0	80.7	0.0	0.0	1,795.2
1977	8.2	6.6	20.3	109.8	119.2	290.3	366.1	253.7	107.6	105.0	8.0	36.4	1,431.2
1978	10.4	17.0	84.6	45.9	191.5	325.5	620.2	421.6	227.8	88.3	4.4	6.4	2,043.6
1979	5.8	17.5	1.0	43.4	45.5	138.3	355.5	359.0	78.7	53.2	5.2	45.1	1,148.2
1980	0.0	14.1	30.4	5.2	84.5	304.6	373.9	274.6	109.8	54.8	0.0	7.8	1,259.7
1981	28.8	0.0	45.7	74.3	185.6	151.5	347.3	276.3	155.6	0.0	16.8	0.0	1,281.9
1982	7.8	17.1	39.9	58.2	38.7	284.4	285.9	524.6	188.8	52.4	24.2	5.5	1,527.5
1983	16.7	7.0	29.5	80.3	166.7	158.1	698.5	436.5	291.6	104.2	0.0	0.0	1,989.1
1984	0.0	36.0	13.3	51.1	172.4	298.0	462.4	403.5	338.2	22.5	11.4	10.8	1,819.6
1985	77.5	10.4	2.3	42.4	237.2	230.3	540.6	682.1	386.2	171.5	0.0	75.9	2,456.4
1986	0.0	38.4	22.0	66.9	181.8	334.4	313.3	378.3	264.1	63.8	0.0	61.6	1,724.6
1987	10.6	58.6	30.5	34.9	51.2	155.3	494.4	309.0	224.0	118.1	0.0	32.4	1,519.0
1988	0.0	25.7	74.9	56.0	175.4	298.3	524.3	348.0	119.6	17.8	18.2	71.9	1,730.1
1989	34.9	9.5	43.1	4.9	153.4	152.3	353.8	365.7	364.7	46.3	0.0	4.4	1,533.0
1990	0.0	61.0	79.1	176.5	302.2	317.4	455.4	354.1	199.8	47.5	6.7	0.0	1,999.7
1991	26.3	41.3	41.6	56.0	180.3	131.2	188.0	315.4	271.2	10.3	0.0	21.5	1,283.1
1992	9.1	19.3	0.0	31.5	145.6	270.9	373.4	404.8	238.8	36.9	19.0	11.2	1,560.5
Average	16.2	23.5	31.6	59.5	148.2	237.2	421.0	395.3	229.2	61.7	6.0	21.1	1,650.5

Table 3-2 (1/3) Monthly Discharge Observed at Respective Gauging Stations (1/3)

Station : Sundarijal (No. 505)													C.A.= 16.5 km ²		A.B.R.= 2,930 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1963	0.220	0.130	0.140	0.190	0.180	0.420	2.040	4.830	2.650	1.100	0.540	0.340	1.065	0.13	4.83			
1964	0.230	0.150	0.110	0.110	0.140	0.287	1.680	3.854	3.649	1.298	0.620	0.471	1.050	0.11	3.85			
1965	0.360	0.284	0.234	0.236	0.218	0.418	1.457	3.175	1.343	0.766	0.584	0.371	0.787	0.22	3.17			
1966	0.328	0.290	0.254	0.220	0.560	1.088	2.948	5.108	3.452	1.045	0.460	0.354	1.342	0.22	5.11			
1967	0.300	0.237	0.223	0.231	0.209	0.440	3.510	3.942	2.639	0.959	0.397	0.223	1.109	0.21	3.94			
1968	0.144	0.108	0.129	0.122	0.098	1.143	3.801	4.445	2.790	1.515	0.528	0.277	1.258	0.10	4.44			
1969	0.211	0.210	0.196	0.191	0.203	0.208	1.114	2.518	2.310	1.052	0.481	0.311	0.750	0.19	2.52			
1970	0.225	0.221	0.209	0.200	0.168	0.400	2.458	4.888	2.955	1.335	0.375	0.194	1.136	0.17	4.89			
1971	0.150	0.111	0.080	0.138	0.143	2.240	2.950	4.267	2.444	0.994	0.560	0.310	1.199	0.08	4.27			
1972	0.223	0.190	0.187	0.157	0.190	0.390	2.290	2.835	2.825	0.863	0.493	0.309	0.913	0.16	2.84			
1973	0.220	0.190	0.186	0.148	0.188	0.940	2.247				0.717	0.340						
1974	0.250	0.187	0.130	0.074	0.288	0.291	1.616	2.243	2.105	0.908	0.500	0.352	0.745	0.07	2.24			
1975	0.289	0.260	0.260	0.184	0.121	0.300	0.620	0.690	1.857	1.165	0.599	0.454	0.567	0.12	1.86			
1976	0.350	0.258	0.147	0.160	0.422	3.589	4.219	4.600	4.193	1.012	0.495	0.485	1.661	0.15	4.60			
1977	0.379	0.335	0.253	0.360	0.431	0.835	2.793	2.915	2.018	1.285	0.904	0.743	1.104	0.25	2.91			
1978	0.637	0.500	0.545	0.510	0.745	1.022	2.288	4.985	3.093	1.702	0.676	0.371	1.423	0.37	4.99			
1979	0.238	0.129	0.085	0.121	0.157	0.301	1.818	2.255	2.021	0.984	0.598	0.510	0.768	0.09	2.26			
1980	0.317	0.214	0.133	0.161	0.258	1.462	2.905	2.562	2.294	1.234	0.740	0.522	1.067	0.13	2.90			
1981	0.333	0.259	0.258	0.273	0.390	0.720	2.179	2.774	2.141	1.066	0.642	0.438	0.956	0.26	2.77			
1982	0.321	0.360	0.283	0.410	0.261	0.374	1.205	2.219	2.255	0.883	0.380	0.350	0.775	0.26	2.25			
1983	0.237	0.190	0.166	0.210	0.224	0.286	2.770	3.784	3.760	2.245	1.055	0.717	1.304	0.17	3.78			
1984	0.573	0.429	0.400	0.397	0.594	1.097	3.258	3.342	3.140	1.050	0.550	0.403	1.269	0.40	3.34			
1985	0.400	0.250	0.206	0.215	0.342	0.560	2.110	2.828	2.980	1.430	0.734	0.476	1.044	0.21	2.98			
1986	0.326	0.248	0.180	0.190	0.216	0.547	2.234	2.850	2.733	1.368	0.711	0.497	1.008	0.18	2.85			
Mean	0.303	0.239	0.208	0.217	0.281	0.807	2.355	3.387	2.680	1.185	0.597	0.409	1.056	0.21	3.39			
Min.	0.144	0.108	0.080	0.074	0.098	0.208	0.620	0.690	1.343	0.766	0.375	0.194	0.392	0.07	1.34			
Max.	0.637	0.500	0.545	0.510	0.745	3.589	4.219	5.108	4.193	2.245	1.055	0.743	2.007	0.50	5.11			

Station : Mahankal (No.507)													C.A.= 13.7 km ²		A.B.R.= 2,940 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1963	0.140	0.080	0.110	0.070	0.100	0.420	3.320	5.020	2.440	1.320	0.770	0.560	1.196	0.07	5.02			
1964	0.340	0.230	0.180	0.200	0.190	0.560	2.420	3.810	3.400	1.470	0.810	0.560	1.181	0.18	3.81			
1965	0.320	0.230	0.170	0.160	0.110	0.400	2.270	3.120	2.010	1.030	0.740	0.530	0.924	0.11	3.12			
1966	0.390	0.250	0.180	0.140	0.370	0.620	2.470	6.370	2.690	0.780	0.610	0.480	1.279	0.14	6.37			
1967	0.240	0.180	0.170	0.180	0.140	0.760	2.800	2.590	2.110	0.850	0.450	0.450	0.910	0.14	2.80			
1968	0.310	0.220	0.400	0.210	0.180	1.950	3.750	4.130	2.360	1.580	0.860	0.710	1.388	0.18	4.13			
1969	0.400	0.210	0.190	0.150	0.160	0.350	1.730	2.360	2.160	0.910	0.640	0.510	0.814	0.15	2.36			
1970	0.340	0.240	0.190	0.160	0.210	0.960	2.170	3.380	2.180	1.340	0.720	0.500	1.033	0.16	3.38			
1971	0.310	0.240	0.180	0.370	0.570	3.200	3.340	3.740	1.730	0.770	0.560	0.380	1.283	0.18	3.74			
Mean	0.310	0.209	0.197	0.182	0.226	1.024	2.697	3.836	2.342	1.117	0.684	0.520	1.112	0.18	3.84			
Min.	0.140	0.080	0.110	0.070	0.100	0.350	1.730	2.360	1.730	0.770	0.450	0.380	0.689	0.07	2.36			
Max.	0.400	0.250	0.400	0.370	0.570	3.200	3.750	6.370	3.400	1.580	0.860	0.710	1.822	0.25	6.37			

Table 3-2 (2/3) Monthly Discharge Observed at Respective Gauging Stations (2/3)

Station : Shyamdado (No.510)													C.A.= 3.34 km ²		A.B.R.= 2,450 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1963	0.062	0.041	0.035	0.029	0.028	0.121	0.241	1.069	0.709	0.181	0.107	0.076	0.225	0.03	1.07			
1964	0.064	0.044	0.034	0.026	0.037	0.061	0.356	0.738	0.467	0.262	0.170	0.114	0.198	0.03	0.74			
1965	0.065	0.045	0.035	0.028	0.020	0.162	0.391	0.458	0.227	0.126	0.095	0.070	0.144	0.02	0.46			
1966	0.060	0.048	0.034	0.026	0.024	0.043	0.276	0.939	0.663	0.271	0.144	0.066	0.216	0.02	0.94			
1967	0.045	0.033	0.031	0.036	0.019	0.086	0.585	0.498	0.450	0.218	0.127	0.057	0.182	0.02	0.59			
1968	0.050	0.038	0.025	0.025	0.020	0.094	0.450	0.800	0.246	0.299	0.131	0.080	0.188	0.02	0.80			
1969	0.063	0.047	0.041	0.033	0.032	0.043	0.222	0.291	0.248	0.142	0.097	0.070	0.111	0.03	0.29			
1970	0.070	0.054	0.043	0.038	0.046	0.157	0.734	1.133	0.593	0.909	0.816	0.248	0.403	0.04	1.13			
1971	0.077	0.063	0.052	0.063	0.058	1.200	0.928	1.360	0.563	0.255	0.162	0.079	0.405	0.05	1.36			
Mean	0.062	0.046	0.037	0.034	0.032	0.219	0.465	0.810	0.463	0.296	0.205	0.096	0.230	0.03	0.81			
Min.	0.045	0.033	0.025	0.025	0.019	0.043	0.222	0.291	0.227	0.126	0.095	0.057	0.101	0.02	0.29			
Max.	0.077	0.063	0.052	0.063	0.058	1.200	0.928	1.360	0.709	0.909	0.816	0.248	0.540	0.05	1.36			

Station : Gauri Ghat (No. 530)													C.A.= 67.8 km ²		A.B.R.= 2,340 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1965	0.930	0.520	0.350	0.390	0.210	1.840	7.140	11.710	3.240	1.780	1.790	1.300	2.600	0.21	11.71			
1966	1.250	0.790	0.670	0.220	0.110	0.560	7.360	14.810	7.050	2.820	1.420	0.800	3.155	0.11	14.81			
1967	0.620	0.310	0.370	0.480	0.170	0.890	10.920	8.260	4.590	1.470	1.230	0.930	2.520	0.17	10.92			
1968	0.680	0.600	0.620	0.370	0.220	4.270	8.540	13.190	8.120	5.570	2.630	1.540	3.863	0.22	13.19			
1969	0.660	0.320	0.300	0.270	0.300	0.240	2.180	6.080	6.400	3.550	2.460	1.700	2.038	0.24	6.40			
1970	1.120	0.700	0.650	0.510	1.050	1.860	7.240	10.830	6.400	4.060	2.660	1.650	3.228	0.51	10.83			
1971	1.060	0.660	0.600	1.520	1.430	15.910	8.440	10.150	3.780	3.050	1.980	1.320	4.158	0.60	15.91			
1972	0.650	0.540	0.380	0.270		0.230				1.090	0.530							
Mean	0.871	0.555	0.493	0.504	0.499	3.225	7.403	10.719	5.654	3.186	1.908	1.221	3.020	0.49	10.72			
Min.	0.620	0.310	0.300	0.220	0.110	0.230	2.180	6.080	3.240	1.470	1.090	0.530	1.365	0.11	6.08			
Max.	1.250	0.790	0.670	1.520	1.430	15.910	10.920	14.810	8.120	5.570	2.660	1.700	5.446	0.67	15.91			

Station : Budhanilkantha (No.536.2)													C.A.= 4.43 km ²		A.B.R.= 2,720 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1969	0.027	0.025	0.029	0.023	0.033	0.042	0.310	0.660	0.640	0.270	0.084	0.026	0.181	0.02	0.66			
1970	0.020	0.014	0.014	0.015	0.031	0.210	0.710	1.310	1.070	0.360	0.100	0.031	0.324	0.01	1.31			
1971	0.025	0.020	0.018	0.046	0.040	0.720	0.930	1.090	0.540	0.360	0.130	0.086	0.334	0.02	1.09			
1972	0.064	0.076	0.085	0.087	0.087	0.190	0.860	0.700	0.820	0.240	0.120	0.092	0.285	0.06	0.86			
1973	0.072	0.055	0.071	0.043	0.064	0.440	0.620	1.050	0.920	0.630	0.270	0.088	0.360	0.04	1.05			
1974	0.051	0.044	0.038	0.032	0.041	0.072	0.550	0.820	0.860		0.180	0.130						
1975	0.068	0.054	0.037	0.028	0.067	0.150	1.180	0.950	1.340	0.630	0.200	0.035	0.395	0.03	1.34			
1976	0.051	0.051	0.037	0.053	0.083	0.440	0.790	1.040	0.760	0.350	0.110	0.026	0.316	0.03	1.04			
1977	0.044	0.019	0.024	0.041	0.110	0.150	0.310	0.540	0.380	0.180	0.120	0.080	0.167	0.02	0.54			
1978	0.073	0.074	0.075	0.051	0.190	0.460	0.890	0.990	0.570	0.430	0.160	0.091	0.338	0.05	0.99			
1979	0.050	0.046	0.032	0.032	0.046	0.190	0.570	0.630	0.360	0.160	0.058	0.040	0.185	0.03	0.63			
1980	0.025	0.024	0.022	0.003	0.039	0.150	0.650	0.740	0.430	0.170	0.058	0.047	0.197	0.00	0.74			
1981	0.033	0.015	0.010	0.023	0.064	0.190	0.470	0.880	0.760	0.280	0.150	0.077	0.246	0.01	0.88			
1982	0.068	0.072	0.043	0.092	0.039	0.220	0.670	1.030	0.700	0.400	0.230	0.130	0.308	0.04	1.03			
1983	0.079	0.052	0.057	0.051	0.040	0.140	0.770	1.020	1.170	0.740	0.450	0.140	0.392	0.04	1.17			
1984	0.077	0.035	0.030	0.027	0.065	0.490	1.150	1.140	1.080	0.530	0.180	0.092	0.408	0.03	1.15			
1985	0.050	0.035	0.029	0.030	0.059	0.048	0.660	0.960	1.140	0.570	0.360	0.170	0.343	0.03	1.14			
Mean	0.052	0.042	0.038	0.040	0.065	0.253	0.711	0.915	0.796	0.394	0.174	0.081	0.297	0.04	0.91			
Min.	0.020	0.014	0.010	0.003	0.031	0.042	0.310	0.540	0.360	0.160	0.058	0.026	0.131	0.00	0.54			
Max.	0.079	0.076	0.085	0.092	0.190	0.720	1.180	1.310	1.340	0.740	0.450	0.170	0.536	0.08	1.34			

