APPENDIX-3 RURAL SOCIOLOGY AND GENDER

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CHAPTER 1 INTRODUCTION

"*We are forsaken by Nepalese government, since we are at Indian border, which is remote from central, and have been much influenced by Indian culture*. " This is a common voice of farmers in the Study area, especially in VDCs, which are located near international border. Although Eastern Terai as general is regarded as relatively wealthy area due to geographical reason, it consists of various social dimensions in terms of livelihood, social strata, social norms and so on.

In order to identify the social dimension, this APPENDIX-3 RURAL SOCIOLOGY AND GENDER, aims to develop mainly two aspects: one is to understand social feature of the Study area, which may be related to think of mechanism of water users organization as well as baseline data toward implementation and operation stages. Another is to pre-evaluate the irrigation project from social point of view, to examine what kind of positive social impact could be expected by irrigation development, in turn, how negative impact could be prevented. About information used in the discussion, quantitative data have been collected from concerned offices such as DDC, VDC, concerned NGOs as well as result of household questionnaire survey which was conducted in this Study, and in turn, qualitative information were collected through direct interview to farmers, series of consultation meetings, and field observation.

This Appendix consists of, aside from this CHAPTER 1 INTRODUCTION, six chapters; namely, CHAPTER 2: SIGNIFICANCE OF RURAL SOCIOLOGY AND GENDER ANALYSIS TOWARD IRRIGATION PROJECT, CHAPTER 3: OVERVIEW OF SOCIAL DIMENSION IN NEPAL, CHAPTER 4: THE STUDY AREA, CHAPTER 5: LESSON LEARNED FROM EXISTING ORGANIZATION, CHAPTER 6: EXPECTED SOCIAL IMPACT BY IRRIGATION PROJECT, and CHAPTER 7: GENDER AND SOCIAL ASPECT, WHICH SHOULD BE CONSIDERED IN IRRIGATION PROJECT.

CHAPTER 2 firstly argues the significance of rural sociology and gender analysis toward irrigation project. Following that, CHAPTER 3 describes the overview of social dimension, to confirm the position of eastern Terai area, and moves on to details of the social dimension in the Study area in CHAPTER 4. In CHAPTER 5, discussed are lessons learned through existing community organizations, especially from the case of existing water users association.

With referring those findings, CHAPTER 6 pre-evaluates expected social impact by irrigation development, including positive and negative, and gives recommendations for minimizing the negative impact. Then, CHAPTER 7, in the end, suggests the points, which should be considered for irrigation development from social point of view, especially regarding to sustainable water utilization.

CHAPTER 2
SIGNIFICANCE OF RURAL SOCIOLOGY AND GENDER ANALYSIS TOWARD IRRIGATION PROJECT

There have been tremendous number of irrigation projects implemented in the world and at the same time, plenty of them have been the target of criticism because of un-functionality or failure. What is the difference between successful irrigation project and the one of less effect? The difference must come from the points such as; natural condition, operation and maintenance of the facility, manner of water allocation, technical issues, validity toward needs of people, and so on. As it could be seen, the differences are not only related to technical issues, but also the issue of mobilizing system itself including operation and maintenance of the facility, collection of ISF, communication between the project executing agency and beneficiaries, etc.

These points above can be missed due to misunderstanding or ignorance of the feature of particular target society and impose the mechanism examined in the office without sufficient field survey or consulting users, which might be theoretically functional but tend to be unsuitable in certain society. Furthermore, neglect of finding feature of the society may create the burden of more marginalized social group, or widen the gap between the rich and the poor. Analysis of rural society, including gender issue, will contribute to provide the idea about the society, which could be one element of thinking mechanism of mobilizing the system.

In order to understand certain society, an entrance might be the question, "*Who are the main actors of irrigation development project?*" Categorizing in two parts, the answer might be "Government" and "Farmers". Whereas the actor as "government side" could be described as a certain unified description in a sense, the definition of "farmer" varies depending on the living context even within the Study area. The significance of rural sociology and gender analysis, in one ward, is to pursue this theme.

The diversity of "farmer" could be categorized by religious and cultural aspect as represented by caste system, gender, living standard, geographical location, landholding size, social structure, and etc. Regarding to irrigation development, it might be important to focus on the dimension by living standard, social strata and their elements to define them, behavioral characteristics by different social group and so on, which could be considered as critical factors to think of mechanism to mobilize system better.

At the same time, rural sociological analysis includes the analysis of social environment surrounding those "farmer", such as; feature by location, feature by social strata, external and internal movement within the society which has been changing, communal work which could be done by unit of "community", etc. Some of them could be internal factor of the society and others might be external. Understanding the environment could be essential for examining the manner of approach to the target society by the project executing agency, since the approach cannot be same to all stakeholders.

From knowing those social dimension as well as environment surrounding farmers, capacity and potential of "farmers" as the main actor of irrigation development will come up.

"Capacity" in this sense includes economical capacity, manageability of organization, capacity in terms of human relationship considering social structure, and so forth. The following chapter will describe the overview of social dimension in rural life at countrywide to grasp the idea for confirming the position of Terai.

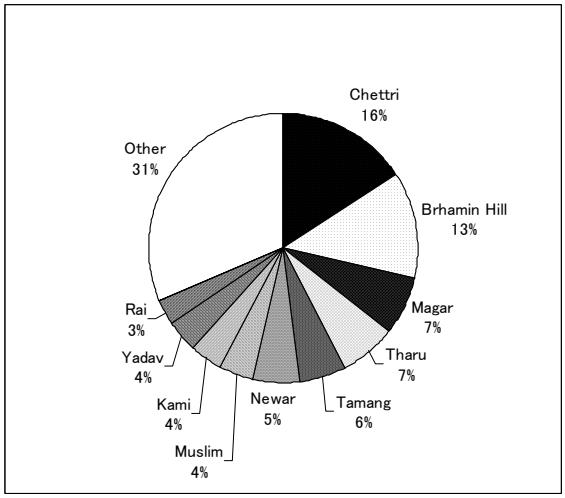
CHAPTER 3 OVERVIEW OF SOCIAL DIMENSION IN NEPAL

3.1 Idea of Religion and Caste System and its Distribution

Nepalese constitution guarantees the equality and right of whole nation before law, which prohibits discrimination by caste and provides the principle of equal reward under same labor regardless of both sexes. In the clause of Economic Freedom, there is a provision of freedom in terms of selection of occupation. The influence toward division of labor is getting less and people have different occupation from the one defined by caste these days. However, it is still germane to people's life, inherited by populations' in-depth of feelings even unconsciously, culturally and traditionally. In this sense, caste system is still in -negligible feature to understand Nepalese society, in term of not only understanding changing social strata, but to understand the aspect which might be bonded to caste system such as livelihood, social network, extension of social network, and so on.

To understand one of the features of Nepalese society, brief information on caste system will be explained. Until the Government has started the survey on caste distribution in 1981, the actual situation of caste distribution had not been known. Originally, the caste was divided into four (4), namely Brahmin, Kshatriya, Vaishya and Shudra, based on the division of labor, which the categories may contain elements of hierarchy. Gradually, it has been divided into sub-caste, not simply based on Hinduism, but also by social and cultural creation. During this process, other religion such as Muslim or native ethnic groups have been also regarded as one of the caste, and their position is also mutually understood in the society. Major religion is Hindu with the share of 81%, followed by Buddhism (10.7%) and Islam (4.2%). According to the recent population census (2001), there are 102 caste/ethnic groups, including "no caste (Foreigners)", and out of 97 caste/ethnic group exist in Sunsari district. The share of major caste at National level, Eastern Terai and Sunsari district is as follows;[1]

Figure 3.1.1 Caste Distribution at National Level



As Terai is defined as "marshy ground or a meadow" in Hindi language, Terai region is a flat plain land in the southern part of Nepal. The full-scale migration into Terai area started from middle of 20 century after deforestation of the thick forest as well as eradication of malaria.

[1] Source: Central Bureau of Statistics (2002), "Population Census 2001, National Report",
-ditto- "Population of Nepal- VDC/Municipalities, Population Census 2001"

According to the result of field survey by Centre for Economic and Technical Studies (CETS) in1992, around 90% of the people who "think" that they migrated into Terai are from Hills. The data seems relatively excessive than observation in the region, however the figure 3.1.2 also shows, as Brahmin Hill is the majority with share of 16% in Eastern Terai region.

Figure 3.1.2 Caste Distribution at Eastern Terai

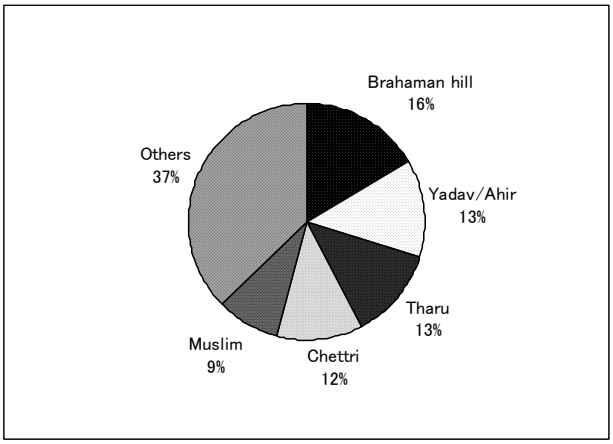
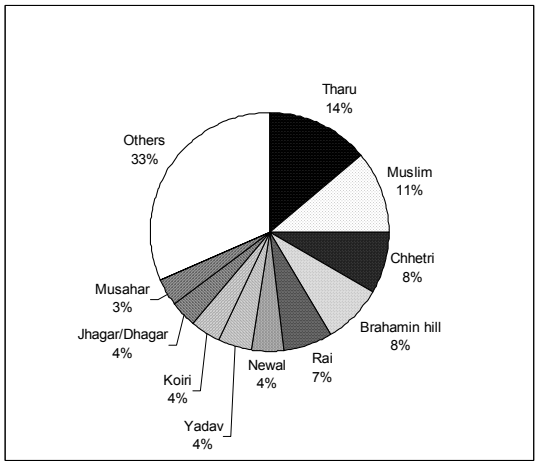


Figure 3.1.3 Caste Distribution in Sunsari District



Although people have been living this area for not short period, people who are from Hills or Indian side in earlier times are differentiated culturally. It could be said that Terai consists of diversity in terms of caste/ethnic group due to the history of migration. Moreover, because of the geographical feature, which suits to cultivation, the traditional division of labor of major caste in Terai belongs to agriculture production.

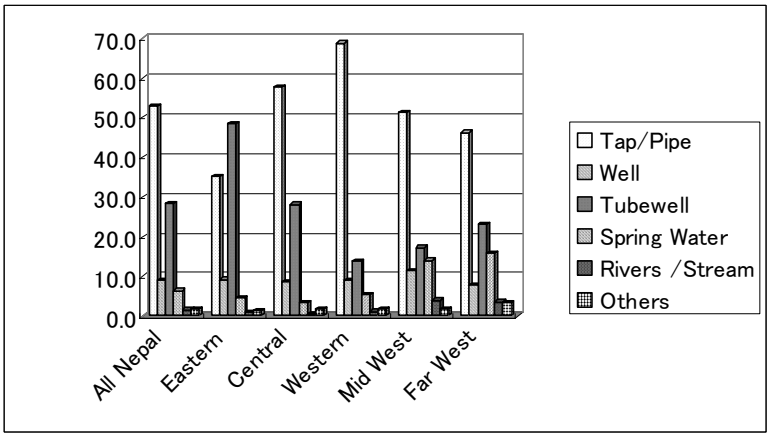
Meanwhile in Sunsari District, Tharu is the majority with the share of 14%, followed by Muslim (11%).

3.2 Social Feature by Development Region

3.2.1 Basic Social Information

Since Nepal is a country, which lies from the skirts to Himalayan Mountains, the living condition as well as other social features varies depending on the location. It is said generally that development started from Eastern Side, which is relatively accessible and close to Kathmandu area, and the differences could be observed, for example, in the data of access to drinking water and illiteracy, which shows a part of the basic social conditions.

Figure 3.2.1 Access to Drinking Water by Development Region

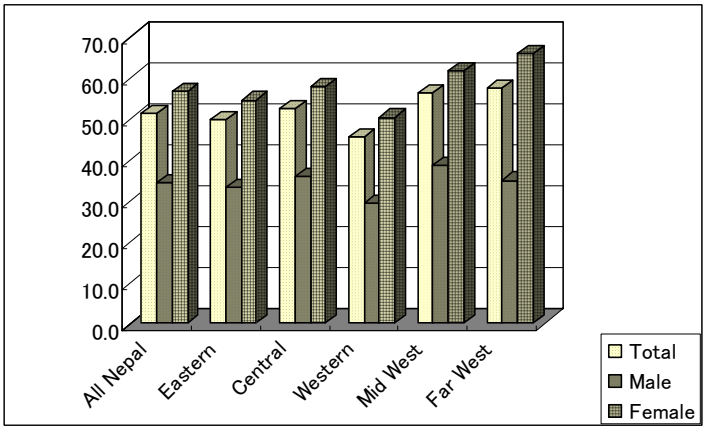


As it could be seen in figure 3.2.1 [2], around 52% of

[2] Source: Central Bureau of Statistics (2002), "Population of Nepal- VDC/Municipalities, Population Census"

household has access to Pipe/Tap water, and 37.4% has access to well or tube-well at national level. Whereas, in Eastern Development Region, the share of access to Pipe/Tap goes down to 35.3%, however still 57.6% of the households keep access to well or tube-well.

Figure 3.2.2 Illiteracy Rate by Development Region

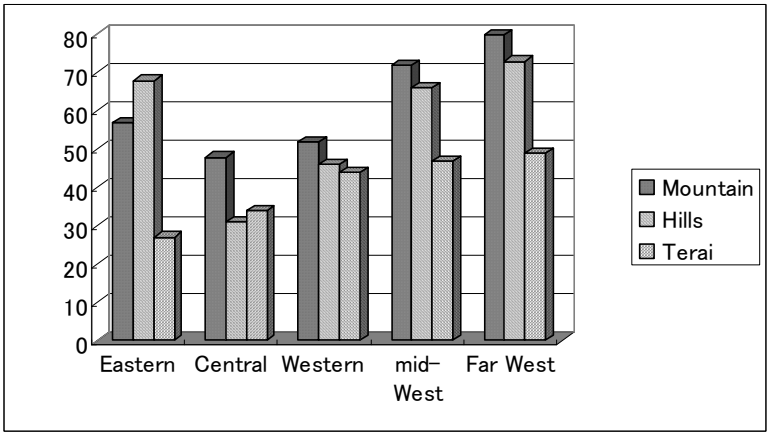


On the other hand, about illiteracy rate, it is quite high as around 51% at national level, and 49% in Eastern Development Region. As it could be seen in the figure 3.2.2[3], the illiteracy rate of female is almost 55% at national level as well as at eastern development region, and in western part of the country, the rate is relatively high as according to progress of development.

3.2.2 Poverty by Region

Generally saying, eastern region is comparatively advanced comparing to western region, and especially eastern Terai is relatively developed within Terai region. In this sense, development of Eastern Terai might have meaning of food security of Nepal as a whole, in order to supply to other places as granary. According to Nepal Human Development Report published by Nepal South Asia Centre supported by UNDP in 1998, the proportion of people under poverty line could be expressed as follows, with using "head count index", namely, the proportion of total population that happens to be below the poverty line[4]. As it could be seen in figure 3.2.3[5], the proportion of population below the poverty line in Terai is the lowest in Eastern Terai region as shown as 27%, whereas 80% in mountain far west.

Figure 3.2.3 Incidence of Poverty by Region



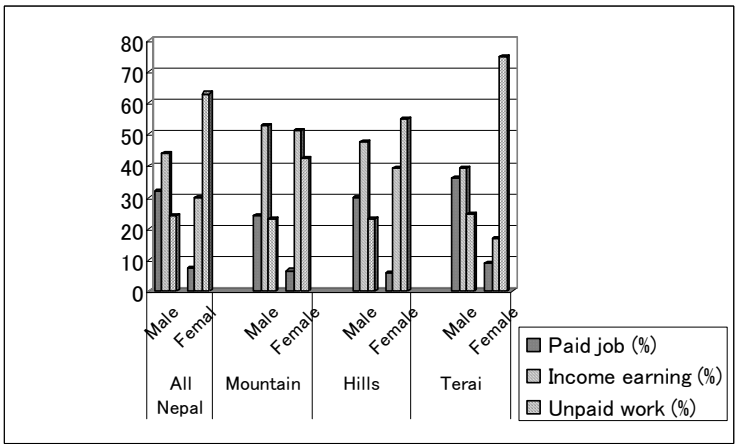
[3] Source: Central Bureau of Statistics (2002), "Population of Nepal- VDC/Municipalities, Population Census"
[4] "Poverty line" is defined as the level of income below which people are diagnosed as absolutely poor, which was defined on consumption space, based on normative nutritional daily per capita requirements and other non-food basic consumption requirements (Source: Nepal Human Development Report, 1998).
[5] Source: UNDP, "Nepal Human Development Report 1998"

3.2.3 Distribution of Employment by Region, Type and Gender

The survey by Central Department of Population Studies done by Tribhuvan University (CDPS) in 1997 identifies the distribution of employment by opportunity to be involved in paid job as well as proportion of income earning. It also indicates the proportion of accessibility from gender aspect.

The pattern of work participation indicates that a large proportion of women working as unpaid family workers. Shown in figure 3.2.4[6], especially in Terai, around 74% of women are engaged in unpaid work, whereas 42% in Mountains. Meanwhile, the proportion of women who earn income is limited to 16%. This shows that women's share in income is severely limited by their status of being unpaid workers as well as lack of opportunity for income earning activities.

Figure 3.2.4 Distribution of Employment by Type, Region and Gender



CHAPTER 4 THE STUDY AREA

4.1 Characteristics of the Village Structure

There are thirteen (13) VDCs, each of which is composed of nine (9) wards. The ward is the smallest unit of administrative recognition. It will be the liaison for external visitors.

As mentioned in APPENDIX-II, board of directors of VDC consists of eleven (11) elected committee members including Chairperson, vice-chairperson, and every ward chairperson. As the advisor, a secretary from Ministry of Rural Development positioned in DDC is placed. On the other hand, the Ward Development Committee consists of four (4) committee members and chairperson, who are selected by democratic election. It is decided that one (1) member out of four Ward Committee members should be a woman. Two (2) times general assemblies are held in a year.

Main functions of VDC are, 1) Public works such as maintenance of road, 2) Liaison with government agencies as well as NGOs, 3) Collection of land tax, 4) Promotion of acquisition of citizenship, and 5) Supervision of public facilities such as school, health post, post office, etc.

[6] Source: Tribhuvan University (1997), Central Department of Population Studies (CDPS),

The budget of VDC consists of; 1) contribution from central government: 500,000Rs/year (it was reduced to 250,000Rs in 2002 practically), 2) Tenant fee of communal land, 3) Tax for large-scale commercial agriculture business, and 4) 75 % of land tax (25% goes to DDC). The total of except subsidy by central government will be around 70,000Rs/year in the case of Ghuski VDC.

There is no planning division in the committee. In the case of Ghuski VDC, for example, the major performance in 2001 was maintenance of road (0.5km) and distribution of four (4) tube wells to poorer family.

Within a ward, there are some settlements (It is called "tole" in Nepalese) in each VDC. "Tole" consists of basically same sub-caste and/or consists of several kinships. There are 10 to 38 toles in one VDC, totally 271 in the Study area, and the average number of household is around 69, which varies from 16 to 216. Whereas "Ward" or "VDC" have only administrative meanings, "tole" is a kind of extended kinship, which people put on more social value.

Apart from these units as administration or settlement, there is women group called "Aama Samuha", which means mothers' group in each VDC. Depending on the VDC, this group has been formed informally for long period or formed formally as registered organization in DDC. Whereas the participation of women is low at Ward or VDC level, this group could be the place for women to participate in VDC activities.

4.2 Characteristics of Family Structure

The average family members per household is 6.4, according to the result of household survey by the Study, targeting 200 households who are engaged in farming. Out of 6.4, 3.7 are male and 2.7 are female.

The definition of "household" is always controversial in sociology. In the case of the Study area, it is "sharing kitchen". Mostly in the Study area, one of the sons, who are not necessarily to be the first son, lives together with parents. It is common for daughter in law to cook for all family members, however, it is still common to have separate kitchen.

Since it is patriarchy culture, the head of the house is mostly 100% male, and sons are relatively regarded as important than daughters and are raised carefully. For example, it could be observed in Dowry[7] system. The amount of Dowry is practically decided by son of parents depending on how they think the value of their son, which means how they made efforts to raise him. The daughter in law is regarded as lower position in the family and even as for heritage. Inheritance of property is basically limited to the birthright of son, although there are exceptions.

4.3 Caste, Ethnic Group and Religion

Nowadays, it is said that inter-caste relationship is getting less constrains in their lives, except marriage. In position of fact, for example, as for communal meeting given by external

[7] "Dawry" originally means a gift given by her parents to daughter who gets married, which may be cash or land. However in practice, since the gift with bride will be a property of bridegroom, his parents tend to demand the amount. It is legally prohibited anymore. It is around 10,000 to 25,000Rs in the Study area, according to interviews.

agencies as well as gossiping among them, people gathering there are mixture of sub-caste, including different religion from observations. This tendency could be observed especially among those who belong to relatively lower caste, whereas class-consciousness still remains in the society of higher caste. In the Study area, the majority belongs to those castes. Even through the interview to a person belonging to the lowest caste, the interviewee expressed that discrimination toward them are getting decreased by 90% time to time except the occasion of marriage.

On the other hand, during the survey when the Team asked villagers about religion and caste distribution in VDC, it was easy for them to identify major groups in each location. Although the value of caste as social strata is getting less important in people's life, it seems still one of the social units to deal with social dimension in terms of expressing tendency of landholding size, characteristics of family structure, analysis of the social network and so forth.

There are around 30 sub-castes mixed in the Study area. In fact, Muslim society is also divided into some castes and each of them is included and understood in the caste system of Hinduism as their culture, and has also certain position in the caste hierarchy. Muslim(Miya) population is the majority as 23.4%, followed by Meheta(Hindu), 19.25%, Yadav(Hindu), 10.7% and the rest are consisted of sub-caste of Hindu.

Looking by location, in upper stream, major sub-caste are Muslim(Miya)(27.4%), Mushar(13.8%), Meheta(12.2%), instead in middle stream, Muslim(Miya)(33.6%), Meheta(21.1%), Yadav(9.4%) are majority, and in lower stream, major three are Meheta(24.2%), Muslim(Ansari)(14.0%), and Yadav(11.1%). As it could be observed, as a whole, Muslim population is one of the majorities in the Study area. There is a tendency that percentage of Meheta is higher in lower stream, where the vegetable growing is popular due to soil condition. Distribution of caste at VDC level is shown in the table below.

Table 4.3.1 Caste Distribution at VDC levels

VDC Name	Population	No of HH	Miya (Muslim)	Meheta	Yadav	Musahar	Mandal /Dahnuk	Ansari (Muslim)	Baniya	Teli	Oranwa	Kumal (Pandit)	Others
Sahebganji	3,426	643	0	61	191	24	122	0	144	76	0	0	24
Kaptanganji	8,146	1,327	126	531	139	291	13	0	58	0	8	99	60
Dewanganji	6,498	1,111	230	433	166	72	0	0	18	3	0	3	188
Ghuski	9,580	1,476	0	77	36	75	102	639	0	13	0	42	495
Rajganji Sinuwari	8,251	1,439	61	431	440	135	95	0	0	0	0	48	231
Madhayaharsahi	4,901	827	41	615	59	26	61	0	0	0	0	1	24
Basantapur	4,702	753	236	119	156	0	190	0	10	0	29	0	15
Harinagara	7,038	1,148	239	297	0	79	0	0	88	61	0	58	325
Ramnagar Bhutaha	11,087	1,698	1,110	0	0	0	0	0	0	35	0	0	553
Jalpapur	5,681	1,084	645	1	0	158	68	0	101	0	0	0	113
Narsimha	17,365	2,769	970	40	444	375	197	0	114	115	200	0	315
Gautampur	3,783	698	69	286	4	19	15	0	63	76	67	6	95
Babiya	7,219	1,218	246	242	102	253	0	0	0	76	0	0	299
Total	97,677	16,191	3,973	3,133	1,737	1,507	863	639	596	455	304	257	2,737

4.4 Social Structure

As mentioned in the former sections, social strata consisting of caste base has been changing nowadays. In turn, the stratum is much related to land holding size, living standard and gender. In the result of the survey, the tendency of income level and caste could not be

classified. A feeling of belonging to certain society stands on unit of family, however it is quite individualistic to non-family members. The relationship between the upper and lower class seems more patron and client relation rather than the one of relation rooted to loyalty.

So-called "Big man" in VDC tends to be big landowner, who is generally equal to rich. It is said that "Big man" has open or hidden authority and can influence decision making in communities, and even has political influence. The existence of him seems not like "leader" of their community who is respected by all community members, but regarded as the person who cannot oppose to. Religious influence is not very strong, although it could be observed sometimes in Muslim society.

Observing the relationship between landowner and sharecropper/leaser for example, it is usually based on the verbal contract, and there is no other obligation for leaser to obey his/her landowner for other occasions. For example, according to an interview in Harinagara VDC, it was quite common for land leaser to lend money from landowner or neighbors in past days, and as it could be seen in western Terai for example, the strict relation with landowner was forced sometimes as it could be seen in the case of "Kamaiya system[8]".

Instead these days, those who do not have mortgage to access to public loan system, rent money from so called "local money lender" with high interest as such as 12-60% of annual interest. In fact, local moneylender is usually big landowner, local trader, trader from India, or just neighbors. It means those who provide loan are becoming to be more professional, rather than trying debtors to draw into socially bound relationship. Meanwhile, verbal contract system, which is most commonly practiced in the Study area, may be one of the causes of confusion or troubles between landowner and sharecropper/leaser.

Viewing social structure from gender point of view, despite the legal abolition of discrimination toward different sex is stated in constitution at the level of national law, there exist quite many limitations as for women in regulations related to kinship law. In practice in rural areas, females are positioned in clearly lower class than male within a family as well as village level, and generally women themselves receive their traditional position as following to social and cultural norms.

When the Team made interview to a group of women, they were eager to speak, especially about the micro-credit program, which seems their most interest topic these days. However, once the topic moved to agriculture or whatever related to decision making in the family, it seemed difficult for them to answer and hardly could get clear opinion. Moreover, they strongly expressed that they do not want to be involved in same group with males since males do not hear their voices, but meanwhile, they could not even express what they wish to do for further improvement of their lives. This finding may express how they are not used to be involved in any decision making process in their life.

[8] A form of farm labors who work for landlord under contract, which has been practiced mainly in Western part of Terai, which are Kailali, Bardiya, and Bake and Kanchanpur districts. However in fact, they are debt-labors who work under severe working conditions with low wage, and if they could not repay the debt, their children would become "Kamaiya" in his whole life. Because it creates problems on human rights and enlarges the gap and already a resolution was made at National level few years ago. So, the right of those native people was already confirmed legally and various rehabilitation projects for returning them to self-support have started.

4.5 Feature of Network among Populations

Social network in the rural society is quite wide in the Study area regardless of diversity of caste, religion and their origin. In this session, the range of social network will be discussed from several aspects.

1) Network in Kinship

Kinship is the smallest and tightest unit of the society. As already mentioned, "tole"(=settlement) consists of one to several kinship groups in the Study area. Usually, marriage is arranged by parents or relatives, which is not necessarily neighbors, but with the one from outside of the village even from other district or beyond the international border, for avoiding consanguineous marriage. It means their kinship is physically wide as extended to different country. According to an interview to the farmers, the proportion of marriage with people from India is 40-50% especially in the VDCs along the international border. In any family event, such as marriage or religious event, people with kinship get together to the house of the head of the family.

2) Network in Agriculture Activity

2.1) Information on New Technology and Inputs

As details are mentioned in APPENDIX-6, farmers do not rely on public agriculture extension service and mostly exchange information among them. The most common medium of information is, "see and talk among farmers". It might be common among farmers generally, but there is a tendency that farmers believe the effect of new technology or introduction of new species, when they confirm it by seeing the result with his eyes.

Given an example, in Ward No.7 and No.8 of Jalpapur VDC, commercial vegetable growing is getting common. According to the farmers, they have started cultivation of vegetable since one innovative farmer with 15katha (0.45ha) succeeded commercial vegetables. There are some farmers who practice commercial vegetable growing even they are leasing land or sharecropping. The information of fertilizer as well as insecticides is also collected through conversation among neighbors.

As it could be seen, the most reliable information source for farmers is "farmers". They are mostly neighbors in same Ward or in same VDC. On the other hand, they go to Indian market to buy fertilizer or seeds since the price is cheaper than in Nepal, but for selling product, mostly sell to trader directly or in local market, Inarwa, or sometimes in big cities such as Dharan or Biratnagar, depending on the quantity of production. It is not common to sell product collectively with other farmers.

2.2) Employment of Labor

Generally, the farmers who have more than 1.5 to 2.0 bigha (1.07 to 1.34ha) employ farm labors for their cultivation. It is common that the landowner does not have concrete contract with certain labors. Depending on the content of the work and the necessity, the owner look for workers who are physically strong within neighboring villages and employ them temporary. As for farm labors, they always look for employment within their network,

which is wide beyond VDC. According to the result of interviews, people know each other, at least which family they come from, although the population in one VDC in the Study area is between 3,400 and 17,000. This could be possible because of the geographical condition as well as strong kinship across distance.

In the case of transplanting in average size of land, for example, the wife of landowner works together with labors and she also works for others' land in spare time when she finished transplanting in her family's land. It seems that their relationship is just like labor exchange.

3) Communal Event

There is no linear and formal information distribution system within Ward, Ward to Ward, Ward to VDC, and VDC to VDC. Because of the lack of information distribution system, what has been done at Ward or VDC level is not properly informed to village people. This could be a cause of misunderstanding or increase suspicion of people who are not involved in that event.

In front of the house, which locates along the main road or with big tree, it is quite common to find group of people gathering. They are not necessarily family, but neighbors regardless of caste or religion, ages, etc. This is the informal but important place for information exchange. The topic varies from gossip of neighbors to political issues.

4.6 Conflict Management

"When someone feed their cattle in someone's field without permission secretly, and conflict occurred with the owner, how do they solve those problems?"

The answer is "Panchat[9]." In the Study area, "*panchat*" is the most common meeting which is held for conflict management. The direct translation of "*panchat*" at present could be said as "meeting", however, it is used for particularly "meeting for conflict management".

There is no particular written rules or regulations in villages. There is no particular traditional authority or religious leader who take care of problems. Above all, there is no official function of VDC for solving conflict or problems. Instead, when the problems or conflict happened in a village, the issue is not taken to police directly but undertaken by "*panchat*".

Most of "*panchat*" is held among those who raised the conflict with standing both supporters in totally around 30-40 villagers, which varies depending on the topic. The meeting goes like debate style without having chairperson. The debate goes till making final decision, and sometimes decides how they will make punishment for the person concerned.

[9] Originally, "Panchat" used to be elders meeting within same caste. During the period under the rule of Mahendra in 1960's, the name of "Panchat" was used to express the political system based on traditional social system and religion. During that period, present VDC used to be called "Panchat village", and had function for conflict management in the village. It seems its name has been used as general term.

Around 90% of problems are solved through "*panchat*", according to Madhya Harsahi VDC, and when they could not solve it, they will bring the issue to police. For this purpose, it is common to have "*panchat*" in the place close to police, which is found in bigger VDCs such as Harinagara. The topic varies from problems within a family like heritage to corruption of VDC committee.

What this system shows could be so analyzed that it is not necessarily to have powerful leadership person for them to solve problems in their culture. The ways of reaching to consensus must be having time to talk each other. In addition, it seems that the society is tolerant enough or indifferent to receive the person who was judged in the meeting after the conflict has been managed.

4.7 Livelihood in Rural Life

4.7.1 Perception of "Rich" and "Poor"

As combining the result from the interview and household survey, a farmer who has around 2 bigha (1.34ha) can easily maintain around 10 family members by purely agriculture income, with hiring farm labor to cultivate his land. Summarizing the result of interviews to VDC officials, around 65% of household in the Study area do not reach to this category. The perception of "Rich" and "Poor" in the rural context could be considered from this line which indicates the complete self-sufficiency, which means they do not buy cereals, especially rice. That is to say, the one who has land more than 2bigha (1.34ha) could be regarded as middle, higher-middle with 3-6bigha (2.0–4.0ha), and the "rich" could be defined as the one with more than 6 bigha (4.0ha) of land.

4.7.2 Income and Expenditure

According to the household survey done by this Study, which the sample number is 200 with targeting to landholders, average gross income was around 121,000Rs/year. As a mode, 47 households have income between 100,000 to 150,000Rs, whose average landholding size is around 67katha (2.0ha). The big difference could not be found by the location. Among income, 67.0% is from agriculture product (including home consumption), 8.5% is from livestock, selling fish and forestry product (bamboo), around 12.0% is from salary of employment including farm labor, and migrant work is 5.0% and rest is from other work.

Table 4.7.1 Major Income Source by Caste

	Caste	Average Annual Income	Average Income from Agriculture		Average Income from Livestock		Average Income from Forestry		Average Income from Farm Labour		Average Income from other paid work		Average Income from business		Average Income from Migrant Work		Average Income from Others	
		(Rs)	%	(Rs)	%	(Rs)	%	(Rs)	%	(Rs)	%	(Rs)	%	(Rs)	%	(Rs)	%	(Rs)
1	Muslim	142,433	59.8	85,160	6.5	9,194	3.9	5,613	0.3	375	4.9	6,925	7.2	10,233	1.3	1,867	7.6	10,887
2	Sudhi	91,917	68.2	62,667	7.8	7,200	16.2	14,850	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
3	Yadav	110,538	58.6	64,826	9.6	10,629	0.2	268	2.1	2,331	1.9	2,141	3.3	3,656	7.7	8,483	7.0	7,769
4	Bramin	72,040	41.1	29,640	10.7	7,700	0.0	0	0.0	0	0.0	0	10.4	7,500	27.1	19,500	0.0	0
5	Tharu	95,360	56.1	53,520	21.9	20,920	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6	Meheta	132,182	69.4	91,784	4.9	6,464	1.8	2,406	1.5	2,029	3.0	3,990	3.8	5,075	3.8	4,994	6.9	9,107
7	Khatwe	75,806	55.0	41,673	4.8	3,675	0.0	0	9.5	7,200	11.5	8,750	0.0	0	5.5	4,167	8.8	6,667
8	Other Terai	135,086	60.7	81,950	3.3	4,455	1.6	2,107	2.7	3,610	5.4	7,355	12.5	16,857	4.9	6,554	5.9	7,932
9	Chetri	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	8,054
10	Newar	245,400	60.9	149,400	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	39.1	96,000	0.0	0
11	Tamang	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
12	Others	126,563	62.1	78,623	5.2	6,570	2.4	3,000	2.8	3,600	5.7	7,200	0.0	0	0.0	0	16.6	21,000

Observing from caste respectively, the caste which takes highest share of agriculture

production is Meheta, which share is around 70% of total income. They are traditionally vegetable growers and these days it is for commercial purpose. Tharu, in turn, gets around 22% of income from livestock since they traditionally keep and eat meat including pork. Khatwe, which is one of the lowest castes, gets around 12% of income from farm labor work. Khatwe may consist of higher proportion in the case of landless people.

The average expenditure is 110,000Rs/year. The mode of expenditure is between 50,000 to 80,000Rs/year, which the number of sample is 61 out of 200 samples. The proportion by categories are as follows; Agriculture 41.8%, food 27.2%, cloths and other goods 7.3%, repayment of credit 6.3%, medication 4.7%, religious event 4.1%, education 3.3%, livestock 1.3%, tax 0.3%, energy 0.2%, and rest 3.5% is others. It is no wonder the expenditure for agriculture is the highest among total expenditure followed by food. However around 30% could be used for other purpose including both for basic living and surplus items. For instance, average expenditure for miscellaneous goods including cloths is around 16,000Rs, and the one for religious purpose is 500-50,000Rs, of which the mode is around 5,000Rs/year (74 out of 200 samples).

About 10% of the respondent has savings of 2,000-100,000Rs, of which the mode is around 50,000Rs. In turn, around 50% of the respondent have loan of 3,000-500,000Rs, of which the range of mode is between 20,000 to 50,000Rs as shown in the result of 30 out of 103 samples who have loan. The major purpose is for mostly agriculture input from the result of household survey.

4.7.3 Increase of Migrant Work

The number of young generations (20-25years old) who go for India or Middle-East countries to work is increasing regardless of the fluctuation of agriculture production. Mostly, they are not head of the house, since it is preferable culturally that head of the house should be at home to take care of his family. According to Ghuski VDC, around 50% of young males go to India as labor as well as big cities such as Kathmandu and Biratnagar according to the interview to farmers. In the case of Kaptanganj VDC, the number of issued I.D., which is necessary to be carried when people go to India, was around 400-500 during 2 to 3 months (May-July). This number can be calculated as around 35% of the male population between 15 to 34 years old[10], and from this number the tendency of huge number of migrant work could be observed. Especially people prefer to work in India since there is no language problem. Hindi language and Maithali, which is the language most common in the Study area are quite similar or some of them have been using Hindi in their daily life.

According to the interview, the major reasons to go for migrant work are as follows;

- Impossible to survive with his agriculture production and labor work in Nepal
- Wage is comparatively high as such as 130Rs/day (without meal)
- There is job-availability through a year.

It seems that the reason to go for migrant work is not necessarily due to poorness, but also for

[10] According to the population census in 2001, the male population between 15 to 34 years old is around 1,340.

surplus income generation. According to an interview in Dewanganj VDC, the money sent from migrant worker will be used to build house, buy extra land, and so on. Majority of the people who have experience to work abroad say that they have intention to go again if they are physically healthy, but others say that they prefer to stay at home considering the labor condition.

As for social impact by migrant work, no prominent impact could be seen since they usually only work in farm without having time to be affected culturally, in addition to the cultural similarity. As for positive impact, an example was given to say that they could get a job of tractor driver after they returned from India since they learnt the skill there. It is expected that the number of migrant workers will be continuously increased if there is not enough job available in their living area.

4.8 Land Holding

4.8.1 Land Holding Pattern

Due to the land Reforms Act in Nepal, nobody can have more than 11bigha (7.37 ha) of land in Terai region, and people heritage the land to sons equally but not to daughters basically. Following to this regulation, even if it seems that there are few big-landowners according to census, there are big landowners who own big land as a family. For example, a farmer who the Team interviewed in Ghuski VDC has 25 bigha (16ha) of land. However it has been already distributed to four (4) sons. The tendency of land holding size at VDC wise is shown in the table below.

Table 4.8.1 Land Holding Size at Each VDC

Location	VDC names	Landless	less than 1bigha	1 to 3 bigha	3 to 6 bigha	more than 6 bigha	Total Share (%)
Lower Stream	Sahebganji	16	36	39	6	3	100
	Kaptanganji	9	38	26	16	11	100
	Dewanganji	20	66	9	3	2	100
	Ghuski	10	53	24	9	4	100
Middle Stream	Rajganji Sinuwari	11	48	26	10	5	100
	Madhayaharsahi	16	61	12	7	4	100
	Basantapur	27	16	39	11	7	100
	Harinagara	17	48	23	9	3	100
	Ramnagar Bhutaha	54	30	10	4	2	100
	Jalpapur	13	54	16	12	5	100
Upper Stream	Narsimha	25	26	29	14	6	100
	Gautampur	11	76	8	5	0	100
	Babiya	9	61	18	8	4	100
	Total	19.0	45.9	21.6	9.0	4.5	

Generally in Terai, “Landless” has two(2) meanings; one has completely no land even the place to stand his house, and another has 1-3 katha (0.03 – 0.09ha) of land, which is not enough for cultivation. In Ramnagar Bhutaha VDC where around 65% of the population are Muslim, more than half of the population are completely landless, which is the highest rate in the Study area. According to interviews, most of them have small piece of land at least enough to stand their houses. In the case of Basantapur VDC, on the other hand, 27% of the

households are completely landless and living on the communal land. Their livelihood is totally depending on the wage from farm labor or whatever other labor type to work.

The majority, namely around 48% of the Study area, is categorized as landholder with less than 1 bigha (0.67ha), except for Basantapur and Sahabganj VDC.

4.8.2 The Relationship between Land Holding Size and Income

The relationship between landholding size and income could be analyzed as below, according to the household survey done by the Study Team. As it could be obviously seen, the income level is corresponding to land holding size, and the income of the farmer with more than 4ha is more than four (4) times higher than the one of farmers with less than 1ha of land. Comparing to the range of income and land holding size, the average landholding size of the farmer who has gross income of 100,000 to 150,000Rs is 2.0ha. On the other hand, the farmer who has more than 200,000Rs of income has more than 7.0ha of land.

Table 4.8.2 Average Annual Income and its source by Land Holding Size

Land size	Sample No	Share (%)	Average Annual Income (Rs)	Income from Agriculture		Income from Livestock		Income from Forestry		Income from Farm Labour		Income from other paid		Income from business		Income from Migrant Work		Income from Others	
				Rs	%	Rs	%	Rs	%	Rs	%	Rs	%	Rs	%	Rs	%	Rs	%
4ha more	25	12	299,306	226,915	75.8	10,734	3.6	18,600	6	0	0	3,600	1.6	15,640	6.9	5,520	2.4	7,879	3.5
1-4ha	110	54	124,743	80,582	64.6	7,315	5.9	0	0	1,336	1.1	3,570	4.4	5,848	7.3	6,858	8.5	11,660	14.5
less than 1ha	67	33	70,732	29,508	41.7	5,879	8.3	1,589	2	4,702	6.6	7,323	24.8	7,912	26.8	4,284	14.5	4,165	14.1
	202	100																	

As it could be seen, big landholders (more than 4ha) draw 78.6% of income from agriculture production. In turn, the share of agriculture income of small landholders (less than 1ha) is less than 50%. It shows that farmers cannot rely on agriculture as major income if the landholding size is less than one (1) ha. Other sources of income for small landholders are from 24.8% of paid work except farm labor, 6.6% from farm labor, 26.8% from small business such as small-scale trading (e.g. buying vegetables in local market and sell them in Inarwa, or buy less expensive products in Indian market and sell them in local market), and 14.5% is from the money sent by migrant workers.