Table 3-2 (3/3) Monthly Discharge Observed at Respective Gauging Stations (3/3)

Station : Thika Bhairaw (No.540)													C.A.= 42.5 km ²		A.B.R.= 2,390 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1963	0.210	0.057	0.200	0.140	0.130	0.110	1.390	4.030	3.580	2.070	0.400	0.240	1.046	0.06	4.03			
1964	0.160	0.140	0.110	0.160	0.410	0.380	2.370	3.310	4.600	1.220	0.660	0.470	1.166	0.11	4.60			
1965	0.300	0.220	0.240	0.280	0.240	0.510	6.730	6.130	1.870	0.860	0.500	0.190	1.506	0.19	6.73			
1966	0.260	0.200	0.100	0.070	0.080	0.050	0.810	7.740	3.270	0.910	0.450	0.250	1.183	0.05	7.74			
1967	0.140	0.060	0.150	0.220	0.080	0.170	2.420	4.050	1.900	0.790	0.250	0.180	0.868	0.06	4.05			
1968	0.090	0.060	0.130	0.070	0.160	1.650	3.140	3.100	1.180	3.240	0.430	0.140	1.116	0.06	3.24			
1969	0.040	0.020	0.030	0.040	0.150	0.030	1.000	3.810	2.580	0.880	0.320	0.080	0.748	0.02	3.81			
1970	0.090	0.090	0.070	0.080	0.060	0.650	4.400	4.990	2.270	1.470	0.800	0.490	1.288	0.06	4.99			
1971	0.300	0.280	0.330	0.280	0.330	6.700	1.930	3.300	1.850	1.110	0.820	0.540	1.481	0.28	6.70			
1972	0.390	0.450	0.420	0.290	0.190	0.230	2.620	1.060	1.220	0.530	0.450	0.360	0.684	0.19	2.62			
1973	0.270	0.230	0.250	0.210	0.220	2.070	2.060	1.420	2.890	2.360	0.640	0.330	1.079	0.21	2.89			
1974	0.230	0.150	0.150	0.160	0.170	0.150	0.540	4.320	5.320	0.450	0.250	0.230	1.010	0.15	5.32			
1975	0.160	0.110	0.100	0.100	0.120	0.250	3.300	5.620	3.650	1.800	0.680	0.420	1.359	0.10	5.62			
1976	0.250	0.210	0.150	0.120	0.130	0.790	2.830	2.350	2.510	0.980	0.460	0.260	0.920	0.12	2.83			
1977	0.140	0.180	0.140	0.100	0.110	0.340	1.690	1.750	1.020	0.560	0.330	0.270	0.553	0.10	1.75			
1978	0.250	0.160	0.300	0.230	0.210	1.220	3.780	5.760	5.220	1.310	0.460	0.210	1.593	0.16	5.76			
1979	0.140	0.110	0.140	0.090	0.050	0.040	8.960	6.280	0.570	0.090	0.080	0.080	1.386	0.04	8.96			
1980	0.070	0.060	0.060	0.050	0.040	2.880	3.730	1.850	0.810	0.470	0.180	0.130	0.861	0.04	3.73			
1981					0.077	0.070	0.490	0.420										
1982			0.130	0.110			0.410	0.980	2.020	0.710	0.580	0.450						
1983	0.410	0.420	0.310	0.240	0.280	1.040	4.730	4.820	3.470	1.610	1.200	0.760	1.608	0.24	4.82			
1984	0.750	0.720	0.720	0.650	0.570	0.470	2.040	2.370	7.020	1.320	0.270	0.170	1.423	0.17	7.02			
1985	0.160	0.110	0.076	0.051	0.099	0.160	2.300	1.860	4.810	3.950	1.410							
Mean	0.229	0.192	0.196	0.170	0.178	0.907	2.768	3.536	2.892	1.304	0.528	0.298	1.100	0.17	3.54			
Min.	0.040	0.020	0.030	0.040	0.040	0.030	0.410	0.420	0.570	0.090	0.080	0.080	0.154	0.02	0.57			
Max.	0.750	0.720	0.720	0.650	0.570	6.700	8.960	7.740	7.020	3.950	1.410	0.760	3.329	0.57	8.96			

Station : Chobhar (No.550)													C.A.= 585.0 km ²		A.B.R.= 1,900 mm		Unit : m ³ /sec	
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Annual	Min.	Max.			
1963	2.84	1.30	3.80	2.64	2.38	6.84	27.60	58.40	36.40	16.30	7.76	4.52	14.23	1.30	58.40			
1964	2.67	1.56	1.05	1.74	2.30	6.86	32.50	41.40	34.60	11.90	5.87	3.50	12.16	1.05	41.40			
1965	2.20	1.27	1.33	2.23	0.98	8.87	36.54	51.55	17.66	10.59	9.57	4.27	12.26	0.98	51.55			
1966	3.79	2.28	0.96	0.33	1.28	2.89	29.74	66.26	23.30	7.90	4.84	3.50	12.26	0.33	66.26			
1967	2.27	1.61	2.24	2.20	1.25	5.30	38.21	46.03	27.39	8.20	5.07	3.39	11.93	1.25	46.03			
1968	2.70	2.10	1.24	0.77	1.34	9.68	53.17	49.24	18.84	26.59	6.54	3.46	14.64	0.77	53.17			
1969	2.54	1.49	2.01	1.21	2.06	1.32	17.92	46.87	22.95	8.04	3.64	1.68	9.31	1.21	46.87			
1970	1.11	1.05	0.77	0.60	0.85	7.34	57.64	58.78	43.05	19.78	8.31	3.49	16.90	0.60	58.78			
1971	1.72	1.38	1.28	5.61	5.06	72.87	44.25	45.89	22.12	14.36	7.08	3.00	18.72	1.28	72.87			
1972	1.53	2.05	2.46	1.68	0.73	7.88	94.52	35.99	38.83	16.38	9.67	4.74	18.04	0.73	94.52			
1973	2.08	1.47	3.34	0.52	1.58	19.11	49.21	55.48	62.15	39.19	9.27	3.75	20.60	0.52	62.15			
1974	1.60	0.72	0.71	1.14	4.26	2.28	47.30	79.84	61.56	15.09	7.18	4.91	18.88	0.71	79.84			
1975	3.63	3.25	1.19	1.54	2.59	6.80	64.96	62.44	92.04	25.89	8.74	5.12	23.18	1.19	92.04			
1976	3.41	3.17	0.88	2.70	5.76	37.60	40.77	56.31	34.01	14.24	6.57	3.50	17.41	0.88	56.31			
1977	2.74	2.32	0.70	2.14	3.52	22.30	45.50	34.98	19.51	10.83	6.33	5.39	13.02	0.70	45.50			
1978	3.24	1.36	1.38	2.61	5.28	23.86	61.47	80.08	39.40	31.70	9.60	4.72	22.06	1.36	80.08			
1979	2.75	3.66	1.21	1.88	1.47	3.54	34.26	46.92	19.36	9.63	5.22	4.84	11.23	1.21	46.92			
1980	2.39	1.13	1.32	0.51	1.78	16.43	41.28	45.32	24.08	9.34	4.36	2.38	12.53	0.51	45.32			
1981	1.98	1.32	1.12	3.29	4.34	3.89	28.30	35.50	39.00									
Mean	2.48	1.82	1.53	1.86	2.57	13.98	44.48	52.49	35.59	16.44	6.98	3.90	15.34	1.53	52.49			
Min.	1.11	0.72	0.70	0.33	0.73	1.32	17.92	34.98	17.66	7.90	3.64	1.68	7.39	0.33	34.98			
Max.	3.79	3.66	3.80	5.61	5.76	72.87	94.52	80.08	92.04	39.19	9.67	5.39	34.70	3.66	94.52			

Table 3-3 Monthly Mean Natural Runoff at Intake Point of Selected Schemes

Name of Scheme	River & Tributary	Catchment Area (km ²)	Monthly Mean Runoff at Intake Point (Unit : m ³ /sec)											
			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
AK-04	Biswambhara	5.84	0.081	0.064	0.056	0.058	0.075	0.215	0.629	0.905	0.720	0.327	0.159	0.109
AK-05	Boshan Khola	6.80	0.135	0.115	0.105	0.108	0.128	0.294	0.784	1.112	0.892	0.427	0.228	0.168
AK-07	Dakshinkali	10.00	0.163	0.129	0.112	0.117	0.152	0.435	1.271	1.831	1.456	0.662	0.323	0.221
AK-14	Indrayani	5.20	0.082	0.065	0.056	0.059	0.076	0.218	0.636	0.916	0.728	0.331	0.161	0.110
AK-25	Sali Nadi Khola	12.00	0.200	0.158	0.137	0.143	0.186	0.533	1.555	2.239	1.781	0.809	0.394	0.270
AB-02	Bidol	3.60	0.040	0.032	0.028	0.029	0.037	0.108	0.314	0.452	0.359	0.163	0.080	0.055
AB-10	Katunje	2.40	0.023	0.018	0.016	0.017	0.021	0.062	0.180	0.259	0.206	0.094	0.046	0.031
AB-04	Dhunge Dhara	6.90	0.082	0.065	0.056	0.059	0.076	0.219	0.638	0.920	0.731	0.332	0.162	0.111
AB-12	Kutudhal	7.30	0.086	0.068	0.059	0.062	0.080	0.229	0.668	0.963	0.766	0.348	0.170	0.116
-do-	residual catchment area	0.40	0.004	0.003	0.003	0.003	0.004	0.010	0.030	0.043	0.034	0.016	0.008	0.005
AB-14	Mahadev Khola	4.40	0.052	0.041	0.036	0.038	0.049	0.139	0.407	0.586	0.466	0.212	0.103	0.071
AL-10	Kotkhu	16.00	0.180	0.142	0.124	0.129	0.167	0.480	1.403	2.020	1.607	0.730	0.356	0.244
AL-13	Lubhu	5.20	0.057	0.045	0.039	0.041	0.053	0.152	0.443	0.638	0.508	0.231	0.112	0.077
AL-19	Thika Bhairaw-I	39.00	0.554	0.438	0.381	0.397	0.515	1.477	4.312	6.211	4.938	2.244	1.094	0.749
AL-03	Champi	43.00	0.673	0.532	0.463	0.482	0.625	1.793	5.236	7.542	5.997	2.725	1.328	0.909
-do-	residual catchment area	4.00	0.119	0.094	0.082	0.085	0.110	0.316	0.924	1.331	1.058	0.481	0.234	0.160
AL-02	Bhore	44.00	0.686	0.542	0.472	0.492	0.637	1.828	5.336	7.686	6.112	2.777	1.354	0.927
-do-	residual catchment area	1.00	0.013	0.010	0.009	0.009	0.012	0.034	0.100	0.145	0.115	0.052	0.025	0.017
AL-20	Thika Bhairaw-II	47.00	0.709	0.560	0.488	0.508	0.659	1.890	5.517	7.946	6.319	2.871	1.400	0.958
-do-	residual catchment area	3.00	0.023	0.018	0.016	0.017	0.022	0.062	0.181	0.260	0.207	0.094	0.046	0.031
AL-08	Khokana	49.00	0.730	0.577	0.502	0.523	0.678	1.946	5.680	8.181	6.505	2.956	1.441	0.987
-do-	residual catchment area	2.00	0.021	0.017	0.014	0.015	0.019	0.056	0.163	0.235	0.187	0.085	0.041	0.028

Table 3-4 Available Water at Intake Point of Model Schemes

Code No.	Name of Scheme	River & Tributary	Catchment Area (km ²)	Available Water at Intake Point (Mean Discharge, Unit : m ³ /sec)											
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
AK-04	Biswambhara	Manohara River*	5.84	0.081	0.064	0.056	0.058	0.075	0.215	0.629	0.905	0.720	0.327	0.159	0.109
AK-05	Boshan	Boshan Khola	6.80	0.135	0.115	0.105	0.108	0.128	0.294	0.784	1.112	0.892	0.427	0.228	0.168
AK-07	Dakshinkali	Kharpa & Hundu Khola	10.00	0.146	0.099	0.083	0.115	0.152	0.411	1.216	1.811	1.411	0.603	0.312	0.216
AK-14	Indrayani	Ghate/Manamatta Khola	5.20	0.077	0.057	0.049	0.058	0.076	0.213	0.624	0.912	0.719	0.319	0.159	0.109
AK-25	Sali Nadi	Sali Nadi Khola	12.00	0.197	0.153	0.133	0.143	0.186	0.526	1.540	2.234	1.768	0.793	0.393	0.269
AB-02	Bidol	Saraswisi/Tholo Khola	3.60	0.040	0.032	0.028	0.029	0.037	0.108	0.314	0.452	0.359	0.163	0.080	0.055
AB-10	Kanunje	Budhi Ganga/Ghate Khola	2.40	0.016	0.011	0.009	0.016	0.022	0.045	0.131	0.224	0.157	0.056	0.040	0.029
AB-12	Kutudhal	Hanumante/Ghate Khola	7.30	0.027	0.011	0.008	0.018	0.035	0.134	0.494	0.868	0.613	0.165	0.112	0.063
AB-14	Mahadev Khola	Mahadev Khola	4.40	0.046	0.028	0.024	0.037	0.049	0.122	0.370	0.560	0.430	0.173	0.099	0.069
AL-10	Kotkhu	Karnanasia/Kotkhu Khola	16.00	0.155	0.113	0.099	0.127	0.167	0.429	1.273	1.929	1.481	0.602	0.338	0.236
AL-13	Lubhu	Sineri(Lubhu) Khola	5.20	0.055	0.044	0.038	0.041	0.053	0.149	0.436	0.633	0.500	0.224	0.111	0.076
AL-19	Thika Bhairaw-I	Lele & Nallu (Nakhu) Khola	39.00	0.187	0.130	0.098	0.106	0.144	0.279	0.938	1.110	2.269	1.203	0.619	0.297
AL-20	Thika Bhairaw-II	Nakhu Khola	47.00	0.491	0.235	0.217	0.417	0.569	1.565	5.000	7.560	5.810	2.326	1.207	0.803

Scheme Code No.	Name of Scheme	River & Tributary	Catchment Area (km ²)	Available Water at Intake Point (80% Reliable Discharge, Unit : m ³ /sec)											
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
AK-04	Biswambhara	Manohara River*	5.84	0.059	0.040	0.035	0.037	0.042	0.080	0.431	0.672	0.562	0.256	0.128	0.083
AK-05	Boshan	Boshan Khola	6.80	0.109	0.086	0.080	0.083	0.089	0.134	0.550	0.836	0.705	0.345	0.191	0.137
AK-07	Dakshinkali	Kharpa & Hundu Khola	10.00	0.102	0.051	0.040	0.072	0.085	0.137	0.816	1.340	1.091	0.459	0.249	0.162
AK-14	Indrayani	Ghate/Manamatta Khola	5.20	0.055	0.033	0.027	0.037	0.042	0.076	0.425	0.676	0.559	0.247	0.127	0.083
AK-25	Sali Nadi	Sali Nadi Khola	12.00	0.142	0.094	0.081	0.091	0.104	0.191	1.052	1.658	1.378	0.617	0.316	0.203
AB-02	Bidol	Saraswisi/Tholo Khola	3.60	0.029	0.020	0.017	0.018	0.021	0.040	0.215	0.336	0.281	0.128	0.064	0.041
AB-10	Kanunje	Budhi Ganga/Ghate Khola	2.40	0.010	0.006	0.006	0.010	0.012	0.013	0.072	0.157	0.112	0.042	0.032	0.022
AB-12	Kutudhal	Hanumante/Ghate Khola	7.30	0.004	0.002	0.002	0.005	0.006	0.011	0.283	0.620	0.445	0.088	0.080	0.035
AB-14	Mahadev Khola	Mahadev Khola	4.40	0.031	0.014	0.009	0.023	0.027	0.036	0.241	0.409	0.328	0.127	0.079	0.052
AL-10	Kotkhu	Karnanasia/Kotkhu Khola	16.00	0.105	0.070	0.061	0.080	0.093	0.141	0.832	1.408	1.129	0.452	0.269	0.176
AL-13	Lubhu	Sineri(Lubhu) Khola	5.20	0.040	0.027	0.023	0.026	0.030	0.054	0.296	0.469	0.389	0.175	0.089	0.057
AL-19	Thika Bhairaw-I	Lele & Nallu (Nakhu) Khola	39.00	0.327	0.187	0.157	0.200	0.237	0.432	2.762	4.459	3.665	1.556	0.813	0.509
AL-20	Thika Bhairaw-II	Nakhu Khola	47.00	0.297	0.041	0.041	0.229	0.277	0.378	3.269	5.513	4.424	1.703	0.936	0.571

Note *: In interim report, Intake of Biswambhara was considered on the Godagare Khola which is a tributary of the Manohara River, with a catchment area of 1.7 km². Available water in this table was reviewed in Phase-II Study for model schemes based on the monthly discharge estimated.

Table 3-5 Summary of Land Classification in Selected Model Schemes

Selected Model Scheme	Land Classification										Total ha (%)			
	S1		S2		S3		N1		N2			Others *		
	ha	(%)	ha	(%)	ha	(%)	ha	(%)	ha	(%)		ha	(%)	
Kathmandu District														
AK-04 Biswambhara	0	0.0%	9	6.7%	126	93.3%	0	0.0%	0	0.0%	0	0.0%	135	100%
AK-05 Boshan	0	0.0%	132	68.0%	29	14.9%	0	0.0%	0	0.0%	33	17.0%	194	100%
AK-07 Dakshinkali	0	0.0%	0	0.0%	100	100.0%	0	0.0%	0	0.0%	0	0.0%	100	100%
AK-14 Indrayani	0	0.0%	99	36.9%	169	63.1%	0	0.0%	0	0.0%	0	0.0%	268	100%
AK-25 Shali Nadi	0	0.0%	185	72.0%	47	18.3%	0	0.0%	0	0.0%	25	9.7%	257	100%
Sub-total	0	0.0%	425	44.5%	471	49.4%	0	0.0%	0	0.0%	58	6.1%	954	100%
Bhaktapur District														
AB-02 Bidol	0	0.0%	65	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	65	100%
AB-10 Katunje	0	0.0%	37	68.5%	17	31.5%	0	0.0%	0	0.0%	0	0.0%	54	100%
AB-12 Kutudhal	0	0.0%	80	96.4%	3	3.6%	0	0.0%	0	0.0%	0	0.0%	83	100%
AB-14 Mahadev Khola	0	0.0%	160	88.9%	20	11.1%	0	0.0%	0	0.0%	0	0.0%	180	100%
Sub-total	0	0.0%	342	89.5%	40	10.5%	0	0.0%	0	0.0%	0	0.0%	382	100%
Lalitpur District														
AL-10 Kotkhu	0	0.0%	406	87.1%	31	6.7%	0	0.0%	0	0.0%	29	6.2%	466	100%
AL-13 Lubhu	0	0.0%	178	80.9%	27	12.3%	0	0.0%	0	0.0%	15	6.8%	220	100%
AL-19 Thika Bhairaw-I	0	0.0%	583	65.4%	267	29.9%	0	0.0%	0	0.0%	42	4.7%	892	100%
AL-20 Thika Bhairaw-II	0	0.0%	78	51.0%	74	48.4%	0	0.0%	0	0.0%	1	0.7%	153	100%
Sub-total	0	0.0%	1,245	71.9%	399	23.1%	0	0.0%	0	0.0%	87	5.0%	1,731	100%
13 schemes														
Total	0	0.0%	2,012	65.6%	910	29.7%	0	0.0%	0	0.0%	145	4.7%	3,067	100%

Note : S1 : Highly suitable, S2 : Moderately suitable, S3 : Marginally suitable, N1 : Currently not suitable, N2 : Permanently not suitable.

* : Main settlements and river channel

Table 3-6 Present Land Use on Selected Model Schemes

Selected Model Scheme	Irrigation Area (ha)		Land Use Condition of the Selected Area (ha)											
	in Interim Report		Total (Gross Area)				Settlement, etc.		Brick Yard, etc.		Others *1		Agricultural Land	
	Gross	Net										Gross	Net Area	
Kathmandu District														
AK-04 Biswambhara	125	100	135	100%	8	5.9%	0	0.0%	12	8.9%	115	85.2%	92	68.1%
AK-05 Boshan	210	168	194	100%	30	15.5%	3	1.5%	8	4.1%	153	78.9%	122	62.9%
AK-07 Dakshinkali	100	80	100	100%	4	4.0%	0	0.0%	12	12.0%	84	84.0%	67	67.0%
AK-14 Indrayani	140	112	268	100%	28	10.4%	0	0.0%	114	42.5%	126	47.0%	101	37.7%
AK-25 Shali Nadi	300	240	257	100%	41	16.0%	0	0.0%	20	7.8%	196	76.3%	157	61.1%
Sub-total	875	700	954	100%	111	11.6%	3	0.3%	166	17.4%	674	70.6%	539	56.5%
Bhaktapur District														
AB-02 Bidol	60	48	65	100%	2	3.1%	17	26.2%	6	9.2%	40	61.5%	32	49.2%
AB-10 Katunje	90	72	54	100%	2	3.7%	0	0.0%	2	3.7%	50	92.6%	40	74.1%
AB-12 Kutudhal	147	118	83	100%	2	2.4%	22	26.5%	5	6.0%	54	65.1%	43	51.8%
AB-14 Mahadev Khola	450	360	180	100%	30	16.7%	0	0.0%	10	5.6%	140	77.8%	112	62.2%
Sub-total	747	598	382	100%	36	9.4%	39	10.2%	23	6.0%	284	74.3%	227	59.4%
Lalitpur District														
AL-10 Kotkhu	445	356	466	100%	63	13.5%	81	17.4%	14	3.0%	308	66.1%	246	52.8%
AL-13 Lubhu	165	132	220	100%	45 *2	20.5%	6	2.7%	6	2.7%	163	74.1%	130	59.1%
AL-19 Thika Bhairaw-I	600	480	892	100%	181	20.3%	7	0.8%	83	9.3%	621	69.6%	497	55.7%
AL-20 Thika Bhairaw-II	400	320	153	100%	8	5.2%	0	0.0%	35	22.9%	110	71.9%	88	57.5%
Sub-total	1,610	1,288	1,731	100%	297	17.2%	94	5.4%	138	8.0%	1,202	69.4%	961	55.5%
13 schemes														
Total	3,232	2,586	3,067	100%	444	14.5%	136	4.4%	327	10.7%	2,160	70.4%	1,727	56.3%

Note *1 : non-farm area other than settlement area and brick yards, including road, stream, gully with some bush, etc.

*2 : including new settlement plan area.

Table 3-8 Present Farm Budget in Selected 13 Model Schemes

Scheme No. Scheme Name	(Unit: NRe.)												
	AK-44 Biswan- bhara	AK-45 Boshan	AK-07 Daktah- kall	AK-14 Indrayani	AK-25 Shah Nadi	AB-02 Bibol	AB-10 Kanafe	AB-12 Kunohal	AB-14 Mahadev Khola	AL-10 Kotiba	AL-13 Lubhu	AL-19 Tulka Bhadraw-I	AL-20 Tulka Bhadraw-II
Holding Size (ha)	0.41	5.9	0.28	5.6	5.9	0.28	5.9	0.24	0.30	0.26	0.19	0.23	0.25
No. of Family	5.9	5.9	5.9	5.7	6.4	6.0	5.9	5.9	5.6	5.9	5.3	6.2	5.8
Farm Income													
Gross Farm Income	23,800	16,420	14,940	23,810	20,430	11,290	14,660	18,320	14,650	10,880	12,470	13,850	7,160
Planned Area (ha)	0.369	0.280	0.290	0.263	0.270	0.190	0.228	0.300	0.255	0.175	0.214	0.218	0.127
Production	1,561	1,184	1,184	1,384	1,142	804	964	1,269	1,078	739	905	920	539
Gross Income	14,494	10,998	10,998	14,243	10,606	7,463	8,956	11,784	10,009	6,866	8,402	8,543	5,004
Planned Area (ha)	0.303	0.162	0.062	0.239	0.135	0.152	0.178	0.240	0.208	0.125	0.150	0.188	0.111
Production	604	323	123	574	269	302	353	478	414	250	298	373	220
Gross Income	4,976	2,663	1,010	4,733	2,214	2,492	2,913	3,956	3,411	2,057	2,452	3,075	1,812
Maize	0.041			0.007					0.005	0.011		0.012	0.028
Production	60			11					8	17		17	40
Gross Income	463			84					59	129		130	310
Mustard	0.041	0.078	0.098	0.007	0.014	0.014	0.060	0.013	0.023	0.012	0.020	0.020	0.003
Production	25	47	59	4	8	9	4	4	8	14	7	12	2
Gross Income	415	794	993	75	137	146	61	61	132	231	116	203	26
Potatoes	0.049	0.028	0.008	0.067	0.065	0.019	0.039	0.039	0.013	0.023	0.012	0.023	0.004
Production	493	281	84	667	649	391	391	391	130	228	115	225	39
Gross Income	3,451	1,964	489	4,571	4,545	1,333	2,735	2,735	912	1,599	807	1,578	274
E.L. Potatoes					0.076								
Production					643								
Gross Income					2,925								
Legumes			0.104						0.008			0.035	0.008
Production			84						11			47	10
Gross Income			1,351						127			563	122
Vegetables													
Planned Area (ha)													
Production													
Gross Income													
Livestock Income	7,150	2,100	5,780	3,100	1,510	2,790	2,930	5,960	1,780	590		630	330
Total Farm Income	30,950	18,520	20,720	26,910	21,940	14,080	17,610	24,480	16,430	11,470	12,470	14,460	7,490
Non Farm Income	19,790	18,560	19,770	25,800	29,400	20,270	25,890	18,560	19,266	19,750	23,100	21,610	27,100
Gross Family Income	50,740	37,080	40,490	52,710	51,340	34,350	43,500	43,040	35,690	31,220	35,570	36,070	34,590
Production Cost (Farm Expense)	7,940	4,820	3,810	7,500	6,700	3,470	4,490	5,690	4,510	3,300	3,740	4,290	2,220
Living Expense **	30,680	28,860	30,410	29,640	32,990	30,300	29,890	31,520	29,900	26,860	27,640	30,740	30,980
Net Reserve	12,720	3,400	6,270	15,770	11,650	580	9,120	5,830	1,280	1,060	4,190	1,040	1,380
Per Capita Monthly Income	717	552	572	771	668	477	614	640	504	491	478	518	489
Net Farm Income ***	43,400	32,260	36,680	45,410	44,640	30,880	39,010	37,350	31,180	27,920	31,830	31,780	32,360

Remarks :

* : Farm Survey, JICA Study Team, 1964.

** : Estimated 100 % of Present Situation for "Without Project Condition" and 115 % of Present situation for "With Project Condition".

*** : Net Farm Income = Gross Farm Income - Production Cost.

Table 4-1 Rehabilitation Plan of Canal

Unit : Length in m

Item	Type	AK-4 Bishwam- bhara	AK-5 Boshan	AK-7 Dhaksinakali	AK-14 Indrayani	AK-25 Shali Nadi	AB-2 Bidol	AB-10 Kamuje	AB-12 Kunudhal	AB-14 Mahadev Khola	AL-10 Kotkhu	AL-13 Lubhu	AL-19 Thika Bhairaw-I	AL-20 Thika Bhairaw-II	TOTAL
Main Canal Breakdown (Total of Each Type)	Total	4,350	5,375	4,850	2,425	6,075	2,550	2,525	3,300	3,925	5,400	3,900	10,175	5,925	60,775
	Type-1	-	350	-	-	-	1,350	675	-	-	-	-	-	-	2,375
	Type-2	1,150	4,275	3,850	625	1,000	-	-	1,900	800	-	675	750	1,200	16,225
	Type-3	-	-	1,000	600	3,500	1,200	1,850	1,400	1,350	350	1,275	-	2,125	14,650
	Type-4	3,200	750	-	1,200	-	-	-	-	-	-	-	-	2,600	7,750
	Type-5	-	-	-	-	1,575	-	-	-	1,775	2,900	1,950	3,300	-	11,500
	Type-6	-	-	-	-	-	-	-	-	-	2,150	-	-	-	2,150
	Type-7	-	-	-	-	-	-	-	-	-	-	-	1,950	-	1,950
	Type-8	-	-	-	-	-	-	-	-	-	-	-	4,175	-	4,175
Replacement (Replacement of old masonry canal)	Type-1	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Type-2	-	2,200	1,100	-	-	-	-	-	-	-	-	-	-	3,300
	Type-3	-	-	1,000	-	2,625	700	850	500	125	-	750	-	-	8,250
	Type-4	1,800	500	-	1,000	-	-	-	-	-	-	-	-	-	5,900
	Type-5	-	-	-	-	1,575	-	-	-	1,775	-	1,950	1,900	-	7,200
	Type-6	-	-	-	-	-	-	-	-	-	1,200	-	-	-	1,200
	Type-7	-	-	-	-	-	-	-	-	-	-	-	1,950	-	1,950
	Type-8	-	-	-	-	-	-	-	-	-	-	-	4,175	-	4,175
	Sub-total	1,800	2,700	2,100	1,000	4,200	700	850	500	500	1,900	2,700	8,025	4,300	31,975
Improvement (Improvement of earth canal)	Type-1	-	350	-	-	-	1,350	675	-	-	-	-	-	-	2,375
	Type-2	1,150	2,075	2,750	625	1,000	-	-	1,900	800	-	675	750	1,200	12,925
	Type-3	-	-	-	600	875	500	1,000	900	1,225	350	525	-	425	6,400
	Type-4	1,400	250	-	200	-	-	-	-	-	-	-	-	-	1,850
	Type-5	-	-	-	-	-	-	-	-	-	2,900	-	1,400	-	4,300
	Type-6	-	-	-	-	-	-	-	-	-	950	-	-	-	950
	Type-7	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Type-8	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Sub-total	2,550	2,675	2,750	1,425	1,875	1,850	1,675	2,800	2,025	4,200	1,200	2,150	1,625	28,800
Secondary Canal (Branch Canal)	Total	460	800	400	2,175	0	0	0	0	2,865	5,575	3,300	11,240	920	27,735
	Type-1	-	425	-	850	-	-	-	-	2,865	1,800	1,325	5,280	210	12,755
	Type-2	460	375	400	1,100	-	-	-	-	-	1,850	1,975	3,690	710	10,560
	Type-3	-	-	-	225	-	-	-	-	-	1,925	-	260	-	2,410
	Type-4	-	-	-	-	-	-	-	-	-	-	-	2,010	-	2,010
Tertiary Canal (Main Farm Ditch)		4,411	4,350	2,910	5,600	6,645	1,010	1,680	2,930	5,880	13,160	6,540	27,770	3,250	86,136