4.9 Gender Analysis

Box 4.9.1 Gender Sensitiveness

Gender is a formal fact of being male or female, which is defined culturally and socially.

From society to society, sphere of activities, which are supposed to be done by male or female vary, and are defined, not formally, but culturally and socially, which have been changing with the times. Within same sex, there could be gender issues, such as position of first-born son in patriarchy system, by differences of social status, etc. Generally speaking, gender issue is confused as discrimination or oppression of women, however it does not necessarily mean discrimination. It is the matter of "access and control" toward common resources, in other wards, freedom to selection under common condition.

In the case of the Study area, culture as a whole is male-dominated culture in terms of decision-making process, access to control toward economic activities, education, and so forth due to patriarchy social system. Since "activities done by outside of the house" mostly are regarded as male job, even if female cooperate with them, it will not appear on surface.

Here, one would like to discuss gender issues, from aspect of ; 1) agriculture related activities, and 2) communal activities.

1) Agriculture Related Activities

As for agriculture related activities, for example, according to the result of household survey by the Study Team, the share of transplanting work done by male was shown as around 70%. In fact, observing in the field, it is hardly to find male doing this work.

In turn, most of the ones who are transplanting are female labors. One of those female labors could be the wife of landowner in relatively small land, but in larger land all of them are labors employed and supervised by the male landowner. Meaning of "70%" could be analyzed that the male who supervises female labors regards him as the one who works for transplanting. Additionally, from cultural aspect, it is regarded as more prestigious for female members to be at home, not working in the field. This cultural sense may probably manipulate the response of the survey.

Further, plowing is totally done by male. It is culturally taboo for women to do it with probably considering physical difficulties. Apart from plowing, all of the works related to agriculture production done by both male and female including vegetable caring, of which the weight done by male is 30% heavier than women. In turn, in terms of any decision making, for example, what to grow and/or where to sell and how to use the profit are mostly managed by male.

Table 4.9.1 Gender Division of Labor

Division of Labor	male	female	male kid	female kid
a. Fetching Water	1.4	92.8	1.4	4.4
b. Domestic Work	0.2	97.5	0.1	2.1
c. Education for Kids				
Decision Making	82.9	9.2	0.0	0.0
Education at Home	73.5	8.9	2.3	1.6
d. Farming				
Land Preparation	94.2	1.9	0.2	0.2
Sowing	94.6	1.5	0.0	0.0
Transplant	69.8	26.3	0.0	0.0
Weeding	70.4	25.6	0.0	0.0
Irrigation	93.1	3.0	0.0	0.0
Threshing	73.6	21.7	0.1	0.3
Processing	67.7	25.5	0.1	0.0
Backyard Gardening	67.1	27.8	0.2	0.5
Selling Products	81.1	13.2	0.0	0.0
e. Livestock Rearing				
Caring Cattle	65.8	19.2	8.3	5.8
Caring Small Animals	54.6	18.6	7.9	6.4
Milking	95.9	1.5	0.0	0.0
Collecting Eggs	4.1	2.9	2.8	2.9
f. Receiving Extension Service	75.0	23.2	0.4	0.1
g. Decision Making on Selling				
Farm Product	89.6	9.6	0.1	0.1
Livestock Product	85.2	12.9	0.2	0.2
Product from Garden	79.7	15.7	0.8	0.8
h. Decision Making on Buying				
Farm Input	99.2	0.3	0.0	0.0
Food	78.2	21.8	0.0	0.0
General Goods for Living	61.4	37.5	0.5	0.5
I. Decision Making on Loan	97.2	0.8	0.0	0.0
j. Work as Farm Labor	91.3	3.1	0.0	0.0
k. Other Paid Work	81.7	3.7	0.1	0.1
l. Social Activities	54.5	32.8	6.4	6.3

Women in big farmer are involved in farm work indirectly, such as preparing food for farm labors. In turn, women in small farmers work as labor together with their husbands.

As for the wage for farm labors, it also differs by sex, which is: 35-80Rs/day with two meals for male, and 20-35Rs/day with two meals for female. People express that there is no specific reason, but there is a difference of wage, probably by cultural reason.

However as it could be seen in the example of transplanting work, presence of women tend to be concealed in public. However they are absolutely greater contributors toward agriculture activities.

2) Communal Activities

It could be observed that female seems to get more opportunities to participate under facilitation of external agencies. Remarkable activities which should be mentioned in the Study area are; 1) District Health volunteer work, and 2) Grameen Development Bank.

Those who are working as volunteer for district health center are relatively active character who has leadership, literate and respected by other women. The volunteer in Ramnagar Bhutaha and Harinagara VDC, whom the Team made interview, seemed reasonable to this role.

Whereas many complains toward VDC committee were heard through the interviews to males, the activities by district health group are quite appreciated. The reason must be the activity itself being objective-driven which is easier to see the result, and at the same time, the process of selection of volunteers was clear and selected by their consensus, combined with the neutral facilitation by external agency.

Box 4.9.1 District Health Volunteer Group

District Health Volunteer Group
(by interview to District Health Office)

District Health Volunteer group is organized by district health center in cooperation with central government, UNICEF and WHO, started from 1988. Regarding to the Study area, it covers all VDC. 2-4 volunteers from each ward are chosen in the meetings by Aama Samuha under facilitation by district health officer (1 volunteer is selected out of 400 in Terai), and they proceed voluntary work, such as assistance for immunization for children, providing medicine as necessity of villagers, promotion of family planning, and so on. The volunteers receive 15 days training on basic health training (200Rs/day will be provided during the training). Monthly meeting have been held at ward wise and depending on the issue, they receive brief lecture on nutrition, childcare, etc.
Medicine are provided by district health office through volunteers, and at the moment there is no problems on management.

Those volunteer are selected by *Aama Samuha* (mothers group) according to some criteria, such as active, leadership, comparatively educated and married. The process is; 1) an officer visits ward and ask *Aama Samuha* to select some potential women considering literacy, eagerness, etc. , and 2) finally, district health officer makes interview to her.

Women interviewed say that they like meetings since meeting with friends are interesting, and like to learn new things, and the participation rate of the meeting is quite high, as it explained as minimum15 participants from each Ward.

It seems that Grameen Development Bank also utilize this active district health volunteer group for starting micro-credit project. As like the Grameen Bank in Bangladesh, the procedure to take loan will be through group of five (5) members. The repayment will be done under responsibility of members under solidarity without any mortgage, as to say mortgage of solidarity, which means without repayment from the one who took loan, next member cannot get loan and have to pay fine as a group.

Box 4.9.2 Grameen Development Bank

Grameen Development Bank

As getting hint from the Grameen Bank in Bangladesh, Grameen Development Bank has started at national wise. The purpose of organization is to increase rural women's economic status by providing micro credit. Harinagara branch was established in 1998 with 6 field staffs. There are seven (7) sub-branches within Harinagara. The capital is from Nepal Rastra Bank(51%) and other co-operative banks (49%). There are 10 women groups are receiving loan, which is the maximum number to take care with available staff.
At the moment, repayment rate is almost 100%. Their major problem is 1) Insufficient field staff to monitor and collect repayment for more than 10 groups.

According to women who are participating this program, there were some problems that their

husband take the money from his wife and could not repay in time. However, after bank officers started to visit their houses to let their husband understand, their attitude has changed, and this kind of problems have disappeared these days.

3) Other Information

As it could be seen above, women tend to have interest to participate to improve their lives from the point, which they are more familiar and give full play to her ability with responsibility and solidarity among them. Considering this point, it might be more practical to start making effort to increase participation of women from the point which women have more interest such as sanitation, health, education, etc. which is related to their daily life.

Finally as other information, there was a notable point at family level, which was observed in the village. Comparing the interview to big landholder and small landholder, the women in small landholder, which means economically lower class, tend to participate in the conversation, whereas the one in big landholder never appeared in the circle of conversation, regardless of religion. Analyzing this point, women in lower class are less educated, but on the other hand, they have more big voice since they are earning money through farm labor, which the work is quite same or sometime heavier than male. This tendency implies that the change in culture is possible depending on the social circumstances.

4.10 Major Problems and Interests of the Farmers

Is it really necessary for farmers in the Study area to establish irrigation system? This is the question which seems quite crucial matter of course for planning the project, but it quite often happens that it matches only for the needs of limited people. In this section, problems and needs of the people living in the Study area will be identified through the result of the series of survey, especially from the result of consultation workshops with farmers in order to know the validity of irrigation project in the Study area.

As it could be seen in the former chapters, the Study area is a bit advanced comparing to other areas in Nepal, and the problems they raise seem not always limited to basic human needs but also further demands. According to the result of the workshops held at farmers level by location, "lack of irrigation facility" was raised as one of the serious problems. The result of one VDC from each workshop held at each location of stream is as follows:

Table 4.10.1 The Result of Problem Ranking at Consultation Workshop (Aug, 2002)

	Lower Stream	Middle Stream	Middle Stream	Upper Stream
VDC / Rank	Kaptanganj	Rajganj Sinuwari	Gautampur	Jalpapur*
1	Lack of security	Irrigation Problem	Irrigation Problem	Irrigation Problems
2	Lack of electricity	Road condition is bad	Cattle theft	Unemployment
3	Road condition is bad	Lack of health post	Education	Education
4	Education problem	Lack of security	Road condition is not good	
5	Irrigation Problem	Education problem	Lack of toilet	
Others	Inundation, Lack of transportation, Lack of bridge at canal and Maria Dahr, No bus	Lack of Capital, Quality of fertilizer, Availability of quality seeds, Lack of extension service,	Drainage problem, Transportation, Price of agriculture product is low, Lack of market,	Wage is low, Availability of fertilizer, Gender inequality, Lack of

	parking, Lack of maintenance of Rajaji Temple, Electricity Problems, Lack of telephone, Water supply system, Lack of health education, Lack of cold storage, Unemployment (especially for educated people), Problem of fertilizer	Market, Lack of electricity, Lack of veterinary doctor, Lack of toilet, Lack of telephone	Lack of telephone, Lack of bridge, Problem of availability of agriculture input, Lack of employment	doctor, Lack of drinking water facility, Price of fertilizer, Quality of fertilizer, Lack of capital, Low price of marketing **The rank was assumed by surveyor from observation of the meeting.*

The problem of "Lack of irrigation facility" is also confirmed in the result of household survey. According to the result of household survey, 173 people out of 200 raised it as first priority problem in the field of agriculture.

Observing the consultation workshops, there was a tendency that the lack of irrigation problem raised strongly in middle stream comparing to other area. It could be analyzed that farmers in middle stream have more expectation and needs toward introducing irrigation system to solve water deficit for agriculture.

People in upper stream can get water somehow although proper amount of water has not been distributed by the existing canal network. Because of that, their interest seemed much more on ISF, especially how they can minimize their burden. On the other hand, in lower stream, since farmers have not got experience to get water from the existing irrigation system, they do not have trustiness for water to be distributed by canals. Farmers seem to rely on STW which they can stably receive water regardless of its high cost since they have images that surface water is not reliable. This might be the reason why the "irrigation problem" was ranked in lower priority issue. However, this would not mean there is no problem of irrigation water.

During consultation workshop, the inundation problem was claimed seriously since the series of workshops were held just after inundation problem had occurred. It seems that it is the problem which occurs 1 or 2 times a year, however it is not very serious comparing to other problems.

The problem of theft shows the anxiety of people living the in international border area. The number of theft from Indian side as well as Nepal is increasing. In Gautampur VDC, for example, around 20 cattle was stolen in the first half of year 2002 and even kidnapping have occurred. According to an interview, the theft of pipe of STW was also serious problems and many people use traditional bamboo pipe to avoid to be stolen in Basantapur VDC.

About the electricity problems, it is planned to be distributed in whole Study area by 2004, according to the electricity authority depending on the enforcement of proper allocation of budget from the central government. However the availability to pay for electricity is different matter.

CHAPTER 5 LESSONS LEARNED FROM EXISTING ORGANIZATION

5.1 Feature of Existing Community Organization

5.1.1 The case of Ramnagar Bhutaha VDC

There are various organizations in VDC such as religious groups, political groups, groups organized by external organizations including government and non-government agencies which have different purposes. The major activities of major community organization formed by assistance of external agencies in the Study area are presented in APPENDIX-2.

In the Study area, as a whole, it seems that it is not very common to organize as community for certain purposes. During the survey, the raised organization including formal and informal are mostly the one organized by external agencies for certain activities or religious groups.

Showing the example in the case of Ramnagar Bhutaha VDC, the name of organization raised are as follows; (a) Rural Development Bank, (b) Poultry Farming Group, (c) Sewing group, (d) Ettehael Millat Community, (e) Muslim organization, and (f) Bhutaha Madarsa(Religious school). (a) and (b) are groups organized by NGO for the purpose micro-credit and saving, and income generating activities. (c) is a group which was organized by assistance of NGO at initial period and still continuing little by little. (d) is a group for moral improvement for making campaign for example for self-control of alcohol organized by all political parties as well as religious leaders. (e) and (f) are obviously Islamic religious organizations for religious purpose. According to the village people, the most active organization is (d) since all political members as well as religious leaders are included.

However, the purpose of this organization seemed quite vague and even the major activities could not been explained by the participants. It could be observed that there is relatively less interest of people to organize themselves for certain purpose as compared to the number of organization existing in the VDC.

5.1.2 The Case of Existing Water Users Association

1) The Case of WUG for S13 Canal of SMIP, Stage III (Phase I)

S13 is one of the Secondary canals of SMIP (Stage III, phase I) in Morang district, which was newly rehabilitated in 2001. The tertiary canal is connected directly from the secondary canal. As there were existing farmer-managed-irrigation system in the location, which could be connected directly from the secondary canal without constructing sub-secondary canal.

Nine (9) watercourses exist along the tertiary canal, which were built 30 years back and rehabilitated last year together with the tertiary canal. Depending on the location, the size of watercourse varies and the watercourse, which the Team visited, covers only around 10 bigha with around 20 farmers (each farmer have 2 to 10 katha (0.06 to 0.3ha)). There have been informal water users group for these 30 years, but as reconstructed canals, SMIP initiated to organize WUG.

There are some committee members including chairperson of WUGs. However, even the chairpersons did not know how many farmers are using the canal, but one who told that there

are around 72-80 household. Nowadays the consultant of SMIP is making survey to collect information of users to make the list of WUG, and even the chairperson did not know when it would be completed and will be handed over to them.

An Association Organizer (AO), who is in charge of collection of ISF, was selected by farmers with informal selection. The ISF has not been collected yet since the construction has just completed. Farmers know that they have to pay certain amount of ISF. However, they do not know who and how to pay.

As for land acquisition, in the scheme of SMIP Stage III (Phase I), the land used for construction of water course should be managed by the farmers, although it used to be compensated by the project in former stages. However, farmers as well as an engineer of the project have understood that the compensation will be done after completion of the construction.

2) The case of WUG for SS9E Canal of SMIP, Stage II

The watercourses branching from SS9E canal falls in SMIP Study II area has been constructed two to three years ago under SMIP (stage II). There are seven (7) outlets in watercourse designed by the project without any consultation to the farmers. Already extra outlets are easily found.

There is no formal scheduling of water allocation, and farmers themselves arrange water distribution. There is enough water in sub-secondary and tertiary canals throughout the year. However, there is not enough water in watercourses since maintenance has not been cared.

WUG was organized more than ten (10) years ago under facilitation by the project and members were selected by the project for consulting land acquisition issue. However since then, they have not had even single meetings among them, as they do not have clear idea why they have organized a group.

About ISF collection, there is difficulty to collect, since around 50% of the landowners live outside the village and the sharecroppers and leasers do not think that paying ISF is their duty. Above all, there is no responsible person for collecting ISF, and the chairperson does by proxy at this moment. According to the chairperson, only 500-600Rs was collected last year from two farmers. Farmers suggested from their experience that only way to collect ISF properly is to collect together with land tax.

As for operation and maintenance of the canal, WUG has not implemented any work so far. Instead, relatively big farmers themselves regardless of WUG maintain the canal by themselves when there is necessity. According to them, small farmers or sharecroppers are not interested in maintenance of the canal since they can easily get enough water somehow to irrigate their land.

5.2 Lessons Learned from Existing Organization

As mentioned in former sections, people in the Study area seem not to get used to organize themselves for pursuing certain purposes. Especially, in the case of organization under facilitation by external agencies, such as water users association, some common tendencies could be observed as follows:

- There is "organization", but farmers do understood they organized themselves for the "executing agency" but not for them.

- There is no common understanding between "farmers" and "executing agency" as well as among the organization, and it seems that the misunderstanding causes other problems such as low ISF collection rate, etc.

- Although people in any stage, namely farmers in field level, WUG/WUA committee members, as well as project field officers know that there are "problems" in "somewhere", and complain each other. However, people do not know where the "somewhere" is since the demarcation between farmers and government is not very clear for them. The issue could be said as lack of accountability

- Since executing agency side is rushing to complete the process of activities within limited time, it seems that people could not catch up the speed and it may be causing "dependency" of farmers.

The points raised could be prevented by the change in approach of executing agency side. In order to overcome these issues in planning future projects, lessons learned from these experiences could be summarized as follows;

Process of Establishing WUG / WUA:

As it could be seen in the case of existing WUG, one of the reasons which make system un-functional must be rooted in the process of establishment of WUG. Observing the manner of approach in existing organization, it seems that the organization was formed due mainly to the convenience of the external agency without consulting with the farmers. If the external agency approach is like the one mentioned above, it is no wonder that farmers consider that they organize themselves for "external agency", not for "them". In this sense, the manner of approach to the farmers from the initial period should stress "ownership".

Clear Decision Making Process and its dissemination:

In the case of existing WUG, which the Team interviewed, decision making process was not clear and even the single meeting was not held in cases within the organization. As a result, ISF has not been properly collected and the maintenance of the canal has not been done. Above all, the un-functional committee of the organization is repeatedly blamed. These could be solved through clear decision making within the organization as well as proper information dissemination of determined issues to all the members.

The same could be noted to the relationship between the farmers and the executing agency side. One of the reasons why the existing system is not functional is due to lack of mutual trust between executing agency and the farmers. In order to avoid misunderstanding each other or to make things more clear, transparency should firstly come from the executing agency side including the issue of budget, use of budget, etc.

Frequent Communication and Consultation

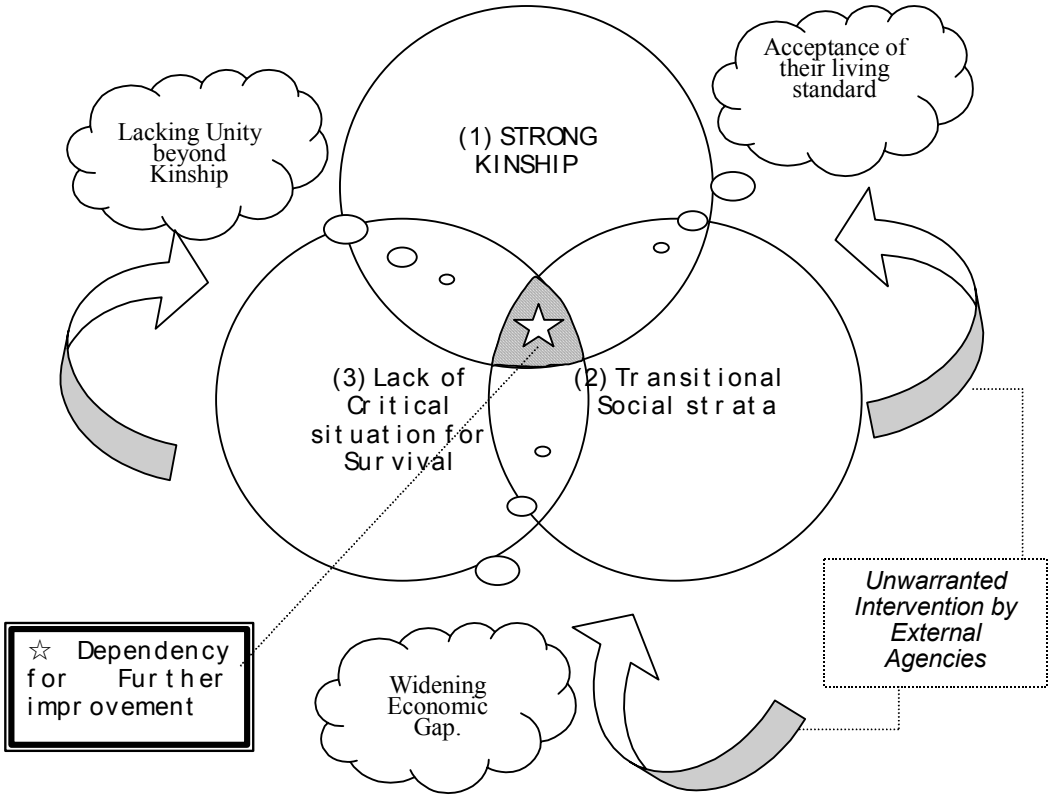
What might be most important in mobilizing organization must be the mutual trust. In order to build this relationship, frequent communication among stakeholders must be necessary. Above all, clear demarcation must be essential about what to be responsible for each part.

As far as observing existing organization, the communication and consultation between the external agency and farmers seemed not enough to build relationship of mutual trust. Moreover, the manner of approach by external agency seemed quite one-way without enough consultation with farmers in terms of organizing group, construction, and so on, as it could be seen in the example of WUG. This could be also possibly solved by changing attitude of external agency.

5.3 Feature of the "Community"

Summarizing the situation in the Study area, prominent features, which might become constraint to establish an organization, have come up. In other word, this might be one of the internal reasons why the improvement of their living standard is stagnant comparing to the condition given to them. In this chapter, "community" is defined as the size of one VDC and as a unit to approach from external side. It could be expressed that the feature of "community" in the Study area is in one word, *"independent but dependent"*. This could be explained from the major social features of the people in the Study area as follows:

Figure 5.3.1 Feature of the "Community"



Three features

The three (3) circles show the dominant feature of the "community", which are (1) Strong kinship, (2) Transitional social strata, and (3) Lack of critical situation for survival.

The feature (1) *Strong Kinship* shows literally strong bonds of kinship. As it could be observed, while the pattern of behavior of the farmers is quite individualistic, it is the one as unit of kinship. The kinship generally consists of same sub-caste/religions/tribes, which could be seen as they get married only with person from homogeneous group, even with the one who is living outside of the country as well as in a distant place. It could be said that farmers are individualistic once they go beyond this unit of kinship.

About the feature (2) *transitional social strata,* it shows the change in social strata. As already mentioned in former chapters, the social strata nowadays tend to be demarcated by living standard or landholding size but not by caste system within the certain society, which here could be said as the society of farmers. There is already a fact that the tendency of landholding size cannot be categorized by caste-wise anymore, but the income level is in proportion to landholding size. This traditional aspect, the caste system remains in mind in wide extent of the society including lowest to highest, and it may become a barrier for farmers to overcome beyond their certain world.

As it could be drawn in former sessions, as for (3) *No critical situation for survival*, the living standard of the Study area is relatively high comparing to other Nepalese standard. In other word, it is possible for them to survive anyway due to the natural resources such as rain and land which they are vested. In the case of agriculture, for example, people have physical capacity to use water pump or STW when there is necessity and there is water availability as well.

Internal Characteristics

Looking at the overlapped area with those features, *firstly*, where (1) *strong kinship* and (2) transitional social strata are overlapped, namely, where they have relief to be bonded with kinship, which belong to certain position of social strata, people tend to accept their lives and spirit to pursue further development will be stagnant. *Secondly*, the overlapping sphere of (2) *transitional social strata* and (3) *no critical situation for survival* expresses the economic gap widen by following to capitalistic aspect of social strata. It means the person in higher class have more access to opportunity to amplify their property, in turn, the living standard of the person in relatively lower class will be stagnant since they can survive anyway although there is difficulty. Above all, even if they improve their lives up to certain level, there are traditional social strata which might not be easy to overcome though the bias is getting less.

Furthermore, as it could be seen in the overlapped sphere of (3) *no critical situation* and (1) *strong kinship*, absence of critical situation for survival and relief of belonging to homogeneous group as kinship may be one of the causes for un-necessity of uniting themselves beyond some extent. The tendency of indifference to unrelated social group could be observed from this point. For example, in the case of existing canal use, it is easy to find extra outlet, which was not designed. The canal users do not care about it since they are not in problem as serious as affecting to their survival, and at the same time farmers do not care what others do since they are indifferent to unrelated social group.

The Feature seen from integration of all these features

The point which is covered by these three (3) features could be expressed as "***dependency for further improvement***" toward someone outside of their "community". It could be explained

that where there are lack of unity, if people accept their lives as it is and if the economic gap is getting large, people living there tend to rely on outsiders to improve their lives further. In other word, farmers do not have interest to improve their lives further beyond certain extent, since they take it for granted that they cannot make largely improvement.

What should be pointed out here is, this feature does not mean that the farmers cannot live without depending on someone external. They have capacity to manage by themselves anyhow up to certain extent as it could be seen in present agriculture operation. However for further improvement, they are indifferent and leave them some what in the charge of external support.

Possibility to change

Although the feature of dependency for further improvement could be observed, there is a tendency of changing. It could be explained that, whereas the feature of "strong kinship" and "Lack of critical situation for survival" have not changed, the social strata is in transition period. It means that they can improve their lives more if they really wish. Once farmers can feel confidence that they can change their lives by themselves, the feature of dependency for further improvement could be reduced. Then, it could be improved more if there is external support.

However, one thing noted here is that, above mentioned structure could be worsened by unwarranted intervention or improper approach by external agencies. If an external agency approaches to farmers pushily without knowing their capacity in physically and in capably, they will widen the farmer's expectation. It is no wonder that the farmers will depend on the externals for their further improvement. It will increase dependency of people with making wrong notion that " Life beyond certain extent can only be improved by external assistance". One of the most critical point for planners to avoid creating this kind of wrong notion is therefore completely based on awareness and philosophy of external agency side.

CHAPTER 6 EXPECTED SOCIAL IMPACT BY IRRIGATION PROJECT

The principal purpose of irrigation project is obviously increase of agriculture production. However, the effectiveness will not be limited to it and it is expected to bring direct and indirect impact in the society.

The social impact which could be expected by this irrigation project in the Study area can be explained as following categories such as; 1) quantitative, 2) qualitative, 3) conceivable negative impact, and 4) Impact toward gender. In this session, those impacts will be examined by category.

(1) Quantitative Social Impact

Since irrigation project is aiming to increase agriculture production, which is the base of life of the farmers, it may bring positive impact in terms of improvement of livelihood, and other indirect impacts as follows could be also expected.

- Increase of Agriculture Production

- The income will be raised,
- Food Sufficiency will be achieved,
- Increase job opportunity through construction work for canal facilities as well as farm labor thanks to increase of crop intensity, and
- Working hours in the field could expect to be reduced in order to produce same amount of production.
    - Facilitation of Service Road
- Enlarge accessible market, and
- Extend network of communication beyond a VDC

It could be expected that if working hours in the field could be reduced to produce same amount of production, it is expected to create spare time. Spare time contains possibility of increasing access to education, creation of time for being engaged in other income generating activities, and creation of time for recreation. Extension of communication network means enlargement of access to information.

The impact raised cannot be followed as linear. However, more possibility will be created depending on how the beneficiaries utilize the opportunity.

(2) Qualitative Social Impact

Qualitative Social Impact could appear in the process of activities, especially through communal activities. In the irrigation project, WUA plays essential role for sustainability of the activity such as decision making on the location of outlet of the water course, operation and maintenance of the facility, collection of ISF and equal water distribution. The impact will be expected at both individual and communal level:

Firstly, qualitative impact expected at individual farmers level will be as follows;

- Awareness toward individual potential by themselves by being engaged in certain role in the organization: The awareness would create self-confidence and this may lead to working as “communal” for further improvement.
- Opportunity to know how to be creative to improve their lives through communal activities toward limited resource,
- Enlargement of information network through communal activities, and
- Self-confidence to change themselves; It could be expected in relatively lower society, such as small landholders, lower caste farmers and women.

Secondly, the expected impacts at communal levels are as follows;

- Improvement on manageability of communal work (plan, implement and manage by themselves, including budget); It could be an opportunity to empower the capacity of community for achieving communal benefit such as improvement of public transportation,

for example, with utilizing the capable organization.

- Improvement of decision-making process with transparency would create mutual trust within the group.

- Change in social strata, especially for oppressed social group such as lower caste group, small-scale farmers as well as women, through interacting different social groups, and

- Collective power to change; although one of the predominant features of the community is expressed as "individualistic", it may be necessary to pursue for further improvement.

(3) Conceivable Negative Impact

When changes occur in the society, they must have both positive and negative aspect depending on each person in the society. It is necessary to try to find out those issues at planning stage in order to find alternative way or minimize those impacts. One of the biggest issues on negative impacts feared in this irrigation project is the affect toward fisherman. This aspect will be discussed in APPENDIX 10, so avoid duplication in this section.

What could be conceived in the case of irrigation project at individual level might be the burden of ISF. As far as analyzing the livelihood of people in the Study area, the proposed ISF is not the price that the farmers cannot afford or have to suffer so much as compared to the merit which they might get. However, as agriculture is the business depending on the availability of water as well as weather, there must be case which farmers cannot gain expected production even when they get enough water. Considering this kind of inevitable incident such as calamity, it might be necessary to examine how to avoid accelerating burden especially to oppressed social groups, considering exception of ISF payment.

Finally, irrigation canal can be used not only for irrigation purpose but also for other living purpose such as feeding and bathing for buffalo, soaking Jute fiber for processing, washing, children playing in the water, fishing, etc. In this Study area, since almost 100% houses have own hand pump-well, the canal has not been used as source for drinking water.

The availability of water to use for this kind of purposes must be also the point which people might have interest. The amount of water used for this kind of activities are small, and not affect the canal system itself. However, from the aspect of maintenance of the canal, it must be necessary to consider the rules at WUG/A levels, how to use the canal and its punishment, etc., if any.

(4) Impact toward Gender

As for positive impact, the impact expected might be same as "qualitative impact", which are mostly expected through capacity building through activity of WUA or indirect "quantitative impact" caused by improvement of livelihood. Although the possibility to involve women in WUA from the beginning is quite few from the result of the series of surveys, providing the opportunity may be "entitlement" to provide condition in order to make self-effort.

As for negative impact, it is supposed that promotion of vegetable growing might increase the

burden of women, since mostly female member of the family assist to cultivate vegetable, which is basically conducted in the farm close from the residence area. However, as a result of the survey, it became clear that the women who work in the farm are either small landholder or farm labor. Thus, in the case of increase of vegetable growing, there is a positive impact of increasing employment opportunity as farm labor.

CHAPTER 7 SOCIAL AND GENDER ASPECT, WHICH SHOULD BE CONSIDERED IN THE IRRIGATION PROJECT

Social and gender aspect is not the topic which could be considered independently, and definitely require to be taken as part of perspective of any field in irrigation project, since it brings changes in the society, where people live.

In former chapters, the social condition of the Study area was observed, the feature of the community was grasped, and the social impact toward irrigation project was examined. Finally as a conclusion, one would like to examine the suggestion to be considered in this irrigation project from social aspect. Suggestions will be raised according to the category which are; 1) Toward Agriculture Development, 2) Toward Poverty Alleviation, 3) Toward Institutional Development, and finally conclude with 4) Toward executing agency side. Suggestions toward Gender issues are included in each category since it is not an independent topic.

7.1 Toward Agriculture Development

The strategy and the plan of agriculture development proposed in this Study seem quite reasonable in terms of capacity of farmers and suitable to the needs of them in general, considering the problems they have. There are some issues, which should be strengthened from social point of view.

Firstly, women are not regarded as playing important role in agriculture activities despite of their contribution. There is a discussion that it is not the matter which the external people argue. However, it was also observed in the field that there are women who have great interest to participate in social activities and actually are very active in women's group. Considering this situation, what outsiders can do for it must facilitate the opportunity to participate. Those could be considered, for example, in the case of agriculture extension service.

About the agriculture extension services, at the moment, the extension service seems not fully functional and the reputations by farmers are not favorable. The suggestion to improve extension service will be discussed in APPENDIX 5. What should be strengthen from social aspect is, firstly, clear selection process of the recipient, and open chance for women to participate with giving the theme which women might have interest (the theme could be consulate with farmers). Including women and men in agriculture via irrigation as a tool may enlarge the opportunity to be aware gender roles as well as the capacity they have.

7.2 Toward Poverty Alleviation

In the case of irrigation project, the direct beneficiaries will be the ones who cultivate for their production. In this sense, the ones who have more land may gain more benefit than the

small land cultivator, which means the gap between rich and poor will not be decreased directly by the project. Irrigation project aims base-up rather than reducing the gap or targeting poorest of the poor. It may expect trickle-down effect within the area, for example, widening job-opportunities, etc.

The social stratum which should be cared must be the stratum which is relying on the cultivation in very limited farm land or leased land.

It is suggested in this Study that the user of water should burden ISF, not only landowner, but also sharecropper and tenant. The proposed ISF based on hectare, and in this case, the burden could be fair. However, once the production is affected by bad climate condition, the extent of the damage, in other word, the difference of the amount what they can get is greatly different. Considering this point, it is recommended to examine devices such as exception for payment of ISF depending on certain condition, in order not to oppress the poor to be poorer.

In long term, the utilization of WUA for pursuing other profit such as collective marketing, exchanging technology among WUAs, etc. should be examined.

7.3 Toward Institutional Development

1) Issue of Ownership

Considering the characteristics of the people as observed in the feature of the "community", the feature shown as "*dependency for further improvement*" may be the critical point for establishing organization. Since farmers can survive anyhow up to certain level, they do not need to cooperate each other. In the case of irrigation project, organizing group for water use is essential in terms of equal water distribution as well as proper maintenance of the canal. What must be important to break the bias toward change in organization might be awareness to "ownership". "Ownership" means firstly the awareness that they can improve more if they wish, secondly the awareness that they can improve more if they cooperate with each other, and thirdly the awareness that they can improve more if they manage by themselves.

Reliable system might be pre-condition for having this awareness. Actually it must be the role of the government to assure the system from engineering aspect. Since social strata are in transitional period, the sphere of interaction among farmers could be also changed. This change could be possibility to break the bias toward change.

2) Clear Information Network and Clear Decision Making Process

For equal distribution of water, common information should be shared among users properly. As observed in the community, people are in trustless to any organization. This situation may have occurred due to lack of information in most of the case.

Equal information dissemination will provide equal access and control to all users, regardless of poor and rich. This might contribute to make organization, which have proper function.

Since the rotation use of irrigation water is proposed in this irrigation plan, communication among WUG, WUG-WUA, WUA-WUA, and WUG/A with the project must be very important. Especially communication between upper stream and lower stream must be necessary in order to distribute water equally. This may work in the case of ISF collection,

as well as maintenance of the canals as a whole operation of the system.

Furthermore, in existing irrigation projects, there were various misunderstandings among users. In many cases farmers are not sure who collects ISF, how the ISF will be used. Above all, there are lots of doubts by farmers to say that the board of directors is corrupted. If the corruption is a biggest issue, only way to solve this problem is to make the system transparent. For keeping transparency, proper information dissemination system will contribute to solve this problem.

3) Clear Demarcation between farmers and the government

Clear demarcation of government and farmers in terms of responsibility will be necessary for clarify the accountability of executing agency side as well as farmers. As it could be seen in the lesson learned from existing water users organization, farmers as well as officers are not responsible for what they have to do, since the demarcation of the role is not clear. Since there is a social feature of "*dependency for further improvement*" in the study area, it is easier for them to rely on someone external without knowing where to be accountable.

4) Gender Aspect

Although Irrigation Policy states that 20% of the WUA member should be women, it cannot mean gender sensitive project.

From the result of the series of the survey, since presence of women in agriculture is high in terms of working in the field, but not in decision making process such as selection of crops, land use, etc. Above all, women cannot have land ownership generally. In this present condition, it might not be easy for men as well as women to follow the policy.

The level of participation cannot be measured on surface. Without understanding the philosophy of the executing agency who claim this policy, it cannot be effective in real meanings and just end up as symbolic practice.

On the other hand, it is quite stereotype way of thinking that women and social welfare including health and sanitation issues are always looked as if those are the issue of women. However, at initial point, it can be easy entrance for women to participate in their society. Now in the Study area, the situation is already on the stage of taking off to further stage to expand more integration.

If the government aims to enlarge "Entitlement" namely, to enlarge the condition which women/men can make self-effort, the government side should be aware and understand the importance of it. In this sense, the meaning of 20% of women's participation should be discussed within the agency. After having common understanding within the agency, the agency can encourage women to participate.

7.4 Toward Executing Agency Side

As it could be observed in lesson learned from existing project, the feature of "*dependency for further improvement"* must be changed for making organization functional and it could be changed by changing approach of executing agency side. *Firstly*, it is essential for executing agency side to be aware what does it mean by "participation". In the existing projects, it has been also recommended to increase "participation" of farmers, and joint management with the

government has been proposed. However, many of them could not accomplish the expected outcome, such as sustainable function of the irrigation system, due to lack of full understanding what should be achieved through "participation". Leaving everything to farmers does not mean encouraging "farmers' participation". As external intervention, the government side has also responsibility to facilitate them with frequent communication. It is time-required process, however, better not to rush to pursue "output".

Secondly, it is recommended to identify who will be concerned people and to facilitate all the stakeholders in the process of decision-making. One of the biggest purposes of organizing WUA is for equal distribution of water, since without organization, the farmers in upper stream stand always in advantage and the farmers in lower stream will be always suffered. The approach to farmers in relatively higher level and the ones in lower level must be different. In order to listen to the voice of those farmers, from initial stage, the external intervention should assist to listen the voice of those people. If everyone are included in the decision making process, participants could have common understanding of the concerned issues, such as who are the users and how the arrangement of the facility should be. If it is achieved, "ownership" is expected to be raised and the possibility of well-operation and maintenance of the canal could be also expected.

Thirdly, it does not require much input, but "change in attitude". Too much input creates "unnecessary dependency" and "too much expectation" of farmers. If there is not such amount of input, they will think by themselves to be able to manage with their own resources, but if someone provide them, they expect that and wait something will be done by someone.

Fourthly, facilitate information dissemination system from very beginning. Equal and transparent information distribution is indispensable. Through operation process, the ownership will be expected to be raised among them.

Fifthly, during implementation and operation period, self-monitoring by farmers must be important. Monitoring by themselves will lead to finding the problems by themselves and may think solutions by themselves. Which means in one word that, the awareness to change. Nowadays evaluation of the project is getting common. However, depending on "who" and "how" evaluates, it may just end up in satisfying the external agency side. The external agency may also observe the process in order to utilize the experience for further activities. In order to do that, it might be useful to keep baseline data including indicators for qualitative data at very beginning.

Finally, to overcome those issues, frequent, continuous communication and consultation with the farmers are very necessary. Visiting site by the officers of the agency and consultation with the farmers in any point must be the basic and crucial action.

ATTACHMENT 1

Questionnaire for Rural Socio-Economic Survey

Date of Survey: / / , Time: from : to :
Name of Surveyor: _____

Name of Village: _____
Name of VDC: _____ Ward No. _____

1. Personal Data:

1.1 Name:		1.2 Marital status: M / S / widow
1.3 Age:	1.4 Sex: M / F	1.5 Occupation
1.6 Highest degree: 1. illiterate, 2. Pre-primary, 3. Primary, 4. Lower Secondary, 5. Secondary, 6. Higher Secondary, 7. Diploma, 8. Degree		

* *"illiterate" means those who can not read and write.*

2. Family Structure

No	Names of household members	Sex (M/F)	age	Relation with you	Highest degree or actual education status*	Occupation	Head of the family (check)
1							
2							
3							
4							
5							
6							
7							
8							

* Refer the number of 1.6

3. Culture

3.1 What is your caste / ethnic group? (circle one)

1.Muslim / 2.Sudhi / 3.Adav / 4.Bramin / 5.Tharu / 6.Mehita / 7.Khatwb / 8.other Terai / 9.Chetri / 10.Newar / 11.Tamang / 12.Others ( )

3.2 What is your religion?

1. Hindu, 2. Muslim, 3. Buddism, 4. Others ( )

4. Land Ownership

4.1 Land Holding

Form of Land tenure	Land Tenure (Katha)	No. of Parcels held
a. Owned		
b. Leased		
c. Share cropping		
d. Tenanted		
Total (a+b+c-d)		

4.2 Who decide how to use the land? _____

4.3 In terms of contract,

4.3.1 Landowner and leaseholder

1. Product:	kg per katha / (crop / year / others) to be given to landowner
2. Cash:	Rs per katha / (crop / year / others) to be given to landowner
3. Others:	

4.3.2 Landowner and sharecropping farmer

1. Product:	% of the total yield to be taken by landowner to be taken by landowner
2.Inputs:	% of the total input shared by farmers
3.Others:	

4.3.3 Tenant and Landowner

1. Product:	kg per katha / (season / year / others) to be taken by landowner
2. Cash:	Rs per katha / (season / year / others)
3.Others:	

4.3.4 In the case of leaseholder, do you have difficulty to pay land rent? (Yes / No)

4.3.5 If the answer of 4.3.4 is yes, what is the difficulty?

1. Low productivity of land, 2. Low price /unit of agricultural yield, 3. High rent of land, 4. Others ( )

4.4 How has the land been used?

Manner of use	Area (katha)	Manner of use	Area (katha)
1. Farmland		2.Pasture	
a. Fully		3.Forest	
b. Partially irrigated land		4.House and its surroundings	
c. Rain fed land		5.Others( )	
d. Sub-total			

4.5 How long does it take from your house to the farm?

1.to the nearest farm: ( ) min. by (1. foot / 2. bicycle / 3. others ( ))
2.to the farthest farm: ( ) min. by (1. foot / 2. bicycle / 3. others ( ))

5. Agriculture

5.1 Cereals

5.1.1 What kind of cereals do you cultivate, its variety, planted/harvested area, yield, etc.

P.R *	Major Crops	Variety	Planted area / (katha)	Harvested area (katha)	Yield (kg/katha)		Crop mixed, if any
					This season	Last season	
	Paddy (Monsoon)						
	Paddy (Spring)						
	Wheat						Mixed crop with ( )
	Pulse ( )						
	( )						
	( )						
	Oil seed						
	( )						
	( )						

	Potato						Mixed crop with ( )
	Jute						
	Sugarcane						
	Others						
	Total						

* P.R : Priority Ranking: Which plant do you prefer must? Put the number from 1 to 5, as 1 is the first priority..
* *The total might be larger than the actual land held, since some crops are planted as mixed.*

5.1.2 What is the reason why there is difference between planted area and harvested area?

a. Lack of water, b. Calamity, c. Pest/Disease
d. Others

5.1.3 When do you plant and harvest different varieties of paddy?

Crops \ Month*	1	2	3	4	5	6	7	8	9	10	11	12
Paddy (Monsoon)												
Paddy (Spring)												

* *Nepalese calendar is used in the Nepalese version.*

5.1.4 Why do you want to grow paddy?

1. I have knowledge and skill of growing paddy, 2. lack of knowledge & skills for other crops, such as vegetables, 3. Necessary for self-consumption since rice is main food, 4. Others ( )

5.2 Vegetables

5.2.1 Do you grow vegetables? (Yes / No)

5.2.2 If the answer of 5.2.1 is yes, is it for commercial purpose? (Yes / No)
* If the answer is yes, go to 5.2.3, and if the answer is no, go to 5.2.4.