Table 4-2 Rehabilitation Plan of Canal Structures

Item	Type	unit	AK-4 Bishnambhara	AK-5 Boshan	AK-7 Dhakshinkari	AK-14 Indrayani	AK-25 Shali Nadi	Sub-total Kathmandu District	AB-2 Bidol	AB-10 Katuje	AB-12 Kutudhal	AB-14 Mhaseev Khole	Sub-total Bhaktapur District	AL-10 Kotkhu	AL-13 Lubhu	AL-19 Thika Bhairaw-I	AL-20 Thika Bhairaw-II	Sub-total Lalitpur District	TOTAL
Field Diversion Box		nos	106	110	74	127	146	563	30	44	69	133	276	300	165	622	88	1,175	2,014
Aqueduct		nos	10	0	0	0	2	12	0	0	1	1	2	0	0	0	3	3	17
Catch Drain		nos	2	2	0	0	1	5	2	1	2	0	5	0	1	2	2	5	15
Diversion	total	nos	1	3	2	4	1	11	0	0	0	7	7	6	5	16	2	29	47
	Type-1	nos	0	2	2	2	0	6	0	0	0	3	3	2	2	2	2	8	17
	Type-2	nos	1	1	0	2	1	5	0	0	0	4	4	3	3	8	0	14	23
	Type-3	nos	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0	7	7
Drainage Crossing		nos	1	0	0	0	3	4	1	2	0	1	4	1	0	5	0	6	14
Drop		nos	2	0	0	0	1	3	0	1	2	7	10	3	0	15	1	19	32
Escape	total	nos	6	4	2	2	5	19	1	1	2	1	5	1	1	2	2	6	30
	Type-1	nos	4	4	2	0	3	13	1	1	2	0	4	0	0	0	1	1	18
	Type-2	nos	2	0	0	2	2	6	0	0	0	1	1	0	1	0	1	2	9
	Type-3	nos	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	3	3
Field Diversion	total	nos	20	33	21	19	28	121	11	13	14	35	73	46	39	87	27	199	393
	Type-1	nos	4	23	8	14	26	75	3	6	10	1	20	41	33	64	9	147	242
	Type-2	nos	16	10	13	5	2	46	8	7	4	34	53	5	6	23	18	52	151
Road Crossing	total	nos	2	2	3	8	11	26	1	3	1	9	14	15	8	35	1	59	99
	Type-1	nos	0	2	0	1	2	5	0	0	1	2	3	12	3	11	0	26	34
	Type-2	nos	2	0	3	7	9	21	1	3	0	7	11	1	5	14	1	21	53
	Type-3	nos	0	0	0	0	0	0	0	0	0	0	0	2	0	10	0	12	12
Road crossing of tertiary canal		nos	8	2	0	1	0	11	0	0	1	4	5	11	2	15	0	28	44

Table 4-3 Planted Area under Without and With Project Condition

<Without Project Condition>														(Unit : ha)			
Crops	Farm Land	Paddy	Wheat	Maize	Mustard	Potato	Early Potato	Late Potato	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area	Cropping Intensity (%)	
Kathmandu District																	
AK - 04 Biswambhara	92	83	68	9	9	11	0	0	0	0					180	196.0	
AK - 05 Boshan	122	122	71	0	34	12	0	0	0	0					239	196.0	
AK - 07 Dakshinkali	67	67	15	0	23	2	0	0	0	25					132	197.0	
AK - 14 Indrayani	101	99	79	2	2	18	0	0	0	0					200	198.0	
AK - 25 Shali Nadi	157	157	79	0	8	38	22	22	0	0					325	207.0	
Sub-total	539	528	311	11	77	81	22	22	0	25					1,076	199.7	
Bhaktapur District																	
AB - 02 Bidol	32	32	26	0	0	3	0	0	0	0					61	190.0	
AB - 10 Katunje	40	38	30	2	2	6	0	0	0	0					78	195.0	
AB - 12 Kutudhal	43	43	34	0	1	6	0	0	0	0					84	195.0	
AB - 14 Mahadev Khola	112	110	90	2	6	6	0	0	3	0					216	193.0	
Sub-total	227	223	179	4	9	20	0	0	3	0					439	193.3	
Lalitpur District																	
AL - 10 Kotkhu	246	226	162	15	30	30	0	0	0	0					462	188.0	
AL - 13 Lubhu	130	121	85	7	7	7	0	0	20	0					244	188.0	
AL - 19 Thika Bhairaw-(I)	497	432	373	55	40	45	0	0	15	0					959	193.0	
AL - 20 Thika Bhairaw-(II)	88	86	75	0	2	3	0	0	2	0					167	190.0	
Sub-total	961	866	694	76	78	83	0	0	36	0					1,833	190.8	
Total	1,727	1,616	1,184	91	163	185	22	22	40	25					3,349	193.9	
<With Project Condition>																	
Crops	Farm Land	Paddy	Wheat	Maize	Mustard	Potato	Early Potato	Late Potato	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area	Cropping Intensity (%)	
Kathmandu District																	
AK - 04 Biswambhara	92	46				23	12	12	12		46	35	23	12	219	237.5	
AK - 05 Boshan	122	61				31	9	9	21		61	40	18	21	271	222.5	
AK - 07 Dakshinkali	67	34				17	8	8	8		34	25	17	8	159	237.5	
AK - 14 Indrayani	101	51				25	13	13	13		51	38	25	13	240	237.5	
AK - 25 Shali Nadi	157	79				39	20	20	20		79	67	55	12	389	247.5	
Sub-total	539	270				135	61	61	73		270	204	138	66	1,278	237.0	
Bhaktapur District																	
AB - 02 Bidol	32	16				8	2	2	6		16	10	5	6	71	222.5	
AB - 10 Katunje	40	20				5	10	0	5		20	15	5	5	85	212.5	
AB - 12 Kutudhal	43	22				3	11	0	8		22	14	3	8	89	207.5	
AB - 14 Mahadev Khola	112	56				8	28	0	20		56	36	8	20	232	207.5	
Sub-total	227	114				25	51	2	38		114	76	21	38	478	210.5	
Lalitpur District																	
AL - 10 Kotkhu	246	123				62	18	18	43		123	80	37	43	547	222.5	
AL - 13 Lubhu	130	65				16	33	0	16		65	49	16	16	276	212.5	
AL - 19 Thika Bhairaw-(I)	497	249				124	37	37	87		249	162	75	87	1,106	222.5	
AL - 20 Thika Bhairaw-(II)	88	44				22	11	11	11		44	33	22	11	209	237.5	
Sub-total	961	481				224	99	67	157		481	323	150	157	2,138	222.5	
Total	1,727	864				383	212	130	268		864	603	309	261	3,894	225.5	
<Balance>																	
Crops	Farm Land	Paddy	Wheat	Maize	Mustard	Potato	Early Potato	Late Potato	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area	Incremental Intensity (%)	
Kathmandu District																	
AK - 04 Biswambhara		-37	-68	-9	-9	12	12	12	12	0	46	35	23	12	38	41.5	
AK - 05 Boshan		-61	-71	0	-34	18	9	9	21	0	61	40	18	21	32	26.5	
AK - 07 Dakshinkali		-34	-15	0	-23	15	8	8	8	-25	34	25	17	8	27	40.5	
AK - 14 Indrayani		-48	-79	-2	-2	7	13	13	13	0	51	38	25	13	40	39.5	
AK - 25 Shali Nadi		-79	-79	0	-8	2	-2	-2	20	0	79	67	55	12	64	40.5	
Sub-total		-258	-311	-11	-77	54	39	39	73	-25	270	204	138	66	201	37.3	
Bhaktapur District																	
AB - 02 Bidol		-16	-26	0	0	5	2	2	6	0	16	10	5	6	10	32.5	
AB - 10 Katunje		-18	-30	-2	-2	-1	10	0	5	0	20	15	5	5	7	17.5	
AB - 12 Kutudhal		-22	-34	0	-1	-2	11	0	8	0	22	14	3	8	5	12.5	
AB - 14 Mahadev Khola		-54	-90	-2	-6	3	28	0	16	0	56	36	8	20	16	14.5	
Sub-total		-109	-179	-4	-9	4	51	2	34	0	114	76	21	38	39	17.2	
Lalitpur District																	
AL - 10 Kotkhu		-103	-162	-15	-30	32	18	18	43	0	123	80	37	43	85	34.5	
AL - 13 Lubhu		-56	-85	-7	-7	10	33	0	-3	0	65	49	16	16	32	24.5	
AL - 19 Thika Bhairaw-(I)		-184	-373	-55	-40	80	37	37	72	0	249	162	75	87	147	29.5	
AL - 20 Thika Bhairaw-(II)		-42	-75	0	-2	19	11	11	9	0	44	33	22	11	42	47.3	
Sub-total		-385	-694	-76	-78	141	99	67	121	0	481	323	150	157	305	31.8	
Total		-753	-1,184	-91	-163	198	190	100	229	-25	964	603	309	261	545	31.6	
							Potato Total :		497		Legume :		204		Vegetable Total :		2,936

Table 4-4 Unit Yield and Production under Without and With Project Condition

<Without Project Condition>														
Crops	Paddy	Wheat	Maize	Mustard	Potato	Early Potato	Late Potato	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	
Unit Yield (kg/ha)	4,230	1,990	1,460	600	10,020	8,500	8,500	1,360	820	-	-	-	-	
Kathmandu District														
AK - 04 Biswambhara	298	75	12	7	88	0	0	0	0					
AK - 05 Boshan	512	134	0	28	140	0	0	0	0					
AK - 07 Dakshinkali	255	31	0	17	17	0	0	0	20					
AK - 14 Indrayani	376	110	3	1	195	0	0	0	0					
AK - 25 Shali Nadi	628	110	0	4	535	187	187	0	0					
Sub-total	2048	491	15	49	854	187	187	0	0					
Bhaktapur District														
AB - 02 Bidol	131	44	0	0	33	0	0	0	0					
AB - 10 Katunje	171	62	3	1	63	0	0	0	0					
AB - 12 Kutudhal	176	76	0	0	64	0	0	0	0					
AB - 14 Mahadev Khola	461	215	3	2	65	0	0	4	0					
Sub-total	941	376	6	4	223	0	0	4	0					
Lalitpur District														
AL - 10 Kotkhu	951	276	21	15	275	0	0	0	0					
AL - 13 Lubhu	556	194	10	3	59	0	0	29	0					
AL - 19 Thika Bhairaw-(I)	1989	783	80	29	420	0	0	23	0					
AL - 20 Thika Bhairaw-(II)	379	180	0	1	25	0	0	2	0					
Sub-total	3853	1476	112	46	776	0	0	50	0					
Total	6842	2343	133	99	1853	187	187	54	20					
<With Project Condition>														
Crops	Paddy	Wheat	Maize	Mustard	Potato	Early Potato	Late Potato	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	
Unit Yield (kg/ha)	5,200	-	-	-	13,000	11,000	11,000	1,500	-	12,000	16,000	20,000	18,000	
Kathmandu District														
AK - 04 Biswambhara	239				299	127	127	17		552	552	460	207	
AK - 05 Boshan	317				397	101	101	32		732	634	366	384	
AK - 07 Dakshinkali	174				218	92	92	13		402	402	335	151	
AK - 14 Indrayani	263				328	139	139	19		606	606	505	227	
AK - 25 Shali Nadi	408				510	216	216	29		942	1,068	1,099	212	
Sub-total	1,401				1,752	674	674	110		3,234	3,262	2,765	1,181	
Bhaktapur District														
AB - 02 Bidol	83				104	26	26	8		192	166	96	101	
AB - 10 Katunje	104				65	110	0	6 *		240	240	100	62 *	
AB - 12 Kutudhal	112				42	118	0	7 #		258	224	65	68 #	
AB - 14 Mahadev Khola	291				109	308	0	25 "		672	582	168	274 "	
Sub-total	590				320	563	26	46		1,362	1,212	429	505	
Lalitpur District														
AL - 10 Kotkhu	640				800	203	203	65		1,476	1,279	738	775	
AL - 13 Lubhu	338				211	358	0	24		780	780	325	293	
AL - 19 Thika Bhairaw-(I)	1,292				1,615	410	410	130		2,982	2,584	1,491	1,566	
AL - 20 Thika Bhairaw-(II)	229				286	121	121	17		528	528	440	198	
Sub-total	2,499				2,912	1,091	734	236		5,766	5,172	2,994	2,831	
Total	4,490				4,984	2,328	1,434	393		10,362	9,646	6,188	4,517	
<Total Balance>														
Total	-2,352	-2,343	-133	-99	3,131	2,141	1,247	339	-20	10,362	9,646	6,188	4,517	
					Potato Total :		6,519	Legume :		319	Vegetable Total :			30,713

Remarks : * ; Due to the limitation of irrigable area in dry season, Yield is reduced in the 58% of total planted area.
 # ; Due to the limitation of irrigable area in dry season, Yield is reduced in the whole planted area.
 " ; Due to the limitation of irrigable area in dry season, Yield is reduced in the 47% of total planted area.

Table 5-1

Summary of Project Cost

Scheme	Net Farm		Project Cost (NRs. 1,000)					Total	Cost per ha	
	Land (ha)	Construction Cost	Engineering Cost	Administration Cost	O & M Equipment	Contingencies	Price Escalation		(NRs.)	(US\$)
Kathmandu District										
AK-04 Bishnambhara	92									
Local		8,798	320	687	497	264	1,171	11,737	128	2,604
Foreign		6,466	748	1,603	562	194	300	9,873	107	2,190
Total		15,264	1,068	2,290	1,059	458	1,471	21,610	235	4,794
AK-05 Boshan	122									
Local		10,348	379	811	586	310	1,791	14,225	117	2,380
Foreign		7,672	882	1,892	663	230	463	11,802	97	1,974
Total		18,020	1,261	2,703	1,249	540	2,254	26,027	213	4,354
AK-07 Daksinkali	67									
Local		8,026	295	634	458	241	1,069	10,723	160	3,266
Foreign		6,045	690	1,477	518	181	280	9,191	137	2,800
Total		14,071	985	2,111	976	422	1,349	19,914	297	6,066
AK-14 Indrayani	101									
Local		8,287	301	644	466	249	1,103	11,050	109	2,233
Foreign		6,024	701	1,503	527	181	280	9,216	91	1,862
Total		14,311	1,002	2,147	993	430	1,383	20,266	201	4,095
AK-25 Shali Nadi	157									
Local		13,517	480	1,029	743	406	2,340	18,515	118	2,407
Foreign		9,328	1,119	2,398	841	280	568	14,534	93	1,889
Total		22,845	1,599	3,427	1,584	686	2,908	33,049	211	4,296
Sub-total	539	84,511	5,915	12,678	5,861	2,536	9,365	120,866	224	4,576
Bhaktapur District										
AB-02 Bidol	32									
Local		6,858	205	439	317	206	901	8,926	279	5,693
Foreign		2,890	477	1,023	359	87	142	4,978	156	3,175
Total		9,748	682	1,462	676	293	1,043	13,904	435	8,867
AB-10 Katunje	40									
Local		4,112	151	324	234	123	548	5,492	137	2,802
Foreign		3,087	353	756	265	93	143	4,697	117	2,396
Total		7,199	504	1,080	499	216	691	10,189	255	5,198
AB-12 Kutudhal	43									
Local		5,644	205	439	317	169	751	7,525	175	3,571
Foreign		4,105	477	1,023	359	123	191	6,278	146	2,980
Total		9,749	682	1,462	676	292	942	13,803	321	6,551
AB-14 Mahadev Khola	112									
Local		14,413	526	1,128	815	432	1,919	19,233	172	3,505
Foreign		10,645	1,228	2,631	922	319	494	16,239	145	2,959
Total		25,058	1,754	3,759	1,737	751	2,413	35,472	317	6,464
Sub-total	227	51,754	3,622	7,763	3,588	1,552	5,089	73,368	323	6,596
Lalitpur District										
AL-10 Kotkhu	246									
Local		23,500	846	1,811	1,309	705	4,141	32,312	131	2,681
Foreign		16,736	1,971	4,224	1,481	502	1,029	25,943	105	2,152
Total		40,236	2,817	6,035	2,790	1,207	5,170	58,255	237	4,833
AL-13 Lubhu	130									
Local		14,616	524	1,123	812	438	1,944	19,457	150	3,054
Foreign		10,337	1,223	2,620	918	310	481	15,889	122	2,494
Total		24,953	1,747	3,743	1,730	748	2,425	35,346	272	5,549
AL-19 Thika Bhairaw-I	497									
Local		60,432	2,136	4,579	3,310	1,812	12,289	84,558	170	3,472
Foreign		41,296	4,985	10,680	3,744	1,239	2,985	64,929	131	2,666
Total		101,728	7,121	15,259	7,054	3,051	15,274	149,487	301	6,138
AL-20 Thika Bhairaw-II	88									
Local		15,422	553	1,185	857	463	2,550	21,030	239	4,877
Foreign		10,907	1,290	2,764	969	328	642	16,900	192	3,919
Total		26,329	1,843	3,949	1,826	791	3,192	37,930	431	8,796
Sub-total	961	193,246	13,528	28,986	13,400	5,797	26,061	281,018	292	5,968
Total	1,727	329,511	23,065	49,427	22,849	9,885	40,515	475,252	275	5,616