5.2.3 If the answer of 5.2.2 is yes, what kind of vegetables do you cultivate, its variety, planted/harvested area, yield, etc?

P.R*	Major Crops	Total Area (katha)	Yield (kg/katha)		Crop mixed, if any
			This season	Last season	
	Vegetables				Mixed crop with ( )
	( )				Mixed crop with ( )
	( )				Mixed crop with ( )

	Others				
	Total				

5.2.4 If the answer of 5.2.2 is no, what kind of vegetables do you grow for your self-consumption?

Summer :
1. lady finger, 2. beans, 3.Eggplant, 4. Cucumber family, 5. Others ( )
Winter:
1. Cauliflower, 2. Potato, 3. Tomato, 4. Others ( )

5.2.5 Do you have any problems for cultivation of vegetables? (Yes / No)

5.2.6 If the answer of 5.2.5 is yes, what are those problems?

1. lack of knowledge for cultivation, 2.lack of irrigation facilities, 3. Lack of improved seeds, fertilizer, etc. (inputs), 4. The land is not suitable for cultivating vegetables, 5. Drainage problem,
6 Others ( )

5.3 Opinion about crop-diversification

5.3.1 Even if there is inadequate water in summer, do you still want to grow rice, or think of shifting to summer vegetables?

a. stick to grow rice, b. shifting to summer vegetables, c. Others ( )

5.3.2 If you stick to rice (If the answer of 5.3.1 is a), where do you get water from?

1. Rain, 2. from nearest pond and river, , 3. STW, 4.Others ( )

5.3.3 What is the reason to stick to rice?

1. Following to tradition to cultivate paddy, 2. Lack of knowledge for other crops,
3. Self-sufficient for own food, 4. Others ( )

5.3.4 If you shift to summer vegetables (If the answer of 5.3.1 is b), what kind of vegetables do you want to shift?

1. Cucumber families (pumpkin, cucumber, etc.), 2. Egg plant, 3. Beans, 4. Okra, 5. Chillies
6. Others ( )

5.3.5 What kind of condition do you need to shift to summer vegetables?

1. Improved seeds, 2. Improved fertilizer, 3. Specific training, 4. Irrigation facilities,
5. Others ( )

5.4 Water Source for Agriculture

5.4.1 From where you take water for agriculture in summer?

a. Sunsari-Morang Irrigation System, b. River(s): Name: ,
c. Pond, d. Boring (Shallow Tube Well) e. Rain, f. Others:

5.4.2 From where you take water for agriculture in winter?

a. Sunsari-Morang Irrigation System, b. River(s): Name: ,
c. Pond, d. Boring (Shallow Tube Well) e. Rain, f. Others:

5.4.3 Is the water for agriculture enough through the year? (Yes / No)

5.4.4 If the answer of 5.4.3 is no, in what season the water will be short?

1. Winter, 2. Summer, 3. Both in winter and summer,

In the case of SMIP

5.4.5 Do you pay the water fee for SMIP? (yes / No)

5.4.6 If the answer of 5.4.6 is yes, how much do you pay?

( ) Rs / (time(s) / month / season / year / katha)

5.4.7 Has SMIP improved your production? (Yes / No)

5.4.8 If the answer of 5.4.8 is yes, how much have the production increased?

1. 10-15 kg /katha, 2. 15-20 kg / katha, 3. 20-25 kg/ katha, 4.More than 25kg /katha

5.4.9 If the answer of 5.4.8 is no, what is the problem?

1. no water / insufficient comes in the canal, 2. O & M is not properly functioning, 3. Lack of proper water distribution, 4. Others ( )

5.5 About proposed-project

5.5.1 Do you agree with the proposed project? (Yes / No)

5.5.2 If the answer is no, why you do not agree to the project?

1. I cannot pay ISF, 2. I am not sure about success of the project,
3. Others :

5.5.3 If the answer of 5.5.1 is yes, are you ready to contribute in cash or kind? (Yes / No)

5.5.4 If yes, what is the maximum ISF you are willing to pay? Rs /Bigha

5.6 Agriculture Inputs

5.6.1 Seeds:

Item / Crops	Self supply (kg/katha)	Quantity of external supply (kg/katha)	Supplier a.AIC, b. Domestic private dealer, c. Foreign(India) private dealer, d. Others( )	Total Amount (kg/ katha)	Unit Price (Rs/ kg)
Paddy(Monsoon)					
Paddy (Spring)					
Wheat					
Potato					
Pulse ( )					
Oilseed					
Vegetables ( )					
Jute					
Sugarcane					

5.6.2 Fertilizer and Chemicals

Specify* / Items	Crop1 ( ) (kg/katha) or (Rs / katha)**	Crop2 ( ) (kg/katha) or (Rs / katha)**	Crop3 ( ) (kg/kahta) or (Rs / Katha)**	Supplier a. AIC, b. Domestic private dealer, c.Indian private dealer, d. Others	Unit Price (Rs /kg)
a. Urea					
b. TSP					
c. DAP					
d. Potash					
e. Organic Manure					
f. Herbicide					
g. Insectide					
h. Others ( )					

Note *: To be specified by interviewer, ** for chemicals

5.6.3 How many labour forces do you need for your farming? (per katha)

Specify* / Items	Crop1 ( )	Crop2 ( )	Crop3 ( )
(1) Family labours			
a. Land preparation	Days	days	days
b. sowing/ Transplanting			
c. Weeding	Days	days	days
d. Irrigation and fertilizer application			
e. Harvesting/Threshing	Days	days	days
f. Others ( )	Days	days	days
Sub total			
(2) Hired Labour Requirement (days hired)			
a. Land preparation	Days	days	days
b. sowing / Transplanting			
c. Weeding	Days	days	days
d. Irrigation and fertilizer application			
e. Harvesting/Threshing	Days	days	days
f. Others ( )	Days	days	days
Sub total			
Grand total			

Note*: To be specified by interviewer

5.6.4 Average wage rate for hired labour:

Male: with meal: ( ) Rs/day, without meal: ( )Rs/day
Female: with meal: ( ) Rs /day, without meal: ( ) Rs/day

5.7 Machinery and bullock use

	Machinery / Animal / Manual	*Quantity (No. / hr/ day/ bigha /katha)*	Owned or leased	*Renting fee (No. / hr/ day/ bigha / katha)*
For Paddy				
a. For Land preparation	a.4-wheel tractor b.Animal ( )			
b. For threshing	a.Thresher b. Animals			

c. Irrigation (if any)	a. Pump b. other ( )			
Wheat				
a. For Land preparation	a.4-wheel tractor b.Animal ( )			
b. For threshing	a.Thresher b.Animals			
c. Irrigation (if any)	a. pump b. other ( )			
For other Vegetables (Potato, Sugarcane)				
a. For Land preparation	a.4-wheel tractor b.Animal ( )			
c. Irrigation (if any)	a. pump b. other ( )			

* The unit should be specified by surveyors.

5.8 Post-harvest, existing facilities, Storage, Processing, : (About Potato)

5.8.1 Do you store potato after harvest? (yes / No)

5.8.2 If the answer of 5.8.1 is yes, what kind of storage do you use and where?

◆ Type of storage: (Local technology / Cold storage)
◆ Manner of storing: (private / communal)

5.8.3 Do you process your product? (Yes / No)

5.8.4 If the answer of 5.8.3 is yes, what do you do and how?

◆ Method of processing:
◆ Manner of processing: Individual / Cooperative (name of the org.)

5.9 Marketing

Item / Crops	Home Consumption	To Whom: Village Merchant	Local Assembler	Wholesaler	Others ( )	Farm-gate Price: Min. (Rs/kg)	Max. (Rs/kg)
Paddy (Monsoon)	%	%	%	%	%		
Paddy (Spring)	%	%	%	%	%		
Wheat	%	%	%	%	%		
Potato	%	%	%	%	%		
Sugarcane	%	%	%	%	%		
Jute	%	%	%	%	%		
Pulse ( )	%	%	%	%	%		
( )	%	%	%	%	%		
( )							
Oilseed ( )	%	%	%	%	%		
( )	%	%	%	%	%		
Vegetables ( )	%	%	%	%	%		
( )	%	%	%	%	%		

5.10 Agroforestry System

5.10.1 Have you tried to cultivate vegetables mixed with trees? (Yes / No)

5.10.2 If the answer of 5.10.1 is yes, which vegetables and trees have you planted in your farm?

5.11 What are the most serious problems on farming operation?

1. Major problems, 2. Lack of irrigation facilities, 3. Incidence of pests and diseases, 4. Lack of storage facilities, 5. Poor marketing facilities, 6. Lack of capital /credit, 7. Lack of availability of labour, 8. Others ( )
Problem Ranking (Choose the number what to be circled above) : 1. ,2. 3.

6. LIVESTOCK RAISING

6.1 What kind and how many animals are you raising now and how much their farm gate price?

Item / Livestock	Number of kept (no. or unit)	No. or head of Sold (last year)	Unit Price (Rs/head)
Cow Calves			
Milking Cow			
Bullock			
Buff-Calves			
Buffalo (male)			
Buffalo (female)			
Goat			
Pig			
Poultry			
Duck			

6.2 Do you have milking animals? (Yes / No)

6.3 If yes, how much?

	Amount produced (litter / day)	Litter Sold (last year)	Unit Price (Rs /litter)
Milk		Litter/day	

6.4 Do you poultry production? (Yes / No)

6.5 If yes, how many ?

	Amount Produced (unit / day)	Litter Sold (last year)	Unit Price (Rs / Unit)
Egg		Unit/day	

6.6 Are there any problems for livestock rearing? (Yes / No)

6.7 If the answer of 8.6 is yes, what are major problems?

1. Lack of fodder and grass, 2. Social problems such as theft, etc. 3.Incidence of diseases, 4. Poor marketing facility for production, 5. Others ( )
Problem Ranking (Choose the number what to be circled above) : 1. ,2. 3.

7. Fishery

7.1 Are you engaged in fishing as a major source of your livelihood? (Yes / No)

7.2 If yes, where do you fish? (Please check)

1. Sunsari river, 2. Morija Dhar, 3. Budhi river, 4. Local ditch and ponds, 5. Koshi,
6. Others ( )

7.3 How often do you go for fishing?

1. Daily, 2. ( ) days per week,

7.4 How many hours do you fish per day?

hours

7.5 What is the amount of your total catch per day in kg?

1. In winter:
2. In summer

7.6 What do you do with your catch per day?

Self Consumption (kg)	Sell (kg)	Price (Rs/kg)

8. Extension Service

8.1 DO you receive any agriculture extension service? (Yes / No)

8.2 If yes, from who and what kind of technical assistance do you receive?

Kind of technical assistant you receive	From whom a. JT/JTA, b. NGOs ( ), c. Others ( )
a. Dissemination of new variety	
b. Fertilisation	
c. Pest /disease control	
d. Storing	
e. Processing	
f. Marketing	
g. Agroforestry	
h. Livestock rearing	
i. Fish breeding	
j. Others	

* Refer to the No. Family structure

8.2 If you receive any technical assistance from any agencies, how often do you receive them?

1. more than 1 time / week 2. 1 time / two weeks, 3. 1 time / month, 4.When you have necessity,

9. Income and Expenditure

9.1 Major Staple food

9.1.1 Major meals

	Common menu for meals (If you do not take, write "no")
Breakfast	
Lunch	
Supper	

9.1.2 Do you cultivate something in your backyard for your home consumption? (Yes · No)

9.1.3 If the answer of 9.1.2 is yes, what do you produce?

☐Vegetable: Species ( )
☐Fruits: Species ( )
☐Domestic fowl and other small livestock:

9.2 Food consumption (monthly)

Items	Quantity (kg or number)	Buying	
		Quantity (kg/month)	Rs/kg
Rice			
Wheat flour			
Milk			
Meet & fish			
Potato			
Green Vegetables			
Egg			
Fruits			
Others			

9.3 Information on Income

Major source of Income	Annual Income (Rs)
a. Agriculture (by each crop)	
◆	
◆	
◆	
b. Livestock (by species / products)	
◆	
◆	
◆	
c. Selling fish	
d. Forestry products (wood, firewood, etc.)	
e. Farm labour	
f. Other paid work: ( )	
g. Business ( )	
h. Migrant work (to where?:) (for how long? Months)	
i. Loan	
j. Others	
Total	

9.4 Information on Expenditure

Major expenses	Annual Expense (Rs)
a. Agriculture	
◆ Fertiliser	
◆ Chemicals	
◆ Seeds	
◆ Tools	
◆ Labour	
◆ Others	

b. Livestock ◆ Care (Pasture, Feeding, Transportation, etc.)	
c. Education	
d. Food	
e. Medication	
f. Tax etc.	
g. Energy	
h. Repayment for credit	
i. Social Activities (Religious event, marriage, etc.)	
j. Cloths, general goods for living life, etc.	
k. Water fee	
l. Others	
Total	

9.5 Information on Loan and Savings

9.5.1 Do you have saving? (Yes / No)

9.5.2 If the answer of 9.3.1 is yes, how much saving do you have annually? _____ Rs

9.5.3 Have you applied for loan ? (Yes / No)

** If the answer is yes, go to 9.5.3, and if the answer is no, go to 9.5.4*

9.5.4 If the answer of 9.5.3 is no, what is the reason?

1. I do not need, 2. I do not know the process of getting loan, 3. I don't have anything to submit as mortgage, 4. Others ( )

9.5.5 If the answer of 9.5.3 is yes, how much loan do you have now? _____ Rs

9.5.6 What is the purpose of the loan?

1. For Agriculture production, 2. For live-stock raising, 3. Other income generating activites, 4. Others ( )

9.5.7 If you have loan, from what agency do you borrow?

1. ADBN, 2. SFDP, 3. Women Development Program, 4. Micro Enterprise Development Program (UNDP), 5. Rural Development Bank, 6. LTF, 7. Local money lender, 8.Others ( )

9.5.8 What is the interest?

% per (week / month / year)

9.5.9 Are you able to repay? (Yes / No)

9.5.10 If the answer is "no", what will you do?

1 I will take another loan to repay it, 2. I will forfeit my mortgage, 3. I will sell my land to repay it, 4. I will wait and atch, 5. Others ( )3.

10. Basic Infrastructure

10.1 where do you take water for domestic use?

1. water well (Private / communal), 2. Pipe, 3. Tube-well (Private / Communal) 4. River(s), 5. Others ( )

10.2 Do you have electricity? (Yes / No)

10.3 What kind of fuel do you use?

a. LPG Gas, b. Bio-gas, c. Kerosene, d. Firewood, e. cow dom,

11. Gender

11.1 Division of roles from Gender aspect

Activities	Women (% of engagement)	Men (% of engagement)	Children (% of engagement)	
			Male C	Female C
a. Fetching Water				
b. Domestic work (cooking, washing, etc.)				
c. Education for kids · decision to go to school · helping children to study at home				
d. Farming · land preparation · sowing · transplant · weeding · irrigation · threshing · Processing · farming in the backyard · selling · others ( )				
e. Livestock rearing · caring cattle · caring small animals ( ) · milking · collecting eggs · others ( )				
f. Receiving extension service				
g. Decision making Selling · farm product · livestock product · product from garden · others				
h. Decision making on buying · farm inputs · food · general goods for living (such as soup, cloths, etc.)				
i. decision making on loan				
j. Work as farm labour				
k. Other paid work				
l. Social activities				
m. Others				

12 Community organisation belonged

12.1 Do you belong to any community organisation? (Yes / No)

12.2 If the answer of 6.1 is yes, please fill in the following information

Name of the organisation belonged			
You position held			

What is your merit to belong to the organisation			
Are there any duty and responsibility for the member? (ex. Member fee, voluntary work, activities, participation in meeting, etc.)			

12.3 Do your family members belong to any community organisation? (Yes / No)

12.4 If the answer of 6.1 is yes, please fill in the following information

Name of your family member(s)			
Name of the organisation belonged			
You position held			
What is your family member's merit to belong to the organisation			
Are there any duty and responsibility for the member? (ex. Member fee, voluntary work, activities, participation in meeting, etc.)			

12.5 Has there been any effort to organize WUA in your area? (Yes / No)

12.6 If the answer of 12.5 is yes, is the WUA functioning well? (Yes / No)

12.7 If the answer of 12.6 is yes, what are they doing?

1. Looking after O&M, 2. Collecting ISF, 3. Arranging for provision of extension services,
4. Others ( )

12.8 Are you willing to join to WUA or the proposed project? (Yes / No)

13 Recreation

13.1 Do you / your family have time for recreation? (Yes / No)

13.2 If yes, what do you do for your recreation?

14. When do you feel happiness?

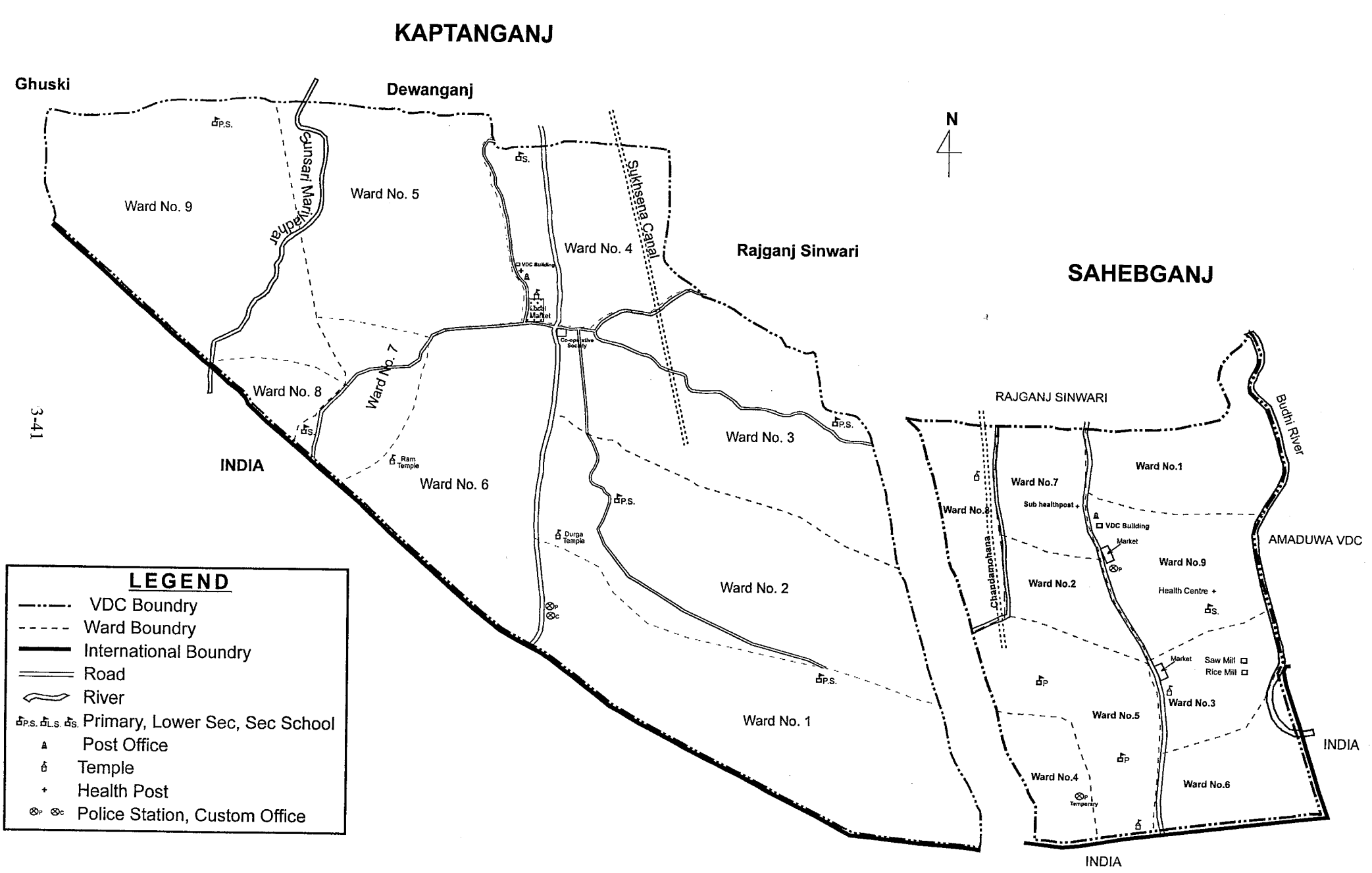
Thank you very much for your cooperation.

ATTACHMENT 2

Caste Information by Ward & VDC

Number of HH					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
					Muslim					Hindu																							
	Population	No of HH	No of toles	ave. no of HH																													
VDC&Ward names					Muslim (Miya)	Muslim (Ansari)	Muslim (Musari)	Muslim (Paitan)	Muslim (Jat)	Chamar	Teli	Meheta	Nuniya	Mussahar	Bhagat	Haluwai	Baniya	Thakur	Kumal (Pandit)	Tharu	Bantar	Jhangad	Yadav	Mandal /Dahnuk	Tatma	Oranwa	Kalwar	Brahamin	Dom	Gurung	Newar	Others	Total (%)	Remark
Sahebganji	**3,426**	**643**			**0**	**0**	**0**	**0**	**0**	**0**	**76**	**61**	**0**	**24**	**0**	**0**	**144**	**0**	**0**	**0**	**0**	**0**	**191**	**122**	**5**	**0**	**0**	**4**	**0**	**0**	**0**	**15**	**642**	
1	520	93	2	47	0	0	0	0	0	0	0	14	0	0	0	0	5	0	0	0	0	0	19	56	0	0	0	0	0	0	0	0	94	
2	282	49	3	16	0	0	0	0	0	0	0	39	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	49	
3	347	80	1	80	0	0	0	0	0	0	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	80	
4	312	58	1	58	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	
5	253	48	2	24	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	
6	374	76	1	76	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	30	0	0	0	0	0	0	0	0	15	75	Others: Miya/Tatma /Bhat
7	330	64	1	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	64	
8	688	121	5	24	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	73	24	0	0	0	0	0	0	0	0	121	
9	320	54	1	54	0	0	0	0	0	0	0	8	0	0	0	0	3	0	0	0	0	0	5	32	5	0	0	0	0	0	0	0	53	
Kaptanganji	**8,146**	**1,327**			**126**	**0**	**0**	**0**	**0**	**23**	**0**	**531**	**0**	**291**	**0**	**6**	**58**	**1**	**99**	**0**	**0**	**0**	**139**	**13**	**0**	**8**	**0**	**1**	**1**	**8**	**18**	**2**	**1325**	
1	1,118	190	4	48	0	0	0	0	0	0	0	53	0	40	0	0	57	0	2	0	0	0	36	0	0	2	0	0	0	0	0	0	190	
2	1,421	241	5	48	96	0	0	0	0	22	0	72	0	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	240	
3	909	150	4	38	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	8	0	0	151	
4	727	117	2	59	0	0	0	0	0	0	0	112	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	116	
5	820	128	2	64	0	0	0	0	0	0	0	87	0	6	0	0	1	0	26	0	0	0	0	1	0	6	0	0	0	0	0	0	127	
6	868	145	4	36	7	0	0	0	0	1	0	15	0	0	0	0	0	1	46	0	0	0	73	0	0	0	0	0	1	0	0	0	144	
7	737	119	4	30	0	0	0	0	0	0	0	10	0	42	0	6	0	0	13	0	0	0	30	0	0	0	0	1	0	0	18	0	120	
8	769	120	1	120	0	0	0	0	0	0	0	0	0	118	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	120	
9	777	117	6	20	23	0	0	0	0	0	0	47	0	35	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	117	
Dewanganji	**6,498**	**1,111**			**230**	**0**	**0**	**0**	**0**	**50**	**3**	**433**	**0**	**72**	**0**	**0**	**18**	**3**	**3**	**3**	**0**	**0**	**166**	**0**	**0**	**0**	**49**	**15**	**0**	**0**	**0**	**68**	**1113**	
1	697	129	2	65	0	0	0	0	0	39	3	35	0	39	0	0	0	0	3	3	0	0	0	0	0	0	0	3	0	0	0	6	131	
2	703	122	3	41	0	0	0	0	0	6	0	31	0	0	0	0	18	0	0	0	0	0	0	0	0	0	49	12	0	0	0	6	122	
3	1,651	288	2	144	6	0	0	0	0	0	0	230	0	29	0	0	0	3	0	0	0	0	6	0	0	0	0	0	0	0	0	14	288	
4	281	53	1	53	0	0	0	0	0	5	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	53	
5	897	145	1	145	109	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	145	
6	707	112	1	112	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	112	
7	496	85	3	28	9	0	0	0	0	0	0	68	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	85	
8	657	113	1	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	0	0	0	0	0	0	0	11	113	
9	409	64	1	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0	0	0	0	0	0	0	6	64	
Ghuski	**9,580**	**1,476**			**0**	**639**	**126**	**117**	**131**	**30**	**13**	**77**	**0**	**75**	**0**	**28**	**0**	**0**	**42**	**0**	**0**	**23**	**36**	**102**	**5**	**0**	**0**	**7**	**6**	**0**	**0**	**22**	**1,479**	
1	1,262	223	3	74	0	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	0	0	0	0	0	0	0	22	223	
2	889	143	2	72	0	0	0	0	0	9	13	14	0	64	0	7	0	0	0	0	0	0	29	0	0	0	0	7	0	0	0	0	143	
3	679	96	1	96	0	53	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	
4	1,461	233	3	78	0	30	0	117	0	0	0	0	0	5	0	0	0	0	42	0	0	23	7	5	5	0	0	0	0	0	0	0	234	
5	1,207	155	2	78	0	93	0	0	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	
6	778	115	2	58	0	35	0	0	69	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	116	
7	981	158	2	79	0	79	16	0	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	158	
8	1,324	205	2	103	0	123	0	0	0	21	0	0	0	0	0	21	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	206	
9	999	148	1	148	0	81	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	
Rajganji Sinuwa	**8,251**	**1,439**			**61**	**0**	**0**	**0**	**0**	**0**	**0**	**431**	**0**	**135**	**0**	**0**	**0**	**11**	**48**	**105**	**0**	**115**	**440**	**95**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,441**	
1	634	115	2	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	58	0	0	0	0	0	0	0	0	0	0	116	
2	986	171	4	43	17	0	0	0	0	0	0	34	0	17	0	0	0	0	0	0	0	34	68	0	0	0	0	0	0	0	0	0	170	
3	563	109	1	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	109	0	0	0	0	0	0	0	0	0	109	
4	1,333	225	4	56	0	0	0	0	0	0	0	68	0	0	0	0	0	0	0	0	0	0	158	0	0	0	0	0	0	0	0	0	226	
5	1,048	175	6	29	0	0	0	0	0	0	0	114	0	0	0	0	0	0	0	0	0	0	61	0	0	0	0	0	0	0	0	0	175	
6	1,114	215	7	31	0	0	0	0	0	0	0	54	0	43	0	0	0	11	0	0	0	0	22	86	0	0	0	0	0	0	0	0	216	
7	722	117	3	39	0	0	0	0	0	0	0	64	0	0	0	0	0	0	29	0	0	23	0	0	0	0	0	0	0	0	0	0	116	
8	497	93	3	31	0	0	0	0	0	0	0	9	0	9	0	0	0	0	19	47	0	0	0	9	0	0	0	0	0	0	0	0	93	
9	1,354	219	7	31	44	0	0	0	0	0	0	88	0	66	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	220	
Madhayaharsahi	**4,901**	**827**			**41**	**0**	**0**	**0**	**0**	**23**	**0**	**615**	**0**	**26**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**59**	**61**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**827**	
1	634	111	3	37	0	0	0	0	0	0	0	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	
2	530	81	3	27	41	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	
3	607	103	4	26	0	0	0	0	0	10	0	62	0	0	0	0	0	0	0	0	0	0	31	0	0	0	0	0	0	0	0	0	103	
4	806	135	5	27	0	0	0	0	0	0	0	81	0	26	0	0	0	0	0	0	0	0	27	0	0	0	0	1	0	0	0	0	135	
5	779	136	2	68	0	0	0	0	0	11	0	122	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	135	
6	385	64	1	64	0	0	0	0	0	1	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	
7	610	102	3	34	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	61	0	0	0	0	0	0	0	0	102	
8	234	39	1	39	0	0	0	0	0	0	0	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	
9	316	56	1	56	0	0	0	0	0	1	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	
Basantapur	**4,702**	**753**			**236**	**0**	**0**	**0**	**0**	**1**	**0**	**119**	**0**	**0**	**0**	**0**	**10**	**2**	**0**	**0**	**0**	**0**	**156**	**190**	**0**	**29**	**0**	**11**	**0**	**0**	**0**	**1**	**755**	
1	559	87	1	87	87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87	
2	154	26	2	13	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	10	3	0	10	0	0	0	0	0	0	25	
3	135	23	1	23	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	12	5	0	6	0	0	0	0	0	0	24	
4	578	106	1	106	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	74	16	0	0	0	0	0	0	0	0	106	
5	704	109	2	55	0	0	0	0	0	0	0	60	0	0	0	0	5	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	109	
6	311	59	1	59	0	0	0	0	0	0	0	24	0	0	0	0	0	2	0	0	0	0	7	27	0	0	0	0	0	0	0	0	60	
7	943	149	4	37	51	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	7	75	0	0	0	0	0	0	0	1	149	
8	765	109	1	109	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	109	

Number of HH					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
					Muslim					Hindu																							
VDC&Ward nunes	Population	No of HH	No of toles	ave. no of HH	Muslim (Miya)	Muslim (Ansari)	Muslim (Musari)	Muslim (Paitan)	Muslim (Jat)	Chamar	Teli	Meheta	Nuniya	Musahar	Bhagat	Haluwai	Baniya	Thakur	Kumal (Pandit)	Tharu	Bantar	Jhangad	Yadav	Mandal /Dahmik	Tatma	Oranwa	Kalwar	Brahamin	Dom	Gurung	Newar	Others	Total (%)	Remark
9	553	85	1	85	0	0	0	0	0	0	0	2	0	0	0	0	5	0	0	0	0	0	2	64	0	13	0	0	0	0	0	86	
Harinagara	**7,038**	**1,148**			**239**	**0**	**0**	**0**	**0**	**30**	**61**	**297**	**178**	**79**	**9**	**26**	**88**	**4**	**58**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**4**	**69**	**1,147**	
1	885	130	1	130	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130	
2	995	166	2	83	0	0	0	0	0	25	0	0	83	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	166	Others: Sarbariya,
3	992	173	3	58	0	0	0	0	0	5	0	0	95	26	9	26	7	0	0	0	0	0	0	0	0	0	0	5	0	0	0	173	
4	531	83	2	42	0	0	0	0	0	0	0	0	0	0	0	0	66	4	0	0	0	0	0	0	0	0	0	0	0	4	8	82	
5	872	144	2	72	58	0	0	0	0	0	14	14	0	0	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	0	144	
6	581	93	1	93	0	0	0	0	0	0	47	42	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	
7	959	154	3	51	0	0	0	0	0	0	0	108	0	15	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	15	153	
8	488	77	2	39	0	0	0	0	0	0	0	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	77	
9	735	128	1	128	51	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	128	
Ramnagar Bhuta	**11,087**	**1,698**			**1,110**	**0**	**0**	**0**	**0**	**65**	**35**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**101**	**0**	**0**	**0**	**0**	**0**	**0**	**387**	**1,698**	
1	1,357	189	2	95	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	189	
2	815	128	4	32	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	128	
3	1,095	176	2	88	106	0	0	0	0	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	176	
4	982	147	1	147	147	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	
5	1,177	178	4	45	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	178	Others: Bungali, Gupta, Dom, Haluwai, Chamar
6	986	169	2	85	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	0	0	0	0	0	66	169	Others: Gupta, Sonar, Bhagat, Paudar
7	2,074	297	2	149	267	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	297	
8	1,193	198	2	99	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	188	198	Sarbariy,a Goshai, Agiri, Paidar
9	1,408	216	1	216	194	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	216	Others: Sarbariya, Shah, Malaha
Jalpapur	**5,681**	**1,084**			**645**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**158**	**0**	**0**	**101**	**17**	**0**	**0**	**91**	**0**	**0**	**68**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**1,086**	
1	335	65	2	33	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	0	39	0	0	0	0	0	0	0	0	0	0	65	
2	293	65	2	33	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	52	0	0	0	0	0	0	0	0	0	0	65	
3	813	169	1	169	68	0	0	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	0	68	0	0	0	0	0	0	0	170	
4	753	140	2	70	56	0	0	0	0	0	0	0	0	56	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	
5	693	101	1	101	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	
6	858	168	3	56	118	0	0	0	0	0	0	0	0	34	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	169	
7	865	168	2	84	151	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	168	
8	789	151	2	76	151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	
9	282	57	1	57	0	0	0	0	0	0	0	1	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	57	
Narsimha	**17,365**	**2,769**			**970**	**0**	**0**	**0**	**0**	**0**	**115**	**40**	**0**	**375**	**0**	**0**	**114**	**0**	**0**	**0**	**0**	**0**	**444**	**197**	**0**	**200**	**0**	**0**	**0**	**0**	**315**	**2,770**	
1	1,900	287	3	96	230	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	287	
2	1,533	252	3	84	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	252	*Uranau)*
3	2,183	360	4	90	18	0	0	0	0	0	68	40	0	29	0	0	0	0	0	0	0	0	90	115	0	0	0	0	0	0	0	360	
4	2,120	365	3	122	146	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0	146	0	0	0	0	0	365	
5	1,116	181	5	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	0	0	0	0	0	0	0	36	181	Others: Mahata, Takur, Maluwai
6	1,378	227	4	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136	68	0	0	0	0	0	0	23	227	Others: Khatawa, Mala (15-20HH), Meheta
7	3,787	537	7	77	430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0	54	538	Others: Teli, Meheta, Yadav, etc.
8	1,924	326	4	82	33	0	0	0	0	0	0	0	0	163	0	0	114	0	0	0	0	0	0	0	0	0	0	0	0	0	16	326	Others: Meheta, others
9	1,424	234	5	47	12	0	0	0	0	0	47	0	0	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	234	
Gautampur	**3,783**	**698**			**69**	**0**	**0**	**0**	**0**	**0**	**76**	**286**	**0**	**19**	**0**	**31**	**63**	**11**	**6**	**0**	**0**	**15**	**4**	**15**	**0**	**67**	**0**	**0**	**0**	**0**	**38**	**700**	
1	492	91	1	91	36	0	0	0	0	0	36	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	
2	551	110	1	110	33	0	0	0	0	0	11	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	110	
3	433	73	1	73	0	0	0	0	0	0	15	44	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	74	
4	250	47	1	47	0	0	0	0	0	0	14	19	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	47	
5	440	72	1	72	0	0	0	0	0	0	0	36	0	0	0	22	0	0	0	0	0	0	4	0	0	11	0	0	0	0	0	73	
6	314	60	1	60	0	0	0	0	0	0	0	6	0	0	0	6	0	0	6	0	0	0	0	0	0	30	0	0	0	0	12	60	Others: Malik, Rislidev
7	198	37	1	37	0	0	0	0	0	0	0	26	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	37	
8	651	125	2	63	0	0	0	0	0	0	0	13	0	19	0	3	63	0	0	0	0	0	0	3	0	0	0	0	0	0	26	127	Others: Rishidev, Mochi
9	454	83	1	83	0	0	0	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	12	0	12	0	0	0	0	0	82	
Babiya	**7,219**	**1,218**			**246**	**0**	**0**	**0**	**0**	**0**	**76**	**242**	**0**	**253**	**0**	**0**	**0**	**0**	**0**	**103**	**0**	**19**	**102**	**0**	**0**	**0**	**0**	**32**	**0**	**0**	**38**	**107**	**1,218**	
1	839	128	2	64	77	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	6	127	
2	1,297	213	2	107	32	0	0	0	0	0	0	128	0	11	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0	0	11	214	Others: Oraon, Jhungad, Thanuyad???(sardar)
3	1,063	189	3	63	47	0	0	0	0	0	76	0	0	19	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	28	189	Others: Meheta & others
4	652	113	1	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	0	0	0	0	0	0	11	113	Others: Meheta, others
5	767	129	1	129	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	129	Others: Khatwe, Meheta, Jhagar, Urawn (Chhetri)
6	589	99	2	50	0	0	0	0	0	0	0	1	0	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	
7	578	94	1	94	0	0	0	0	0	0	0	9	0	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	
8	725	116	1	116	0	0	0	0	0	0	0	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	116	Others: Khatwe, Satiyar,Thakur
9	709	137	1	137	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	103	0	0	0	0	0	0	0	0	0	0	0	137	
Total	97,677	16,191			3,973	639	126	117	131	222	455	3,133	178	1,507	9	91	596	49	257	211	91	172	1,737	863	111	304	49	76	7	8	60	1,029	16,201	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Dewanganj
Rajganj Sinwari
SAHEBGANJ
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Ward No. 7
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Ward No. 3
Ward No. 2
Ward No. 1
Gunsari Marjabahar
Sukhsena Canal
VDC Building
Vegetable Market
Co-operative Society
Ram Temple
Durga Temple
P.S.
S.
RAJGANJ SINWARI
Budhi River
Ward No.7
Ward No.8
Ward No.1
Sub healthpost
VDC Building
Market
Ward No.9
AMADUWA VDC
Ward No.2
Health Centre
Chandanpahara
Market
Saw Mill
Rice Mill
Ward No.3
Ward No.5
Ward No.4
Ward No.6
Temporary
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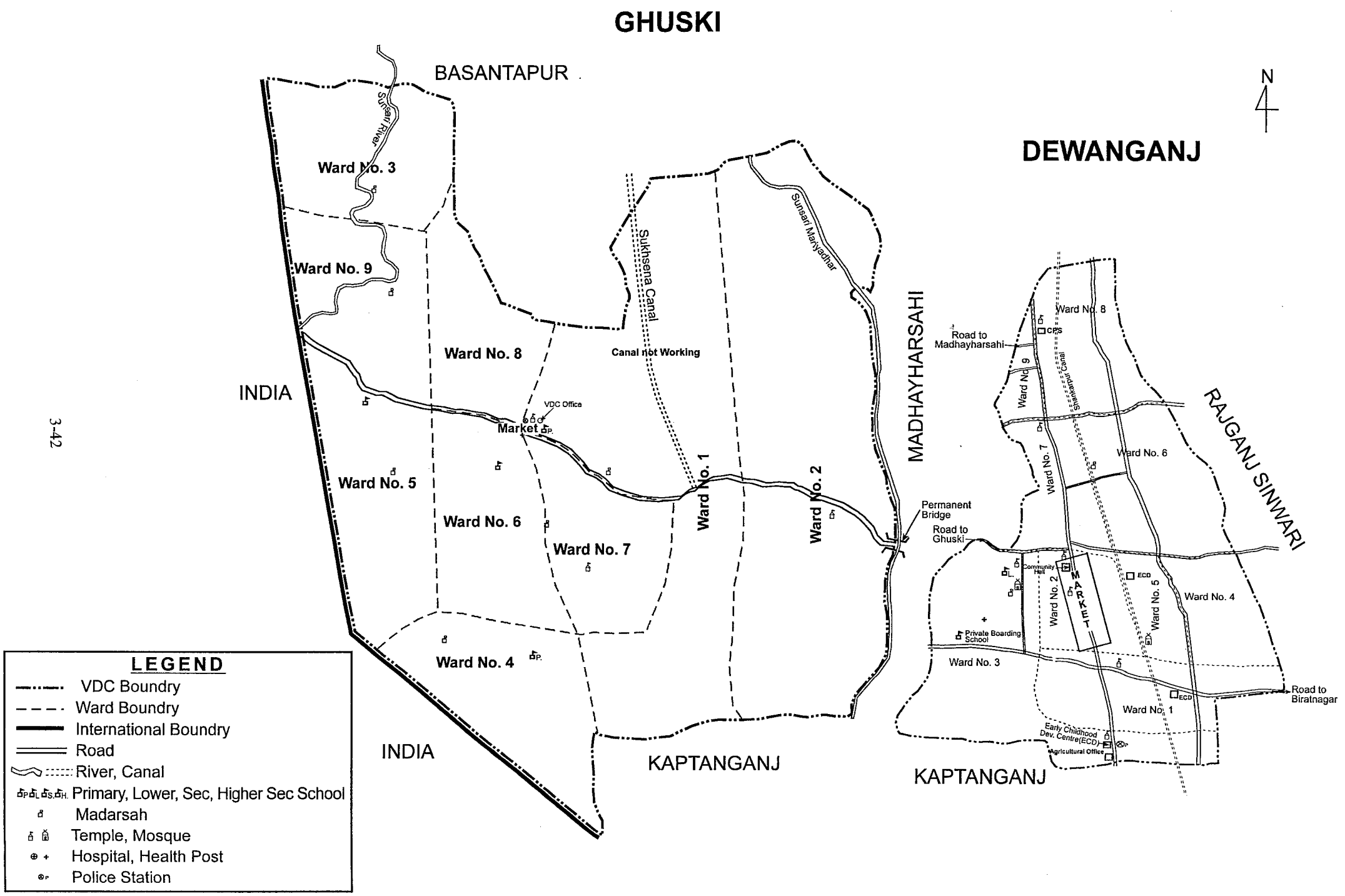
International Boundry
Road
River
Primary, Lower Sec, Sec School
Post Office
Temple
Health Post
Police Station, Custom Office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Canal not Working
Sunsari Mariyadhar
INDIA
VDC Office
Market
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Ward No. 7
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Ward No. 2
Ward No. 4
INDIA
KAPTANGANJ
MADHAYHARSAHI
Road to Madhayharsahi
Ward No. 8
Ward No. 9
Sharadanagar Canal
Ward No. 7
Ward No. 6
RAJGANJ SINWARI
Permanent Bridge
Road to Ghuski
Community Hall
MARKET
ECD
Ward No. 2
Ward No. 5
Ward No. 4
Private Boarding School
Ward No. 3
Road to Biratnagar
Ward No. 1
Early Childhood Dev. Centre(ECD)
Agricultural Office
KAPTANGANJ
LEGEND
VDC Boundry
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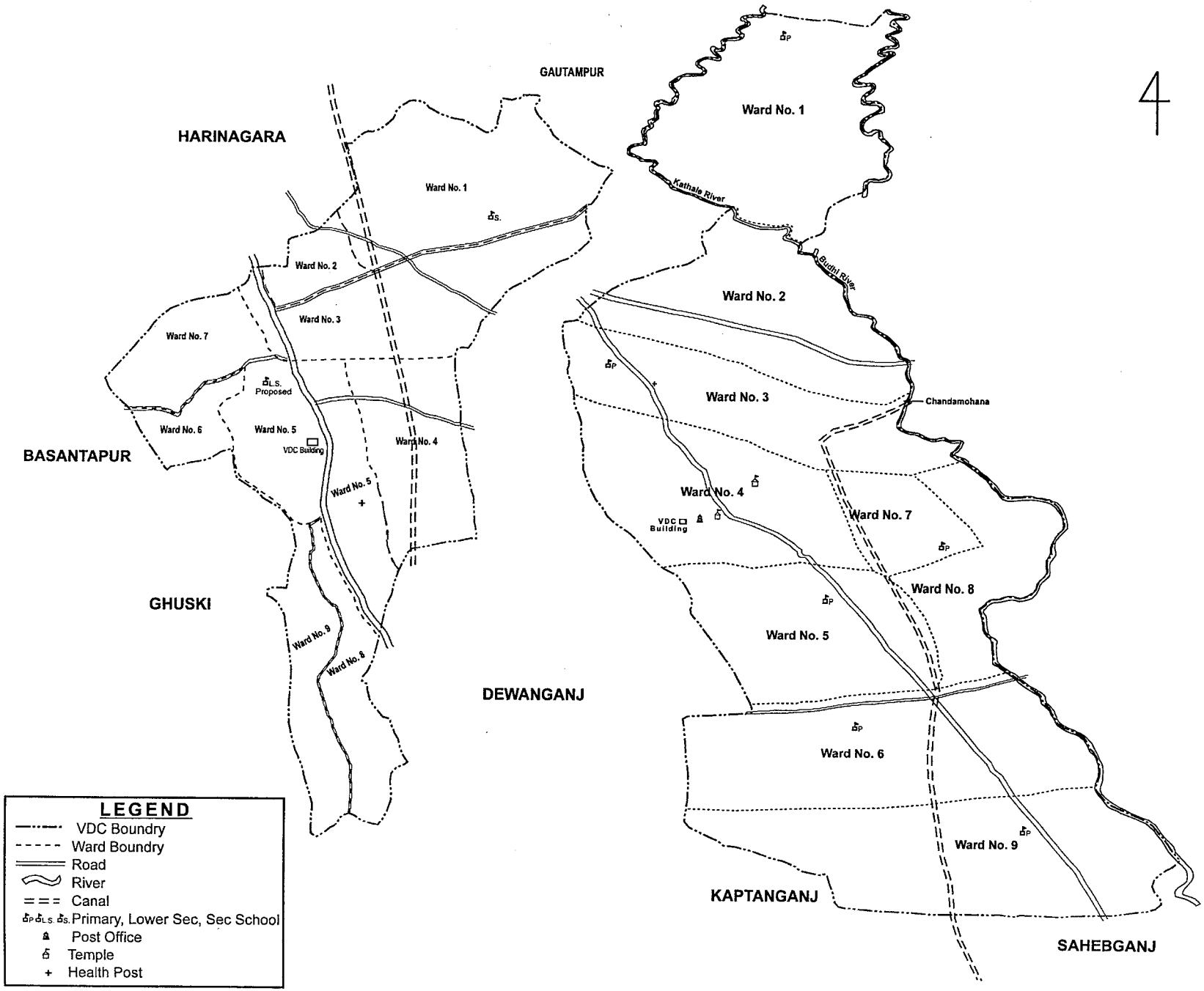
Madarsah
Temple, Mosque
Hospital, Health Post
Police Station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L.S. Proposed
VDC Building
BASANTAPUR
GHUSKI
Ward No. 9
Ward No. 8
DEWANGANJ
Kathale River
Budhi River
Chandamohana
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Ward No. 2
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KAPTANGANJ
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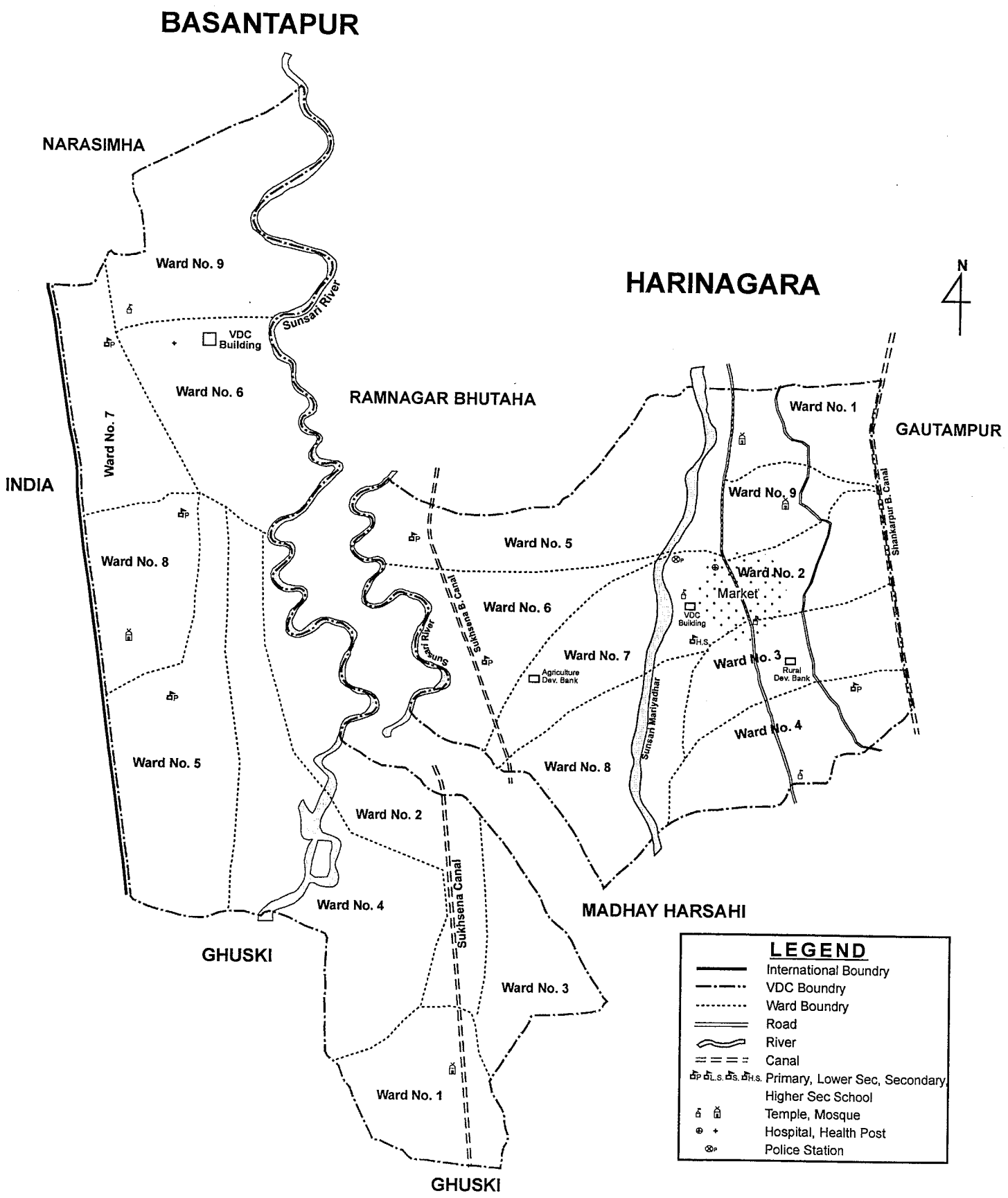
Canal
Primary, Lower Sec, Sec School
Post Office
Temple
Health Post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Sukhsena B. Canal
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GHUSKI
RAMNAGAR BHUTAHA
Ward No. 5
Ward No. 6
Ward No. 7
Agriculture Dev. Bank
Ward No. 8
MADHAY HARSAHI
HARINAGARA
Ward No. 1
GAUTAMPUR
Ward No. 9
Shankarpur B. Canal
Ward No. 2
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VDC Building
H.S.
Ward No. 3
Rural Dev. Bank
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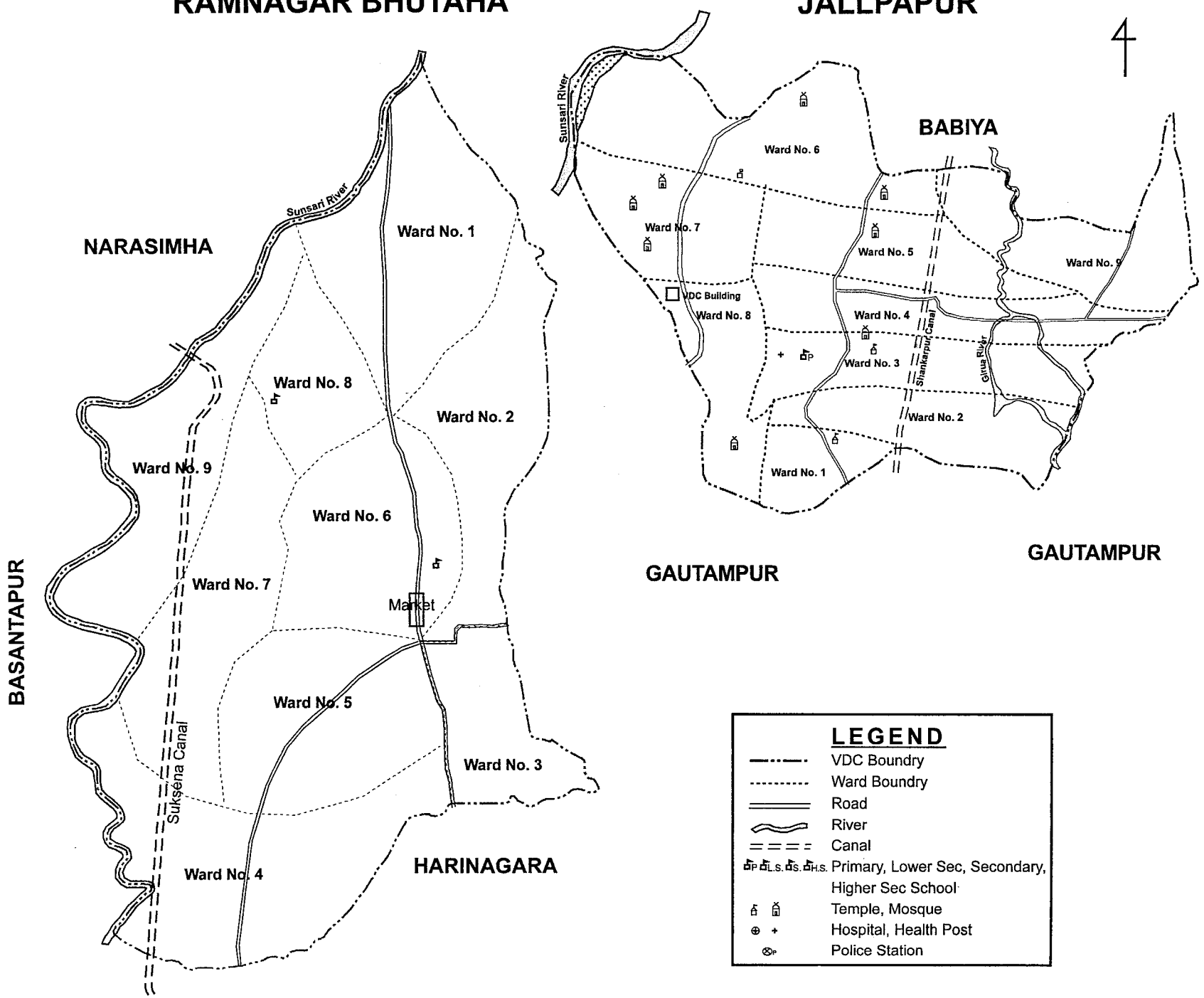
Temple, Mosque
Hospital, Health Post
Police Station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LEGEND
VDC Boundry
Ward Boundry
Road
River
Canal
Primary, Lower Sec, Secondary, Higher Sec School
Temple, Mosque
Hospital, Health Post
Police Station

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APPENDIX-4 METEOROLOGY, HYDROLOGY AND HYDRO- ANALYSIS

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APPENDIX-4 METEOROLOGY, HYDROLOGY AND HYDRO- ANALYSIS

CHAPTER 1 INTRODUCTION

Sunsari River is highly targeted as the promising water resources for the Sunsari Irrigation Project. The first step for designing a guideline for effective distribution of water resources is the estimation of the Sunsari River's runoff throughout the years at recurrent probabilities of 2 years, 3 years, 5 years and 10 years drought.

APPENDIX-4, METEOROLOGY, HYDROLOGY AND HYDRO-ANALYSIS, discusses about meteorological condition and hydrological conditions and water resources assessment, which include surface water and groundwater. The purpose of this Appendix is to evaluate the availability of water resources in the Study Area.

Appendix-4 consists of four chapters, namely CHAPTER 1 INTRODUCTION, CHAPTER 2 METEOROLOGICAL OVERVIEW, CHAPTER 3 METEOROLOGY, CHAPTER 4 HYDROLOGY and CHAPTER 5 WAATER RESOUECES ASSESSMENT.

CHAPTER 2 describes the general feature of climate conditions in/around the Study Area. In addition, it describes river system of Sunsari River. The river system of Sunsari River is complex and it is supposed to be indispensable to clarify the conditions of Sunsari River basin.

CHAPTER 3 deals with rainfall in/around Sunsari River basin. The main purpose of this chapter is to estimate areal rainfall in Sunsari River basin and probable rainfall in the Study Area. This areal daily rainfall data has been utilized to hydrological analysis in Chapter 4.

In CHAPTER 4, the runoff of Sunsari River has been analyzed by using the Tank Model Method. Previous to analysis, condition of data collection and conversion of obtained water level into runoff data are described in the first part of the chapter.

CHAPTER 5 discusses the availability of surface water and groundwater. In addition, availability of Water Resources in Budhi River is assessed for the purpose to evaluate the possibility as the promising water resources for Sunsari Irrigation Project.

In the compilation of this Appendix, input data have been received from DIO, Department of Hydrology and Meteorology and other related offices.

CHAPTER 2 METEO-HYDROLOGICAL OVERVIEW

2.1 Climate

There are two major meteorological stations at Biratnagar Airport and Tarahara Agriculture Center. Both stations show similar climate conditions and general feature of climate is dominated by the monsoon from June to September. The meteorological conditions are summarized as follows.

Table 2.1.1 Climate Conditions at Gauging Station

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
Biratnagar													
Rainfall (mm)	10	13	15	52	165	323	526	375	313	108	10	7	1917
Temperature (°C)	16.0	18.3	23.0	27.1	28.2	28.9	28.7	28.9	28.0	26.1	22.0	17.7	24.4
Humidity (%)	76	67	50	50	64	74	77	79	79	75	72	74	70
Sunshine (Hrs)	7.4	8.2	8.8	8.8	8.8	6.8	5.1	6.2	5.9	8.0	8.6	7.7	7.5
Wind (km/hr)	1.8	2.5	4.0	5.3	5.6	5.0	4.5	3.2	2.7	1.6	1.3	1.3	3.2
Tarahara													
Rainfall (mm)	14	13	18	62	163	323	525	380	300	102	14	11	1925
Temperature (°C)	15.7	17.7	22.1	26.2	27.8	28.6	28.6	28.5	27.8	25.7	21.7	17.6	24.0
Humidity (%)	82	74	59	57	69	78	82	82	83	79	79	78	75
Sunshine (Hrs)	7.3	7.9	8.4	8.7	8.8	6.8	5.1	6.0	5.9	8.0	8.4	7.8	7.4
Wind (km/hr)	3.7	4.5	6.0	7.8	8.3	7.6	7.1	6.3	5.4	3.9	3.6	3.5	5.6
Evaporation (mm)	2.1	3.0	4.4	6.1	6.0	5.2	4.6	4.7	4.2	3.6	2.9	2.1	4.1

Note) As to rainfall, total amount is shown at last column.

The annual average rainfall at Biratnagar and Tarahara is 1917 mm and 1925 respectively. As to distribution of rainfall, about 80 % of rainfall occurs during monsoon season. The mean monthly temperature is 24.4 °C at Biratnagar and 24.0 °C and ranges from about 16 °C to 29 °C. It is highest from June to August and lowest in January.

As to relative humidity, it ranges from 50 % to 79 % at Biratnagar and from 57 % to 83 % at Tarahara. The averages of relative humidity are 70 % and 75 %. Its peak comes in August at Biratnagar and September at Tarahara. On the other hand, it is lowest in around April.

The sunshine hour ranges from 5 to 9 hours. The average of sunshine hours is about 7.5 hours at each station. The longest comes in May and the lowest is September. Wind speed at Tarahara is a little bit faster than that at Biratnagar. It ranges from 3.5 to 8.3 km/hr at Tarahara and from 1.3 to 5.6 km/hr at Biratnagar. Its peak comes in May and is lowest in December.

Pan evaporation data are available only at Tarahara. It ranges from 2.1 mm in December/January to 6.1 mm in April.

2.2 River System

Sunsari River is the tributary of Sapta Kosi River and catchment area at the 600 m down stream from E.W. Highway Bridge is 300 km^2. Sunsari River originates in the northern Terai Plain and flows from the north to south in meandering.

The upper stream of Sunsari River after confluence of Belaha Khola and Thalaha Khola, the river is called as Sunsari Nadi. A tributary of the Khola connects to the Chatra Main Canal at the upper stream of Suksena Canal by emergency outlet.

Formerly, Sunsari River flew along the course of Sunsari Mariya Dhar. Then the river shifted its course as of present form. On the other hand, Sunsari Mariya Dhar is now the swamp in crescent shape.

As to the tributaries of Sunsari River, there are two (2) major tributaries, namely Kakar Khola and Kuruwa Khola. These rivers also originate in the mountainous area, namely Siwalik Range that locates in northern part of Sunsari district.

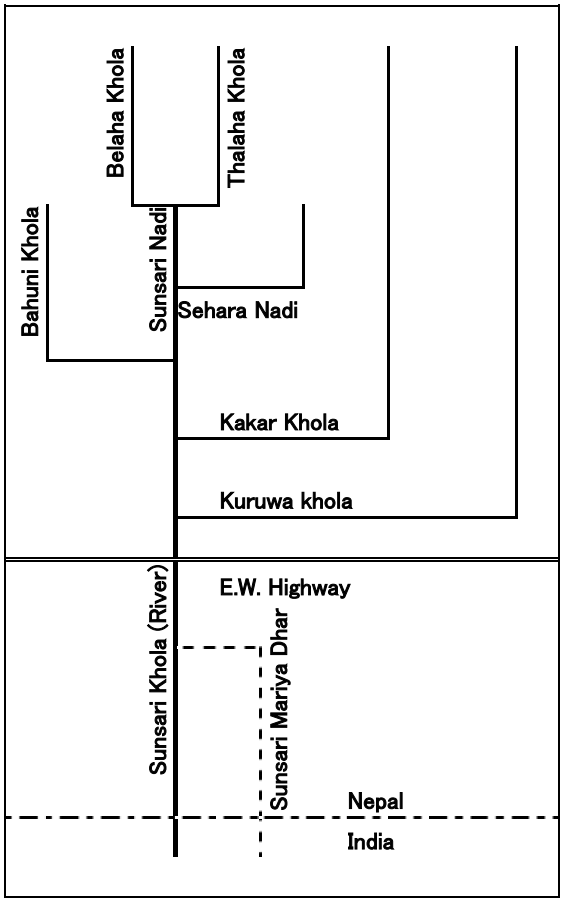


Figure 2.2.1 River System in Sunsari River basin

Kakar Khola (or Seuti Khola) flows along the right edge of alluvial fan in Dharan to the southeast and passes through Terai Plain. This tributary joins Sunsari River at the point in the distance of about 35 km from top of Dharan alluvial fan. On the other hand, Kuruwa Khola (or Sardu Khola) flows along the left edge of Dharan alluvial fan to the south. In Terai Plain, it changes river course to the southwest. And it joins Sunsari River at the point in the distance of about 36 km from top of Dharan alluvial fan.

Sunsari Nadi has perennial flow throughout the year. It is supposed that Sunsari Nadi is recharged by seepage from Sapta Koshi River and irrigation water supplied by SMIP. On the other hand, surface water is not found in Kakar Khola and Kuruwa Khola alluvial fan. However surface water represents in Terai Plain. In this plain, irrigation water is derived by many irrigation facilities from Sunsari Nadi, Kakar Khola, Kuruwa Khola and other tributaries. These irrigation canals connect tributaries to each other and river system is heavily complex.

CHAPTER 3 METEOROLOGY

3.1 Gauging Stations and Data Collection

In/near Sunsari River basin, there are four gauging stations which observe daily rainfall,

namely Dharan Bazar, Chatra, Tarahara and Biratnagar Airport. Location and duration of observation are as follows. JICA Study Team collected these data from the year of establishment and up to the year 2001. In addition, JICA Study Team in cooperation with DIO, has established an additional rain gauge on the roof of DIO building at Inaruwa and started observation from May, 2001 onwards.

Table 3.1.1 Gauging Stations

Stations	Code	Longitude	Latitude	Elevation	Period	Remarks
Dharan Bazar	1311	26°49'	87°17'	444 m	1947-2001	
Chatra	1316	26°49'	87°10'	183 m	1948-2001	
Tarahara	1320	26°42'	87°16'	200 m	1969-2001	
Biratnagar Airport	1319	26°29'	87°16'	72 m	1968-2001	

3.2 General Feature of Rainfall

The long-term patterns of annual rainfall at each station from 1973 to 2001 are shown in following figures and it is not found much difference. It is observed that rainfall have shown a fluctuating pattern in almost 7 or 8 years interval. In addition that, the rainfall at Biratnagar Airport is found high in 1974 and low in 1994.

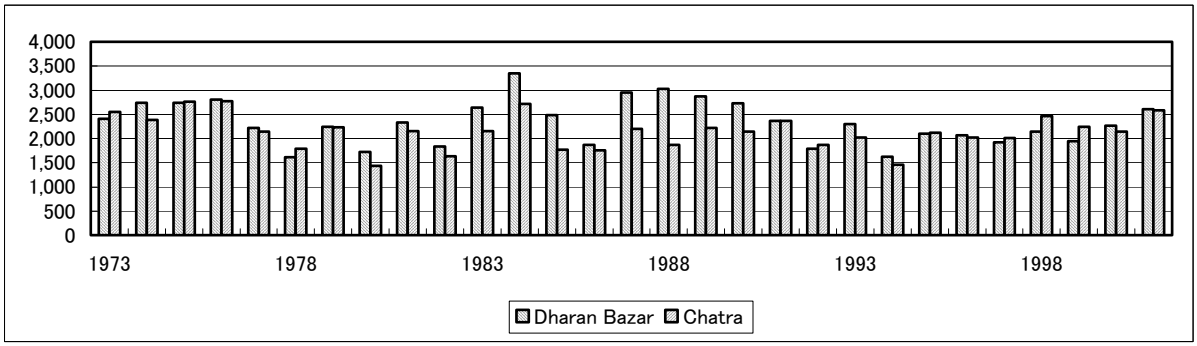


Figure 3.2.1 Annual Rainfall at Dharan Bazar and Chatra

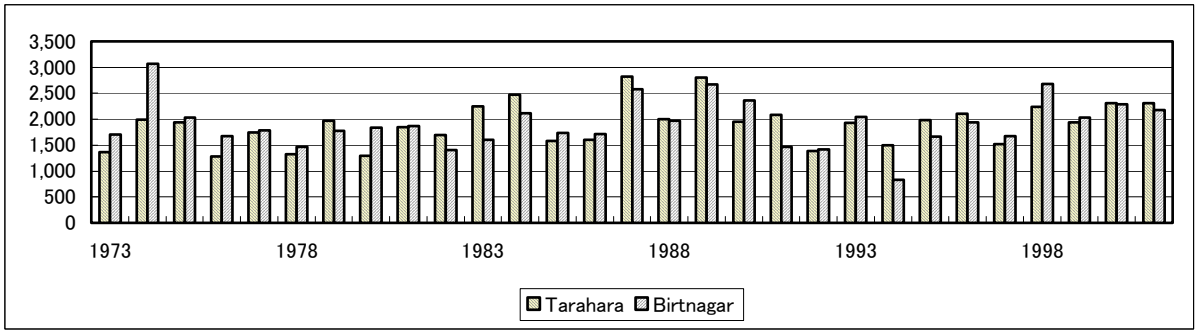


Figure 3.2.2 Annual Rainfall at Tarahara and Biratnagar

Mean annual rainfall and monthly rainfall are summarized as follows. As to annual rainfall, it ranges from 1900 mm to 2400 mm and increase according to shifting northward. Monthly distribution of rainfall is almost same at each station and about 80 % of rainfall occurs in monsoon season. However, correlative coefficient of daily rainfall between each station is about 0.6 at most.

Table 3.2.1 Mean Annual and Monthly Rainfall

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Dharan Bazar	13	15	24	61	173	374	631	572	408	143	15	7	2441
Chatra	17	14	24	58	161	394	603	474	353	143	17	7	2265
Tarahara	14	13	18	62	163	323	525	380	300	102	14	11	1925
Biratnagar	10	13	15	52	165	323	526	375	313	108	10	7	1917

3.3 Areal Rainfall

The observed rainfall by gauge pertains to the point rainfall. To analyze hydrological conditions, it is necessary to convert point rainfall to areal rainfall. Then Thiessen polygon method was adopted to compute areal rainfall. Rainfall data at Dharan Bazar, Chatra and Tarahara were selected for computation by Thiessen polygon method. The respective area covered by each polygon of Sunsari River Basin (upstream of proposed headwork site) are presented in Table 3.3.1.

Table 3.3.1 Polygon Area

Representative Station	Dharan Bazar	Chatra	Tarahara	Total
Polygon area (km^2)	91	46	163	300

Some data of short period are found missing in each rainfall stations. Such missing data are estimated based on the data available in other two rainfall stations. The computed annual rainfall starting from 1973 onwards are presented in Figure 3.3.1. The mean annual rainfall over the period 1973-2001 is found to be 2072 mm.

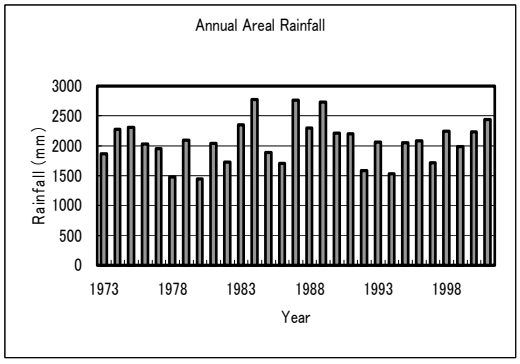


Figure 3-3-1 Annual Areal Rainfall

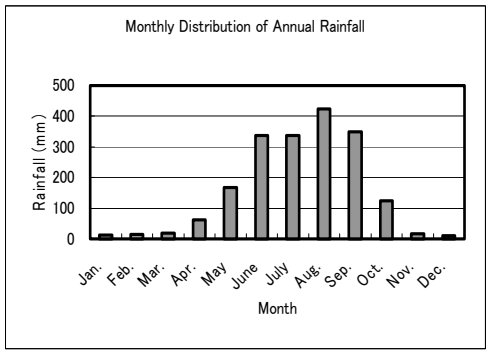


Figure 3-3-2 Monthly Distribution

3.4 Probability Analysis

There are many types of distributions to analyze probability of hydrologic sequences. And there are four major distributions, namely Normal Distribution, Log-Normal Distribution, Extreme Value Distribution and Log-Pearson Type III that are generally adopted for probability analysis. Especially, the log-Pearson Type III is a commonly used distribution in flood studies. On the other hand logarithmic form of extreme value type III is common in studies of droughts. Then, the log-Pearson Type III was adopted for flood study whereas Extreme Value type III is selected for study of droughts. In addition, probability was examined by graphical method of Weibull Plot together.

The Rainfall data recorded at Biratnagar are used for analysis purpose. Since, the study area is very close to Biratnagar, the consideration of these data for analyses may be more appropriate. The data of Dharan Bazar, Chatra and Tarahara, were not considered for analysis because of their dissimilarities in terms of geographical location and hence are not tried. CHAPTER4 deals about probability analysis and runoff by using these data. The un-exceeded probability is summarized and presented in Table 3.4.1. (Data of 1994 are excluded for analysis on annual rainfall because of the conspicuousness).

Table 3.4.1 Un-exceeded & Exceeded Probability of Rainfall at Biratnagar

Return Period	2	3	4	5	10	20	50
Annual Rainfall (mm) (Un-exceeded Probability)	1911	1705	1610	1556	1453	1404	1376
Daily Max. Rainfall (mm) Exceeded Probability	1911	1705	1610	1556	1453	1404	1376

Note) unit : mm

CHAPTER 4 HYDROLOGY

4.1 Gauging Stations and Data Collection

4.1.1 Hydrological Data Collection

There does not exist any Hydrological gauging station in Sunsari River basin. JICA Study Team in cooperation with DIO installed seven (7) water level gauging stations in May 2001 and started recording water levels as well as discharge measurement. Table 4.1.1 shows the location of each gauging stations.

Table 4.1.1 List of Water Level Gauges

Water Gauge	Type	Installation point	Remarks
No.1	Manometer	Highway intersection point	To be set up at the bridge pier
No.2	Staff gauge	Highway intersection point	As a reserve for the manometer
No.3	Staff gauge	Middle of the Sunsari River	
No.4	Staff gauge	Downstream of the Sunsari River	
No.5	Staff gauge	Budhi River	
No.6	Staff gauge	Suksena canal	Northernmost section of the Study Area
No.7	Staff gauge	Shankarpur canal	Northernmost section of the Study Area

4.1.2 Conversion of Stage Records into Discharge

The discharge-rating curve gives the relationship between stage and discharge for a gauging station that can be applied to convert stream levels into corresponding discharges. The formula of rating curve was decided by liner regression analyses as explained below.

$$Q = A \cdot (h - a)^n$$

here, Q : discharge (m^3/s)
h : gauge reading height (EL. m)
a : stage reading at zero flow (datum correction)

A, n : constants

Table 4.1.2 shows the corresponding equations of stage discharge curves for various stations mentioned below.

Table 4.1.2 Rating Formula of Water Level Gauges

Station	Formula	r	Remarks
No.1	$Q=18.671\cdot(h-77.39)^{2.646}$	0.96	h < 79 m
	$Q=32.866\cdot x^2 - 5098\cdot x + 197692$	0.99	h =79 or h > 79 m
No.2	$Q=2.719\cdot(h-80.3)^{2.016}$	0.96	
No.3	$Q=0.995\cdot(h-73.3)^{4.099}$	0.97	
No.4	$Q=12.160\cdot(h-69.05)^{1.243}$	0.97	
No.5	$Q=5.455\cdot(h-62.40)^{1.749}$	0.89	
No.6	$Q=0.051\cdot(h-73.0)^{2.126}$	0.45	
No.7	$Q=0.423\cdot(h-83.0)^{2.851}$	0.80	

For Station No 1, it is found (see Figure 4.1.1) some difference in discharge between calculated value by above equation and observed value particularly during high floods. To minimize the difference, the following formula is combined and applied.

$$Q = a\cdot h^2 + b\cdot x + c$$

here, Q : discharge (m^3/s)
h : gauge reading height (EL. m)
a, b, c : constants

After examining the results, two types of rating formula have adopted according to the height (Elevation) in gauge readings. The basic reason for this may be the large width of Sunsari River. The demarcation elevation is found equal to 79.00. When the gauge reading is less than 79.00m first formula has to be adopted and when the gauge reading is equal or higher than 79m the second formula has to be adopted. .

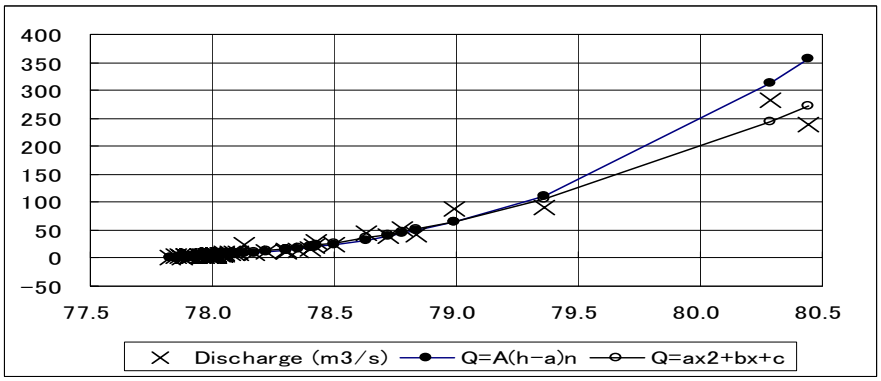


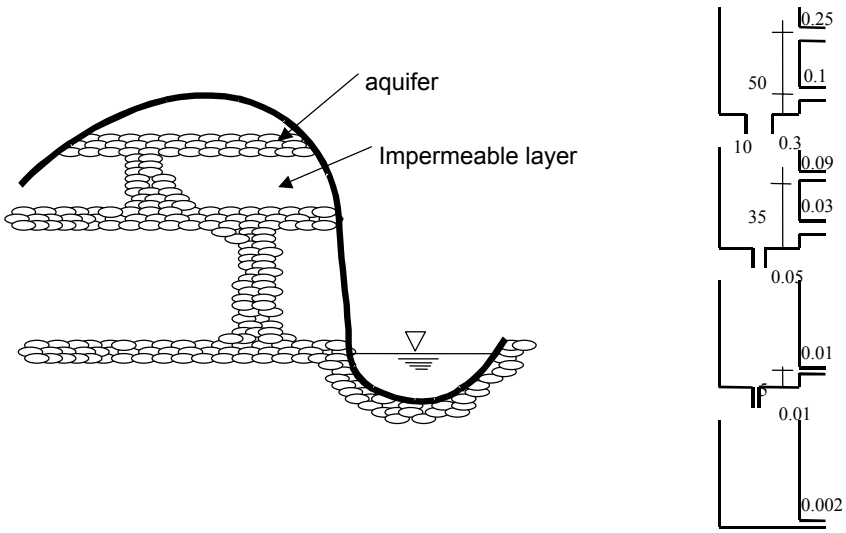
Figure 4.1.1 Discharge Rating at No.1 Station

On the other hand, data at No.6 station varies widely and rating formula is not reliable. This

may be the effect of afflux (back water curve) due to the raised crest of Chanda Mohana Headworks.

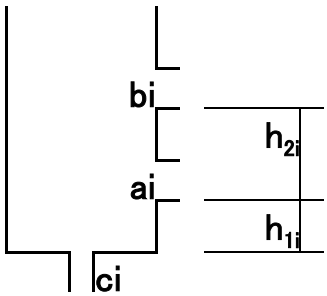
4.2 Runoff Analysis

There are several methods to estimate long-term runoff on daily base. However, the available runoff data required for this study are available of the duration covering less than 8 months. Runoff analysis is required to estimate the runoff as per availability of water resource both in wet and dry seasons. For this purpose, the Tank Model method has been adopted. The basic concept of the Tank Model method is to compose four tanks for analysis of low flow. The first tank at the top represents surface runoff and second tank represents subsurface runoff. Similarly, the third and fourth tanks represent the base flow and ground water percolation respectively. Each tank has side runoff outlet. All four tanks are combined vertically.



Input data required for simulation are daily rainfall, daily observed runoff and monthly mean evaporation. Daily runoff is calculated as per following formula on the day-by-day basis. Calculation is started from first tank and repeated up to fourth tank. Verification of the Tank Model based on observed runoff is executed by changing coefficient and height of runoff outlet.

$$R = \Sigma Ri$$
$$Ri = \Sigma (Rai + Rbi)$$
$$Wi = W1i + P - E$$
$$Rai = (Wi - h1i) \times ai$$
$$Rbi = (Wi - h1i - h2i) \times bi$$
$$Rci = (Wi - h1i - h2i) \times ci$$
$$W2i = Wi - R + Rci$$



here, R : total daily runoff (mm)
Ri : daily runoff from each tank (mm)
Wi : initial water height in each tank (mm)
W1i : former day's water height in each tank (mm)

W2i : last water height in each tank (at the end of calculation on exact day, W1i is replaced by W2i)
P : daily rainfall (mm)
E : evaporation (mm)
Rai,Rbi,Rci : coefficient of runoff outlet
h1i,hli : height of runoff outlet (mm)

In this study, the verification of the Tank Model has been executed and thus runoffs for 29 years from 1973 to 2001 have been estimated. Correlative coefficient between observed and estimated runoff shows 0.91 and this model is supposed to be aceptable. However, estimated runoff in dry season shows slightly higher value compared to observed runoff. This tendency has occurred because of inadequate runoff data. Then, the model should be calibrated with additional data in Phase II study. The comparison between observed and estimated is presented in Figure 4.2.1. In this figure, black painted circles are estimated runoff and unpainted circles are observed one.

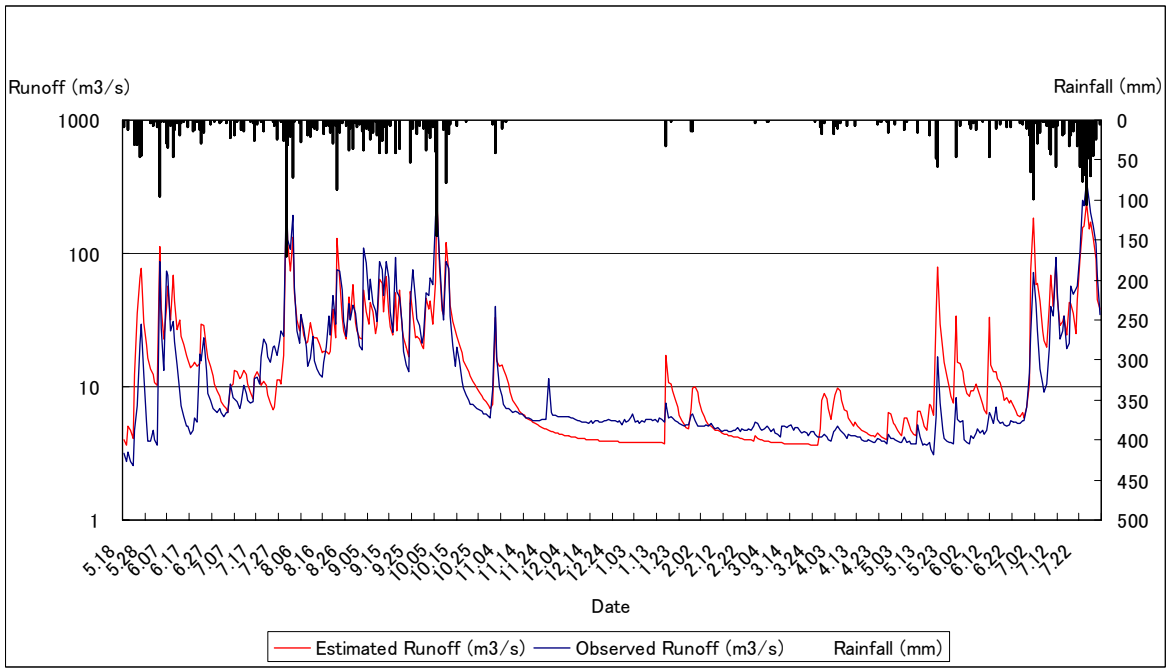


Figure 4.2.1 Comparison between Observed and Estimated Runoff in May.2001 to June.2002

4.3 Probability Analysis

Probability Analysis was done on estimated annual runoff in the same way in probability analysis on annual rainfall.

Table 4.3.1 Un-exceeded Probability of Annual Runoff at Proposed Headwork Site

Return Period	2	3	4	5	10	20	50
Annual Runoff (m^3/s) (Un-exceeded Probability)	467	421	400	387	364	353	347

CHAPTER 5 SURFACE WATER RESOURCES ASSESSMENT

5.1 Sunsari River Water Resources Assessment in the Study Area

The runoff condition of Sunsari River was estimated for twenty-nine (29) years from 1973 to 2001 and presented in CHAPTER 4. On the basis of these results, the availability of water was examined corresponding to the reliability. The reliability was assumed to be 50 %, 60 %, 70 %, 80 % and 90 %. And also, the availability was examined by each 10 days duration throughout the year for the purpose to clarify which period is critical in terms of water deficits.