Table 7-1 Economic Irrigation Benefit under Without and With Project Condition

<Without Project Condition>

Crops	Farm Land (ha)	Paddy	Wheat	Maize	Mustard	Potatoes	Early Potatoes	Late Potatoes	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area (000 NRs.)	Incremental Benefit per ha (000 NRs.)
Return by crop (NRs./ha)	(ha)	29,901	16,540	6,640	3,337	40,520	29,880	29,880	6,608	8,284						
Kathmandu District																
AK - 04 Biswambhara	92	2,476	1,126	61	31	447	0	0	0	0					4,141	45
AK - 05 Bozhan	122	3,648	1,170	0	114	494	0	0	0	0					5,427	44
AK - 07 Dakshinkali	67	2,003	244	0	78	81	0	0	0	205					2,612	39
AK - 14 Indrayani	101	2,960	1,303	13	7	737	0	0	0	0					5,019	50
AK - 25 Shali Nadi	157	4,694	1,298	0	26	1,527	657	657	0	0					8,859	56
Sub-total	539	15,781	5,142	75	256	3,287	657	657	0	205					24,059	48
Bhaktapur District																
AB - 02 Bidol	32	957	423	0	0	130	0	0	0	0					1,510	47
AB - 10 Katunje	40	1,136	490	13	8	243	0	0	0	0					1,890	47
AB - 12 Kutudhal	43	1,286	569	0	3	227	0	0	0	0					2,084	48
AB - 14 Mahadev Khola	112	3,282	1,482	15	19	227	0	0	22	0					5,047	45
Sub-total	227	6,661	2,964	28	30	826	0	0	22	0					10,531	46
Lalitpur District																
AL - 10 Kokhu	246	6,767	2,685	98	99	1,196	0	0	0	0					10,845	44
AL - 13 Lubhu	130	3,615	1,398	43	22	263	0	0	129	0					5,470	42
AL - 19 Thaka Bhairew-(I)	497	12,929	6,165	363	133	1,812	0	0	99	0					21,501	43
AL - 20 Thaka Bhairew-(II)	88	2,579	1,237	0	6	107	0	0	12	0					3,940	45
Sub-total	961	25,890	11,486	504	259	3,379	0	0	239	0					41,756	43
Total	1,727	48,332	19,591	607	544	7,492	657	657	261	205					78,346	45

<With Project Condition>

Crops	Farm Land (ha)	Paddy	Wheat	Maize	Mustard	Potatoes	Early Potatoes	Late Potatoes	Broad Bean	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area (000 NRs.)	Incremental Benefit per ha (000 NRs.)
Return by crop (NRs./ha)	(ha)	38,730				50,586	36,586	36,586	7,343		63,660	105,240	90,931	51,357		
Kathmandu District																
AK - 04 Biswambhara	92	1,782				1,163	421	421	84		2,928	3,631	2,091	591	13,112	143
AK - 05 Bozhan	122	2,363				1,543	335	335	157		3,883	4,173	1,664	1,096	15,548	127
AK - 07 Dakshinkali	67	1,297				847	306	306	61		2,133	2,644	1,523	430	9,549	143
AK - 14 Indrayani	101	1,956				1,277	462	462	93		3,215	3,986	2,296	648	14,395	143
AK - 25 Shali Nadi	157	3,040				1,986	718	718	144		4,997	7,022	4,997	605	24,227	154
Sub-total	539	10,438				6,816	2,242	2,242	540		17,156	21,456	12,571	3,370	76,831	143
Bhaktapur District																
AB - 02 Bidol	32	620				405	88	88	41		1,019	1,094	436	288	4,078	127
AB - 10 Katunje	40	775				253	366	0	15 *		1,273	1,579	455	108 *	4,823	121
AB - 12 Kutudhal	43	833				163	393	0	0 #		1,369	1,471	293	0 #	4,522	105
AB - 14 Mahadev Khola	112	2,169				425	1,024	0	76 "		3,565	3,831	764	533 "	12,388	111
Sub-total	227	4,396				1,246	1,871	88	133		7,225	7,975	1,948	929	25,811	114
Lalitpur District																
AL - 10 Kokhu	246	4,764				3,111	675	675	316		7,830	8,414	3,355	2,211	31,351	127
AL - 13 Lubhu	130	2,517				822	1,189	0	119		4,138	5,130	1,478	835	16,228	125
AL - 19 Thaka Bhairew-(I)	497	9,624				6,285	1,364	1,364	639		15,820	16,999	6,779	4,467	63,340	127
AL - 20 Thaka Bhairew-(II)	88	1,704				1,113	402	402	81		2,801	3,473	2,000	565	12,542	143
Sub-total	961	18,610				11,331	3,630	2,441	1,155		30,589	34,016	13,612	8,077	123,462	128
Total	1,727	33,443				19,393	7,743	4,771	1,827		54,970	63,447	28,132	12,376	226,103	131

<Incremental Benefit>

Crops	Farm Land (ha)	Paddy	Wheat	Maize	Mustard	Potato	Potatoes	Early Potatoes	Late Potatoes	Garden Pea	Summer Vege.	Winter Vege.	Green Leaf Veg.	Bulb crop	Total Area (000 NRs.)	Incremental Benefit per ha (000 NRs.)
Kathmandu District																
AK - 04 Biswambhara	92	-694	-1,126	-61	-31	716	421	421	84	0	2,928	3,631	2,091	591	8,971	98
AK - 05 Bozhan	122	-1,285	-1,170	0	-114	1,049	335	335	157	0	3,883	4,173	1,664	1,096	10,122	83
AK - 07 Dakshinkali	67	-706	-244	0	-78	766	306	306	61	-205	2,133	2,644	1,523	430	6,937	104
AK - 14 Indrayani	101	-1,004	-1,303	-13	-7	541	462	462	93	0	3,215	3,986	2,296	648	9,375	93
AK - 25 Shali Nadi	157	-1,654	-1,298	0	-26	459	61	61	144	0	4,997	7,022	4,997	605	15,367	98
Sub-total	539	-5,343	-5,142	-75	-256	3,530	1,585	1,585	540	-205	17,156	21,456	12,571	3,370	50,772	94
Bhaktapur District																
AB - 02 Bidol	32	-337	-423	0	0	275	88	88	41	0	1,019	1,094	436	288	2,568	80
AB - 10 Katunje	40	-362	-490	-13	-8	10	366	0	15	0	1,273	1,579	455	108	2,933	73
AB - 12 Kutudhal	43	-453	-569	0	-3	-63	393	0	0	0	1,369	1,471	293	0	2,438	57
AB - 14 Mahadev Khola	112	-1,113	-1,482	-15	-19	198	1,024	0	54	0	3,565	3,831	764	533	7,341	66
Sub-total	227	-2,265	-2,964	-28	-30	419	1,871	88	111	0	7,225	7,975	1,948	929	15,280	67
Lalitpur District																
AL - 10 Kokhu	246	-2,003	-2,685	-98	-99	1,915	675	675	316	0	7,830	8,414	3,355	2,211	20,506	83
AL - 13 Lubhu	130	-1,098	-1,398	-43	-22	539	1,189	0	110	0	4,138	5,130	1,478	835	10,759	83
AL - 19 Thaka Bhairew-(I)	497	-3,504	-6,165	-363	-133	4,473	1,364	1,364	540	0	15,820	16,999	6,779	4,467	41,839	84
AL - 20 Thaka Bhairew-(II)	88	-875	-1,237	0	-6	1,006	402	402	69	0	2,801	3,473	2,000	565	8,602	98
Sub-total	961	-7,280	-11,486	-504	-259	7,952	3,630	2,441	916	0	30,589	34,016	13,612	8,077	81,795	85
Total	1,727	-14,888	-19,591	-607	-544	11,902	7,984	4,114	1,564	-205	54,970	63,447	28,132	12,376	147,757	86
Potato Total :							23,182	Legume : 1,361		Vegetable Total : 158,925						

Remarks : * : Due to the limitation of irrigable area in dry season, Yield is reduced in the 58% of total planted area.
 # : Due to the limitation of irrigable area in dry season, Yield is reduced in the whole planted area.
 " : Due to the limitation of irrigable area in dry season, Yield is reduced in the 47% of total planted area.

Table 7-2 Annual O&M Cost and Replacement Cost for Selected Irrigation Schemes

Selected Model Scheme	Irrigation Area		Financial Cost						Economic Cost						CCF = 0.940	
	Gross (ha)	Net (ha)	O&M Cost (NRs.1,000)		Unit O&M Cost		Cost of Gates* (NRs.1,000)		O&M Cost (NRs.1,000)		Cost of Gates* (NRs.1,000)		L/C	F/C		Total
			L/C	F/C	Total	NRs./ha	US\$/ha	L/C	F/C	Total	L/C	F/C				
Kathmandu District																
AK-04 Biswambhara	115	92	245	71	317	3,442	70.25	100	151	251	191	71	262	85	128	212
AK-05 Boshan	153	122	265	85	351	2,876	58.69	198	297	495	209	85	294	168	251	419
AK-07 Dakstinkali	84	67	186	65	251	3,751	76.56	49	67	116	147	65	213	41	57	98
AK-14 Indrayani	126	101	242	67	309	3,060	62.45	108	163	271	188	67	255	91	138	229
AK-25 Shali Nadi	196	157	350	104	455	2,895	59.09	167	250	417	275	104	380	141	212	353
Sub-total	674	539	1,289	394	1,683	3,122	63.70	622	928	1,550	1,010	394	1,404	526	785	1,311
Bhaktapur District																
AB-02 Bidol	40	32	169	31	200	6,264	127.84	53	80	133	132	31	164	45	68	113
AB-10 Katunje	50	40	143	34	177	4,417	90.15	53	80	133	109	34	143	45	68	113
AB-12 Kutudhal	54	43	159	44	203	4,719	96.30	53	80	133	123	44	167	45	68	113
AB-14 Mahadev Khola	140	112	305	114	419	3,741	76.34	594	891	1,485	244	114	358	503	754	1,256
Sub-total	284	227	775	224	999	4,401	89.81	753	1,131	1,884	608	224	832	637	957	1,594
Lalitpur District																
AL-10 Kotkhu	308	246	463	185	648	2,634	53.76	216	325	541	376	185	561	183	275	458
AL-13 Lubhu	163	130	309	113	422	3,246	66.23	167	250	417	248	113	361	141	212	353
AL-19 Thika Bhairaw-I	621	497	869	448	1,317	2,651	54.10	911	1,367	2,278	737	448	1,185	771	1,156	1,927
AL-20 Thika Bhairaw-II	110	88	311	115	426	4,846	98.90	152	229	381	249	115	365	129	194	322
Sub-total	1,202	961	1,952	862	2,814	2,928	59.76	1,446	2,171	3,617	1,610	862	2,471	1,223	1,837	3,060
13 schemes																
Total	2,160	1,727	4,016	1,479	5,495	3,182	64.94	2,821	4,230	7,051	3,227	1,479	4,706	2,387	3,579	5,965

Note *: Replacement cost would be mainly for gates for intake and canal structures.

Table 7-3 Farm Budget of Typical Farm in the Project Areas

(Unit : NRS.)

Scheme No.	AK-04	AK-05	AK-07	AK-14	AK-25	AB-02	AB-10	AB-12	AB-14	AL-10	AL-13	AL-19	AL-20
Farm Size	0.41	0.28	0.28	0.37	0.27	0.19	0.24	0.30	0.26	0.19	0.23	0.25	0.13
Ave. Family No.	5.9	5.6	5.9	5.7	6.4	6.0	5.9	5.6	5.9	5.3	6.2	5.8	5.9

Without Project

Farm Income	30,950	18,520	20,720	26,910	21,940	14,080	17,610	24,480	16,430	11,470	12,470	14,460	7,490
Non Farm Income	19,790	18,560	19,770	25,800	29,400	20,270	25,890	18,560	19,260	19,750	23,100	21,610	27,100
Total Income	50,740	37,080	40,490	52,710	51,340	34,350	43,500	43,040	35,690	31,220	35,570	36,070	34,590
Farm Expense	7,340	4,820	3,810	7,300	6,700	3,470	4,490	5,690	4,510	3,300	3,740	4,290	2,230
Living Expense	30,680	28,860	30,410	29,640	32,990	30,300	29,890	31,520	29,900	26,860	27,640	30,740	30,980
Reserve	12,720	3,400	6,270	15,770	11,650	580	9,120	5,830	1,280	1,060	4,190	1,040	1,380

With Project

Intensive area

Farm Income	113,800	74,940	78,620	99,350	71,750	52,220	53,660	69,370	56,740	50,020	48,620	65,660	34,150
Non Farm Income	19,790	18,560	19,770	25,800	29,400	20,270	25,890	18,560	19,260	19,750	23,100	21,610	27,100
Total Income	133,590	93,500	98,390	125,150	101,150	72,490	79,550	87,930	76,000	69,770	71,720	87,270	61,250
Farm Expense	24,274	16,577	16,577	21,906	15,985	11,249	10,988	13,375	11,904	11,249	10,530	14,801	7,697
Living Expense	35,280	33,190	34,970	34,090	37,940	35,570	34,370	36,250	37,840	33,980	31,790	36,980	37,620
Reserve	74,036	43,733	46,843	69,154	47,225	25,671	34,192	38,305	26,256	24,541	29,400	35,489	15,933
(Increment)	61,316	40,333	40,573	53,384	35,575	25,091	25,072	32,475	24,976	23,481	25,210	34,449	14,553

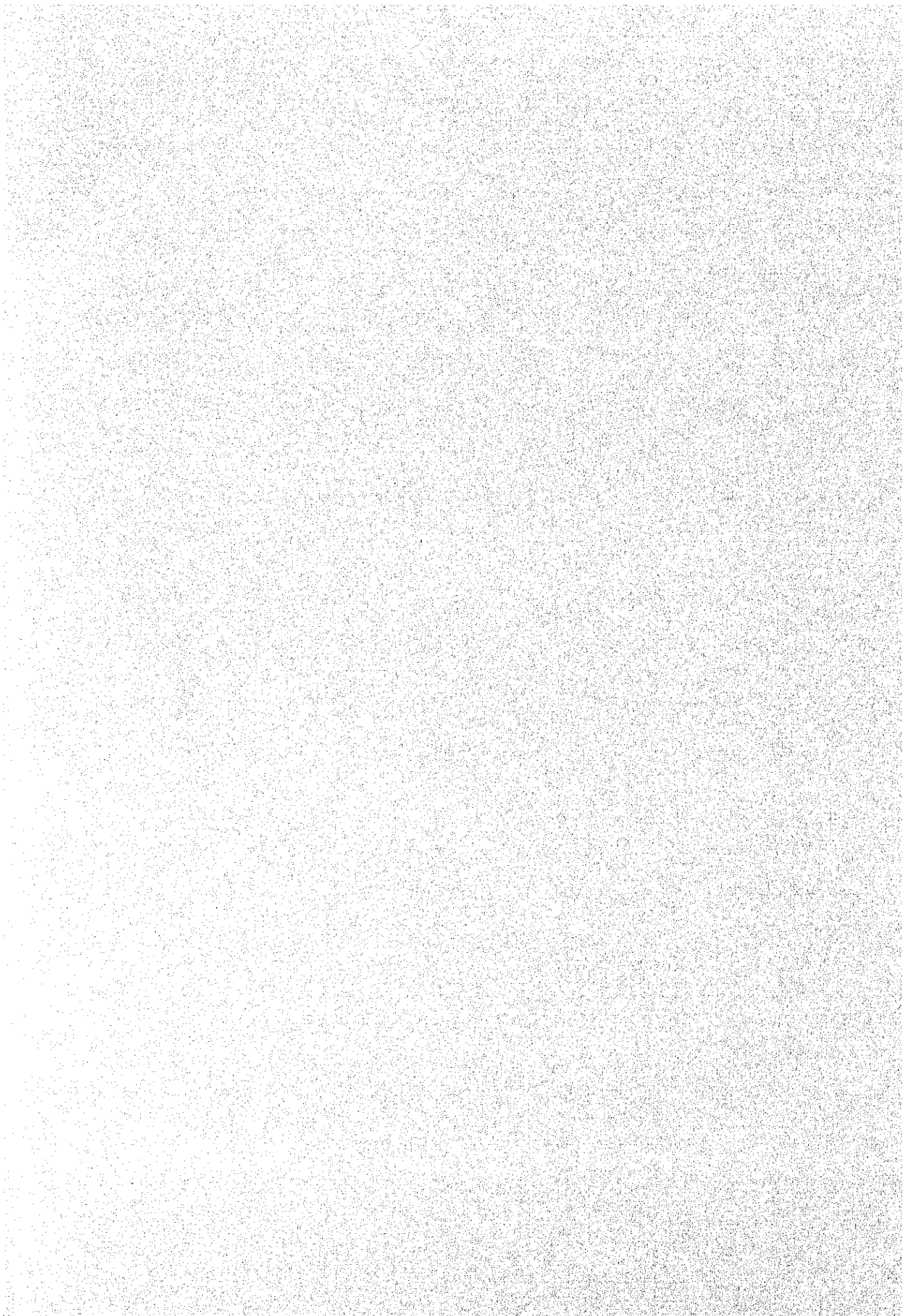
Remote area

Farm Income	71,320	45,920	49,600	61,010	43,770	32,530	39,650	51,860	41,560	30,330	35,190	39,760	20,680
Non Farm Income	19,790	18,560	19,770	25,800	29,400	20,270	25,890	18,560	19,260	19,750	23,100	21,610	27,100
Total Income	91,110	64,480	69,370	86,810	73,170	52,800	65,540	70,420	60,820	50,080	58,290	61,370	47,780
Farm Expense	15,735	10,746	10,746	14,200	10,362	7,292	9,211	11,513	9,978	7,292	8,827	9,594	4,989
Living Expense	35,280	33,190	34,970	34,090	37,940	35,570	34,370	36,250	37,840	33,980	31,790	36,980	37,620
Reserve	40,095	20,544	23,654	38,520	24,868	9,938	21,959	22,657	13,002	8,808	17,673	14,796	5,171
(Increment)	27,375	17,144	17,384	22,750	13,218	9,358	12,839	16,827	11,722	7,748	13,483	13,756	3,791

Remote area (drought)

Farm Income	36,110	47,440	37,730
Non Farm Income	25,890	18,560	19,260
Total Income	62,000	66,000	56,990
Farm Expense	9,211	11,513	9,978
Living Expense	34,370	36,250	37,840
Reserve	18,419	18,237	9,172
(Increment)	9,299	12,407	7,892

Figures



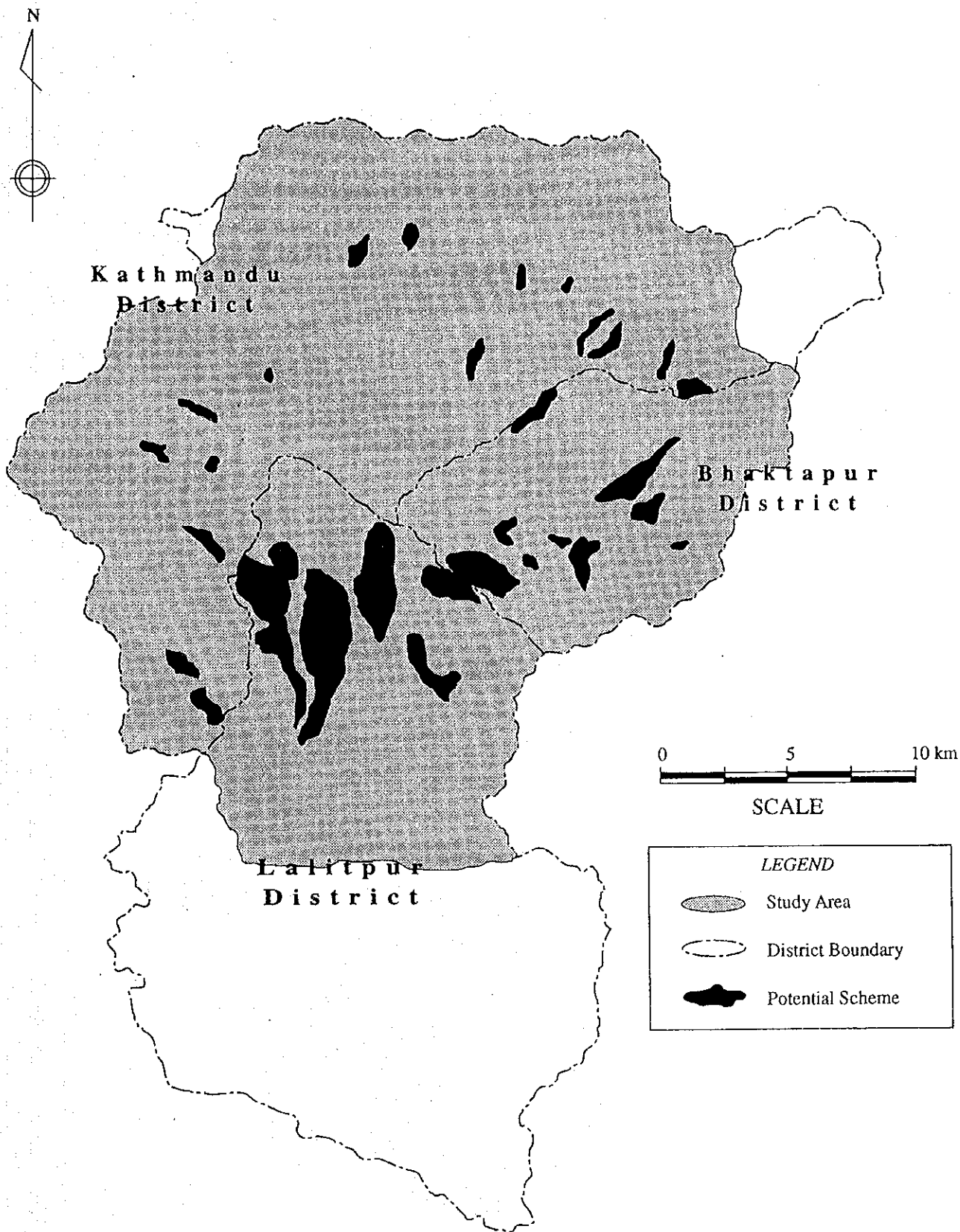


Figure 1-1 Study Area

Figure 1-2 Work Flow of the Study (1/2)

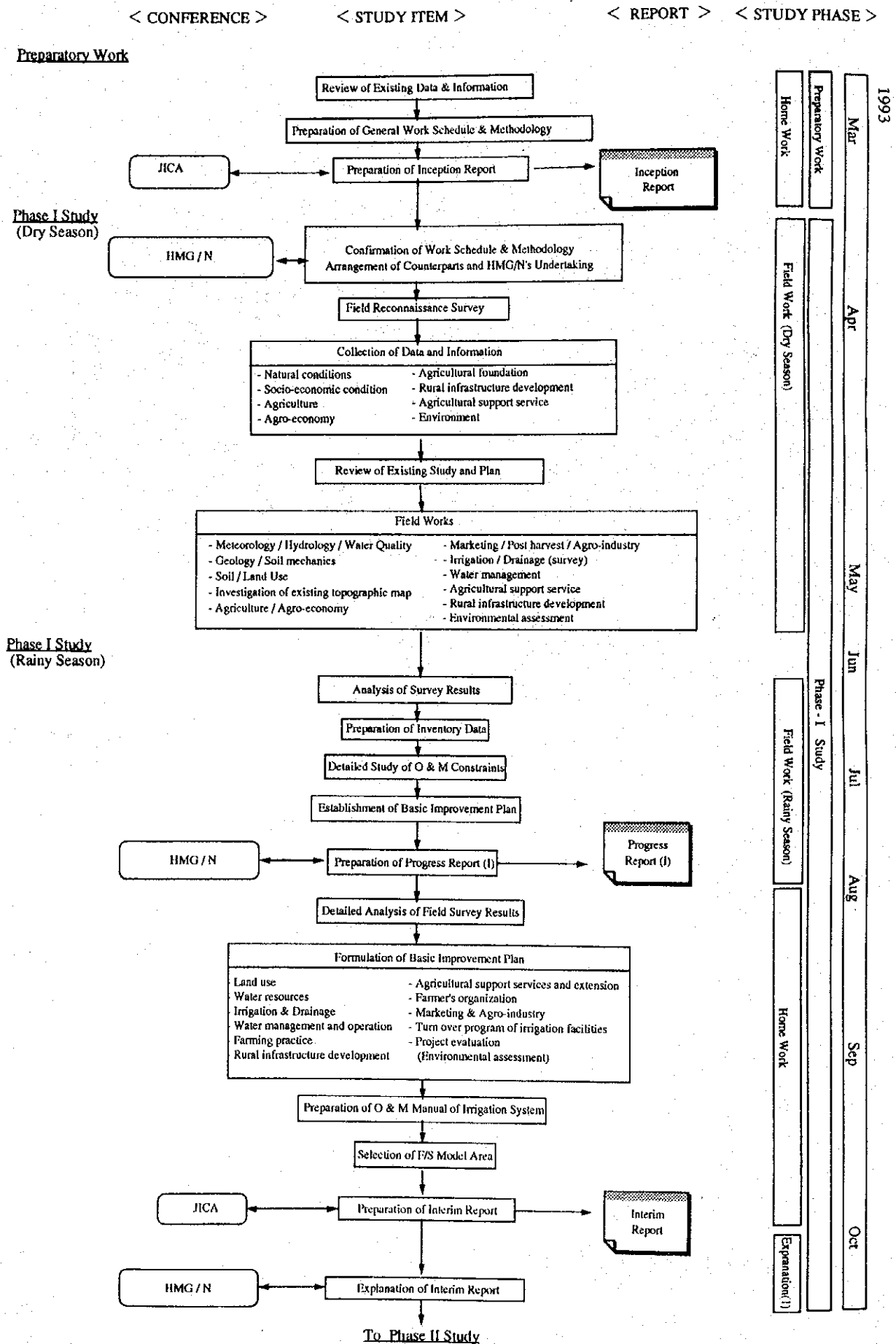


Figure 1-2 Work Flow of the Study (2/2)