The results of study on probable rainfall and runoff corresponding to the reliability have been presented in Figure 5.1.1 and 5.1.2. To 80 % reliability, probable rainfall ranges from 0.3 mm in the late of November to 163.7 mm in the first of July. Rainfall in the last of May and the first of June are 63 mm and 77 mm respectively. Annual rainfall is about 2,700 mm. On the other hand, Probable runoff ranges from 3.694 m^3/s in the first of March to 35.121 m^3/s. Runoff in the last of May and the first of June is 10.120 m^3/s and 13.484 m^3/s. Total runoff is estimated at 390 MCM.

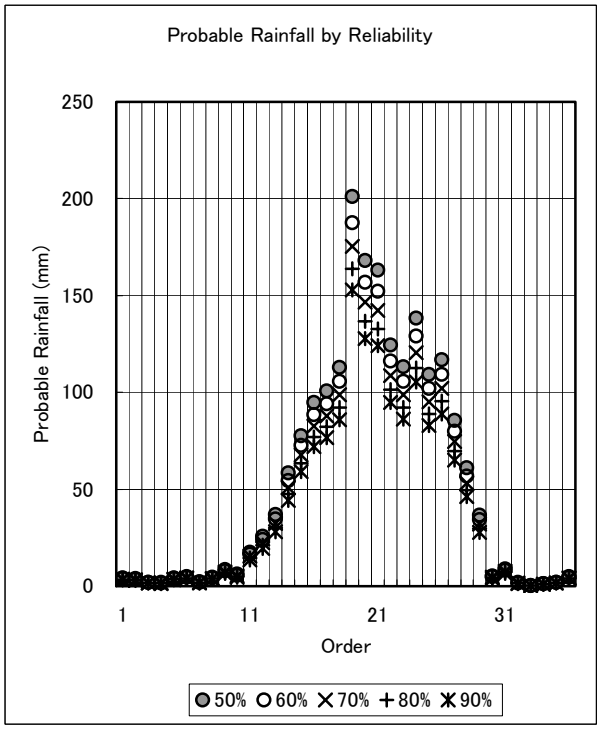


Figure 5.1.1 Probable Rainfall

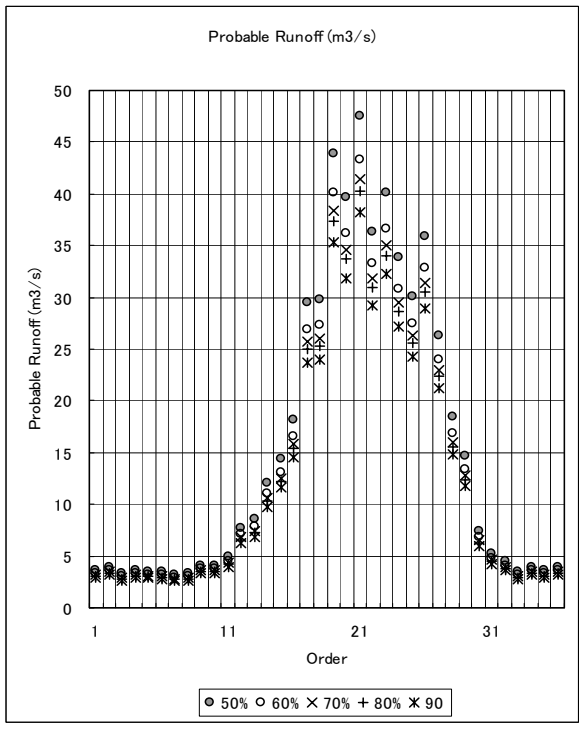


Figure 5.1.2 Probable Runoff

5.2 Budhi River Water Resource Assessment

Budhi River originates in the northern Terai plain near Tarahara. And Budhi River flows from the north to the south in meandering along the eastern boundary of the Study area. The streams are branching, joining and re-branching forming a complex system. The catchment area of Budhi River is 20 km^2 at Geruwa headwork and is 123 km^2 at Chanda Mohana headwork.

There are only two water level gauging stations that were installed in May, 2001 by JICA Study Team in cooperation with DIO, Sunsari. Because of insufficient data it is impossible to analyze the probability of runoff. In 1997, DOI prepared the report for Chanda-Mohana Irrigation Project and estimated mean monthly flow and probable runoff by several methods. These are summarized in Table 5.2.1.

Table 5.2.1 Estimated Mean Monthly Runoff

Method	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
MIP manual	1.65	1.10	0.70	0.50	1.76	3.01	7.02	17.55	12.03	6.02	3.76	2.51
WECS	1.58	1.35	1.21	1.22	1.61	5.67	17.42	21.09	6.21	7.12	3.12	2.04
Reg. Analysis	2.03	1.63	1.49	1.39	2.01	6.25	18.35	22.08	17.32	8.22	3.97	2.56
Biratnagar	10	13	15	52	165	323	526	375	313	108	10	7

Note) unit : m^3/s

There are two (2) irrigation schemes, namely Chanda Mohana and Geruwa. Chanda Mohana scheme was completed last year and Geruwa scheme is not completed yet. Command area of these schemes are 1,800 ha and 400 ha respectively. In Chanda Mohana Project, the covered area by paddy and upland are 1510 ha to 260 ha. Respectively. Based on this information, availability of water has been examined roughly by comparing monthly runoff and crop water requirement.

In this case, the lowest surplus water can be seen at the 14th and 15th of 10 days period (starting from the beginning of the year) which fall on the middle and last of May. The surplus amount is about 0.25 m^3/s. And there is about 1 m^3/s from January to April and about 2/3 m^3/s from November to December. In this examination, Geruwa Project is out of consideration.

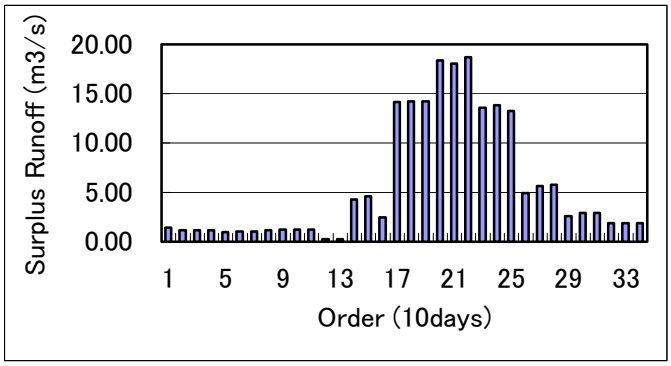


Figure 5.2.1 The Available Water in Budhi River

Then, it can be concluded that the Water Resources of Budhi River is limited and there is hardly any possibility of water supply for irrigation from this river.

5.3 Groundwater Resources Assessment

The tank model method can instruct the storage of groundwater because the third and fourth tanks represent the base flow of ground water. And it is supposed that the lowest water depth in each year shows availability of ground water resource. Figure 5.3.1 shows annual lowest water depth in third and fourth tanks.

It ranges from 1,140 mm to 1,600 mm. Average lowest water depth is 1,330 mm. This amount is supposed to be available as groundwater resources. Then, approximately available water in Sunsari River basin that is the upper basin from proposed headwork site is estimated at 399 MCM at least. This amount is based on about 80 % of available surface water.

On the other hand, annual runoff coefficient (ratio) of rivers in Nepal is reported to be 66 % at most. However, estimated runoff coefficient (ratio) is observed about 80 % in an average for 29 years.

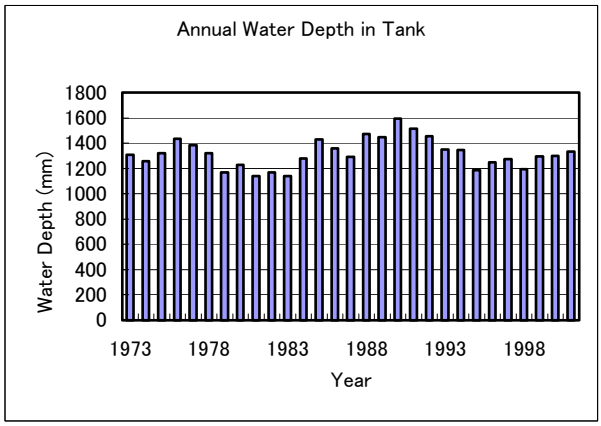


Figure 5.3.1 Annual Water Depth in Tank

It is assumed that about 15 % of surplus (of ground water) is recharged by Koshi River and Canal network (as infiltrated irrigation water). This amount is equal to 0.066 $m^3/s/km^2$. Out of 399 MCM of water available annually on Sunsari River, the contribution of infiltration getting from Kosi river and canal network is about 122 MCM and the remaining part from rainfall in catchment basin is 277 MCM.

CHAPTER 6 BRIEF REVIEW OF WATER AVAILABILITY FOR SMIP

6.1 Water Supplied to SMIP Command Area via Chatra Main Canal

Sunsari-Morang Irrigation Project (SMIP) had started in 1964 to irrigate 68,000 ha of farmland in Sunsari and Morang district. The Project had implemented under the assistance from India and handed over to Nepal in 1975. However, the system could not function properly as per original expectation because the minor canals covering an area less than 200 ha were not constructed. Furthermore, .The intake at Kosi River experienced siltation problem. Then, the World Bank started financing SMIP for canal network improvement, command area development, together with institutional development aspects. The improvement program was executed under three different stages. The abstract of each stage is summarized and presented in Table 6.1.1.

Table 6.1.1 Estimated Mean Monthly Runoff

Stage	Period	Command Area	Components
Stage I	Apr. 1978 – June 1986	9,750 ha	Koshi River control device, Shankapur canal
Stage II	Nov. 1988 – July 1994	16,600 ha	Stajungi and Ramgunji Canal
Stage III	Dec. 1997 – June 2002	46,000 ha	Canal for Remaining Command Area
SMHP	Mar. 1993 – Nov. 1995		Intake of Chatra Main Canal

Note) Total command area is 72,350 ha and command area of Shankapur and Haripur, which is 4350 ha have been extended in the original area. In addition, new intake for Sunder Gunder minor (650 ha) had been constructed at same time with Stage I.

During implementation, the intake capacity was enlarged from original 45 to 60 m^3/s. This intake is expected to cover all 73,000 ha with the system reliability of 70 %. The water duties are 0.85 liter/s/ha in Suksena area and 0.80 liter/s/ha in rest of the command area. On the contrary, water duty in Chanda-Mohana Irrigation Project has been estimated at 1.6 liter/s/ha, which is almost the double of that in SMIP. In addition, water duty in this Study (under SRIP) has been estimated at 2.71 liter/s/ha.

The design water duties with 70 % reliability have been studied in "Sunsari Morang Irrigation Project (SMIP) III Detailed Feasibility and Design in 1995". The results are summarized and presented in Table 6.1.2. These values are calculated in consideration of effective rainfall. On the other hand, the peak design water duty with 80 % reliability has been estimated at 76.9 m^3/s according to the report prepared by World Bank.

Table 6.1.2 The Design Duties with 70 % Probability

(Unit : m3/s)

Date	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1-10	32.1	44.2	28.2	0	3.7	31.0	39.9	58.7	46.2	48.5	39.9	28.6
11-20	34.3	36.0	14.3	0	4.4	46.0	44.9	50.8	32.6	51.3	39.6	29.7
21-end	33.2	31.7	5.2	0	12.7	53.4	30.2	52.9	46.8	48.1	33.3	28.0

The Discharge data of CMC, (with some missing data) are available at Hydropower Station from June 1995 to June 2001. Further, the discharge data of CMC at Suksena diversion point (RD 32) are available from January to November 1999. The comparison between the design duties and the maximum daily discharge of CMC in each ten (10) days period throughout the year are shown in Figure 6.1.1. The probability of rainfall at Biratnagar Airport in 2000 is less than 50 %. In addition to this, 10 days averages of discharge data and 10 days total rainfall data in 2000 are also presented.

In figure 6.1.1, there are deficits of daily maximum irrigation water duty (of 10 days period) for the periods from Jan-II to March-I, from June-II to August-III and from October-I to December-II. These results are based on the observation from the last 7 years. In addition to this, the maximum peak discharge was recorded at 12:00 am on 28th in August 2000 and its value was 53.39 m^3/s.

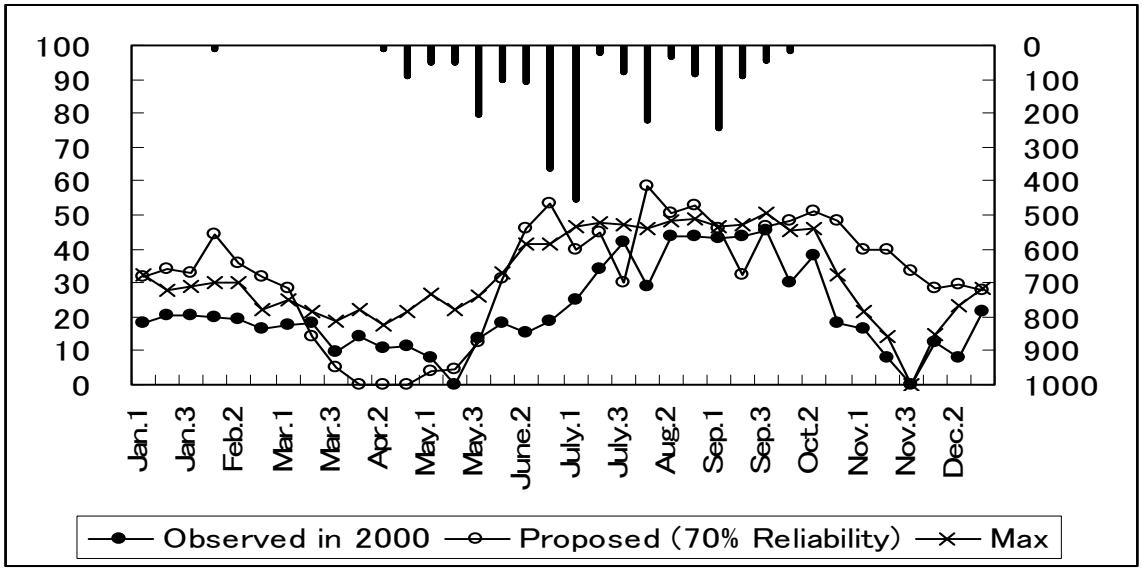


Figure 6.1.1 Comparison between Water Duty and Observed Discharge

As to the comparison between proposed water duty and the 10 days averages of observed discharge, the available irrigation water is found almost deficient through the year except the duration from the middle of March to the first of May in 2000. And it is also realized that discharge is not sensitive to rainfall. Therefore, it can be concluded that CMC is not able to supply the enough irrigation water to the command area even in the year with less than 50% reliability

6.2 Supplementary Irrigation Projects in SMIP Area

In SMIP Area, ten (10) projects have been implemented as the Irrigation Sector Project (ISP) and Second Irrigation Sector Project (SISP) funded by ADB, Presented in Table 6.2.1. ISP was commenced in 1988, covering Eastern and Central Development Regions. And SISP was commenced in 1996/97 as the successor of ISP.

The main objective is to rehabilitate traditional Farmers Managed Irrigation System's (FMIS) as well as construction of few small and medium irrigation projects; the scale is usually less than 500 ha. In general, the small regulators at small stream are some of the features.

Total command areas in Sunsari and Morang under SISP and ISP are 2,316 ha and 964 ha respectively. Some projects are reported still incomplete. For instance, Geruwa Khola ISP, the regulator at headwork has been constructed without the gate installation and the construction of irrigation canals has been suspended because of budgetary deficit and lack of WUA participation. Then it is almost impossible to prospect the completion of the project at present.

Table 6.2.1 ISP and SISP Projects

No./Index	Name of Project	District/VDC/Wards	Command Area (ha)	Water Source	Remarks
ISP S1 /①	Dumraha ISP	Sunsari/Dumraha	440	-	
ISP S2 /②	Madhunban ISP	Sunsari/Madhunban	200	-	
ISP S3 /③	West Kushaha ISP	Sunsari/W. Kushaha	475	-	
ISP S4 /④	Haripur ISP	Sunsari/Haripur	600	-	Uncompleted
ISP S5 /⑤	Girua Khola ISP	Sunsari/Jalpapur	421	Girua Khola	Uncompleted
ISP S6 /⑥	Galfaria ISP	Sunsari/Sripur	180	-	
ISP M1 /⑦	Shkuhani Khola ISP	Morang/Thalaha/3,4	154	Shkuhani Khola	
ISP M2 /⑧	Cheka Khola ISP	Morang/Babiya Birta	280	Chaka Khola	
SISP M1 /⑨	Kamaljhoda ISP	Morang/Babiya Birta/3	230	Cheka Khola	W. Demand 0.52 m^3/s
SISP M2 /⑩	Kocheni Khola ISP	Morang/Babiya Birta/1,3	300	Kocheni Khola	W. Demand 0.60 m^3/s

Besides ISP and SISP, some projects in the SMIP Area have been implemented. One is Chanda-Mohana Irrigation Project financed by OPEC Fund for International Development. Its command area is 1,770 ha as mentioned in Chapter 5.

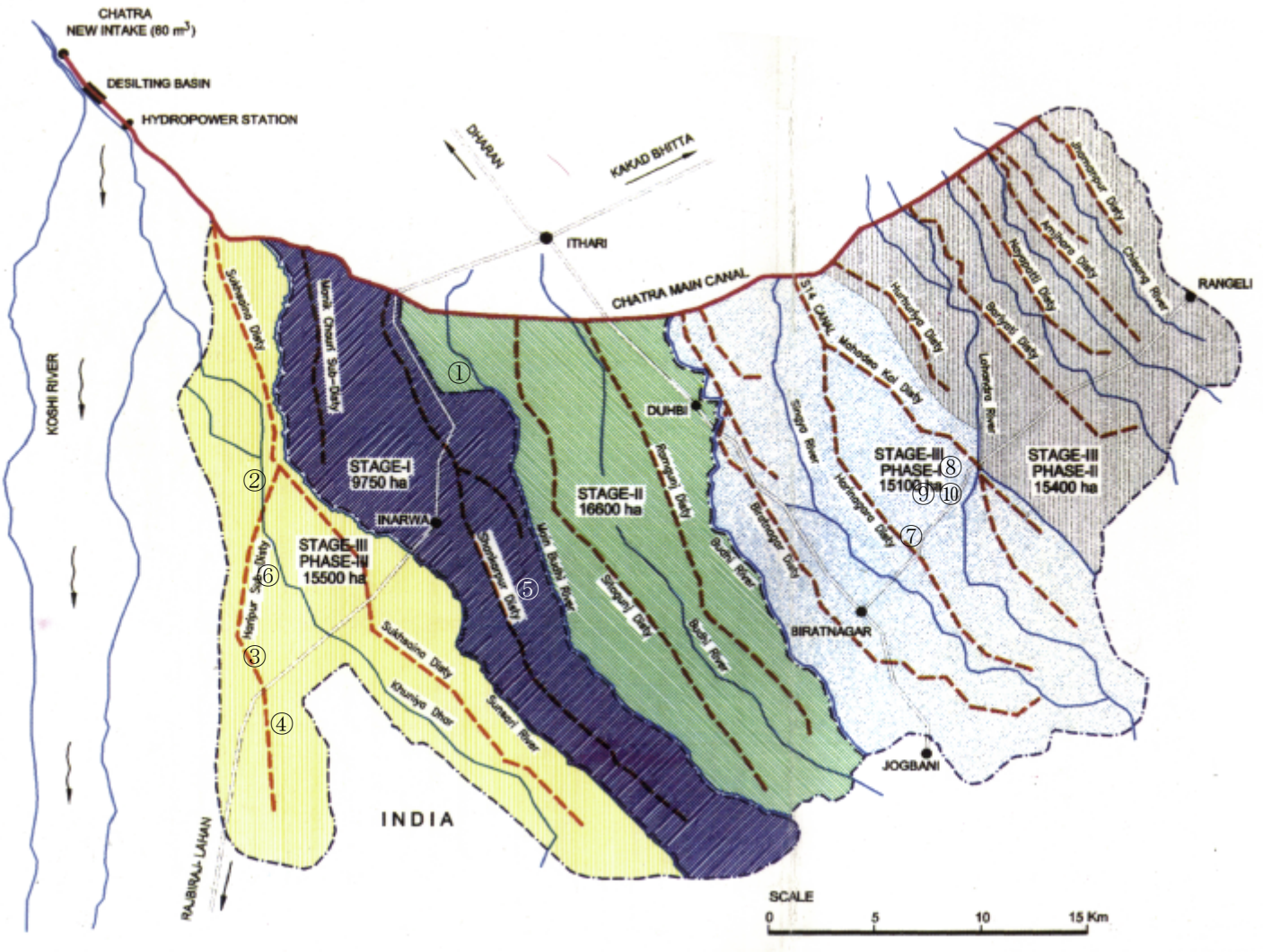


Figure 6.2.1 Location Map of ISP and SIPS Project Area

6.3 Probable Irrigation Coverage of SMIP

The water duty reaches to the highest value of 58.7 m^3/s on the first 10 days of August. It is roughly estimated at 42.5 m^3/s with 70 % reliability as daily maximum discharge at the first of August. And also the average discharge as per the estimation for the year 2000 (roughly) is supposed to be 29.1 m^3/s. In this assumption, the probable irrigation coverage has been calculated and presented in Table 6.3.1..

Table 6.3.1 ISP and SISP Projects

Case	Water Duty (liter/s/ha)		Probable Area (ha)	Remarks
	Suksena	The Others		
Case 1	0.85	0.80	36,000	
Case 2	1.60	0.80	28,000	Water duty of Shankarpur is as same as Suksena.
Case 3	2.71	0.80	21,000	Water duty of Shankarpur is as same as Suksena.

Note) Command Area (ha) : Suksena 13,000 ha ; Shankarpur 9,750 ha ; Others 50,250 ha

These results have been calculated under the assumption that each command area should be reduced equally to meet total intake volume. As the results, it is possible to irrigate only about 50% of total command area with 70% reliability even in Case 1, which is the assumption according to the Study for F/S and Detail Design for Stage III.

6.4 Water to the Study Area from Shankarpur and Suksena Canals

6.4.1 Shankarpur Canals

The capacity of Shankarpur canal at head regulator is designed equal to 4.86 m^3/s to serve 6,743 ha of command area. The discharge data are available from the last ten (10) days of September in 1998 to the last ten (10) days of September in 1999. However, these data are not complete sets and data are missing from November to the middle of December.

Figure 6.4.1 shows comparison between observed and proposed discharge. The irrigation water is not sufficient except the period from March to the first ten (10) days of June and from September to the first ten (10) days of September. The total volumes of proposed and observed discharges are 135.0 MCM and 90.5 MCM respectively. It is suspected that cropping pattern has been actually advanced earlier than proposed one. Anyway, irrigation water is obviously deficient at Shankarpur head regulator.

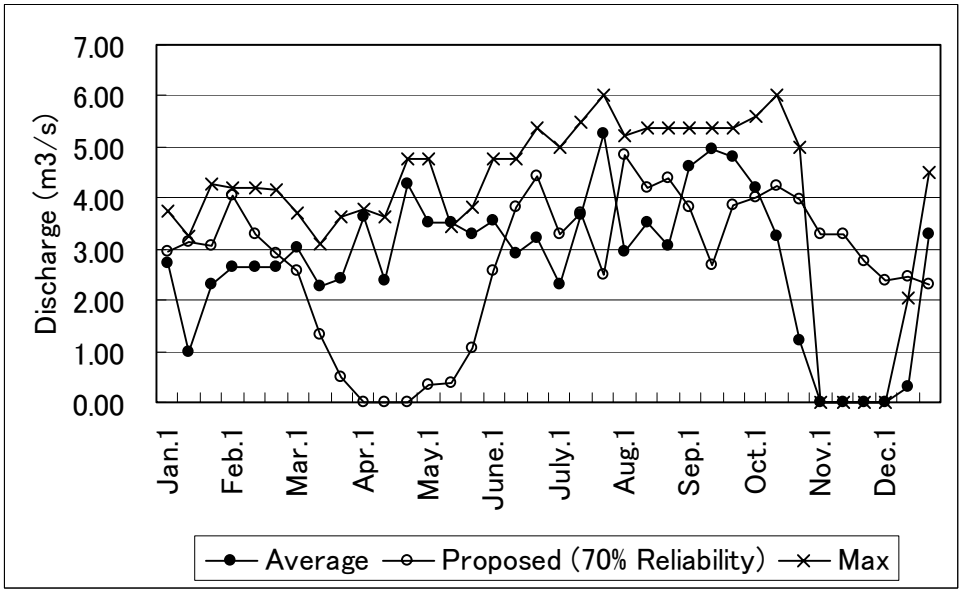


Figure 6.4.1 Observed Discharge and Water Duty at Head Regulator of Shankarpur

JICA Study Team has been observing discharge of Shankarpur canal at the lower stream from E-W Highway from May 2001. The command area at this point is about 4,900 ha. The following figure shows the comparison between observed discharge and water duty in 2001. The figurebalso shows that the deficit of irrigation water to irrigate 4,900 ha farmland continues throughout the year. The water duty has been calculated based on the present conditions like cropping pattern, unit water requirement estimated in this Study and etc. probability of rainfall in 2001 is found less than 50 %.

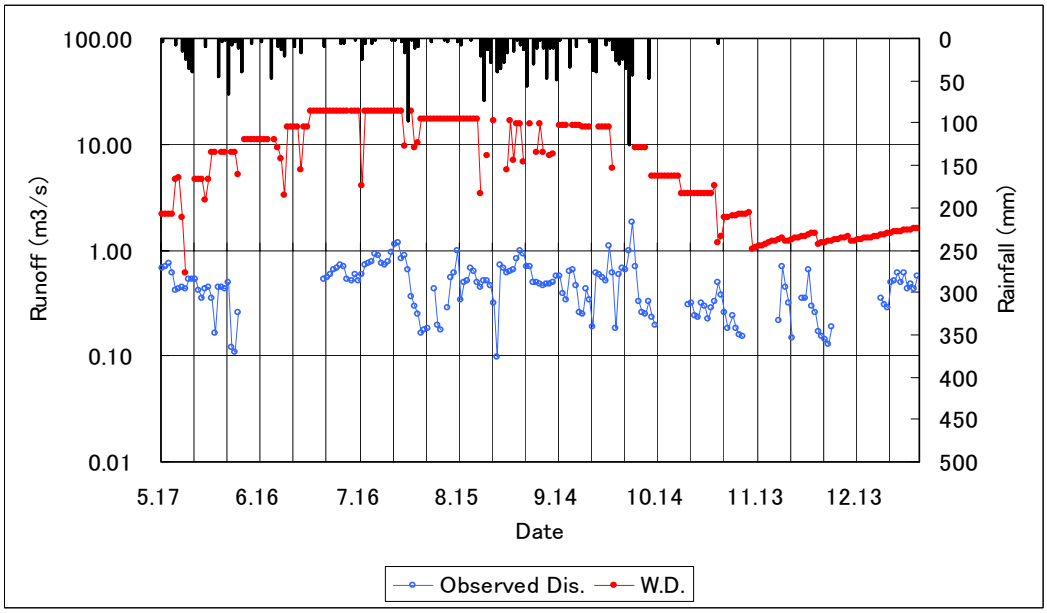


Figure 6.4.2 Observed Discharge and Water Duty at Gauging Station

It is possible to make a conclusion that the deficit of irrigation water may not be due to the absolute deficit but may be from the poor irrigation water management practice. In fact, the several reasons of irrigation water shortage have been maintained out in Seasonal Performance Report on Water Management prepared by NEDECO CONSULTANTS、few of them are

- The inadequate water in CMC has caused the less water than estimation in secondary canal.
- The communication gaps among gate operators have caused untimely and inadequate gate operation of regulators.
- The lack of dissemination of water operation plan has caused farmers' inconvenience in following the rotation schedule.

6.4.2 Suksena Canals

The present capacity of Suksena canal at head regulator is reported to be 6.830 m^3/s for 13,000 ha of command area under Suksena canal system. After implementation of Stage III, the capacity of canal will be increased to 10.010 m^3/s. At present, Suksena canal is running at extremely small capacity (in terms of duty). Figure 6.4.3 shows discharge conditions at head regulator of Suksena.

The discharge data are available only from the middle ten (10) days of September of 1998 to the last ten (10) days of October of 1999. These data are not complete sets and data are missing from November to the middle of December. A comparison among design discharge and actual discharge has been shown and the difference is quite high. That means the

irrigation water is not sufficient throughout the year except during the period from March to May. The total volumes of proposed and observed discharges are 177.6 MCM and 125.1 MCM respectively.

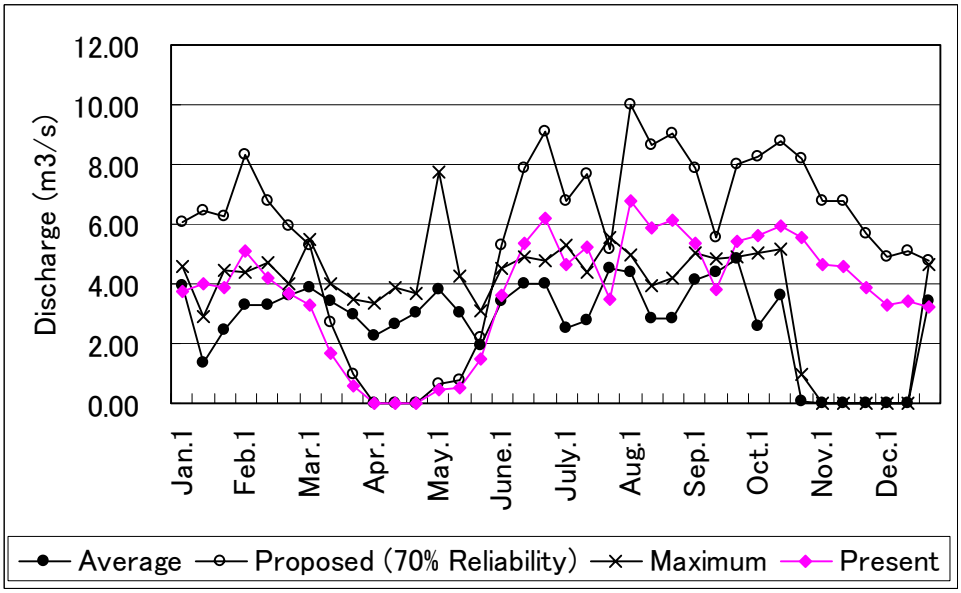


Figure 6.4.3 Observed Discharge and Water Duty at Head Regulator of Suksena

JICA Study Team has observed discharges of Suksena canal at the lower stream from E-W Highway from May 2001. As per the report, the command area at this point is about 4,700 ha. Figure 6.4.3 shows the comparison between observed (or availed) discharge and required discharge (design water duty) for 2001. Figure 6.4.4 shows that the deficit of irrigation water to irrigate 4,700 ha farmland continues throughout the year. The observed data was found sufficient to irrigate just about 250 ha of land.

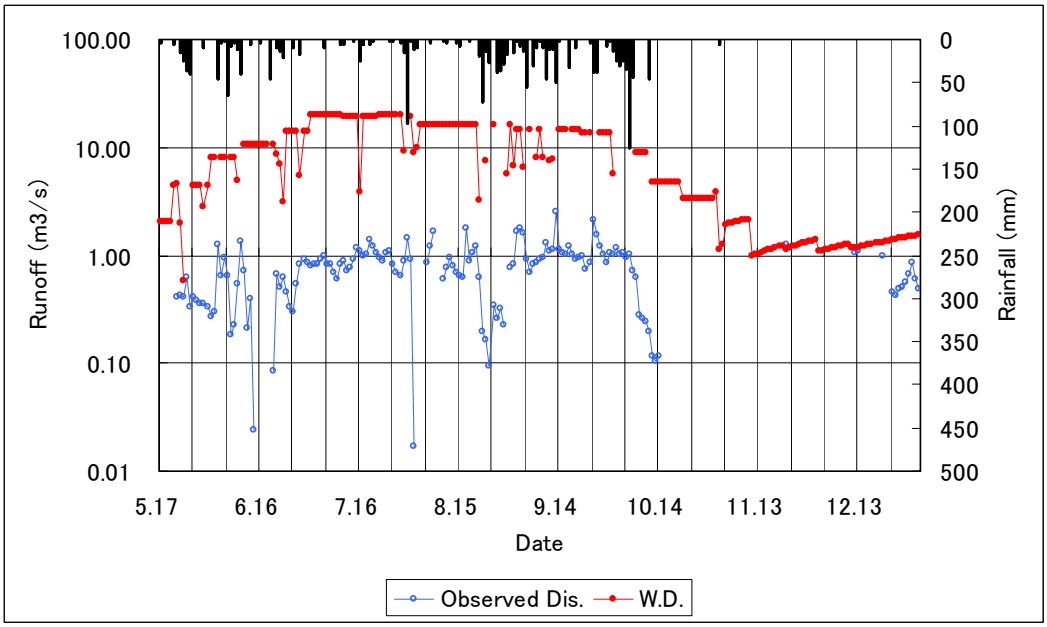


Figure 6.4.4 Observed Discharge and Water Duty at Gauging Station

6.5 Other Surface Water Sources aside from Koshi River

There are about 21 rivers within the SMIP Area. Hydrological data of these rivers are not available. However, runoffs are examined in the study, namely "Sunsari Morang Irrigation III Detailed Feasibility and Design in 1995". There are only four rivers that have perennial flow within SMIP area, namely Budhi Khola (of Duhabi), Lohandra Khola, Chisang River and Sunsari River. Here, Budhi Khola is different from the river mentioned in Chapter 5.

The flow conditions of these four (4) rivers are are presented in Figure 6.5.1. Like Sunsari River, the specific runoff ranges from 20 liter/s/ha to 130 liter/s /ha. The ratio between highest and lowest discharge is about 7. On the other hand, the specific runoff of the left ranges from 5 liter/s/ha to 100 liter/s/ha. The ratio between highest and lowest is about 20.

Then, it is supposed that the runoff condition of Sunsari River is steady compared to those rivers with the conditions mentioned above. Comparing Sunsari River to above rivers, we may come to the conclusion that this river has got the higher potential from the aspect of water resources availability.

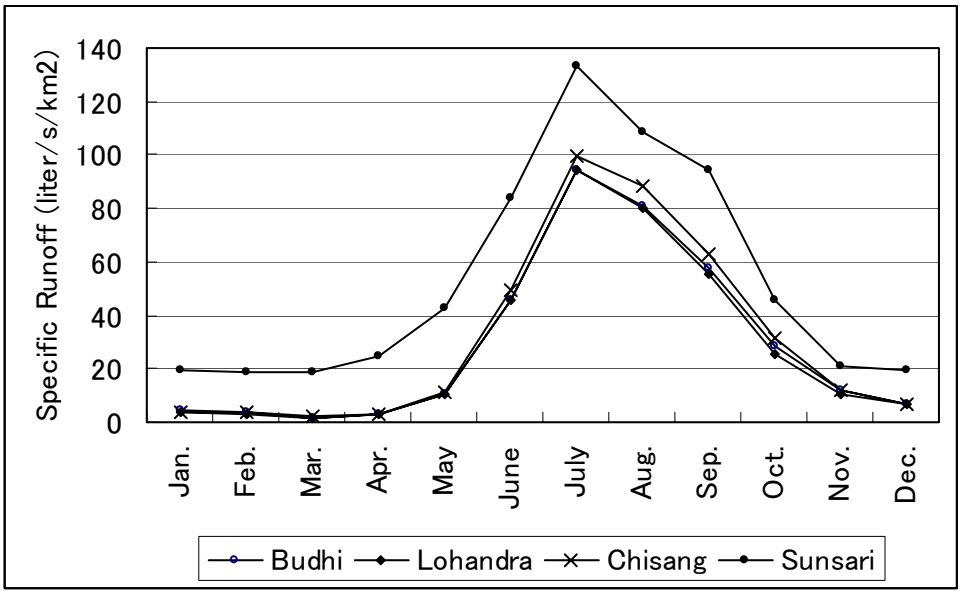


Figure 6.5.1 Specific Runoff of Rivers

Attachment

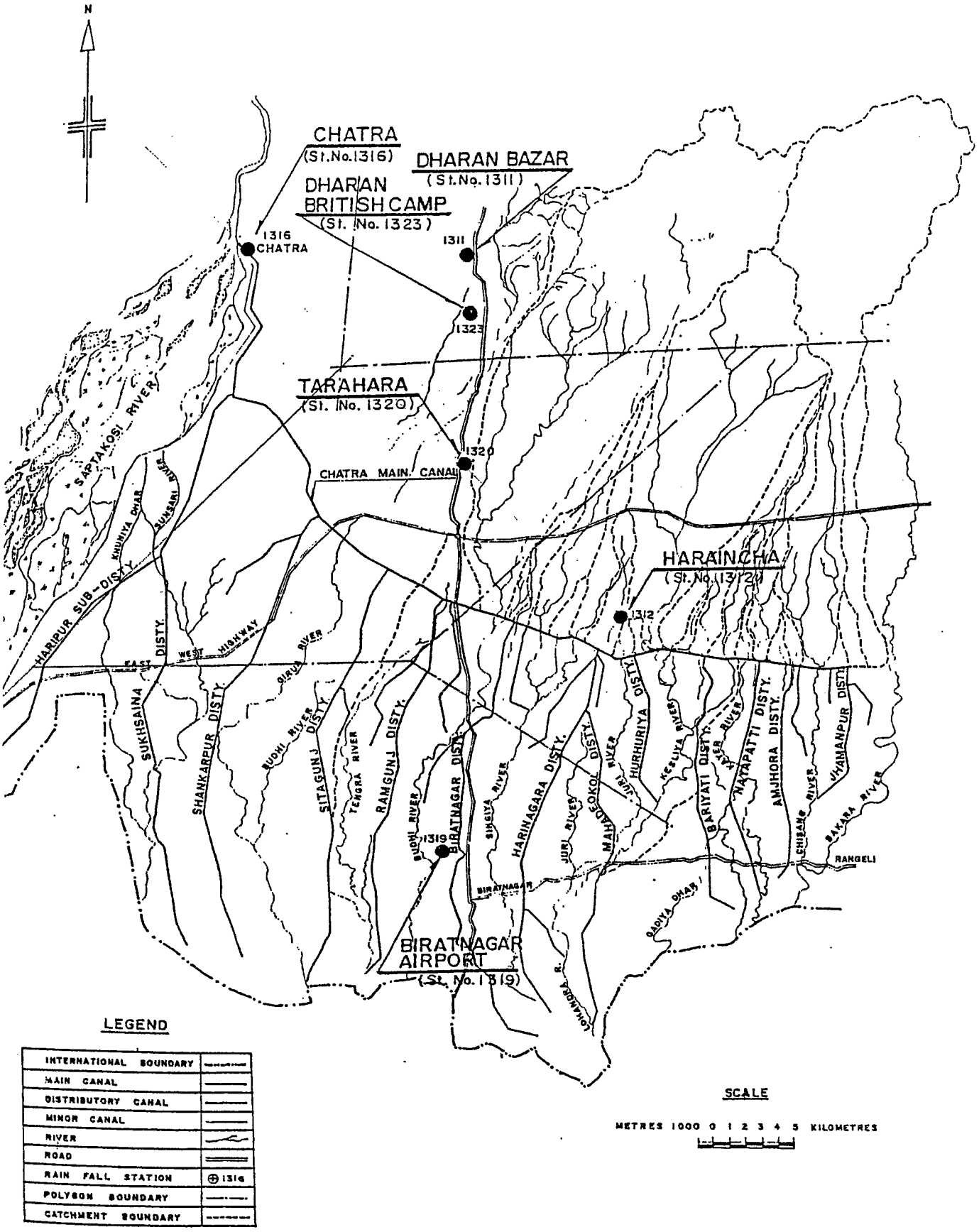


Figure 7-1-1 Location Map of Meteorological Gauging Stations

Attachment

Table 7-1-1 Monthly Rainfall at Dharan Bazar

Station No.1311 (mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	total
1950	−	−	−	0	60	319	437	1,254	712	14	0	0	−
1951	0	0	20	47	270	−	1,217	1,039	104	273	80	0	−
1952	0	10	6	32	216	176	338	209	460	23	0	0	1,470
1953	7	0	31	15	−	−	−	371	334	54	1	0	−
1954	1	16	6	28	−	−	−	191	111	136	0	0	−
1955	0	−	−	−	−	305	650	699	227	13	0	6	−
1956	23	0	7	47	305	656	549	392	176	204	61	1	2,421
1957	54	0	0	0	51	234	855	887	395	70	0	3	2,549
1958	50	0	0	85	67	282	351	691	376	56	0	18	1,976
1959	62	0	35	37	73	331	47	450	420	356	0	0	1,811
1960	0	0	24	0	195	280	436	586	497	91	1	0	2,110
1961	0	6	40	12	213	203	407	858	452	172	7	8	2,378
1962	42	56	27	142	112	490	720	752	476	40	0	0	2,857
1963	0	0	26	59	346	532	645	477	290	169	32	0	2,576
1964	0	0	3	68	117	96	1,398	390	567	34	0	0	2,673
1965	0	0	45	19	65	368	698	1,204	372	−	67	0	−
1966	40	−	2	46	67	176	869	1,137	525	132	7	9	−
1967	0	0	117	109	109	352	942	407	343	29	4	0	2,412
1968	23	1	38	20	90	325	690	810	758	290	0	0	3,045
1969	11	8	71	33	184	413	679	530	374	135	0	0	2,438
1970	36	18	0	12	350	571	898	374	337	41	0	0	2,637
1971	0	0	45	212	405	660	730	555	390	312	7	0	3,316
1972	7	39	15	18	27	335	719	454	−	−	22	0	−
1973	4	29	2	39	134	816	448	383	326	230	0	0	2,411
1974	12	0	81	58	119	343	1,075	386	249	421	0	0	2,744
1975	4	11	0	60	144	603	728	313	679	195	0	0	2,737
1976	23	66	0	116	188	610	611	820	294	78	0	0	2,806
1977	0	2	0	134	216	337	349	649	304	167	35	27	2,220
1978	6	10	42	68	68	267	574	241	252	31	51	0	1,610
1979	3	91	2	45	68	178	685	586	343	194	13	34	2,242
1980	0	0	0	33	39	510	259	316	506	64	0	0	1,727
1981	0	0	42	112	177	394	711	570	271	60	0	0	2,337
1982	2	0	18	135	133	372	487	239	354	91	6	1	1,838
1983	12	24	3	51	368	459	831	302	495	72	0	29	2,646
1984	28	24	0	67	135	626	982	414	909	161	0	1	3,347
1985	3	11	8	5	203	310	734	570	220	356	10	53	2,483
1986	0	0	0	73	201	158	385	426	473	120	17	16	1,869
1987	0	28	81	139	156	333	338	936	733	207	0	4	2,955
1988	3	48	38	128	252	325	801	816	447	162	4	8	3,032
1989	62	24	8	9	252	442	580	412	898	156	28	6	2,877
1990	0	67	56	153	467	299	352	663	516	96	0	57	2,726
1991	0	0	32	19	196	402	507	781	389	24	0	17	2,367
1992	7	9	0	6	121	195	692	239	295	226	4	0	1,794
1993	15	6	26	97	133	281	494	449	446	279	69	0	2,295
1994	34	68	21	74	141	119	315	437	379	24	14	0	1,625
1995	3	8	30	0	91	446	418	392	326	278	110	2	2,104
1996	53	12	1	33	125	250	884	405	253	51	0	0	2,065
1997	10	12	75	110	42	337	375	329	576	17	2	35	1,922
1998	0	3	59	44	34	229	705	584	383	78	20	0	2,139
1999	0	0	0	47	229	282	552	417	215	171	29	2	1,941
2000	0	11	0	127	272	577	375	646	160	94	0	0	2,263
2001	1	5	4	22	277	359	388	710	399	398	42	0	2,605
2002	47	3	39	76	170	338	929	−	−	−	−	−	1,602
sub-total	688	725	1,227	3,122	8,472	18,300	31,838	29,148	20,786	7,145	742	338	
Average	13	15	25	62	177	381	650	572	408	143	15	7	2,466