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Phase II Study

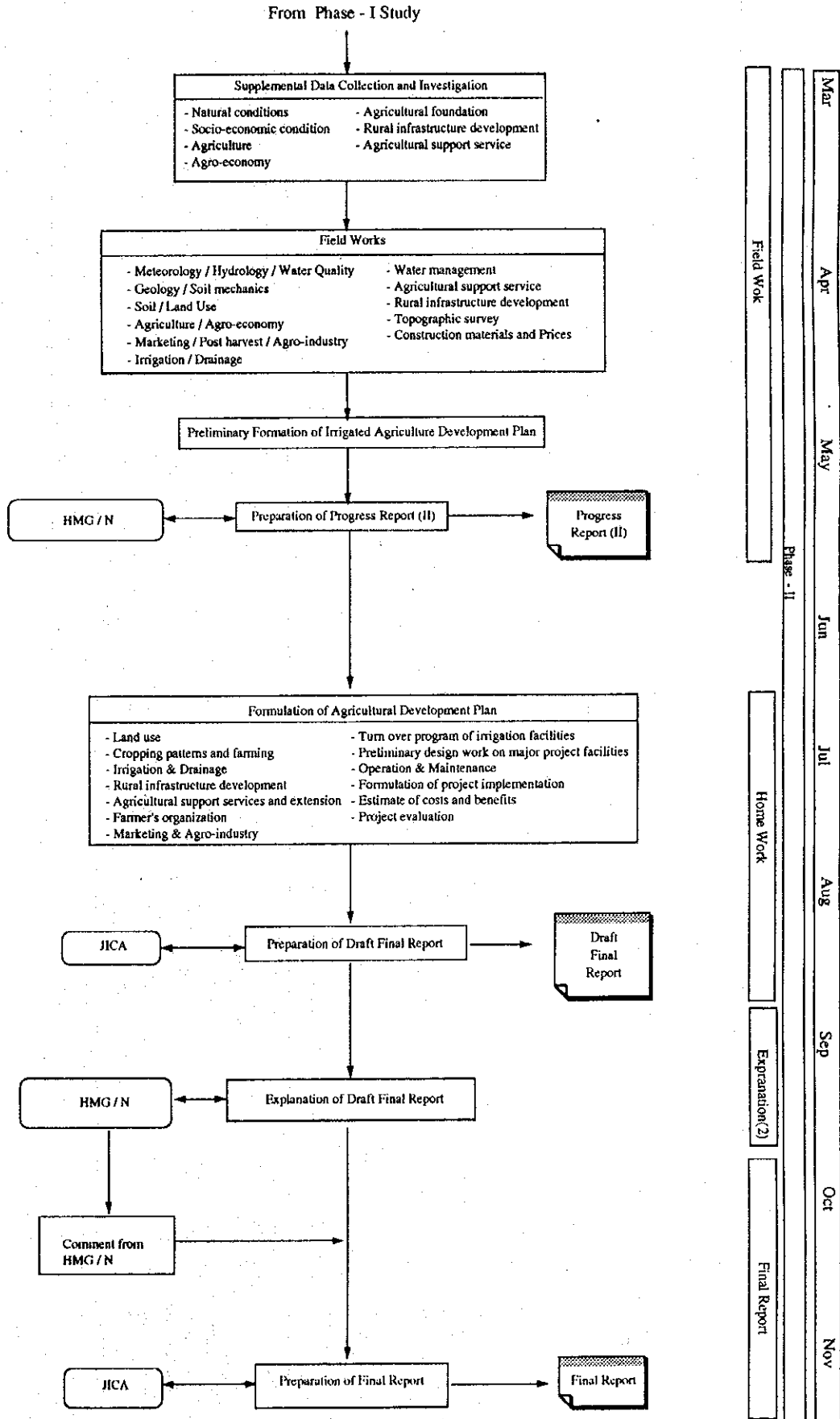


Figure 1-3 Organization of the Phase-II Study

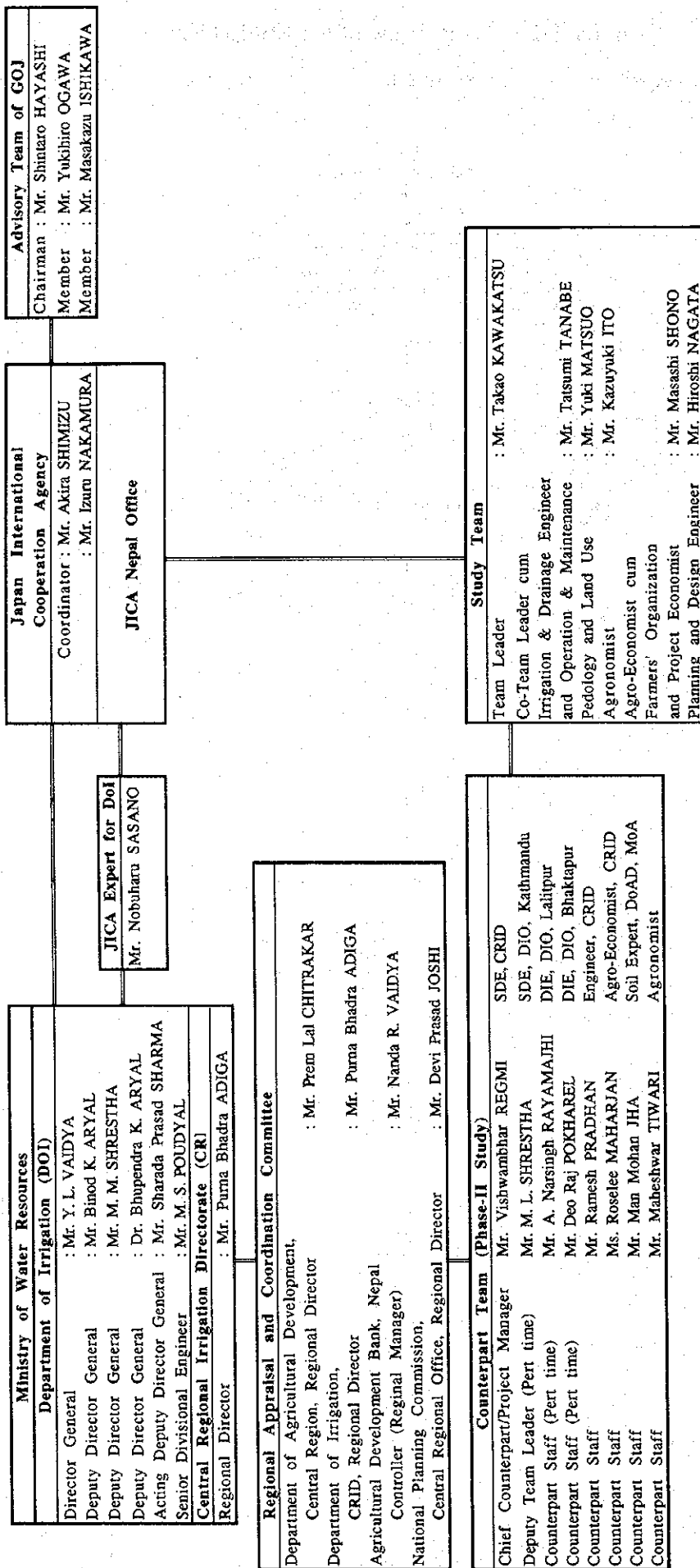


Figure 1-4 Assignment Schedule of the Study Team

Position	Name of Expert	Phase-I 1993												Phase-II 1994											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
		Topographic Mapping																							
Team Leader	T. Kawakatsu			6 (35)	10	4 (50)	22 (40)	14 (10)	23							23 (34)	26					23 (10)	2 (5)		
Co-Team Leader cum Irrigation & Drainage Eng. Operation & Maintenance	T. Tanabe			6 (40)	15	24 (60)	22 (45)	14 (10)	23							31 (57)	26					23 (10)	2 (5)		
Hydrologist	K. Okuwa			16 (30)	15	24 (60)	22 (45)																		
Pedologist cum Land Use	Y. Matsuo			16 (30)	15	9 (30)	7 (30)									31 (57)	26								
Agronomist	K. Itoh			6 (30)	5	24 (60)	22 (45)									31 (57)	26								
Agro-Economist cum Farmers organization & Project Economist	M. Shono			6 (40)	15	24 (60)	22 (45)	14 (10)	23							31 (57)	26					23 (10)	2 (5)		
Planning and Design Engineer	H. Nagata					9 (30)	7 (15)									31 (57)	26								
Reports																									
Inception Report																									
Progress Report (I)																									
Interim Report																									
Progress Report (II)																									
Draft Final Report																									
Final Report																									
Remarks		■ : Field Work in Nepal □ : Home Office Work in Japan																							

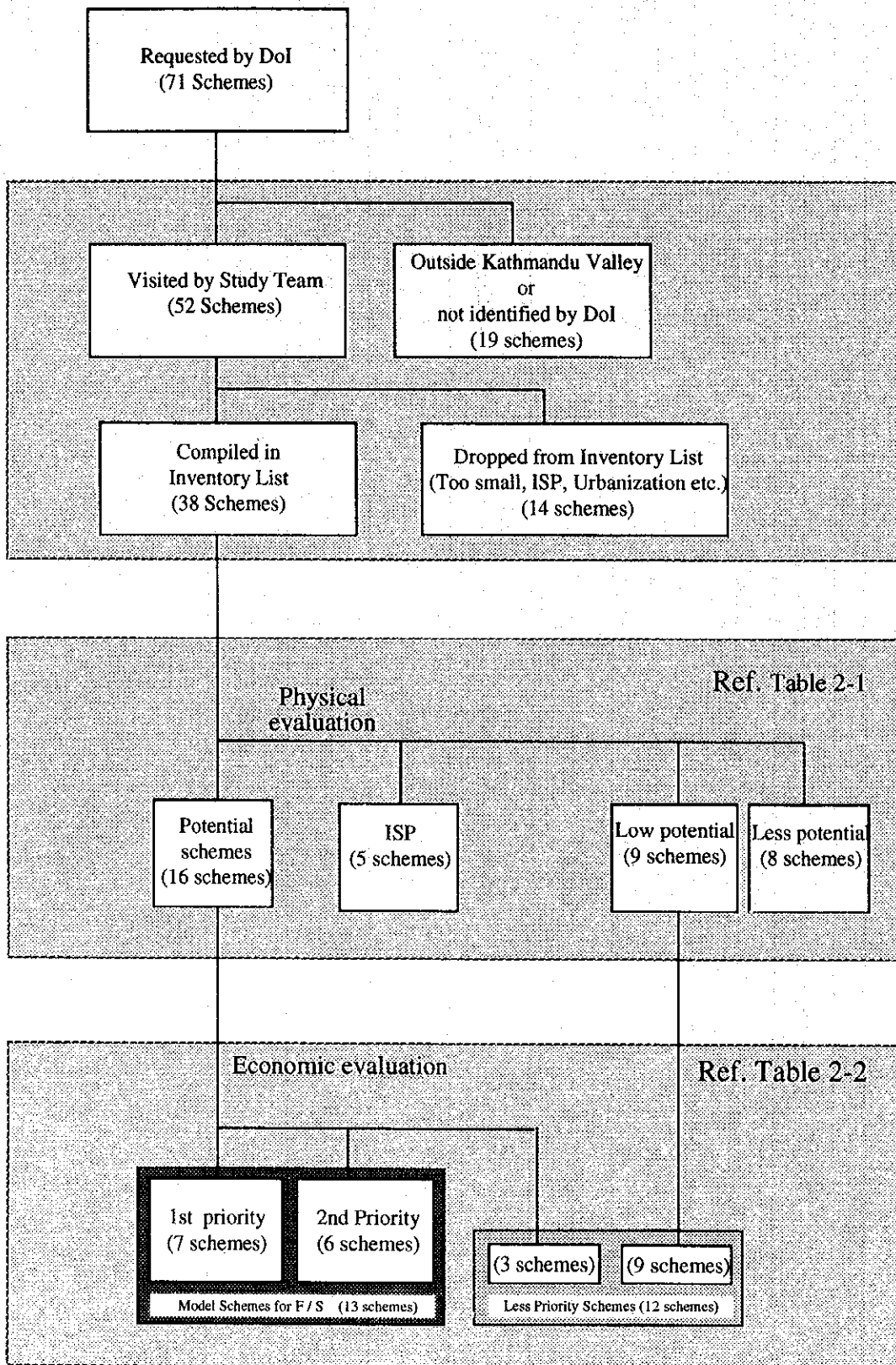
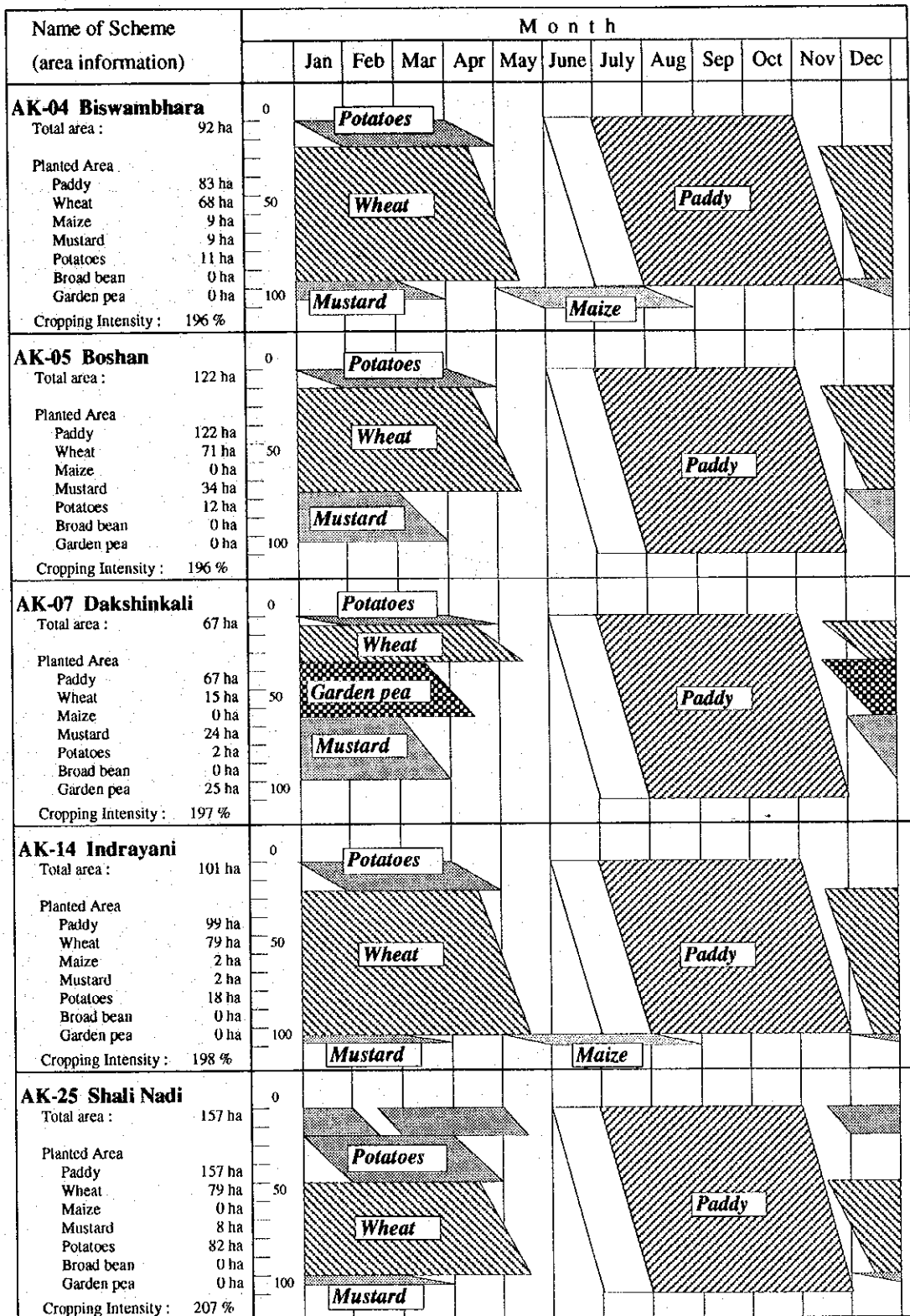
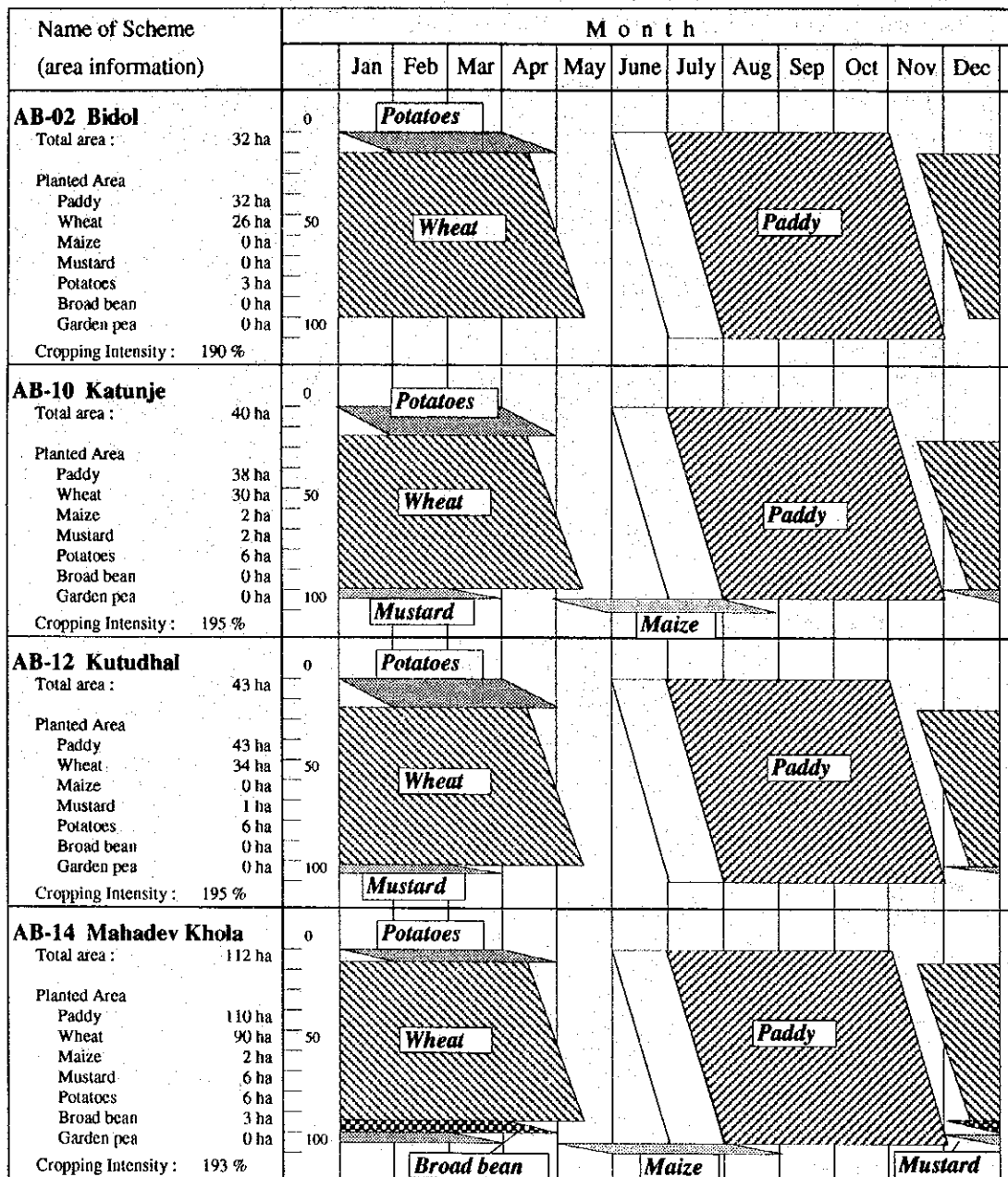