− : Not Available

Table 7-1-2 Monthly Rainfall at Chatra

Station No.1316 (mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	total
1950	8	36	12	8	76	454	389	869	242	24	0	0	2,118
1951	0	0	31	21	198	485	530	873	274	286	33	0	2,731
1952	0	12	35	38	195	185	401	667	456	70	9	0	2,068
1953	18	2	139	34	48	306	581	371	294	40	1	0	1,834
1954	4	24	6	17	66	494	1,217	499	168	150	0	0	2,645
1955	2	0	0	36	42	293	569	608	326	2	0	0	1,878
1956	64	5	12	10	228	799	497	321	164	329	28	1	2,458
1957	71	0	0	1	61	266	634	542	405	163	0	21	2,164
1958	43	0	0	118	112	235	260	552	462	69	0	0	1,851
1959	48	0	50	100	101	483	378	386	239	184	0	0	1,969
1960	0	10	57	0	193	443	549	396	563	49	0	0	2,260
1961	3	63	10	16	98	312	400	485	404	176	0	3	1,970
1962	72	36	24	208	126	411	509	546	238	60	0	2	2,232
1963	0	0	17	57	269	361	567	328	386	112	82	0	2,179
1964	0	0	2	106	129	107	1,154	386	415	147	0	0	2,446
1965	0	7	30	11	68	283	488	787	326	10	51	0	2,061
1966	72	9	0	42	44	176	1,160	951	307	142	1	33	2,937
1967	0	0	122	34	148	324	903	186	312	30	1	0	2,060
1968	15	3	17	31	29	291	761	551	543	295	0	0	2,536
1969	2	8	76	82	131	359	390	187	102	50	1	0	1,388
1970	5	9	10	35	172	395	695	343	217	62	0	0	1,943
1971	0	2	20	175	234	552	359	238	418	474	0	0	2,472
1972	33	30	11	40	109	524	737	297	344	53	1	0	2,179
1973	31	34	4	13	94	773	299	691	327	272	9	0	2,547
1974	9	0	40	90	95	338	968	349	247	253	0	2	2,391
1975	10	10	4	20	112	575	798	222	876	132	0	0	2,759
1976	10	26	0	80	151	454	664	1,013	220	156	4	0	2,778
1977	0	2	16	89	219	300	366	743	190	165	37	22	2,149
1978	2	8	45	59	94	511	620	254	136	33	25	0	1,787
1979	7	52	1	22	57	307	741	516	257	173	10	85	2,228
1980	0	11	13	8	126	350	286	210	383	45	0	0	1,432
1981	13	9	39	90	144	377	680	549	250	0	0	0	2,151
1982	0	1	24	65	101	280	438	249	397	73	5	0	1,633
1983	10	2	3	56	239	389	704	267	370	96	0	21	2,157
1984	56	16	3	61	213	572	825	150	704	119	0	0	2,719
1985	3	7	2	14	179	219	578	208	255	242	58	8	1,773
1986	2	0	0	107	192	239	389	255	315	138	100	23	1,760
1987	0	65	41	41	121	164	388	739	447	180	12	0	2,198
1988	8	28	46	101	113	118	544	743	103	51	6	5	1,866
1989	40	13	6	1	207	348	560	340	574	108	15	6	2,218
1990	2	43	31	85	533	354	275	555	233	31	0	0	2,142
1991	68	2	21	39	116	655	203	625	536	79	0	18	2,362
1992	17	7	0	20	100	195	575	279	316	338	0	15	1,862
1993	13	3	30	82	254	252	378	377	327	286	22	0	2,024
1994	38	37	1	27	162	139	398	307	317	12	22	0	1,459
1995	4	24	11	0	179	210	582	409	303	229	143	25	2,117
1996	39	18	0	10	107	284	1,050	298	173	40	0	0	2,018
1997	11	9	88	153	60	382	277	331	604	44	0	57	2,016
1998	0	4	48	136	127	325	649	504	525	127	24	0	2,467
1999	0	0	0	71	238	329	490	616	270	168	66	0	2,247
2000	2	10	2	92	231	451	428	635	192	97	9	0	2,147
2001	0	0	5	60	286	505	258	346	571	480	70	0	2,581
2002	48	4	98	111	123	175	977	–	–	–	–	–	1,536
sub-total	902	700	1,303	3,023	7,848	19,107	30,514	24,149	18,022	7,144	845	347	
Average	18	14	26	60	164	398	623	474	353	143	17	7	2,296

Attachment

Table 7-1-3 Monthly Rainfall at Tarahara

Station No.1320 (mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	total
1968	–	–	–	–	–	–	–	–	47	30	–	–	–
1969	–	–	25	32	137	348	255	–	–	–	–	–	–
1970	8	7	0	58	85	211	663	423	225	42	0	0	1,722
1971	2	1	10	107	150	529	386	312	314	213	15	0	2,039
1972	42	21	12	42	36	280	500	98	200	37	1	0	1,269
1973	24	5	3	10	79	584	200	190	89	176	4	0	1,364
1974	17	0	56	44	75	245	779	386	294	94	0	0	1,990
1975	7	9	0	14	100	438	655	153	504	57	0	0	1,937
1976	20	29	1	81	165	314	314	335	11	18	0	0	1,288
1977	0	4	2	63	299	195	354	473	91	138	93	33	1,745
1978	4	5	17	116	96	194	568	117	169	11	21	2	1,320
1979	5	8	3	76	70	128	592	395	366	202	16	110	1,971
1980	0	23	11	21	168	278	302	288	180	20	0	0	1,291
1981	14	3	36	88	136	366	622	399	185	3	0	0	1,852
1982	0	4	11	134	82	247	506	153	455	94	12	0	1,698
1983	9	0	5	25	169	460	820	279	327	133	0	22	2,249
1984	34	28	8	92	260	473	760	155	584	67	0	16	2,477
1985	2	0	1	9	217	209	530	180	215	149	21	48	1,581
1986	0	3	0	52	119	217	372	256	381	178	2	21	1,601
1987	0	41	42	84	123	171	425	1,326	410	179	19	2	2,822
1988	8	34	78	122	238	190	486	585	209	42	4	10	2,006
1989	31	22	9	0	246	457	806	414	752	62	0	0	2,799
1990	0	36	10	90	299	392	364	432	317	12	0	0	1,952
1991	65	5	36	57	111	395	322	475	557	52	0	12	2,087
1992	1	4	0	6	206	137	546	177	181	126	0	1	1,385
1993	20	0	31	132	86	343	413	560	193	145	10	0	1,933
1994	58	38	1	41	191	207	274	400	276	9	7	0	1,502
1995	6	21	7	0	132	471	437	356	294	148	83	25	1,980
1996	38	15	0	9	148	169	1,134	411	119	62	0	0	2,105
1997	10	15	88	87	97	250	294	278	343	15	0	47	1,524
1998	0	5	62	80	91	285	678	443	387	185	28	0	2,242
1999	0	0	0	54	233	233	616	444	225	131	0	2	1,938
2000	2	7	1	114	307	601	400	501	269	75	33	0	2,308
2001	0	0	4	55	267	326	418	395	421	365	59	0	2,310
2002	77	4	15	73	252	166	939	–	–	–	–	–	1,526
sub-total	504	397	584	2,068	5,470	10,509	17,729	11,788	9,590	3,270	428	350	
Average	16	13	18	65	171	328	554	380	300	102	14	11	1,973

– : Not Available

Attachment

Table 7-1-4 Monthly Rainfall at Biratnagar Airport

Station No.1319 (mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	total
1968	–	–	–	–	–	–	322	216	219	284	0	–	–
1969	4	–	–	–	98	249	412	–	–	12	8	0	–
1970	3	9	0	82	46	150	395	351	245	31	0	0	1,312
1971	2	2	14	97	99	621	390	291	239	279	6	0	2,040
1972	0	30	6	12	13	340	362	174	254	13	1	0	1,205
1973	44	2	7	11	138	632	144	344	150	198	31	0	1,701
1974	35	0	60	120	216	424	1,085	654	422	48	0	0	3,064
1975	3	16	0	36	177	437	625	223	445	74	0	0	2,036
1976	12	15	2	38	148	441	412	464	121	19	0	0	1,672
1977	0	4	2	59	178	223	445	452	149	161	74	38	1,785
1978	5	12	73	55	99	126	623	119	279	44	36	0	1,471
1979	5	10	1	56	51	130	596	486	290	127	10	13	1,775
1980	0	2	21	5	272	176	528	307	462	60	0	0	1,833
1981	16	13	39	38	196	300	813	296	156	1	0	0	1,868
1982	0	2	14	56	116	374	362	64	324	82	9	0	1,403
1983	12	0	15	37	249	285	472	249	212	39	0	27	1,597
1984	24	23	8	85	217	522	682	118	429	1	0	1	2,110
1985	1	2	24	0	184	179	632	189	286	217	9	16	1,739
1986	0	2	1	39	216	210	487	218	362	151	1	25	1,712
1987	0	6	36	58	120	325	647	749	480	138	12	1	2,572
1988	0	67	23	127	118	129	512	724	121	107	38	4	1,970
1989	15	32	5	0	327	346	685	401	791	59	0	5	2,666
1990	0	16	15	109	313	467	602	510	301	23	0	0	2,356
1991	35	4	22	51	108	163	285	290	411	70	0	26	1,465
1992	2	3	0	2	187	147	396	201	189	291	0	1	1,419
1993	21	1	34	91	130	308	357	699	346	49	9	0	2,045
1994	28	31	9	3	81	165	123	225	160	1	3	0	829
1995	4	15	2	0	47	562	308	253	371	18	70	17	1,667
1996	41	58	0	2	201	220	659	541	150	70	0	0	1,942
1997	12	2	6	62	181	243	476	228	380	17	0	65	1,673
1998	1	4	29	71	48	261	1,225	733	277	22	5	0	2,677
1999	0	0	0	30	177	318	535	501	202	273	1	0	2,036
2000	0	9	0	103	307	569	558	343	382	21	0	0	2,292
2001	2	0	1	77	229	296	206	384	410	561	9	0	2,175
2002	38	3	4	91	169	217	1,000	–	–	–	–	–	1,522
sub-total	365	395	474	1,702	5,456	10,555	18,361	11,998	10,016	3,561	333	239	
Average	11	13	15	55	170	330	556	375	313	108	10	7	1,964

– : Not Available

Attachment

Table 7-2-1 Monthly Mean Maximum Temperatures at Tarahara

Station: 1320 ℃

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	23.8	25.5	29.9	30.0	30.9	30.8	32.5	31.8	32.5	30.9	29.2	25.9	29.5
1972	22.6	23.8	30.7	32.9	34.5	32.5	31.5	31.9	30.9	30.5	27.1	24.8	29.5
1973	22.4	25.5	30.9	35.5	33.1	31.9	32.6	32.4	32.2	30.6	28.8	24.9	30.1
1974	23.0	26.0	30.0	32.1	32.4	32.6	30.7	32.0	31.0	31.3	29.3	23.3	29.5
1975	23.0	25.4	31.2	34.5	33.0	32.6	31.1	32.5	31.1	31.3	28.1	24.3	29.8
1976	23.3	25.3	31.3	33.3	32.3	31.9	32.4	31.6	32.1	30.9	28.6	24.8	29.8
1977	23.4	26.8	32.3	31.1	31.6	31.6	32.2	32.4	32.7	29.4	27.7	24.5	29.6
1978	22.5	26.6	29.4	33.3	32.8	33.1	31.9	33.7	31.5	31.6	27.1	25.5	29.9
1979	24.5	25.2	30.6	34.5	35.6	34.6	32.0	32.9	32.0	30.7	28.8	24.9	30.5
1980	23.7	25.8	30.3	35.7	31.7	33.7	32.6	32.8	32.5	31.2	29.8	26.4	30.5
1981	23.1	26.3	30.0	31.7	32.7	34.2	31.9	32.6	32.6	32.1	30.1	26.0	30.3
1982	25.5	26.0	30.0	32.4	35.0	32.8	32.5	33.1	31.7	31.0	27.7	24.4	30.2
1983	22.3	25.0	29.8	31.6	32.2	33.6	32.7	32.9	32.0	31.7	29.8	24.5	29.8
1984	22.7	24.7	31.0	33.8	31.4	32.3	31.4	32.9	30.9	31.7	29.4	25.2	29.8
1985	23.6	25.7	31.4	34.4	32.4	33.2	31.3	32.9	31.6	30.6	28.5	25.1	30.1
1986	23.2	25.5	31.2	32.5	32.0	33.5	32.1	32.9	31.0	29.6	28.7	25.0	29.8
1987	23.7	26.5	29.4	32.8	33.8	33.4	31.6	31.6	32.0	30.9	29.0	25.0	30.0
1988	24.7	26.7	29.0	32.6	32.6	33.4	32.5	31.9	33.0	32.6	30.7	26.3	30.5
1989	20.5	24.1	29.6	34.7	34.3	32.6	31.4	32.3	31.0	32.0	28.2	24.3	29.6
1990	23.0	24.8	28.6	31.0	32.1	32.6	32.2	22.6	31.0	30.7	31.0	26.9	28.9
1991	22.8	27.1	31.0	33.1	32.3	32.2	32.5	32.5	32.0	32.2	28.8	24.4	30.1
1992	23.2	23.1	30.8	35.2	30.9	32.5	31.5	32.0	32.1	30.3	29.0	24.2	29.6
1993	20.0	26.2	29.4	31.4	32.0	32.4	32.8	31.6	31.7	31.8	29.0	26.9	29.6
1994	24.0	24.4	30.2	33.5	34.2	32.5	33.3	33.0	32.5	31.4	29.4	26.4	30.4
1995	23.2	25.3	30.8	35.8	36.5	32.3	31.9	32.8	32.0	32.3	29.4	24.5	30.6
1996	21.9	26.0	31.2	35.6	32.9	32.6	32.3	32.4	33.5	31.8	30.0	27.1	30.6
1997	22.8	23.9	30.6	30.7	33.7	33.0	32.6	32.7	32.2	31.5	29.2	23.1	29.7
1998	20.3	26.5	28.7	32.6	34.5	34.3	31.6	32.1	32.6	33.0	30.6	27.2	30.3
1999	23.4	28.3	32.5	34.3	32.6	33.3	32.0	31.7	32.1	31.9	30.2	27.5	30.8
2000	22.7	24.3	30.6	33.4	33.2	32.7	32.5	32.6	31.9	32.0	28.2	25.6	30.0
Average	23.0	25.5	30.4	33.2	33.0	32.8	32.1	32.1	31.9	31.3	29.0	25.3	30.0
Max.	25.5	28.3	32.5	35.7	36.5	34.6	32.8	33.7	33.5	33.0	31.0	27.5	

Table 7-2-2 Monthly Mean Minimum Temperatures at Tarahara

Station: 1320 ℃

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	8.9	8.9	13.9	20.3	22.6	25.6	26.0	25.4	24.4	20.9	15.6	10.0	18.5
1972	9.8	9.9	15.0	20.1	24.5	24.9	25.6	24.3	24.5	21.7	13.8	9.1	18.6
1973	10.5	11.4	13.6	21.0	23.4	23.7	25.6	24.4	23.5	20.6	13.7	9.2	18.4
1974	7.8	8.6	13.3	20.0	22.1	23.4	23.7	24.0	22.9	21.0	13.4	7.8	17.3
1975	6.8	10.7	12.8	19.7	22.7	24.6	24.4	24.8	23.7	21.7	13.1	9.5	17.9
1976	8.1	11.3	13.1	18.7	22.8	23.7	24.9	24.1	23.9	18.8	15.7	9.8	17.9
1977	8.0	9.7	14.3	20.2	21.1	24.0	25.1	25.0	24.0	19.4	15.8	10.7	18.1
1978	7.4	9.0	12.0	18.4	23.4	24.7	24.4	24.5	23.2	19.4	15.3	9.6	17.6
1979	8.8	10.0	12.0	20.0	22.2	24.9	25.4	25.2	23.3	19.6	16.2	10.7	18.2
1980	8.3	10.4	14.2	19.8	21.7	24.3	24.9	25.0	23.8	19.2	13.7	10.2	18.0
1981	7.9	10.1	14.0	19.2	22.4	24.6	25.2	25.0	23.8	18.9	13.2	8.9	17.8
1982	8.9	8.6	13.9	18.8	22.7	24.4	24.9	25.4	23.6	18.7	15.2	9.7	17.9
1983	6.9	7.4	13.1	17.2	22.2	24.5	25.1	25.6	24.3	20.3	13.2	8.1	17.3
1984	7.1	9.4	14.6	19.0	23.2	24.8	24.5	24.8	21.2	20.3	12.7	9.7	17.6
1985	8.3	9.8	15.8	20.0	22.2	24.4	24.3	25.4	23.5	20.7	13.4	10.9	18.2
1986	9.0	9.3	13.1	19.2	20.8	24.9	24.5	24.7	23.3	18.3	14.4	9.5	17.6
1987	8.5	10.6	14.9	18.7	20.3	25.0	24.7	24.2	23.2	20.2	15.0	11.0	18.0
1988	9.2	11.6	14.5	18.9	21.9	24.0	24.2	23.7	23.2	19.2	12.3	9.6	17.7
1989	6.5	8.2	13.9	16.5	22.0	23.8	23.4	23.5	23.3	20.4	14.4	9.5	17.1
1990	9.7	11.4	13.7	18.2	22.9	25.1	25.6	25.1	24.5	19.1	13.9	9.9	18.3
1991	7.8	9.6	14.5	18.9	22.9	24.3	25.1	25.2	23.2	19.2	12.4	9.3	17.7
1992	8.2	8.6	13.9	19.3	21.5	24.6	24.1	24.9	23.8	20.4	13.2	9.3	17.7
1993	8.5	11.5	11.9	17.6	22.7	24.4	25.6	25.3	24.2	20.8	16.4	10.5	18.3
1994	10.1	10.4	16.1	19.2	23.6	25.5	26.2	25.8	24.6	19.4	13.7	9.5	18.7
1995	7.2	9.9	14.0	18.6	25.3	25.4	25.9	25.5	24.4	20.5	15.9	11.3	18.7
1996	9.4	11.1	15.5	18.8	23.3	24.4	25.4	25.2	24.4	20.1	14.2	9.1	18.4
1997	7.6	8.7	13.8	18.3	22.1	24.0	25.3	25.3	23.4	17.1	13.9	10.3	17.5
1998	8.2	9.7	13.2	19.0	23.7	25.9	25.1	25.1	24.1	21.9	16.6	10.3	18.6
1999	7.8	11.8	12.8	22.0	23.4	25.0	25.3	25.0	24.0	20.8	14.6	10.6	18.6
2000	8.4	8.0	12.4	19.0	22.9	24.5	25.4	25.2	23.9	20.7	16.7	9.9	18.1
Average	8.3	9.9	13.8	19.2	22.6	24.6	25.0	24.9	23.7	20.0	14.4	9.8	18.0
Min.	6.5	7.4	11.9	16.5	20.3	23.4	23.4	23.5	21.2	17.1	10.3	7.8	

Table 7-2-3 Monthly Mean Maximum Temperatures at Biratnagar Airport

℃

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	23.5	25.6	30.9	30.0	31.0	31.4	31.9	31.0	31.0	30.7	27.9	25.4	29.2
1972	23.7	23.4	30.8	33.6	34.7	32.6	31.7	32.1	30.3	30.5	28.5	25.4	29.8
1973	22.6	27.1	31.8	36.4	32.7	31.5	32.6	32.5	31.4	29.9	28.5	24.9	30.2
1974	23.2	26.2	30.6	32.2	31.0	32.6	30.4	31.5	30.7	31.6	29.9	23.6	29.5
1975	23.6	26.1	32.0	35.0	33.0	32.7	30.8	32.1	30.4	31.6	28.1	24.5	30.0
1976	23.8	25.8	32.1	34.1	32.0	31.5	31.9	30.9	30.6	30.7	28.8	24.8	29.8
1977	22.9	26.8	32.9	31.3	31.2	31.2	31.6	32.2	32.6	29.3	27.3	24.5	29.5
1978	22.1	25.0	30.1	33.7	33.1	32.6	31.5	33.1	31.1	31.5	27.1	25.8	29.7
1979	24.5	25.4	31.5	35.2	36.6	34.7	31.6	32.6	31.6	30.4	28.8	24.7	30.6
1980	23.3	25.9	30.7	36.6	31.6	32.6	31.8	32.0	32.2	30.8	29.8	26.6	30.3
1981	22.9	26.6	30.7	31.8	32.3	33.6	31.4	32.0	32.0	32.3	29.6	25.6	30.1
1982	25.4	26.0	29.8	33.5	35.7	32.2	31.9	32.7	31.8	31.3	27.6	24.4	30.2
1983	22.1	25.1	30.3	32.3	32.0	33.3	32.3	32.7	31.7	31.8	30.0	24.4	29.8
1984	22.9	25.0	31.8	34.6	31.7	31.9	30.8	33.0	31.0	31.8	29.2	24.9	29.9
1985	23.7	26.3	32.1	35.8	32.6	32.7	30.4	32.6	31.3	30.5	28.2	24.7	30.1
1986	23.5	26.2	32.2	33.3	31.6	33.1	31.8	32.8	30.8	29.8	29.3	25.2	30.0
1987	24.1	27.5	30.7	33.5	34.3	33.3	30.4	31.0	31.1	30.7	29.7	26.8	30.3
1988	25.0	27.3	29.8	33.3	32.6	33.0	32.4	31.3	33.5	33.3	30.8	27.4	30.8
1989	23.2	25.5	30.6	35.9	33.6	32.0	31.0	32.0	30.5	31.8	27.8	23.6	29.8
1990	22.6	24.5	28.6	31.2	31.6	32.1	31.4	30.4	31.5	30.6	30.6	25.9	29.3
1991	22.7	27.1	31.2	33.8	32.7	32.1	31.9	32.1	31.3	31.7	28.4	24.2	29.9
1992	23.1	23.5	31.6	36.4	32.8	33.8	32.0	32.4	32.4	30.8	29.1	24.1	30.2
1993	20.0	26.1	29.3	32.5	32.0	32.3	32.8	31.5	31.5	31.7	29.0	26.7	29.6
1994	23.6	24.4	30.2	34.8	35.8	32.9	38.5	33.0	31.7	31.3	29.1	25.5	30.9
1995	22.6	25.0	30.5	35.8	36.7	31.7	31.7	32.4	30.9	31.4	28.9	24.2	30.2
1996	21.7	26.0	30.9	35.8	32.7	32.4	31.9	32.1	32.7	31.1	29.1	26.8	30.3
1997	22.7	24.2	30.6	31.2	33.7	33.0	32.3	32.7	32.1	30.7	28.6	22.4	29.5
1998	19.8	26.3	28.5	32.6	35.2	34.6	31.3	31.5	32.5	32.5	30.1	26.4	30.1
1999	23.2	28.8	33.0	35.5	33.3	33.3	31.8	31.4	31.8	31.0	29.6	26.7	30.8
2000	22.6	25.0	30.8	33.9	33.0	32.9	33.0	33.2	31.9	33.2	29.9	27.1	30.5
Average	23.0	25.8	30.9	33.9	33.1	32.7	31.9	32.1	31.5	31.2	29.0	25.2	30.0
Max.	25.4	28.8	33.0	36.6	36.7	34.7	38.5	33.2	33.5	33.3	30.8	27.4	

Table 7-2-4 Monthly Mean Minimum Temperatures at Biratnagar Airport

℃

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	–	8.8	14.6	19.9	22.5	22.5	24.7	24.3	23.8	19.8	13.8	8.9	–
1972	8.8	9.8	15.7	19.7	25.0	24.7	25.3	25.1	23.6	21.5	14.2	8.9	18.5
1973	9.7	11.6	14.0	21.7	23.4	24.9	26.1	25.9	25.1	21.9	15.4	10.2	19.2
1974	9.0	10.1	15.3	21.4	22.8	24.0	24.6	25.6	23.9	22.4	14.4	8.3	18.5
1975	7.6	12.2	15.1	21.0	23.4	25.4	24.9	25.6	24.4	22.1	12.9	8.6	18.6
1976	8.8	12.2	13.7	20.1	23.2	24.4	25.3	24.7	24.4	19.9	15.6	9.1	18.5
1977	8.5	10.3	15.7	21.1	21.6	24.2	25.7	25.7	24.9	20.1	15.8	10.2	18.7
1978	7.5	9.5	12.8	18.8	23.1	24.9	24.8	25.3	23.8	20.1	14.9	9.2	17.9
1979	9.5	10.7	13.6	21.4	24.0	25.8	25.5	25.9	24.4	21.1	17.2	11.6	19.2
1980	11.0	11.3	15.8	21.9	22.1	25.6	26.0	26.1	25.0	20.4	14.0	10.4	19.1
1981	8.7	10.8	15.4	20.1	22.9	25.4	25.7	26.0	25.0	20.3	13.8	9.3	18.6
1982	8.8	9.8	15.0	20.2	23.4	25.0	25.6	26.3	24.6	20.3	15.5	10.0	18.7
1983	7.8	9.0	14.6	18.5	22.8	25.1	26.0	26.3	25.0	21.5	13.7	8.9	18.3
1984	7.7	10.2	15.3	20.7	23.8	25.5	25.0	25.9	24.1	21.7	12.9	9.5	18.5
1985	8.4	10.4	17.2	21.7	23.0	25.3	25.0	26.3	24.8	21.4	14.4	11.2	19.1
1986	9.6	10.6	15.0	19.8	21.1	25.5	25.5	26.0	24.0	19.8	15.6	10.6	18.6
1987	9.8	11.4	16.1	18.4	22.0	25.0	24.9	25.6	24.0	20.8	15.5	11.0	18.7
1988	9.2	11.9	15.0	19.4	22.8	24.4	25.5	25.3	24.8	20.9	14.3	11.3	18.7
1989	7.6	8.6	13.8	18.0	21.7	24.3	24.9	24.4	22.2	20.8	15.3	10.1	17.6
1990	10.4	12.3	14.6	19.8	22.9	25.1	25.6	25.4	24.9	20.1	14.4	9.9	18.8
1991	8.4	11.0	15.7	19.3	22.5	24.4	24.9	25.2	24.5	20.6	13.1	10.0	18.3
1992	8.6	9.3	15.5	20.4	22.8	25.3	25.4	25.8	25.1	21.1	14.2	9.5	18.6
1993	8.8	12.5	13.3	18.3	23.0	24.8	26.0	25.5	24.4	21.2	16.6	10.8	18.8
1994	10.4	10.9	17.9	20.3	24.5	25.8	26.5	28.2	24.9	20.2	14.4	9.4	19.5
1995	7.5	11.1	14.9	20.1	25.9	25.8	25.7	25.7	24.4	21.1	15.9	11.3	19.1
1996	9.8	12.4	17.3	20.1	23.6	24.9	25.7	25.9	25.2	21.2	15.8	9.8	19.3
1997	7.9	9.9	15.3	19.2	23.0	24.8	26.0	26.1	24.8	19.3	15.7	11.4	18.6
1998	9.3	11.4	14.9	20.4	24.6	26.7	25.9	25.9	25.1	23.4	18.2	11.3	19.8
1999	8.9	12.7	15.2	23.3	23.8	25.2	25.2	25.2	24.3	21.7	15.7	11.2	19.4
2000	9.2	8.9	14.3	19.9	23.9	25.2	25.9	25.9	24.3	21.8	17.1	9.6	18.8
Average	8.9	10.7	15.1	20.2	23.2	25.0	25.5	25.7	24.5	21.0	15.0	10.1	18.8
Min.	7.5	8.6	12.8	18.0	21.1	24.0	24.6	24.3	22.2	19.3	12.9	8.3	

Attachment

Table 7-3-1 Monthly Mean Relative Humidity at Tarahara

Station: 1320 (%)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	84	72	61	70	73	80	81	82	84	78	77	79	76
1972	78	74	59	54	58	74	82	74	82	82	81	83	73
1973	86	77	53	45	67	80	80	83	83	84	77	87	75
1974	84	70	57	63	69	76	84	82	82	81	78	83	76
1975	85	74	56	55	65	75	84	79	81	80	77	82	74
1976	83	69	51	46	67	78	78	80	78	77	81	81	72
1977	79	65	51	60	68	77	79	81	79	80	81	84	73
1978	–	–	–	–	–	–	–	–	–	–	–	–	–
1979	–	–	–	–	–	–	–	–	–	–	–	–	–
1980	–	–	–	–	–	–	–	–	–	–	–	–	–
1981	81	71	56	63	70	75	84	84	83	79	76	84	75
1982	84	74	57	62	60	79	83	80	86	80	85	87	76
1983	84	76	61	58	72	78	84	83	85	82	80	86	77
1984	85	82	66	60	74	81	87	80	85	82	79	86	79
1985	81	75	63	52	70	80	84	83	85	82	84	88	77
1986	86	77	59	58	66	74	82	80	83	80	75	78	75
1987	80	76	63	58	61	77	83	83	83	78	74	78	74
1988	80	76	66	63	71	75	84	86	81	76	75	81	76
1989	81	72	60	41	58	77	85	82	86	79	79	82	73
1990	87	79	67	64	76	80	83	80	84	77	73	85	78
1991	86	75	60	59	70	82	80	85	87	82	78	79	77
1992	80	77	61	50	71	77	84	83	86	82	–	80	–
1993	85	70	56	59	72	79	81	86	82	79	78	73	75
1994	79	78	64	57	67	78	80	81	83	79	76	75	74
1995	79	77	63	44	62	82	84	83	84	80	79	–	–
1996	80	71	60	50	73	78	83	83	83	78	75	73	74
1997	80	74	63	62	66	75	83	83	85	75	74	83	75
1998	84	71	64	63	68	78	87	85	84	79	72	80	76
1999	81	78	53	63	72	77	82	84	80	76	72	76	74
2000	82	78	59	59	74	81	82	82	85	77	82	78	76
Average	82	74	59	57	68	78	82	82	83	79	77	78	75

Table 7-3-2 Monthly Mean Relative Humidity at Biratnagar Airport

Station: 1319 (%)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1971	70	61	67	75	78	84	83	81	83	78	74	75	76
1972	–	–	–	–	–	–	–	–	–	–	–	–	–
1973	83	69	47	41	68	82	81	81	82	82	76	77	72
1974	75	63	48	64	73	73	86	83	82	79	69	71	72
1975	73	71	–	45	64	76	–	80	83	80	75	74	–
1976	76	68	43	47	69	80	81	83	81	76	74	76	71
1977	74	66	48	62	69	80	83	82	79	80	78	77	73
1978	77	69	53	48	66	76	82	80	83	75	81	76	72
1979	78	71	45	49	50	67	85	82	81	79	78	80	70
1980	76	68	54	45	70	76	82	81	80	75	69	74	71
1981	78	69	48	55	65	72	82	82	80	73	73	71	70
1982	76	63	52	53	53	77	82	79	81	75	79	80	71
1983	82	62	47	50	69	76	82	80	84	78	69	76	71
1984	79	71	54	52	72	81	84	81	84	77	70	78	73
1985	78	66	56	51	68	79	84	82	83	81	78	81	74
1986	84	72	48	52	65	74	82	80	82	79	76	77	72
1987	81	71	62	–	58	75	–	82	84	78	73	77	–
1988	78	69	57	58	68	72	83	84	77	73	71	–	–
1989	78	65	56	37	63	78	83	82	85	77	76	76	71
1990	84	74	59	59	74	82	85	81	82	74	67	74	74
1991	77	67	56	50	67	81	81	80	84	77	74	78	72
1992	80	71	49	43	68	73	81	83	81	80	74	81	72
1993	87	73	71	56	70	78	81	85	82	77	80	74	76
1994	81	74	61	47	61	77	77	79	79	75	71	74	71
1995	76	72	58	41	64	83	84	81	86	80	78	86	74
1996	86	76	57	41	72	76	84	81	80	77	75	73	73
1997	76	72	55	59	64	75	81	81	83	74	72	82	72
1998	83	70	62	62	67	78	88	88	84	80	78	79	76
1999	78	72	47	60	71	80	84	85	84	82	77	78	75
2000	81	71	54	58	74	81	82	83	85	77	80	79	75
Average	76	67	50	50	64	74	77	79	79	75	72	74	70

– : Not Available

Attachment

Table 7-4-1 Monthly Mean Sunshine Hours at Tarahara

Station: 1320 hrs/day

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1970	7.5	7.7	8.0	8.4	9.1	5.6	–	–	5.4	8.7	9.5	9.0	–
1971	7.8	8.4	8.1	6.3	8.5	5.3	6.1	5.8	–	–	–	–	–
1972	7.2	8.0	8.3	8.6	9.7	6.6	5.2	7.8	6.2	7.1	8.7	8.4	7.7
1973	5.6	7.5	7.6	8.3	7.8	4.0	5.0	6.1	4.9	6.9	9.6	7.7	6.8
1974	8.9	9.2	8.1	9.3	8.9	7.4	4.9	4.9	5.3	7.9	9.5	8.2	7.7
1975	8.0	8.1	7.9	8.8	8.9	7.1	4.4	6.7	4.3	7.8	9.3	8.5	7.5
1976	8.4	7.6	9.1	8.3	8.8	5.9	6.1	5.5	6.7	8.6	8.1	8.3	7.6
1977	7.2	8.3	8.3	7.8	8.4	7.0	6.1	5.6	6.7	7.2	7.9	8.3	7.4
1978	7.9	7.7	8.9	9.0	7.5	7.0	–	–	5.6	8.0	6.9	8.8	–
1979	8.5	–	9.2	9.1	9.9	–	–	2.9	6.8	7.9	7.1	7.4	–
1980	–	8.2	8.7	10.1	9.0	7.7	5.7	7.4	5.9	8.4	9.3	7.9	–
1981	6.5	8.0	7.7	8.4	8.3	7.4	4.0	5.2	6.1	8.9	8.7	7.6	7.2
1982	7.2	7.1	7.4	9.0	10.6	6.1	4.9	6.6	5.1	7.9	6.3	6.6	7.1
1983	6.2	8.7	8.7	7.3	9.3	9.0	5.3	5.6	6.9	7.6	9.0	7.3	7.6
1984	7.6	7.7	8.5	8.9	7.5	5.3	4.4	7.6	6.6	8.0	9.5	7.9	7.5
1985	7.4	8.3	8.2	9.5	9.2	7.6	5.1	6.5	5.8	8.2	7.1	6.8	7.5
1986	7.4	8.3	9.1	9.1	9.0	8.0	5.0	7.4	5.0	8.2	8.8	8.2	7.8
1987	7.0	8.3	8.4	8.5	10.3	6.3	4.5	4.8	6.2	7.6	8.5	8.0	7.4
1988	7.9	8.1	9.3	8.3	9.6	6.8	5.0	4.0	6.7	8.6	8.3	7.5	7.5
1989	7.0	8.3	7.6	9.8	7.6	7.6	3.6	6.4	4.7	9.1	8.1	7.3	7.3
1990	6.3	6.5	8.6	8.9	8.1	6.6	5.4	6.1	6.1	7.5	8.9	7.8	7.2
1991	7.4	8.0	8.4	9.1	8.7	6.0	6.2	5.6	6.0	8.2	8.2	6.7	7.4
1992	7.5	7.1	8.1	8.6	8.6	8.5	5.8	6.8	6.5	6.9	–	–	–
1993	5.2	6.8	8.5	8.3	8.7	7.1	–	–	–	–	–	–	–
Average	7.3	7.9	8.4	8.7	8.8	6.8	5.1	6.0	5.9	8.0	8.4	7.8	7.4

– : Not Available

The Monthly Mean Sunshine Hours measurement has been stopped in Jul. 1993.