Figure 2-1 Selection Procedure of Priority Project



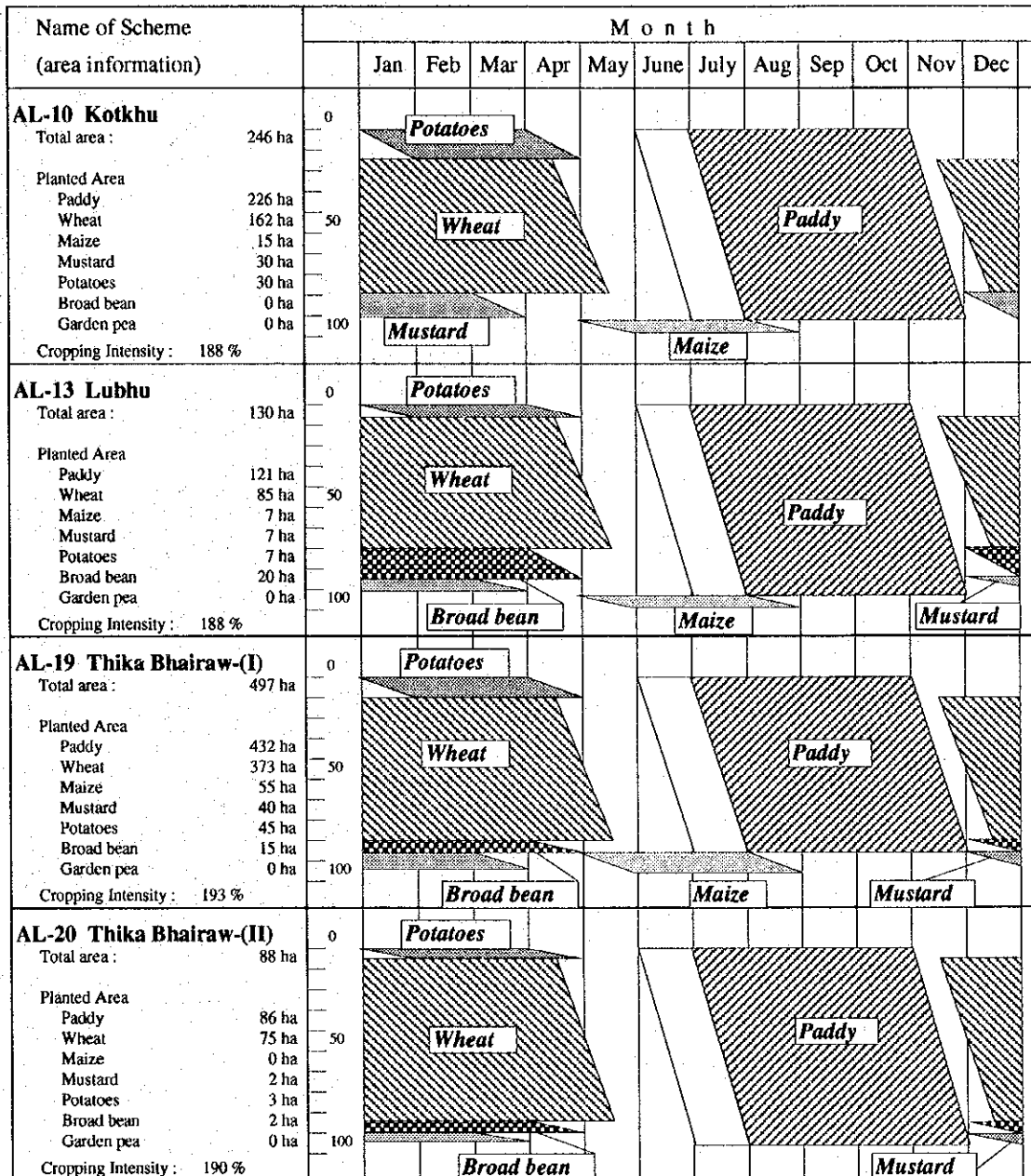
Source : Farm Survey , JICA Study Team , 1994

Figure 3-1
Present Cropping Pattern (1/3)



Source : Farm Survey , JICA Study Team , 1994

Figure 3-1
Present Cropping Pattern (2/3)



Source : Farm Survey , JICA Study Team , 1994

Figure 3-1

Present Cropping Pattern (3/3)

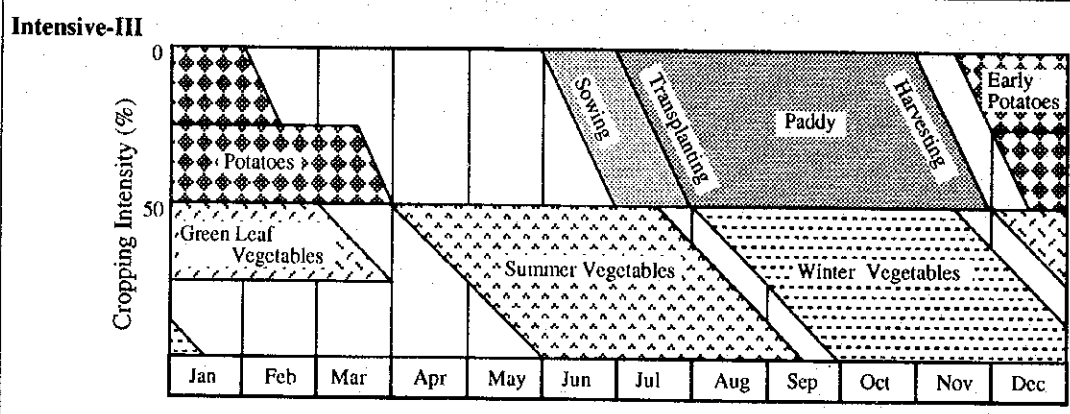
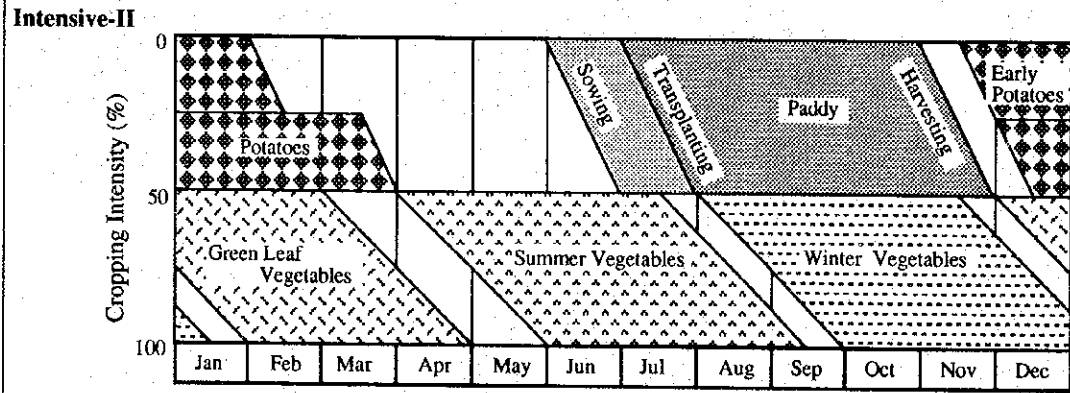
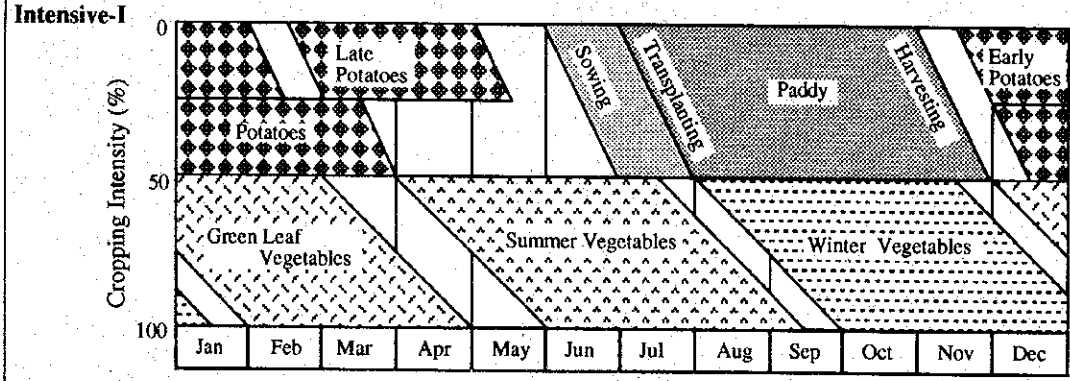
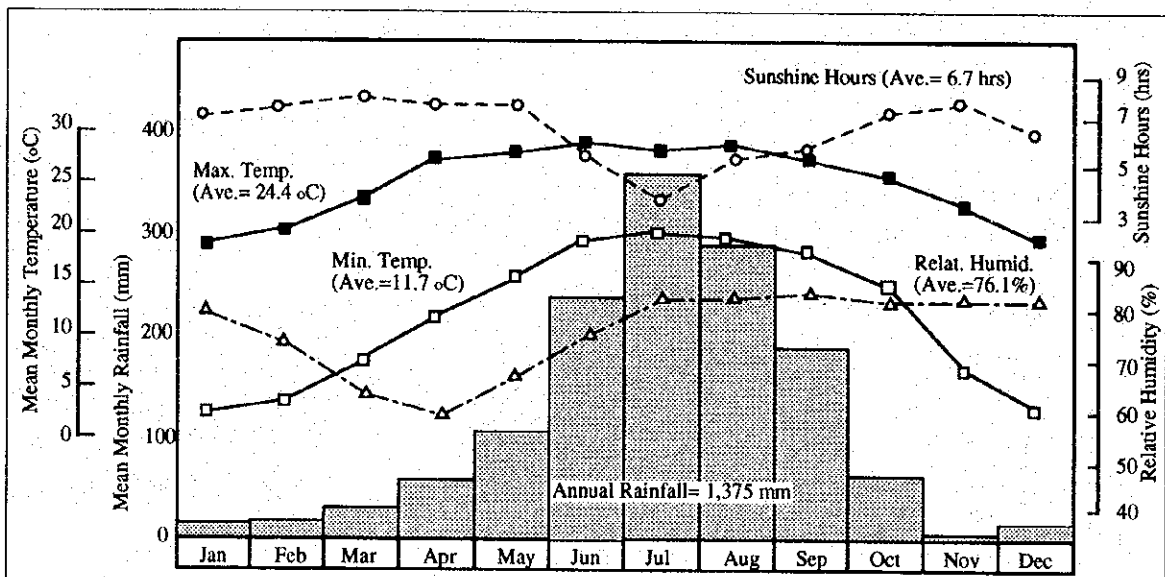
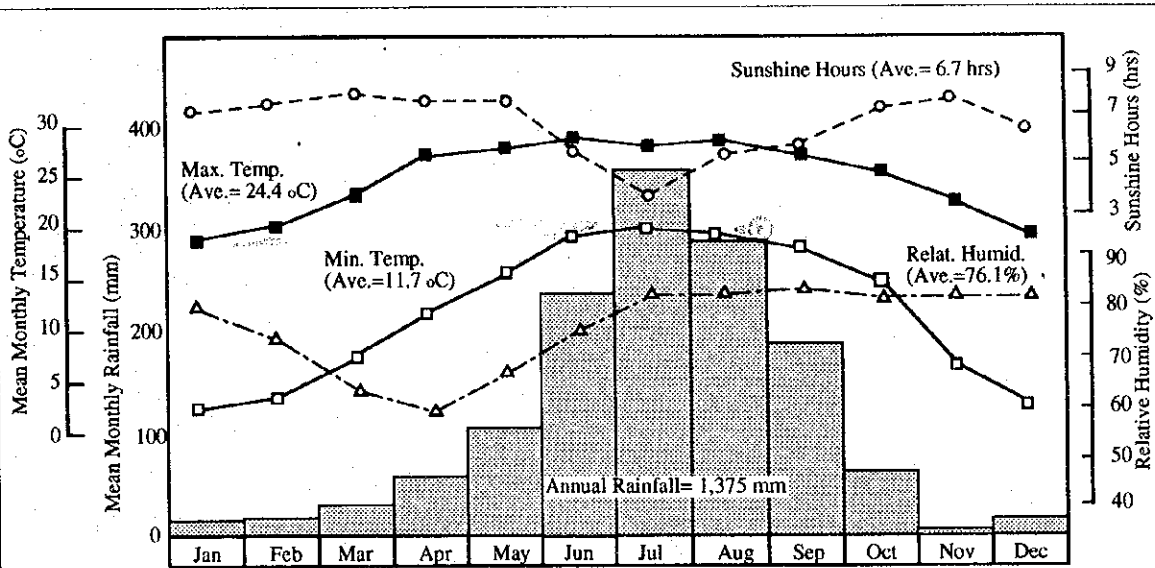
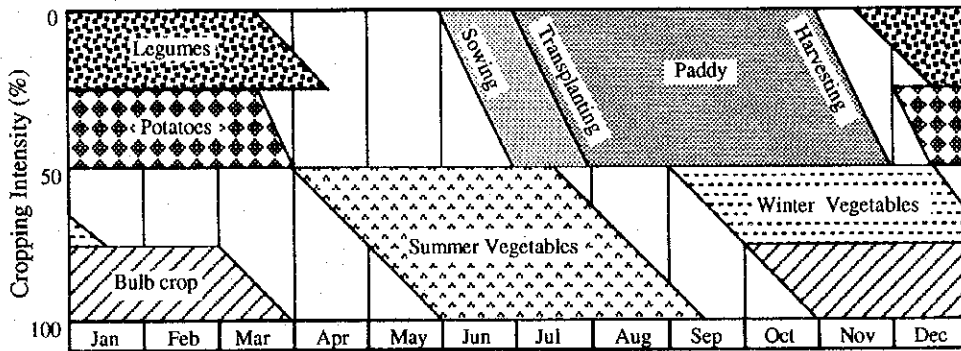


Figure 4-1 Proposed Cropping Pattern (1/2)
< Intensive area >

HIS MAJESTY'S GOVERNMENT OF NEPAL
 THE STUDY ON
 THE REHABILITATION OF GOVERNMENT DEVELOPED
 IRRIGATION SCHEMES IN THE KATHMANDU VALLEY
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Remote - I



Remote - II

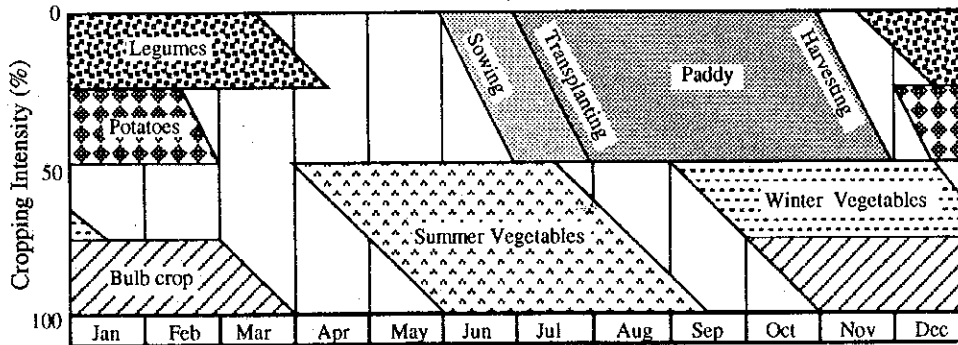


Figure 4-1 Proposed Cropping Pattern (2/2)
< Remote area >

HIS MAJESTY'S GOVERNMENT OF NEPAL
THE STUDY ON
THE REHABILITATION OF GOVERNMENT DEVELOPED
IRRIGATION SCHEMES IN THE KATIMANDU VALLEY
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