Table 7-4-2 Monthly Mean Sunshine Hours at Biratnagar Airport

Station: 1319 hrs/day

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1972	–	–	–	9.1	9.9	7.1	4.9	8.1	6.3	7.5	9.7	8.2	–
1973	6.5	7.8	8.2	7.5	7.1	4.5	6.4	7.2	5.7	7.4	9.1	8.4	7.2
1974	8.9	9.4	8.3	8.7	–	–	–	5.7	5.7	7.9	–	9.8	–
1975	7.8	8.2	8.7	8.7	9.4	7.1	4.5	6.4	5.3	8.1	9.7	8.7	7.7
1976	8.5	8.7	8.9	7.8	9.6	6.0	6.5	5.6	7.0	9.3	8.9	8.5	7.9
1977	8.2	9.2	9.4	8.6	10.0	6.8	5.1	5.6	7.1	7.5	8.0	8.1	7.8
1978	8.5	8.5	9.0	9.8	8.1	6.4	6.7	8.5	5.8	8.2	8.0	8.9	8.0
1979	8.0	8.4	9.5	9.3	10.8	8.2	–	5.6	6.9	–	8.0	7.6	–
1980	8.2	8.1	8.8	9.9	7.6	5.7	–	–	–	–	–	7.8	–
1981	6.2	–	8.5	8.1	8.6	7.7	4.6	5.5	–	–	–	–	–
1982	7.5	–	–	9.3	10.7	6.7	5.1	7.2	5.6	–	7.4	6.9	–
1983	6.3	9.0	8.8	8.2	9.0	8.3	5.4	6.4	6.2	7.1	9.6	7.5	7.7
1984	8.0	7.8	9.3	9.4	7.3	5.2	3.4	8.0	6.1	8.4	9.7	8.1	7.6
1985	7.6	8.7	8.3	9.5	9.4	7.1	4.6	6.4	5.3	7.5	9.3	7.5	7.6
1986	7.3	8.7	9.5	9.4	9.2	8.1	5.3	7.5	5.3	7.7	9.0	8.1	7.9
1987	7.3	8.5	9.0	9.4	10.4	6.2	3.8	5.6	6.1	7.9	9.6	8.5	7.7
1988	8.1	8.6	8.9	9.2	9.9	6.8	5.1	4.0	6.5	8.9	8.9	7.8	7.7
1989	7.8	8.6	7.3	10.2	8.2	7.2	4.3	6.5	4.1	8.9	8.0	6.6	7.3
1990	5.6	6.9	10.1	8.7	8.3	6.5	4.5	6.7	6.1	7.6	9.1	7.4	7.3
1991	7.2	8.4	8.9	8.6	8.6	5.3	5.2	5.1	5.1	8.4	8.2	6.0	7.1
1992	10.1	7.7	8.7	9.1	8.9	8.2	5.4	–	5.8	–	8.3	4.6	–
1993	–	6.0	8.5	8.5	–	–	–	–	5.8	–	–	–	–
1994	–	–	8.9	8.8	9.1	6.3	7.3	6.2	6.9	7.7	8.2	8.3	7.8
1995	6.8	7.9	8.0	9.6	7.4	–	–	–	–	–	–	–	–
1996	–	–	–	–	–	–	–	–	–	–	–	–	–
1997	7.3	8.0	8.6	8.0	9.3	8.0	5.5	6.3	6.5	8.9	8.4	5.3	7.5
1998	4.9	8.4	7.9	5.9	9.1	6.2	3.6	3.8	5.9	8.1	7.5	7.5	6.6
1999	7.3	8.2	9.4	9.1	8.2	5.7	4.5	4.8	6.5	6.1	8.5	8.4	7.2
2000	6.3	7.6	8.9	8.6	5.5	9.3	5.7	5.8	3.4	8.1	6.9	7.6	7.0
Average	7.4	8.2	8.8	8.8	8.8	6.8	5.1	6.2	5.9	8.0	8.6	7.7	7.5

– : Not Available

Attachment

Table 7-5-1 Monthly Mean Wind Speed at Tarahara

Station: 1320 Tarahara

Anemometer Height: 4.5m km/hr

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1970	3.7	4.3	6.2	11.0	11.6	11.0	10.5	9.6	8.6	4.2	3.6	2.7	7.3
1971	2.5	2.7	4.2	10.4	17.7	10.8	9.9	8.4	5.2	3.7	3.9	3.8	6.9
1972	4.5	5.8	8.1	10.9	15.0	11.8	9.8	9.4	6.2	4.3	4.1	4.0	7.8
1973	4.9	5.8	8.1	10.9	15.0	11.8	9.8	9.4	6.2	4.3	4.1	4.0	7.9
1974	5.1	5.8	7.7	9.5	10.2	8.9	8.2	6.6	6.8	4.9	4.2	4.6	6.9
1975	5.0	6.0	8.2	9.8	11.6	9.9	10.1	8.6	7.8	4.8	4.2	4.6	7.6
1976	5.0	6.7	8.0	10.4	9.6	7.7	7.8	8.0	7.8	5.0	4.2	4.2	7.0
1977	7.2	8.3	8.3	7.8	8.4	7.0	6.1	5.6	6.7	7.2	7.9	8.3	7.4
1978	7.9	7.7	8.9	9.0	7.5	7.0	–	–	5.6	8.0	6.9	8.8	–
1979	3.6	4.6	6.3	6.7	6.4	7.2	6.2	5.4	4.4	4.0	3.1	2.4	5.0
1980	2.8	4.0	5.8	7.4	9.4	8.0	7.8	7.8	4.7	3.1	2.2	1.8	5.4
1981	2.6	3.4	6.0	7.8	6.7	6.9	7.4	5.7	4.3	2.2	1.5	1.0	4.6
1982	1.7	2.5	3.9	6.7	6.0	6.8	5.7	6.7	4.4	1.9	2.3	1.6	4.2
1983	2.2	2.4	3.8	6.1	6.0	6.8	5.3	5.2	6.1	3.4	2.6	2.3	4.4
1984	2.4	2.4	2.5	5.1	8.1	5.7	5.9	7.4	6.2	3.5	2.4	1.4	4.4
1985	1.8	3.0	5.4	7.8	7.4	5.9	6.4	3.4	5.0	3.7	3.3	3.7	4.7
1986	4.1	4.4	7.0	8.9	7.4	9.6	9.6	7.0	6.6	4.8	3.9	4.0	6.4
1987	4.6	5.0	6.3	8.3	7.4	7.8	9.8	8.3	6.5	3.9	3.3	3.3	6.2
1988	4.6	4.8	5.7	7.0	8.1	8.1	6.9	6.9	5.6	3.9	3.9	4.6	5.8
1989	3.9	5.6	5.6	7.6	8.9	8.0	6.5	6.1	6.1	3.9	3.7	3.5	5.8
1990	3.5	4.3	5.6	8.5	6.5	8.0	8.5	5.2	5.4	3.9	3.5	3.3	5.5
1991	3.7	4.4	5.4	8.1	11.3	8.7	9.3	7.4	6.1	3.5	3.1	3.5	6.2
1992	3.9	5.4	9.1	9.8	9.3	8.5	9.1	7.0	5.2	–	–	–	–
1993	3.2	4.4	6.2	7.4	7.8	7.0	6.0	5.7	5.1	3.0	2.3	2.4	5.0
1994	2.6	3.8	5.0	6.4	6.3	7.4	6.0	5.0	3.9	2.6	2.3	2.1	4.5
1995	2.9	4.2	4.7	7.1	5.7	5.0	5.0	4.2	3.7	2.1	2.3	2.3	4.1
1996	2.6	2.9	4.4	4.8	5.0	3.9	3.2	2.8	2.0	1.6	1.6	1.8	3.1
1997	2.0	2.9	3.4	3.8	3.4	4.5	3.6	3.4	2.3	1.5	1.3	2.3	2.9
1998	2.8	3.0	3.5	4.4	4.0	4.3	3.7	2.3	1.9	1.3	1.5	1.4	2.8
1999	5.2	6.2	7.5	8.1	1.6	3.4	5.0	6.7	8.0	9.0	7.8	5.7	6.2
2000	1.5	2.8	3.7	5.2	7.2	9.0	2.6	2.5	4.0	5.2	6.0	6.6	4.7
Average	3.7	4.5	6.0	7.8	8.3	7.6	7.1	6.3	5.4	3.9	3.6	3.5	5.6

– : Not Available

Table 7-5-2 Monthly Mean Wind Speed at Biratnagar Airport

Anemometer Height: 3m km/hr

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1983	–	–	6.7	–	–	–	5.7	5.8	6.1	3.4	2.1	2.4	–
1984	2.9	4.3	4.7	8.7	11.3	12.7	5.9	7.5	4.7	3.8	2.0	2.2	5.9
1985	2.8	4.1	6.7	10.3	9.8	7.3	7.5	5.7	2.8	2.6	1.0	1.2	5.2
1986	1.7	2.7	3.8	6.5	5.2	6.2	4.4	1.9	3.0	1.2	0.9	1.8	3.3
1987	2.2	2.8	5.7	7.8	7.5	8.0	8.4	0	5.8	3.2	2.2	2.3	4.7
1988	2.4	3.7	5.2	7.6	8.8	6.9	6.0	5.3	4.0	2.6	2.4	2.0	4.7
1989	2.4	3.9	4.2	6.8	9.1	7.0	5.7	5.2	4.9	2.6	2.5	2.0	4.7
1990	2.0	3.2	4.8	8.7	6.4	6.7	6.2	4.0	4.2	3.0	2.0	1.7	4.4
1991	2.0	2.9	4.1	6.8	9.2	6.3	6.2	4.9	–	1.5	1.4	2.1	4.3
1992	1.8	2.9	5.9	7.2	7.1	6.1	5.6	4.0	1.2	0.2	0.5	0.6	3.6
1993	1.0	1.5	1.4	3.0	3.9	2.8	2.0	1.5	1.5	0.1	1.4	0.1	1.7
1994	0.6	1.1	1.7	1.6	5.9	6.0	4.7	3.8	2.9	1.9	1.8	1.6	2.8
1995	2.4	3.4	4.9	7.8	7.4	5.4	4.5	3.2	2.9	1.0	1.6	1.2	3.8
1996	2.0	2.9	3.2	2.1	2.9	2.9	2.7	1.6	0.5	–	–	–	2.3
1997	–	2.6	4.2	4.3	2.1	2.2	1.4	1.4	0.9	0.4	0.7	0.8	1.9
1998	1.1	1.4	2.6	2.3	2.0	2.2	2.0	0.9	0.7	0.4	0.3	0.3	1.4
1999	0.4	0.5	1.2	1.3	1.0	0.5	1.0	0.6	0.7	0.3	0.1	1.2	0.7
2000	1.2	1.2	1.4	2.0	1.7	1.0	0.9	0.6	0.9	0.3	0.2	0.2	1.0
Average	1.8	2.5	4.0	5.3	5.6	5.0	4.5	3.2	2.7	1.6	1.3	1.3	3.2

Attachment

Table 7-6-1 Monthly Mean Pan Evaporation at Tarahara

mm/day

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1970	2.2	2.9	5.1	7.1	6.7	4.7	5.0	4.6	4.2	3.4	2.9	2.2	4.3
1971	2.2	2.9	2.2	4.8	5.2	5.7	5.3	4.8	4.1	3.9	3.5	2.8	4.0
1972	2.5	3.3	4.9	6.0	7.7	5.4	4.7	3.6	3.9	3.2	2.5	1.9	4.1
1973	1.8	2.8	4.4	7.0	5.8	4.0	4.5	3.2	2.8	2.8	3.1	2.1	3.7
1974	2.1	3.0	4.5	4.4	5.2	4.2	3.9	3.1	3.3	3.2	2.9	2.0	3.5
1975	2.0	2.9	5.2	6.1	5.9	4.3	3.2	3.9	3.6	3.6	3.3	2.0	3.8
1976	2.1	3.4	5.1	6.7	5.6	3.3	3.7	3.4	3.7	3.7	2.7	2.0	3.8
1977	1.9	2.7	4.2	5.5	5.1	5.6	4.9	4.3	3.3	2.6	2.4	2.1	3.7
1978	1.7	2.6	4.3	6.0	5.6	5.3	4.5	4.8	3.7	3.3	2.5	1.9	3.9
1979	2.1	2.8	4.1	5.3	5.8	5.8	4.2	4.4	4.1	3.9	2.6	1.9	3.9
1980	2.0	3.0	4.6	6.6	6.9	5.4	4.4	5.0	3.8	3.8	2.9	2.1	4.2
1981	2.2	2.9	5.3	6.3	5.8	6.1	4.3	4.2	4.2	3.6	2.9	2.4	4.2
1982	1.8	2.9	4.4	5.9	6.8	4.9	4.3	4.1	3.2	3.4	2.3	1.7	3.8
1983	1.7	2.8	4.5	6.2	5.9	6.0	5.1	4.3	4.1	3.3	3.0	2.1	4.1
1984	1.9	2.4	4.0	5.9	5.4	4.3	4.7	4.7	3.1	3.8	2.9	1.8	3.7
1985	0.6	2.7	4.4	6.8	6.6	4.6	4.1	4.1	3.5	2.8	2.5	2.0	3.7
1986	2.2	2.9	4.9	6.4	6.1	6.1	–	5.0	3.8	3.6	2.7	2.2	–
1987	1.9	3.3	4.4	6.1	6.6	5.2	4.9	4.9	6.2	3.5	2.9	2.2	4.3
1988	1.9	2.9	–	5.6	6.5	5.6	5.2	5.9	4.8	3.9	2.9	1.7	–
1989	1.7	3.0	4.3	6.6	6.2	6.0	4.4	5.2	5.1	4.3	2.5	1.8	4.3
1990	1.4	2.4	4.2	5.6	4.6	5.4	4.3	4.3	–	–	3.1	1.9	–
1991	1.8	2.6	4.1	6.1	6.5	6.4	5.4	5.2	4.2	–	3.3	1.7	–
1992	1.8	2.5	5.9	7.7	5.9	5.4	5.0	4.4	3.6	3.1	1.8	1.2	4.0
1993	1.1	2.6	4.3	6.3	5.8	4.9	4.4	4.0	–	–	–	–	–
1994	2.0	2.4	4.0	5.5	6.0	4.3	5.0	5.1	4.7	3.3	2.6	1.8	3.9
1995	1.6	2.7	4.3	7.3	6.6	3.7	4.9	5.1	4.2	3.4	2.6	1.6	4.0
1996	1.5	2.5	4.5	6.2	5.9	5.0	4.4	4.3	4.2	3.3	2.5	1.7	3.8
1997	1.6	2.3	4.2	4.6	–	–	–	–	–	–	–	–	–
1998													
1999	6.2	6.9	5.8	6.1	6.9	7.2	7.1	8.4	6.1	7.4	5.5	4.9	6.5
2000	6.8	6.2	6.2	5.5	5.5	6.6	4.3	8.1	7.0	–	–	–	–
mm/month													
Average	2.1	3.0	4.4	6.1	6.0	5.2	4.6	4.7	4.2	3.6	2.9	2.1	4.1

– : Not Available

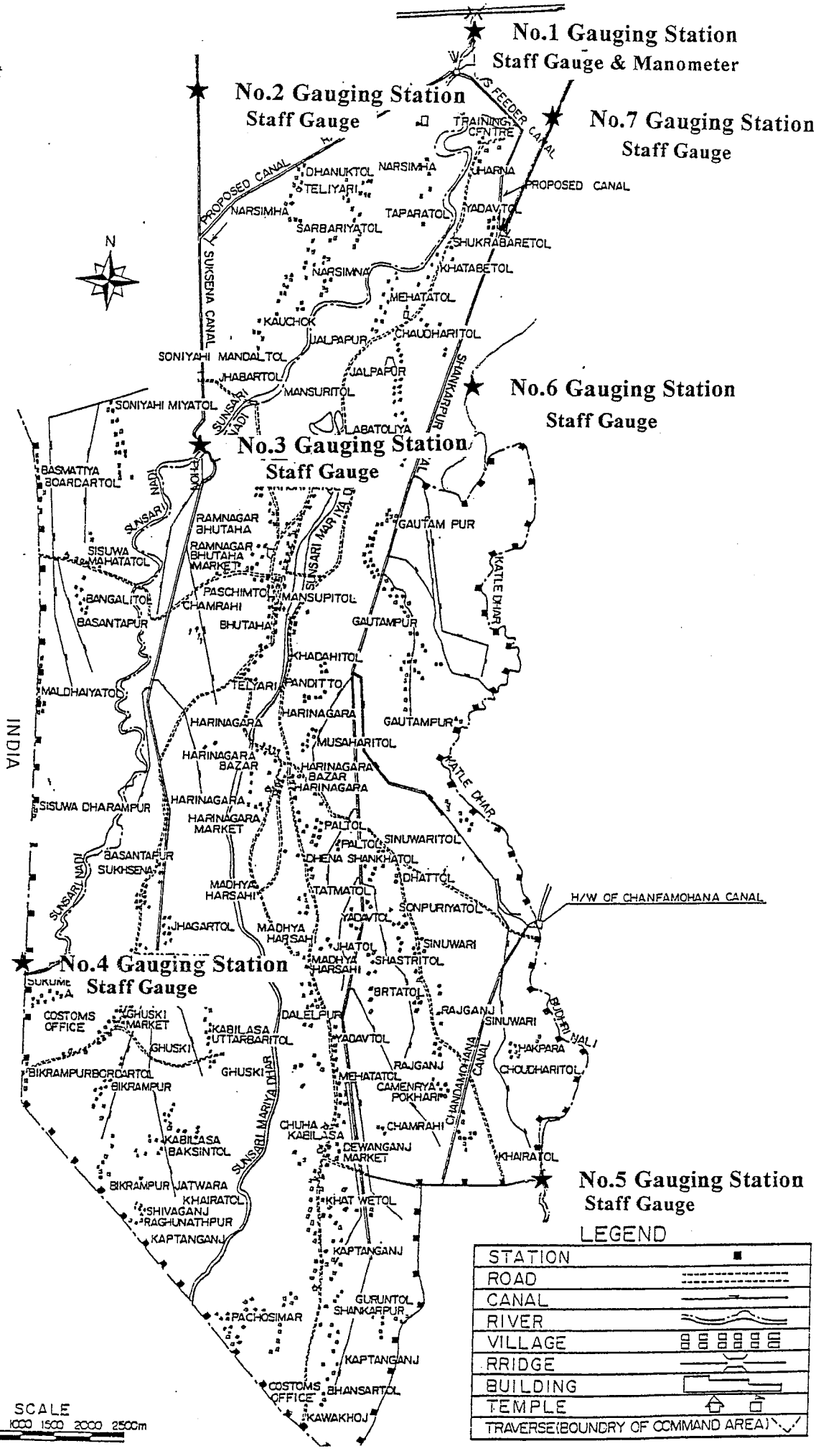


Figure 8-1-1 Location Map of Water Level Gauge Stations

Attachment

Table 8-1-1 Water Level and Discharge Measurement in May.2001

Month: **May** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1																							
2																							
3																							
4																							
5	0.00	Float		**4.670**																			
6	0.80	OTT		**2.683**																			
7	0.00			**2.704**																			
8	0.00	5 cm below																					
9	0.00	DIO								**2.931**			**1.561**										
10	9.00	gauge																					
11	0.00																						
12	0.00	77.84		**2.994**																			
13	0.00													Gauge established									
14	0.00																						
15	19.60	78.77	78.35																	Gauge established			
16	20.60	78.05	78.35			dry			74.76									74.75		83.88	dry		
17	3.30	78.94	78.90		dry	dry		74.75	74.75								74.75	74.74		84.08	84.26		
18	0.00	78.92	77.88		dry	dry		74.77	74.75					63.29	63.24	**4.330**	74.78	74.79	**0.178**	84.22	84.16	**0.855**	
19	0.00	77.80	77.82		dry	dry		74.70	74.71					63.31	63.28		74.81	74.79		84.17	84.26		
20	0.00	77.84	77.88		dry	dry		74.72	74.71					63.29	63.29		74.77	74.78		84.12	84.15		
21	6.60	77.84	77.78		dry	dry		74.70	74.69					63.32	62.96		74.75	74.74		84.00	83.99		
22	0.00	77.90	77.86	**3.342**	80.68	80.70		74.68	74.70	**3.973**	69.31	69.32	**2.392**	63.24	63.26		74.76	74.75		83.99	84.01		
23	15.30	77.92	78.00		80.70	80.69		74.73	74.75		69.32	69.35		63.30	63.26		74.83	74.82		84.01	84.03		
24	24.00	78.20	78.40		80.67	80.71		74.84	74.81		69.50	69.51		63.49	63.54		74.85	74.80		84.01	84.00		
25	35.30	78.30	78.40		80.81	80.76		74.88	74.87		69.56	69.75		63.68	63.90		74.87	74.88		84.17	84.00		
26	39.20	78.56	787.54		80.67	80.64		75.25	75.37		69.96	70.02		64.11	64.04		75.23	75.19		84.07	84.09		
27	0.70	78.30	78.22		80.70	80.68		75.10	74.92		69.87	69.80		64.01	63.79		74.99	74.94		84.10	84.06		
28	0.00	78.04	78.02		80.68	80.67		74.90	74.85		69.65	69.59		63.58	63.45		74.89	74.90		83.92	84.06		
29	0.00	78.02	78.00		80.65	80.68		74.79	74.78		69.55	69.50		63.42	63.40		74.83	74.86		83.93	83.95		
30	10.08	77.96	77.92		80.66	80.67		74.78	74.77		69.52	69.49		63.46	63.44		74.93	74.90		84.02	93.99		
31	0.00	77.90	77.88		80.66	80.65		74.76	74.80		69.50	69.51		63.43	63.40		74.88	74.86		84.02			

Attachment

Table 8-1-2 Water Level and Discharge Measurement in June.2001

Month: **June** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.94	77.92		80.63	80.61		74.77	74.76		69.49	69.48		63.47	63.48		74.85	74.85		83.93			
2	0.00	77.94	77.93		80.65	80.62		74.76	74.75		69.47	69.46		63.47	63.39		74.87	74.86		83.72			
3	45.60	79.02	79.00		81.00	80.96		75.30	75.25		69.54	70.66		63.51	63.78		75.11	75.08		84.02			
4	4.60	78.40	78.48		80.78	80.80		75.15	75.05		70.32	70.15		64.08	63.90		75.03	74.98		84.02			
5	2.60	78.00	78.04		80.90	80.88		75.15	75.09		69.96	69.88		63.76	63.72		75.00	74.98		84.00			
6	65.00	78.60	78.54		80.80	80.78		75.78	75.75		69.98	70.65		63.78	64.48		75.29	75.50		84.05			
7	8.00	77.94	77.90		80.58	80.54		75.77	75.86		70.46	70.60		64.65	64.81		75.49	75.38		83.64			
8	4.60	77.62	77.60		80.60	80.58		75.44	75.45		70.28	70.18		64.94	64.47		75.20	75.23		83.62			
9	10.80	77.86	77.88		80.74	80.76		75.50	75.46		70.08	70.22		64.80	64.81		75.45	75.42		83.84			
10	40.00	77.24	77.20		81.02	80.98		75.28	75.27		70.14	70.09		64.47	64.35		75.07	75.04		Dry	Dry		
11	0.00	77.16	77.46		80.84	80.80		75.27	75.18		70.05	70.00		63.98	63.82		75.00	75.02		Dry	Dry		
12	0.00	77.96	77.90	**11.330**	80.60	80.56	**0.252**	75.13	75.07		69.86	69.70		63.67	63.60		75.07	75.06		Dry	Dry		
13	5.50	77.92	77.88		80.70	80.67		75.00	74.97		69.88	69.67		63.56	63.57		75.05	75.00		Dry	Dry		
14	0.00	78.02	77.98		80.40	80.39		74.90	74.90		69.70	69.65		63.54	63.52		74.89	74.90		Dry	Dry		
15	0.00	78.00	78.00		80.34	80.30		74.88	74.86		69.71	69.70		63.48	63.47		74.89	74.92		Dry	Dry		
16	4.00	78.02	77.96		dry	dry		74.87	74.85	**6.717**	69.70	69.68	**5.473**	63.45	63.43	**5.104**	74.95	74.93		Dry	Dry		
17	0.00	77.98	77.94		dry	dry		74.92	74.89		69.67	69.66		63.43	63.43		75.13	75.08		Dry	Dry		
18	0.70	77.92	78.00		dry	dry		74.89	74.90		69.64	69.64		63.42	63.42		75.03	75.00		Dry	Dry		
19	46.20	78.04	78.02		dry	dry		74.71	74.88		69.65	69.66		63.46	63.49		75.09	75.08		Dry	Dry		
20	0.00	78.00	78.40		80.50	80.46		74.90	74.88		69.67	69.69		63.49	63.48		75.10	75.08		Dry	Dry		
21	10.00	78.44	787.38	**14.111**	80.82	80.78		75.31	75.27	**15.350**	69.97	69.99	**14.030**	64.19	64.35		75.36	75.30		Dry	Dry		
22	13.30	78.42	78.42		80.75	80.72		75.36	75.29		69.98	69.97		64.21	64.32		75.38	75.31		Dry	Dry		
23	20.80	78.45	78.25		80.80	80.76		75.32	75.24		69.99	70.01		64.30	64.26		75.27	75.23		Dry	Dry		
24	0.00	78.30	78.18		80.72	80.70		75.15	75.09		69.99	69.98		63.98	63.82		75.16	75.14		Dry	Dry		
25	0.00	78.22	78.12		80.66	80.64		75.04	75.00		69.80	69.79		63.71	63.60		75.15	75.13		Dry	Dry		
26	9.40	78.16	78.12		80.64	80.63		74.96	74.95		69.76	69.74		63.59	63.56		75.12	75.13		Dry	Dry		
27	0.00	78.08	78.06		80.74	80.76		74.94	74.92		69.73	69.72		63.55	63.53		75.12	75.11		Dry	Dry		
28	16.20	78.12	78.04		80.86	80.85		74.96	74.93		69.82	70.00		63.56	63.62		75.13	75.12		Dry	Dry		
29	0.00	78.02	78.00	**5.980**	80.90	80.86	**0.501**	74.91	74.90		70.00	69.69		63.61	63.58	**6.354**	75.14	75.11	**0.200**	Dry	Dry		
30	0.00	78.02	78.04		80.88	80.84		74.89	74.89		69.68	69.68		63.55	63.56		75.11	75.11		Dry	83.88		
31																							

Table 8-1-3 Water Level and Discharge Measurement in July.2001

Month: **July 2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.96	78.04		80.82	80.86		74.90	74.89		69.69	69.68		63.52	63.51		75.10	75.10		Dry	83.08		
2	0.00	77.92	77.94		80.86	80.84		74.88	74.88		69.67	69.66		63.50	63.51		75.09	75.09		83.08	Dry		
3	0.00	78.00	78.06		80.85	80.86		74.89	74.88		69.65	69.66		63.50	63.48		75.08	75.08		83.08	83.07		
4	0.00	78.04	78.20		80.84	80.92		74.88	75.00		69.64	69.65		63.49	63.48		75.00	75.17		83.09	83.01		
5	9.90	78.26	78.22		80.92	80.88		75.00	74.98		69.70	69.74		63.58	63.64		75.07	75.13		84.06	84.10		
6	0.00	78.16	78.14		80.84	80.86		74.97	74.96		69.74	69.73		63.59	63.58		75.15	75.11		84.08	84.10		
7	0.00	78.15	78.12	**9.649**	80.86	80.84		74.95	74.94		69.72	69.70		63.54	63.55		75.11	75.12		84.12	84.12		
8	0.00	78.12	78.10		80.82	80.80		74.94	74.93		69.70	69.69		63.56	63.52		75.12	75.11		84.18	84.14		
9	0.00	78.06	78.04		80.76	80.78		74.93	74.92		69.69	69.68		63.49	63.47		75.12	75.10		84.16	84.18		
10	5.10	78.18	78.14		80.86	80.85		74.92	74.93		69.67	69.66		63.48	63.50		75.10	75.09	**0.175**	84.23	84.18	**0.539**	
11	5.70	78.22	78.20		80.88	80.87		74.94	74.95	**7.692**	69.68	69.72	**5.004**	63.51	63.52	**6.096**	75.11	75.08		84.20	84.19		
12	0.00	78.18	78.20		80.84	80.80		74.97	74.96		69.74	69.71		63.51	63.50		75.09	75.08		84.06	84.09		
13	0.00	78.16	78.10		80.82	80.84		74.95	74.94		69.70	69.67		63.48	63.48		75.08	75.07		84.07	84.06		
14	1.60	78.14	78.10		80.86	80.90	**0.850**	74.96	74.95		69.67	69.66		63.47	63.48		75.08	75.08		84.13	84.10		
15	0.00	78.08	78.12	**7.759**	80.96	80.95		74.94	74.95		69.66	69.66		63.49	63.27		75.07	75.07		84.00	84.14		
16	24.20	78.18	78.22		80.93	80.94		75.05	75.07		69.79	69.75		63.26	63.24		74.92	75.00		84.14	84.09		
17	5.00	78.22	78.26		80.92	80.89		75.05	75.06		69.80	69.81		63.29	63.51		74.91	74.89		84.17	84.24		
18	0.00	78.28	78.25		80.92	80.90		75.04	75.08		69.83	69.79		63.67	63.11		74.95	74.93		84.24	84.20		
19	5.30	78.46	78.50		81.03	81.00		75.10	75.16		69.86	69.87		63.26	63.28		75.10	75.02		84.14	84.34		
20	1.70	78.44	78.40		80.98	80.97		75.27	75.24		70.05	70.01		63.29	63.24		75.02	75.04		84.30	84.32		
21	0.00	78.46	78.43	**21.423**	80.94	80.92	**1.197**	75.30	75.28		69.99	69.98		63.30	63.31		75.00	75.05		84.34	84.24	**1.671**	
22	0.00	78.32	78.23		80.90	80.89		75.27	75.20		69.96	69.93		63.45	63.33		75.02	75.03		84.22	84.22		
23	0.00	78.34	78.36		80.88	80.86		75.10	75.13		69.91	69.89		63.32	63.34		75.02	75.01		84.20	84.20		
24	0.00	78.34	78.36		80.92	80.92		75.18	75.16		69.88	69.88	**7.096**	63.39	63.64	**4.696**	75.11	75.06		84.22	84.25		
25	2.10	78.36	78.40		80.88	80.99		75.20	75.27		69.89	69.95		63.75	63.75		75.11	75.11		84.30	84.36		
26	2.00	78.44	78.40		80.86	80.84		75.21	75.18		69.89	69.95		63.67	63.72		75.13	75.16		84.41	84.40		
27	0.00	78.38	78.33		80.83	80.79		75.20	75.10		70.05	70.01		63.98	63.77		75.00	75.07		84.40	84.44		
28	3.20	78.32	78.60		80.80	80.78		75.18	75.40		70.03	70.07		63.62	63.63		74.98	74.98		84.24	84.30		
29	16.00	78.50	78.54	**23.031**	80.86	80.89	**1.033**	75.38	75.35		70.04	70.25		64.02	64.14		75.08	75.17	**0.630**	84.30	84.28		
30	96.50	80.30	80.36	**239.77**	80.98	81.08	**1.486**	76.86	76.90	**218.41**	70.08	70.13		64.84	66.04		75.88	76.26		84.16	84.16		
31	2.30	79.65	79.40		80.94	80.82		76.70	76.58		70.28	70.28		65.86	65.50		75.82	75.58	**4.990**	84.00	83.90		

Table 8-1-4 Water Level and Discharge Measurement in August.2001

Month: **August** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	11.50	79.36	79.30		80.40	80.36		76.41	76.28	**87.48**	70.32	70.33		64.80	64.66		75.42	75.34		83.90	83.86		
2	10.10	79.22	79.12		80.36	80.32		76.74	76.71		70.33	70.21		64.90	65.08		75.36	75.33		83.85	83.80		
3	0.00	78.98	78.93	**87.61**	canal was closed			76.21	76.02		70.17	70.13		64.80	64.62		75.26	75.20		83.70	83.74	**0.183**	
4	0.00	78.56	78.48		canal was closed			75.65	75.48		70.04	70.01		64.48	64.24		75.15	75.09		83.73	83.74		
5	0.00	78.52	78.55		80.84	80.88		75.43	75.40		70.00	69.99		63.99	63.90		75.07	75.05		83.74	83.74		
6	3.50	78.64	78.60		80.95	80.98		75.57	75.62		70.31	71.28	**13.50**	63.94	63.92	**9.70**	75.03	75.05		83.02	83.04		
7	0.00	78.56	78.52		81.10	81.08		75.53	75.46		71.22	71.14		63.88	63.83		75.05	75.03		84.00	84.00		
8	0.00	78.44	78.40		dry	dry		75.38	75.31		71.06	70.98		63.80	63.72		75.02	75.01		83.78	83.74		
9	0.00	78.34	78.32		dry	dry		75.22	75.19		70.91	70.90		65.59	63.54		75.00	74.97		83.74	83.72		
10	1.30	78.26	78.30		80.76	80.78		75.28	75.23		70.93	70.85		63.75	63.54		74.96	74.96		83.02	83.02		
11	4.50	78.32	78.27	**10.048**	80.82	80.85		75.18	75.17	**11.775**	70.87	70.85	**16.16**	63.67	63.68	**7.70**	74.98	74.98		83.88	83.86		
12	0.00	78.26	78.28		80.90	80.88		75.20	75.17		70.77	70.75		63.62	63.64		74.99	74.98		83.88	84.30		
13	0.00	78.30	78.27		80.85	80.84		75.14	75.13		70.73	70.73		63.52	63.58		75.00	75.00		84.12	84.14		
14	3.10	78.26	78.24		80.82	80.80		75.12	75.05		70.69	70.67		63.57	63.60		75.01	75.00		84.20	84.50		
15	7.00	78.24	78.26		80.80	80.78		75.00	74.99		70.64	70.62		63.56	63.54		75.01	75.00		83.90	83.94		
16	0.00	78.22	78.25		80.76	80.80		74.99	74.97		70.61	70.61		63.51	63.57		75.00	74.99		84.04	84.06		
17	0.80	78.72	78.77		81.10	81.12		75.52	75.60		70.74	70.79		63.67	63.69		75.00	75.02	**0.212**	84.00	84.14		
18	2.30	78.66	78.60		80.88	80.86		75.68	75.51		71.13	71.09		63.72	63.76		75.00	74.99		84.18	84.18		
19	0.00	78.50	78.54		80.90	80.95		75.36	75.39		70.08	70.12		63.79	63.74		74.99	74.99		84.15	84.15		
20	0.00	78.66	78.60		80.98	80.95		75.46	75.41		70.00	70.50		63.65	63.76		75.00	75.01		84.06	84.06		
21	19.90	78.57	78.52		80.80	80.76		75.43	75.45		70.24	70.14		63.70	63.70		75.03	75.04		84.00	84.04		
22	72.10	78.96	79.10		80.60	80.54		75.61	75.21		70.10	70.90		66.26	66.70		75.59	76.29		84.14	84.00		
23	13.30	78.12	79.05		80.56	80.54		76.24	76.13		70.96	70.98		65.10	65.98		75.88	75.80		84.06	84.08		
24	27.50	78.82	78.77		80.50	80.48		76.04	75.98		70.80	70.76		65.85	65.83		75.50	75.32		84.00	84.06		
25	0.00	78.66	78.58	**45.086**	80.67	80.65	**0.332**	75.64	75.52	**34.856**	70.47	70.43	**24.15**	65.74	65.79		75.28	75.26		83.97	83.84	**0.245**	
26	38.40	78.52	78.55		80.62	80.60		75.54	75.49		70.70	70.43	**with held**	65.72	65.65		75.23	75.21		83.09	84.10		
27	35.80	78.80	78.77		80.65	80.64		75.86	75.73		70.78	70.71		65.70	65.68		75.52	75.42		84.18	84.24		
28	28.70	78.68	78.60		80.60	80.58		75.78	75.66		70.65	70.62		65.60	65.65		75.76	75.63		84.20	84.16		
29	16.30	78.72	78.68		canal was closed			75.92	75.83		70.64	70.72		64.00	64.64		75.68	75.54		84.14	84.14		
30	0.00	78.64	78.60		80.85	80.82		75.77	75.73		70.75	70.70		63.70	63.69		75.48	75.42		84.14	84.16		
31	14.60	78.56	78.53		80.86	80.85		75.64	75.56		70.58	70.50		64.05	64.09		75.34	75.27	**0.251**	84.14	84.18		

Table 8-1-5 Water Level and Discharge Measurement in September.2001

Month: **September** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	1.70	79.54	79.68	**88.13**	81.08	81.10	**1.067**	76.40	75.38	**97.01**	70.40	70.38		63.50	63.55		75.24	75.22		84.16	84.36		
2	8.40	79.72	79.80		81.10	81.12		75.39	75.36		70.38	70.28		63.60	65.56		75.20	75.18		84.36	84.34		
3	12.80	79.86	79.90		81.10	81.05		75.58	76.68		70.30	70.09		64.02	64.08		75.26	75.31		84.33	84.28		
4	55.80	79.40	79.28		809.00	80.86		76.40	76.26		71.10	70.08		64.72	65.97		76.19	75.92		84.22	84.16		
5	0.00	78.86	78.78	**40.855**	80.82	80.80		75.95	75.88	**44.488**	70.90	70.88	**35.30**	63.65	63.70		75.64	75.56		84.20	84.18	**0.476**	
6	30.00	79.02	78.90		80.84	80.86		76.10	75.95		70.90	70.91		65.60	65.54		75.40	75.37		84.10	84.00		
7	10.30	78.76	78.70		80.85	80.88		75.86	75.81		70.76	70.70		64.00	64.16		75.44	75.39		84.06	84.04		
8	2.50	78.78	78.68		80.90	80.87		75.87	75.91		70.69	70.70		63.75	63.80		75.36	75.40		84.04	84.04		
9	10.40	78.60	78.65		80.88	80.90		75.70	75.65		70.65	70.60		65.00	65.04		75.38	75.35		84.02	84.04		
10	46.40	79.18	79.14		80.98	81.00		76.38	76.29		71.15	71.10		64.87	64.85	**21.470**	75.49	75.58	**4.53**	84.04	84.04		
11	10.90	79.10	79.02		80.95	80.92		76.23	76.25		70.09	70.07		64.74	64.77		75.61	75.54		84.06	84.02		
12	10.60	78.88	78.92		80.96	80.94		75.89	75.96		70.21	70.61		64.59	64.57		75.42	75.50		84.04	84.06		
13	49.30	79.16	79.10		80.98	81.54		76.30	76.33		70.88	71.14		65.70	66.20		75.97	75.79		84.12	84.10		
14	1.40	79.04	78.98		80.96	80.94		76.27	76.05		71.09	71.02		65.70	64.78		75.64	75.52		84.16	84.06		
15	0.00	78.72	78.66	**37.528**	80.94	80.92		75.84	75.72		70.90	70.78		64.64	64.27		75.35	75.31	**1.543**	83.99	83.96	**0.408**	
16	0.00	78.54	78.50		80.92	80.90		75.61	75.77		70.65	70.60		64.26	64.21		75.27	75.22		83.80	84.04		
17	32.80	79.30	79.18		80.96	80.98		76.16	76.36		70.83	71.10		65.00	65.80		75.75	75.78		84.14	84.17		
18	0.00	79.06	78.96		80.92	80.90		76.00	75.90		71.01	70.90		64.83	64.78		75.37	75.31		84.16	84.16		
19	8.70	78.88	78.82		80.89	80.88		75.82	75.70		70.85	70.80		64.47	64.24		75.23	75.20		84.19	83.88		
20	0.00	78.66	78.54		80.88	80.90		75.58	75.48		70.70	70.50		64.14	64.12		75.18	75.16		83.89	83.78		
21	0.00	78.40	78.32		80.92	80.89		75.37	75.33		70.38	70.24		63.94	63.89		75.15	75.14		83.80	83.86		
22	0.00	78.34	78.28	**12.743**	80.79	80.86	**0.458**	75.29	75.25	**14.89**	70.20	70.14	**11.03**	63.90	63.85		75.20	75.12		84.10	83.90		
23	4.20	78.36	78.30		80.88	80.84		75.22	75.27		70.09	70.04		63.77	63.73		75.11	75.10		83.84	84.00		
24	37.60	78.72	78.64		81.20	81.16		75.80	75.69		70.20	70.54		64.04	64.06		75.16	75.15		83.38	84.12		
25	38.70	79.00	78.88		81.08	81.04		76.18	76.03		70.50	70.92		64.18	64.32	**16.690**	75.31	75.29	**0.228**	84.14	84.14	**0.390**	
26	0.00	78.80	78.72		80.98	80.95		75.96	75.84		70.87			63.34	64.08		75.30	75.29		84.10	84.14		
27	0.00	78.62	78.58		80.92	80.90		75.69	75.53		70.69			64.31	64.28		75.25	75.23		84.10	84.10		
28	7.60	78.56	78.48		80.87	80.85		75.62	75.56		70.60			64.93	64.86		75.29	75.26		84.04	84.10		
29	1.00	78.42	78.35		80.94	80.92		75.49	75.45		70.50			64.45	64.50		75.24	75.20		84.84	83.94		
30	13.20	78.50	78.44		80.92	80.90		75.46	75.42		70.36			64.26	64.19		75.18	75.17		84.14	84.14		

Table 8-1-6 Water Level and Discharge Measurement in October.2001

Month: **October** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	25.30	78.78	78.75	**51.055**	80.95	80.96	**1.221**	75.84	75.88		70.40	70.77		64.26	64.19		75.30			83.34	84.14		
2	30.70	78.72	78.68		80.90	80.92		75.93	75.91		70.78	70.80		64.47	64.68		75.49			84.13	84.12		
3	24.30	78.80	78.84		80.94	80.90		75.97	76.03		70.90	70.99		64.93	65.03		75.70			84.16	84.18		
4	34.90	78.90	78.86		80.89	80.90		76.10	76.16		71.05	71.08		65.56	65.43		75.89			84.14	84.18		
5	125.0	80.12	80.42		80.88	80.95		76.77	77.03		71.12	71.20		65.32	65.59		77.32			84.16	84.54		
6	43.40	80.38	80.26		80.82	80.81		77.36	76.98		71.42	71.40		65.08	66.48		drawn	drawn		84.80	84.56		
7	0.80	79.32	79.16	**89.391**	80.80	80.77		76.70	76.48	**103.97**	71.35	71.30	**arround**	67.70	67.80		drawn	42.00		84.24	84.14	**0.523**	
8	0.00	78.94	78.82		80.65	80.60		76.12	75.97		70.99	70.90	**103.97**	67.46	66.34		79 cm	86.00		83.93	83.90		
9	0.00	78.64	78.52		80.62	80.60		75.82	75.76		70.75	70.60		65.17	64.93		94 cm	99.00		83.84	83.84		
10	0.50	78.50	78.42		80.60	80.60		76.12	76.47		70.50	71.00		64.64	64.53		102.00	100.00		83.84	83.82		
11	45.90	79.16	78.96		80.58	80.56		76.38	76.09		71.12	71.09		64.44	64.33		86.00	91.00		83.82	84.00		
12	0.00	78.72	78.65		80.52	80.50		75.88			70.73	70.68		65.00	64.81		96.00			83.81	83.80		
13	0.00	78.44	78.38	**28.35**	80.50	80.50		75.62	75.52		70.60	70.57		64.62	64.46		102.00	106.00		83.83	83.70		
14	0.00	78.36	78.30		80.52	80.50		75.52	75.46		70.40	70.37		64.36	64.33		108.00	111.00		83.84	dry		
15	0.00	78.30	78.27		dry	dry		75.41	75.40		70.33	70.30		64.10	64.13	**13.677**	112.00	115.00		dry	dry		
16	0.00	78.20	78.22		dry	dry		75.89	75.36		70.30	70.29		64.04	64.01		116.00	118.00		dry	dry		
17	0.00	78.20	78.18		dry	dry		75.31	75.26		70.20	70.15		63.98	63.97		119.00	121.00		dry	dry		
18	0.00	78.20	78.20		dry	dry		75.21	75.19		70.10	70.02		63.98	63.95		122.00	124.00	**0.189**	dry	dry		
19	0.00	78.12	78.13	**23.37**	dry	dry	**Dry**	75.18	75.09	**20.879**	70.00	69.97	**22.55**	63.91	63.92		125.00	124.00		dry	dry		
20	0.00	78.20	78.16		dry	dry		75.03	75.01		69.96	69.95		63.89	63.83		124.00	125.00		dry	dry		
21	0.00	78.15	78.13		dry	dry		75.00	74.98		69.93	69.90		63.77	63.75		125.00	126.00		dry	dry		
22	0.00	78.14	78.10		dry	dry		74.97	74.96		69.88	69.86		63.81	63.83		127.00	127.00		dry	dry		
23	0.00	78.12	78.08		dry	dry		74.98	74.97		69.84	69.83		63.79	63.78		128.00	129.00		83.90	83.88		
24	0.00	78.10	78.09		dry	dry		Missing			69.82	69.82		63.83	63.85		Missing			83.90	83.90		
25	0.00	Missing			dry	dry		Missing			69.81	68.80		63.76	63.73		Missing			83.84	83.80		
26	0.00	Missing			dry	dry		Missing			69.79	69.78		63.69	63.58		Missing			83.80	83.82		
27	0.00	Missing			dry	dry		Missing			69.76	69.75		63.47	63.37	**5.31**	Missing			83.90	83.90		
28	0.00	77.95	77.93	**7.253**	dry	dry		74.93	74.92		69.74	69.74		63.82	63.79		130(74.705)	129.00	**0.234**	83.88	83.88	**0.246**	
29	0.00	77.88	77.85		dry	dry		74.91	74.90		69.73	69.72		63.72	63.61		127.00	124.00		83.80	83.80		
30	0.00	77.84	77.82		dry	dry		74.90	74.89		69.71	69.72		64.05	64.13		118.00	115.00		83.88	83.86		
31	0.00	78.03	78.07		dry	dry		74.91	75.05		69.73	69.73		64.16	63.85		123.00	124.00		83.92	83.90		

Table 8-1-7 Water Level and Discharge Measurement in November.2001

Month: **November** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	5.40	78.20	78.18		dry	dry		75.60	75.59		69.78	69.88		636.80	63.77		125.00	126.00		84.04	84.06		
2	0.00	78.32	78.27		dry	dry		75.35	75.27		69.94	70.02		63.74	63.76		127.00	129.00		83.87	84.04		
3	0.00	78.20	78.15		dry	dry		75.18	75.09		69.91	69.80		63.63	63.61		129.00	131.00		83.84	83.83		
4	0.00	78.06	78.04	**8.478**	dry	dry		75.02	75.01		69.78	69.74		63.58	63.62		132(74.69)	134.00	**0.174**	83.73	83.76	**0.229**	
5	0.00	78.00	77.98		dry	dry		74.99	74.98		69.74	69.72		63.59	63.61		135.00	134.00		83.82	83.82		
6	0.00	77.99	77.94		dry	dry		75.00	74.98		69.73	69.71		63.80	63.56		136.00	136.00		83.74	83.74		
7	0.00	77.92	77.91		dry	dry		74.97	74.99		69.68	69.70		63.58	63.57		137.00	138.00		83.72	83.70		
8	0.00	77.92	77.90		dry	dry		75.01	75.00		69.69	69.67		63.57	63.56		133.00	140.00		73.70	83.70		
9	0.00	77.98	77.97		dry	dry		75.02	75.01		69.69	69.71		63.54	63.52		138.00	138.00		Dry	Dry		
10	0.00	77.98	77.98	**8.312**	dry	dry		75.00	74.99	**8.530**	69.68	69.67	**7.721**	63.52	63.55	**6.254**	138.00	139.00		Dry	Dry		
11	0.00	77.98	77.97		dry	dry		74.98	74.98		69.65	69.63		63.53	63.52		139.00	139.00		Dry	Dry		
12	0.00	77.96	77.96		dry	dry		74.97	74.97		69.62	69.60		63.50	63.53		138.00	139.00		Dry	Dry		
13	0.00	77.96	77.96		dry	dry		74.98	74.98		69.59	69.57		63.51	63.53		139.00	136.00		Dry	Dry		
14	0.00	77.96	77.95		dry	dry		74.97	74.96		69.56	69.53		63.54	53.51		136.00	135.00		Dry	Dry		
15	0.00	77.95	77.94		dry	dry		74.98	74.98		69.50	69.48		63.52	63.49		131.00	129.00		Dry	Dry		
16	0.00	77.94	77.94		dry	dry		74.97	74.97		69.47	69.44		63.50	63.51		127.00	126.00		Dry	Dry		
17	0.00	77.94	77.93	**5.091**	dry	dry		74.96	74.96	**5.679**	69.46	69.50	**5.018**	63.49	63.48		124.00	123.00		Dry	Dry		
18	0.00	77.95	77.95		dry	dry		74.98	74.96		69.50	69.52		63.46	63.53		120.00	119.00		Dry	Dry		
19	0.00	77.94	77.94		dry	dry		74.96	74.95		69.51	69.50		63.51	63.49		118.00	120.00		83.72	83.86		
20	0.00	77.94	77.94		dry	dry		74.95	74.95		69.49	69.48		63.49	63.51		129.00	137.00		84.18	84.20		
21	0.00	77.94	77.94		80.98	80.98		74.96	74.95		69.48	69.49		63.49	63.48		146.00	145.00		84.04	84.00		
22	0.00	77.94	77.94		80.96	80.96		74.96	74.95		69.52	69.53		63.49	63.50		145.00	144.00		83.90	83.90		
23	0.00	77.93	77.93		dry	dry		74.98	74.97		69.51	69.50		63.48	63.47		143.00	142.00		83.70	83.68		
24	0.00	77.92	77.92		dry	dry		74.96	74.96		69.56	69.59		63.51	63.49	**6.333**	143.00	142.00		63.68	63.67		
25	0.00	78.07	78.05		dry	dry		75.10	75.07		69.70	69.69		63.48	63.50		145.00	143.00		Dry	Dry		
26	0.00	780.14	78.02	**5.553**	dry	dry		74.99	74.99		69.69	69.67		63.47	63.49		142.00			83.80	84.06		
27	0.00	78.024	78.02		dry	dry		74.96	74.95		69.67	69.66		63.48	63.47		143.00	137.00		83.82	84.04		
28	0.00	78.024	78.02		dry	dry		74.95	74.94	**6.593**	69.64	69.62		63.48	63.49		132(74.69)	133.00	**0.169**	84.19	84.14	**1.068**	
29	0.00	78.010	78.01		dry	dry		74.95	74.95		69.61	69.58		63.47	63.53		132.00	134.00		83.84	83.92		
30	0.00	78.010	78.01		dry	dry		74.95	74.94		69.57	69.55		63.52	63.53		135.00	135.00		83.84	83.84		

Attachment

Table 8-1-8 Water Level and Discharge Measurement in December.2001

Month: **December** **2001**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	78.02	78.02		dry	dry		74.96	74.95		69.54	69.53		63.51	63.52		136.00	136.00		83.78	836.78		
2	0.00	78.02	78.02		dry	dry		74.97	74.96		69.53	69.52		63.49	63.45		135.00	137.00		83.70	83.70		
3	0.00	78.01	78.01		dry	dry		74.96	74.96		69.51	69.50		63.48	63.47		138.00	139.00		83.68	83.68		
4	0.00	77.99	77.99	**5.490**	dry	dry		74.95	74.95		69.50	69.49		63.47	63.49		139.00	140.00		83.66	83.66		
5	0.00	77.99	77.99		dry	dry		74.96	74.95		69.49	69.48		63.48	63.40		141.00	141.00		83.75	83.75		
6	0.00	77.99	77.99		dry	dry		74.96	74.96		69.48	69.48		63.18	63.60		142.00	143.00		Dry	Dry		
7	0.00	77.99	77.98		dry	dry		74.95	74.94		69.48	69.47		63.53	63.50		143.00	144.00		Dry	Dry		
8	0.00	77.97	77.97		dry	dry		74.93	74.92		69.47	69.47		63.45	63.47		145.00	145.00		Dry	Dry		
9	0.00	77.97	77.97		dry	dry		74.92	74.92		69.46	69.46		63.43	63.46		144.00	144.00		Dry	Dry		
10	0.00	77.97	77.97		dry	dry		74.93	74.92		69.46	49.45		63.44	63.22		143.00	143.00		Dry	Dry		
11	0.00	77.97	77.97	**4.591**	dry	dry		74.92	74.92	**5.013**	69.46	69.45	**4.573**	63.16	63.14	**4.127**	144.00	144.00		Dry	Dry		
12	0.00	77.96	77.96		80.92	80.94		74.93	74.92		69.45	69.44		63.28	63.30		145(74.56)145			Dry	Dry	**0.00**	
13	0.00	77.96	77.96		80.94	80.94		74.92	74.92		69.44	69.44		63.33	63.29		145.00	144.00		Dry	Dry		
14	0.00	77.96	77.96		dry	dry		74.91	74.91		69.44	69.43		63.39	63.36		145.00	145.00		Dry	Dry		
15	0.00	77.96	77.96		dry	dry		74.92	74.92		69.43	69.43		63.34	63.37		144.00	144.00		Dry	Dry		
16	0.00	77.96	77.96		dry	dry		74.92	74.91		69.42	69.43		63.38	63.41		143.00	143.00		Dry	Dry		
17	0.00	77.95	77.95		dry	dry		74.91	74.91		69.44	69.45		63.38	63.40		144.00	145.00		Dry	Dry		
18	0.00	77.95	77.95		dry	dry		74.91	74.91		69.45	69.44		63.60	63.66		145.00	144.00		Dry	Dry		
19	0.00	77.95	77.95		dry	dry		74.91	74.90		69.44	69.45		63.73	63.63		143.00	142.00		Dry	Dry		
20	0.00	77.94	77.94		80.90	80.90		74.91	74.91		69.45	69.45		63.53	63.48		142.00	143.00		83.80	84.06		
21	0.00	77.94	77.95		dry	dry		74.92	74.92		69.44	69.44		63.45	63.47		142.00	141.00		83.90	83.88		
22	0.00	77.95	77.95	**4.868**	dry	dry		74.91	74.91	**5.247**	69.42	69.43	**4.610**	63.49	63.46		141.00	141.00		83.86	83.87		
23	0.00	77.95	77.95		80.70	80.72		74.91	74.91		69.43	69.42		63.40	63.41		140.00	140.00		84.06	84.04		
24	0.00	77.97	77.98		80.70	80.70		74.90	74.90		69.42	69.42		63.42	63.41	**4.776**	142(74.59)141		.08to0.09	84.12.	84.02	**0.855**	
25	0.00	77.98	77.98		80.72	80.74		74.91	74.91		69.41	69.41					140.00	140.00		84.08	84.18		
26	0.00	77.98	77.98		80.72	80.75		74.92	74.92		69.41	69.42					140.00	140.00		83.94	84.16		
27	0.00	77.98	77.98		80.76	80.75		74.91	74.91		69.42	69.41					139.00	139.00		84.15	84.12		
28	0.00	77.98	77.98	**5.223**	80.79	80.80		74.91	74.91		69.41						139.00	139.00		84.00	84.02		
29	0.00	77.98	77.98		80.86	80.86		74.91	74.91								140.00	140.00		84.04	84.04		
30	0.00	77.98	77.98		80.80	80.75		74.90	74.90								141.00	141.00		84.00	84.00		
31	0.00	77.98	77.98		80.73	80.72		74.91	74.91								141.00	141.00		84.10	84.12		

Table 8-1-9 Water Level and Discharge Measurement in January.2002

Month: **January** **2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.99	77.99		80.75	80.75		74.91	74.91		69.42	69.42		63.28	63.23		142.00	142.00		84.02.	84.02		
2	0.00	78.00	78.01		80.80	80.82		74.92	74.92		69.42	69.41		63.25	63.27		143.00	143.00		dry	dry		
3	0.00	78.00	78.00		80.68	80.68		74.92	74.91		69.41	69.41		63.28	63.27		144.00	145.00		83.84	84.00		
4	0.00	78.00	78.00		80.67	80.66		74.91	74.90		69.41	69.40		63.24	63.26		146.00	146.00		84.02	84.01		
5	0.00	77.96	77.98	**4.871**	80.70	80.72		74.90	74.90		69.40	69.40		63.34	63.32		132.00	134.00		83.94	83.92		
6	0.00	77.97	77.97		80.80	80.80		74.89	74.89		69.40	69.40		63.33	63.34		137.00	137.00		83.88	83.86		
7	0.00	99.97	77.97		80.92	80.95		74.89	74.89		69.41	69.40		63.33	63.32		138.00	138.00		84.08	83.92		
8	0.00	77.98	77.98		81.02	81.05		74.90	74.90		69.40	69.40		63.19	63.21		139.00	140.00		83.92	84.06		
9	0.00	77.97	77.97		81.00	81.02		74.91	74.91		69.40	69.40		63.19	63.20		149.00	145.00		84.04	84.20		
10	0.00	77.97	77.97		80.90	80.86		74.90	74.90		69.40	69.40		63.24	63.26	**3.887**	142.00	143.00		84.14	84.00		
11	0.00	77.97	77.97	**4.895**	80.73	80.73	**0.497**	74.90	74.90		69.40	69.40		63.22	63.25		140.00	139.00		83.92	83.90		
12	0.00	77.97	77.97		80.75	80.78		74.90	74.9	**6.103**	69.40	69.40	**3.648**	63.29	63.24		1.39(74.6	139.00	**0.182**	84.16	84.10	**1.013**	
13	0.00	77.96	77.96		80.74	80.73		74.91	74.90		69.40	69.40		63.27	63.28		139.00	140.00		84.10	84.10		
14	0.00	77.98	77.98		80.71	80.70		74.91	74.91		69.40	69.40		63.30	63.62		138.00	138.00		84.04	84.02		
15	0.00	77.98	77.99		80.72	80.75		74.90	74.90		69.40	69.40		63.63	63.58		136.00	136.00		84.06	84.16		
16	0.00	77.99	77.99		80.80	80.82		74.90	74.99		69.41	69.41		63.62	63.60		136.00	131.00		84.14	84.16		
17	9.10	78.05	78.06		80.83	80.84		75.02	74.96		69.54	69.54		63.60	63.57		129.00	132.00		84.18	84.16		
18	0.00	78.00	77.99		80.83	80.83		74.92	74.92		69.46	69.46		63.51	63.53		136.00	136.00		84.10	83.70		
19	2.60	78.00	77.99		80.70	80.68		74.91	74.91		69.46	69.46		63.47	63.46		138.00	140.00		83.70	83.68		
20	0.00	77.99	77.99		80.65	80.66		74.91	74.91		69.46	69.46		63.44	63.45		143.00	143.00		83.70	83.60		
21	0.00	77.97	77.99	**5.116**	80.66	80.65		74.90	74.90		69.45	69.45		63.43	63.44		143.00	143.00		Dry	Dry		
22	0.00	77.98	77.97		80.62	80.62		74.89	74.89		69.45	69.45		63.27	63.41	**3.935**	1.44(74.6	145.00	**0.176**	Dry	83.83	**Dry**	
23	0.00	77.97	77.97		80.62	80.60		74.88	74.88		69.45	69.45		63.33	63.38		145.00	145.00		83.76	83.76		
24	0.00	77.97	77.97		80.60	80.58		74.88	74.88		69.43	69.43		63.39	63.35		144.00	145.00		83.72	83.84		
25	0.00	77.97	77.97		80.58	80.57		74.88	74.88		69.42	69.42		63.04	63.06		145.00	145.00		83.90	83.82		
26	0.00	77.97	77.97		80.60	80.60		74.89	74.89		69.40	69.40		63.08	63.11		144.00	145.00		83.70	83.72		
27	0.00	77.97	77.96		80.58	80.55		74.88	74.88		69.40	69.40		63.15	63.20		145.00	145.00		84.00	84.04		
28	31.50	78.04	78.05		Dry	Dry		75.01	75.03		69.50	69.50		63.23	63.38		134.00	131.00		84.00	84.01		
29	7.90	78.01	77.99		Dry	Dry		74.97	74.92		69.48	69.48		63.66	63.60		139.00	139.00		Dry	Dry		
30	0.00	77.98	77.98		Dry	Dry		74.91	74.90		69.45	69.45		63.41	63.37		140.00	142.00		Dry	Dry		
31	0.00	77.97		**4.913**	Dry	Dry		74.90	74.89	**5.888**	69.45	69.45	**4.560**	63.36	63.33		145.00	146.00		Dry	Dry		

Table 8-1-10 Water Level and Discharge Measurement in February.2002

Month: **February** **2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.97	77.97		dry	dry		74.88	74.88		69.45	69.45		63.35	63.32		151.00	154.00		dry	dry		
2	0.00	77.97	77.96		dry	dry		74.88	74.88		69.44	69.44		63.40	63.38		153.00	154.00		dry	dry		
3	0.00	77.96	77.96		dry	dry		74.88	74.88		69.43	69.42		63.36	63.39		154.00	154.00		dry	dry		
4	0.00	77.96	77.96		dry	dry		74.88	74.88		69.42	69.41		63.35	63.37		155.00	155.00		dry	dry		
5	0.00	77.97	77.97		dry	dry		74.88	74.87		69.40	69.40		63.34	63.33		155.00	155.00		dry	dry		
6	0.00	77.97	77.97		dry	dry		74.87	74.87		69.40	69.40		63.31	63.29		155.00	155.00		dry	dry		
7	0.00	77.97	77.97	**5.082**	dry	dry		74.86	74.86		69.40	69.40		63.33	63.31	**4.992**	156(74.4	156.00	**very low**	dry	dry	**Dry**	
8	0.00	77.96	77.96		dry	dry		74.85	74.86		69.40	69.40		63.34	63.37		156.00	156.00		dry	dry		
9	0.00	77.96	77.96		dry	dry		74.85	74.85		69.40	69.40		63.31	63.13		154.00	154.00		83.70	83.71		
10	0.00	77.95	77.95		dry	dry		74.85	74.85		69.39	69.39		63.10	63.09		154.00	154.00		dry	84.00		
11	0.00	77.95	77.95	**4.419**	80.70	80.72	**0.619**	74.84	74.84		69.39	69.38		63.16	63.14		153.00	153.00		84.02	84.04		
12	0.14	77.95	77.94		80.66	80.67		74.84	74.84		69.38	69.38		63.13	63.11		152.00	152.00		84.00	84.01		
13	0.00	77.94	77.94		80.65	80.64		74.84	74.84		69.38	69.38		63.14	63.14		151.00	151.00		84.00	84.00		
14	0.00	77.94	77.94		80.62	80.62		74.84	74.84		69.38	69.38		63.15	63.16		151.00	151.00		84.05	84.08		
15	0.00	77.94	77.94	**4.162**	80.61	80.60		74.83	74.83	**5.482**	69.38	69.38	**3.755**	63.14	63.12	**3.601**	152.00	152.00		84.10	84.12		
16	0.00	77.94	77.94		80.63	80.63		74.83	74.83		69.38	69.38		63.12	63.11		151.00	151.00		84.00	84.09		
17	0.00	77.94	77.94		80.61	80.60		74.83	74.83		69.38	69.38		63.14	63.12		150.00	150.00		84.12	84.15		
18	0.00	77.95	77.95		80.62	80.64		74.82	74.82		69.38	69.38		63.12	63.13		150.00	150.00		84.16	84.12		
19	0.00	77.95	77.95		80.66	80.64		74.82	74.82		69.38	69.38		63.11	63.12		150.00	150.00		84.10	84.11		
20	0.00	77.95	77.95		80.65	80.63		74.82	74.82		69.38	69.38		63.14	63.13		149.00	149.00		84.08	84.07		
21	0.00	77.94	77.94		80.60	80.62		74.81	74.81		69.37	69.37		63.14	63.14		148.00	149.00		84.07	84.05		
22	0.00	77.94	77.94		80.62	80.60		74.81	74.81		69.36	69.36		63.15	63.14		148.00	148.00		84.03	84.00		
23	0.00	77.95	77.95		80.59	80.63		74.81	74.81		69.36	69.36		63.12	63.14		148.00	148.00		84.05	84.05		
24	0.00	77.95	77.95		80.60	80.58		74.81	74.81.		69.35	69.35		63.13	63.12		148.00	148.00		84.07	84.09		
25	0.00	77.95	77.96		80.59	80.61		74.82	74.85		69.38	69.38		63.12	63.11		146.00	143.00		84.12	84.10		
26	0.00	77.98	77.99	**4.681**	80.63	80.64	**0.284**	74.82	74.84	**5.528**	69.35	69.35	**3.636**	63.14	63.14		148.00	147.00		84.10	84.08	**0.706**	
27	0.00	77.97	77.96		80.65	80.62		74.84	74.84		69.34	69.34		63.14	63.12		146.00	145.00		84.08	84.09		
28	0.00	77.95	77.95		80.62	80.62		74.82	74.82		69.34	69.34		63.11	63.10		145.00	147.00		84.10	84.06		
29																							
30																							
31																							

Table 8-1-11 Water Level and Discharge Measurement in March.2002

Month: **March** **2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.95	77.95		80.81	80.60		74.82	74.82		69.34	69.34								83.99	83.94		
2	0.00	77.95	77.95		80.60	80.64		74.82	74.82		69.34	69.34								84.05	84.09		
3	0.00	77.95	77.95		80.98	81.00		74.81	74.81		69.33	69.33								84.10	84.12		
4	0.00	77.95	77.95		80.97	80.95		74.81	74.81		69.33	69.33								84.10	84.09		
5	0.00	77.94	77.94		80.95	80.92		74.81	74.81		69.33	69.32								84.08	84.04		
6	0.00	77.94	77.94		80.90	80.89		74.80	74.80		69.34	69.34								84.07	84.08		
7	0.00	77.94	77.94		80.89	80.89		74.80	74.80		69.34	69.33								84.08	84.07		
8	0.00	77.93	77.93		80.87	80.86		74.80	74.80		69.33	69.32								84.02	84.06		
9	0.00	77.93	77.93	**3.599**	80.88	80.88		74.79	74.79	**3.494**	69.32	69.32	**2.460**							83.87	83.86		
10	0.00	77.93	77.93		80.87	80.86		74.79	74.79		69.32	69.32								83.92	83.91		
11	0.00	77.93	77.93		80.88	80.85		74.79	74.79		69.32	69.32								83.89	83.88		
12	0.00	77.94	77.94		80.88	80.87		74.80	74.8		69.31	69.31								83.90	83.91		
13	0.00	77.94	77.94		80.85	80.84		74.80	74.80		69.31	69.31								84.09	84.18		
14	0.00	77.94	77.94		80.84	80.84		74.79	74.79		69.32	69.32								84.24	84.15		
15	0.00	77.94	77.93		Dry	Dry		74.79	74.79		69.32	69.32								84.09	84.19		
16	0.00	77.93	77.93	**3.891**	Dry	Dry		74.79	74.79	**3.443**	69.31	69.32	**2.397**							84.16	84.25		
17	0.00	77.93	77.93		Dry	Dry		74.79	74.79		69.32	69.32								84.10	84.02		
18	0.00	77.93	77.93		Dry	Dry		74.78	74.78		69.32	69.31								83.87	84.05		
19	0.00	77.93	77.93		Dry	Dry		74.78	74.78		69.30	69.31								84.07	84.14		
20	0.00	77.93	77.93		Dry	Dry		74.78	74.78		69.30	69.30								84.26	84.28		
21	0.00	77.93	77.93		80.72	80.74		74.77	74.77		69.30	69.30								84.28	84.23		
22	0.00	77.93	77.93		80.85	Dry		74.77	74.77		69.30	69.30								84.19	84.20		
23	0.00	77.93	77.92	**3.756**	Dry	Dry		74.76	74.76	**3.294**	69.30	69.30	**2.334**							84.18	84.22		
24	0.00	77.92	77.92		Dry	Dry		74.76	74.76		69.30	69.30								84.20	84.06		
25	0.00	77.92	77.92		Dry	Dry		74.76	74.76		69.30	69.30								83.88	83.95		
26	0.00	77.92	77.92		Dry	Dry		74.75	74.75		69.30	69.30								83.66	83.65		
27	0.00	77.92	77.91		Dry	Dry		74.75	74.75		69.29	69.29								83.64	83.67		
28	0.00	77.91	77.91		Dry	Dry		74.74	74.74		69.30	69.30								83.56	83.56		
29	0.00	77.91	77.91		Dry	Dry		74.74	74.74		69.30	69.30								Dry	Dry		
30	0.00	77.90	77.90		Dry	Dry		74.73	74.73		69.30	69.30								Dry	Dry		
31	0.00	77.90	77.90		Dry	Dry		74.73	74.73		69.30	69.30								Dry	Dry		

Table 8-1-12 Water Level and Discharge Measurement in April.2002

Month: **April 2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.90	77.90		Dry	Dry		74.73	74.73		69.29	69.29								Dry	Dry		
2	0.00	77.91	77.92		Dry	Dry		74.77	74.76		69.30	69.30								Dry	Dry		
3	0.00	77.98	77.96		Dry	Dry		74.76	74.76		69.30	69.30								Dry	Dry		
4	0.00	77.95	77.94		Dry	Dry		74.78	74.78		69.31	69.31								Dry	Dry		
5	0.00	77.94	77.94		Dry	Dry		74.77	74.77		69.32	69.31								Dry	Dry		
6	0.00	77.93	77.93		Dry	Dry		74.77	74.77		69.30	69.30								Dry	Dry		
7	0.00	77.93	77.93		Dry	Dry		74.76	74.76		69.29	69.29								Dry	Dry		
8	0.00	77.92	77.92		Dry	Dry		74.75	74.75		69.29	69.29								Dry	Dry		
9	0.00	77.93	77.92	**3.356**	Dry	Dry		74.75	74.75	**2.685**	69.29	69.29	**2.076**							Dry	Dry		
10	0.00	77.92	77.92		Dry	Dry		74.75	74.75		69.29	69.29								Dry	Dry		
11	0.00	77.92	77.92		Dry	Dry		74.75	74.78		69.29	69.30								Dry	Dry		
12	0.00	77.91	77.91		Dry	Dry		74.78	74.77		69.29	69.29								Dry	Dry		
13	0.00	77.91	77.91		Dry	Dry		74.77	74.76		69.29	69.29								Dry	Dry		
14	0.00	77.91	77.90		Dry	Dry		74.76	74.75		69.28	69.28								Dry	Dry		
15	0.00	77.92	77.90	**2.856**	Dry	Dry		74.73	74.74	**2.502**	69.24	69.26	**1.883**							Dry	Dry		
16	0.00	77.90	77.00		Dry	Dry		74.74	74.74		69.25	69.24								Dry	Dry		
17	0.00	77.90	77.90		Dry	Dry		74.74	74.73		69.24	69.24								Dry	Dry		
18	0.00	77.89	77.89		Dry	Dry		74.73	74.72		69.24	69.24								Dry	Dry		
19	0.00	77.89	77.89		Dry	Dry		74.72	74.71		69.24	69.24								Dry	Dry		
20	0.00	77.89	77.89		Dry	Dry		74.71	74.70		69.24	69.26								Dry	Dry		
21	0.00	77.89	77.89		Dry	Dry		74.70	74.72		69.24	69.24								Dry	Dry		
22	0.00	77.90	77.90		Dry	Dry		74.73	74.73		69.26	69.25								Dry	Dry		
23	0.00	77.90	77.90		Dry	Dry		74.73	74.73		69.30	69.30								Dry	Dry		
24	0.00	77.90	77.89		Dry	Dry		74.74	74.73		69.30	69.30								Dry	Dry		
25	0.00	77.89	77.89		Dry	Dry		74.73	74.75		69.27	69.26								Dry	Dry		
26	0.00	77.89	77.89		Dry	Dry		74.76	74.72		69.25	69.25								Dry	Dry		
27	0.00	77.89	77.91	**2.579**	Dry	Dry		74.73	74.72	**2.491**	69.25	69.25	**1.817**							Dry	Dry		
28	0.00	77.90	77.90		Dry	Dry		74.71	74.71		69.24	69.24								Dry	Dry		
29	0.00	77.90	77.90		Dry	Dry		74.70	74.70		69.24	69.24								Dry	Dry		
30	0.00	77.89	77.89		Dry	Dry		74.71	74.70		69.24	69.24								Dry	Dry		
31			s																				

Attachment

Table 8-1-13 Water Level and Discharge Measurement in May.2002

Month: **May** **2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	
1	0.00	77.89	77.89	**2.553**	Dry	Dry		74.70	74.70		69.24	69.24								Dry	Dry		
2	0.00	77.89	77.89		Dry	Dry		74.69	74.69		69.25	69.25								Dry	Dry		
3	35.50	77.89	77.89		Dry	Dry		74.70	74.70		69.25	69.24								Dry	Dry		
4	5.40	77.89	77.89		Dry	Dry		74.69	74.69		69.24	69.24								Dry	Dry		
5	0.00	77.90	77.90		Dry	Dry		74.70	74.70		69.24	69.24								Dry	Dry		
6	0.00	77.90	77.89		Dry	Dry		74.72	74.72		69.26	69.24								Dry	Dry		
7	0.00	77.89	77.89		Dry	Dry		74.70	74.70		69.26	69.25								Dry	Dry		
8	0.00	77.89	77.89		Dry	Dry		74.69	74.69		69.24	69.24								Dry	Dry		
9	0.00	77.89	77.89	**2.527**	Dry	Dry		74.69	74.68	**2.314**	69.23	69.24	**1.469**							Dry	Dry		
10	2.50	77.89	77.89		Dry	Dry		74.68	74.68		69.24	69.24								Dry	Dry		
11	0.00	77.88	77.88		Dry	Dry		74.69	74.69		69.24	69.24								Dry	Dry		
12	0.00	77.88	77.88		Dry	Dry		74.69	74.69		69.27	69.26								Dry	Dry		
13	0.00	77.88	77.88		Dry	Dry		74.68	74.68		69.24	69.24								Dry	Dry		
14	0.00	77.89	77.89		Dry	Dry		74.68	74.68		69.24	69.24								Dry	Dry		
15	0.00	77.89	77.88		Dry	Dry		7.68	74.67		69.24	69.24								Dry	Dry		
16	0.00	77.88	77.88		Dry	Dry		74.66	74.66		69.24	69.24								Dry	Dry		
17	0.00	77.88	77.88	**2.325**	Dry	Dry		74.65	74.65	**2.160**	69.24	69.23	**1.449**							Dry	Dry		
18	57.60	78.00	78.04		Dry	Dry		74.87	74.91		69.22	69.20								Dry	Dry		
19	55.3	78.20	78.26		Dry	Dry		75.10	75.06		69.33	69.41								84.09	84.05		
20	9.40	78.12	78.08		Dry	Dry		75.02	74.97		69.52	69.71								83.93	83.87		
21	0.00	78.02	77.96		Dry	Dry		74.87	74.82		69.65	69.60								Dry	Dry		
22	0.00	77.91	77.89		Dry	Dry		74.76	74.75		69.50	69.43								Dry	Dry		
23	0.00	77.89	77.89		Dry	Dry		74.74	74.73		69.40	69.46								Dry	Dry		
24	0.00	77.89	77.88	**2.319**	80.75	80.78		74.72	74.72	**2.534**	69.40	69.39	**2.777**							Dry	Dry		
25	0.00	77.88	77.88		81.03	81.08		74.71	74.70		69.37	69.32								Dry	Dry		
26	0.00	77.88	77.88		80.88	80.85		74.71	74.71		69.32	69.32								Dry	Dry		
27	4.90	78.07	78.04		80.79	80.79		74.87	74.85		69.30	69.29								Dry	Dry		
28	0.00	78.02	77.99		80.78	80.78		74.82	74.82		69.32	69.42								Dry	Dry		
29	0.00	77.98	77.98		80.93	80.95		74.80	74.79		69.41	69.40								Dry	Dry		
30	0.00	77.98	77.98		80.91	80.93		74.78	74.77		69.39	69.40								Dry	84.09		
31	0.00	77.94	77.92		80.93	80.93	The Gauging pole has been uprooted and stolen. So, only the depths has been measured above the concrete floor under the culvert of the highway.	74.76	74.75		69.40	69.40								84.14	84.11		

Table 8-1-14 Water Level and Discharge Measurement in June.2002

Month: **June 2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	lst	2nd	(m^3/sec)	
1	0.00	77.90	77.89		70.00	78.00		74.75	74.75		69.34	69.33								84.06	84.00		
2	0.00	77.89	77.89		80.00	85.00		74.74	74.74		69.32	69.32								84.13	84.09		
3	2.70	77.93	77.91		86.00	86.00		74.77	74.76		69.31	69.30								84.12	84.10		
4	0.00	77.93	77.90	**3.287**	90.00	90.00		74.76	74.75	**3.662**	69.32	69.42	**2.493**							84.14	84.12		
5	0.00	77.90	77.90		80.00	78.00		74.75	74.75		69.39	69.37								84.27	84.23		
6	0.00	77.93	77.92		85.00	83.00		74.78	74.78		69.33	69.32								84.26	84.24		
7	0.00	77.89	77.89		63.00	62.00		74.77	74.77		69.32	69.31								84.22	84.23		
8	0.00	77.91	77.90		65.00	67.00		74.79	74.78		69.34	69.34								84.27	84.25		
9	0.00	77.90	77.89		65.00	65.00		74.77	74.77		69.40	69.36								84.26	84.24		
10	0.00	77.89	77.89		63.00	62.00		74.77	74.77		69.34	69.33								84.20	84.22		
11	0.00	78.02	77.98		70.00	68.00		74.86	74.83		69.36	69.34								84.23	84.21		
12	0.00	77.94	77.93		68.00	65.00		74.82	74.82		69.35	69.40								84.19	84.18		
13	0.00	77.92	77.91		55.00	55.00		74.82	74.81		69.42	69.44								84.24	84.21		
14	0.00	77.90	77.90		48.00	45.00		74.82	74.82		69.43	69.43								84.23	84.20		
15	0.00	77.90	77.90		43.00	42.00		74.82	74.82		69.42	69.41								84.24	84.22		
16	0.00	77.90	77.90		42.00	42.00		74.81	74.81		69.41	69.41								84.13	84.09		
17	0.00	77.89	77.89		40.00	40.00		74.80	74.80		69.40	69.39								84.12	84.10		
18	0.00	77.97	77.91	**3.624**	45.00	48.00		74.80	74.81	**3.749**	69.37	69.37								84.07	84.05		
19	64.2	77.91	77.91		50.00	52.00		74.80	74.80		69.37	69.36								84.06	84.05		
20	0.00	77.93	77.92		68.00	65.00		74.79	74.79		69.38	69.36								84.04	84.03		
21	4.50	77.95	77.95		63.00	62.00		74.83	74.82		69.36	69.37								84.00	83.93		
22	0.00	77.94	77.93		61.00	60.00		74.80	74.80		69.40	69.39								dry	dry		
23	2.40	77.94	77.94		60.00	59.00		74.80	74.80		69.40	69.40								dry	dry		
24	0.00	77.94	77.94		59.00	59.00		74.81	74.81		69.41	69.40								dry	dry		
25	0.00	77.94	77.95		60.00	62.00		74.80	74.82		69.39	69.39								dry	84.04		
26	3.40	77.97	77.96	**4.598**	62.00	62.00		74.83	74.82	**4.134**	69.38	69.40	**3.236**							84.05	84.10		
27	0.00	77.96	77.96		61.00	60.00		74.81	74.81		69.50	69.54								84.16	84.13		
28	0.00	77.96	77.96		60.00	60.00		74.80	74.80		69.50	69.48								84.19	84.15		
29	trace	78.10	78.30		72.00	75.00		74.89	75.08		69.68	69.70								84.22	84.24		
30	55.50	78.45	78.72		80.00	82.00		75.20	75.36		69.70	69.71								84.36	84.32		
31																							

Table 8-1-15 Water Level and Discharge Measurement in July.2002

Month: **July 2002**

Date	Rain Fall (mm)	Station No 1			Station No 2			Station No 3			Station No 4			Station No 5			Station No 6			Station No 7			Remarks
		Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	Gauge(m)		Dis.	
		Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	Ist	2nd	(m^3/sec)	
1	48.40	78.86	79.98		Dry	Dry		75.57	76.58											84.19	84.11		
2	1.20	78.84	78.66		Dry	Dry		75.79	75.51											84.21	84.15		
3	0.00	78.50	78.44		Dry	Dry		75.43	75.32											84.18	84.16		
4	0.00	78.35	78.28		Dry	Dry		75.28	75.16											84.22	84.24		
5	0.00	78.22	78.20		Dry	Dry		75.11	75.06											84.23	84.25		
6	9.80	78.18	78.15		55.00	58.00		75.04	75.02											84.17	84.23		
7	0.00	78.15	78.20	**7.723**	65.00	70.00		75.04	75.06	**9.472**	69.73	69.75	**7.506**							84.16	84.18		
8	0.00	78.42	78.40		63.00	64.00		75.21	75.17		69.92	69.94								84.26	84.28		
9	31.20	78.80	78.76		65.00	65.00		75.68	75.63		70.26	70.27								84.32	84.35		
10	28.10	78.68	78.56		70.00	68.00		75.57	75.49		70.25	70.24								84.34	84.29		
11	9.66	79.26	79.08		68.00	65.00		76.18	75.99		70.48	70.90								84.38	84.37		
12	37.00	78.93	78.80		57.00	56.00		75.89	75.71		70.80	70.54								84.36	84.32		
13	0.00	78.55	78.43		55.00	55.00		75.40	75.36		70.32	70.10								84.36	84.30		
14	0.00	78.63	78.61		57.00	56.00		75.41	75.39		70.23	70.20								84.42	84.39		
15	0.00	78.76	78.61		60.00	60.00		75.56	75.44		70.28	70.30								84.32	84.27		
16	0.00	78.47	78.40	**17.451**	67.00	68.00		75.37	75.26	**14.114**	70.28	70.20	**12.18**							84.34	84.32		
17	28.20	78.30	78.62		70.00	72.00		75.16	75.45		70.15	70.10								84.36	84.32		
18	0.00	78.99	78.86		75.00	75.00		75.87	75.65		70.51	70.50								84.37	84.39		
19	0.0	78.98	79.02		69.00	70.00		75.79	75.91		70.40	70.60								84.40	84.38		
20	95.20	78.98	79.06		68.00	70.00		75.88	75.81		70.59	70.58								84.36	84.30		
21	43.40	79.00	79.10		80.00	83.00		75.91	76.04		70.60	70.66								84.35	84.33		
22	113.7	79.47	79.97		82.00	80.00		76.28	76.57		70.90	71.10								84.37	84.40		
23	120.9	80.48	80.10		68.00	68.00		77.00	76.92		71.30	71.60								84.67	84.56		
24	73.50	80.20	80.06		66.00	65.00		76.98	76.89		71.70	71.61								84.42	84.36		
25	105.6	81.00	80.66		65.00	66.00		77.24	76.92		71.70	71.78								84.44	84.47		
26	72.40	80.50	80.40	**283.590**	65.00	65.00		77.04	76.90	**256.660**	71.71	71.60								84.50	84.46		
27	70.70	80.38	80.20		67.00	65.00		76.94	76.81		71.62	71.55								84.38	84.35		
28	32.90	79.86	79.75		62.00	61.00		76.76	76.69		71.60	71.53								84.31	84.26		
29	23.30	79.64	79.50		61.00	60.00		76.64	76.41		71.49	71.40								84.21	84.15		
30	0.00	79.16	79.02		61.00	60.00		76.28	75.98		71.23	71.03								84.09	84.00		
31	0.00	78.85	78.76		60.00	60.00		75.89	75.81		70.94	70.80								83.85	83.84		

The gauge reader remained out of contact for the information to continue for the extended months July and August.

Table 9-1-1 Summary of Estimated Runoff from 1973 to 1987

UNIT:M3/s

Month		1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	F	3.187	3.342	3.903	3.400	4.116	5.355	4.012	4.958	4.209	4.095	4.094	5.093	4.738	6.570	4.648
Jan.	M	3.157	4.373	3.690	4.153	4.088	4.543	3.983	4.352	4.111	4.068	4.063	7.740	4.661	5.121	4.519
	L	3.782	3.600	3.641	4.473	4.061	4.483	4.031	4.204	4.076	4.043	4.380	5.863	4.612	4.765	4.446
	F	3.515	3.386	3.784	8.063	4.113	4.219	4.568	4.126	3.971	4.034	4.271	4.717	4.574	4.598	6.479
Feb.	M	3.180	3.305	3.612	5.279	4.031	4.180	7.083	4.896	3.936	3.997	4.058	4.884	4.653	4.517	5.237
	L	3.454	3.263	3.576	4.380	3.998	4.116	4.571	4.488	3.902	3.972	4.273	6.070	4.567	4.469	4.882
	F	4.141	3.232	3.549	4.105	3.973	4.073	4.182	4.227	3.877	4.250	4.198	4.584	4.510	4.435	5.608
Mar.	M	3.212	3.208	3.524	3.940	3.947	5.024	3.991	4.079	3.852	4.054	3.985	4.329	4.474	4.402	5.956
	L	3.071	6.418	3.499	3.853	3.920	4.286	3.892	4.012	5.124	3.946	4.003	4.291	4.447	4.373	5.100
	F	3.003	7.622	3.476	3.803	5.447	4.218	3.836	3.973	5.393	3.896	3.896	6.266	4.415	4.344	4.560
Apr.	M	2.964	4.329	3.455	3.770	6.983	6.070	6.166	3.937	5.178	7.024	4.858	4.603	4.384	4.463	4.738
	L	3.381	4.061	4.699	12.879	5.336	8.755	4.762	4.329	9.107	13.147	4.548	6.758	4.386	6.009	8.776
	F	4.034	4.668	4.666	7.191	11.503	6.044	4.077	6.333	6.547	5.435	6.054	12.171	6.214	14.102	20.141
May	M	7.597	8.221	3.941	18.621	9.107	5.284	8.089	9.793	9.891	7.579	19.175	11.209	12.550	10.221	8.403
	L	4.178	4.690	7.530	11.499	15.983	6.678	4.897	5.960	9.700	6.851	16.766	17.247	13.148	7.759	5.902
	F	6.830	4.526	9.979	23.183	16.588	7.889	4.988	13.046	10.684	8.259	33.706	44.123	14.444	7.712	9.015
June	M	77.164	9.360	52.234	33.817	20.296	22.905	11.127	49.068	8.153	27.007	18.065	43.994	16.260	13.911	9.384
	L	60.162	32.026	43.017	24.987	16.500	16.799	9.930	14.170	47.523	20.873	41.218	32.954	15.951	12.869	14.585
	F	24.842	39.384	33.016	60.232	24.521	19.641	21.411	18.494	100.572	44.376	85.265	32.480	19.152	34.262	61.046
July	M	13.324	16.285	12.696	24.272	20.123	67.154	43.075	22.173	17.844	37.430	80.886	52.244	24.529	20.978	18.755
	L	25.609	138.220	102.953	27.264	27.059	40.516	71.116	15.481	39.884	21.504	34.735	99.455	82.481	22.906	12.091
	F	39.599	45.773	33.868	22.554	25.370	18.676	19.524	15.338	27.477	17.613	19.977	26.711	21.402	34.100	85.246
Aug.	M	22.325	13.817	12.970	42.475	64.530	13.439	30.257	23.413	29.010	10.607	20.662	20.670	15.887	11.240	189.465
	L	13.963	40.182	16.537	55.275	35.011	11.504	53.487	14.955	52.883	14.750	23.076	23.220	29.614	20.293	22.061
	F	15.140	38.695	44.306	18.828	12.487	8.514	42.758	16.106	27.111	19.187	17.741	22.325	19.179	50.074	46.465
Sep.	M	10.273	21.269	54.149	16.950	20.108	16.464	39.305	23.200	18.373	51.220	49.069	118.571	24.107	40.598	38.980
	L	10.213	15.998	43.028	13.577	13.632	13.519	13.673	23.071	10.966	26.582	25.328	36.483	16.420	13.127	32.617
	F	16.007	20.725	20.457	11.976	23.956	7.476	28.958	14.650	10.945	9.311	19.414	11.821	17.738	12.110	18.422
Oct.	M	27.194	22.264	15.595	6.520	11.453	5.554	14.951	7.079	6.145	6.198	9.972	15.032	29.956	22.677	24.946
	L	8.402	8.925	6.669	6.546	6.296	4.693	7.739	5.332	5.007	16.619	6.909	13.666	12.471	8.499	18.900
	F	5.271	5.409	5.125	5.021	15.101	6.905	5.645	4.627	4.549	6.251	5.306	6.628	6.879	6.018	8.158
Nov.	M	4.182	4.478	4.519	4.551	6.228	4.788	4.817	4.338	4.352	5.243	4.794	5.572	7.122	6.699	6.011
	L	3.739	4.061	4.241	4.349	5.054	4.369	4.868	4.198	4.252	4.576	4.558	5.105	5.325	5.098	5.333
	F	3.534	3.868	4.106	4.247	4.595	4.193	18.265	4.124	4.194	4.329	4.441	4.886	4.925	4.768	5.023
Dec.	M	3.435	3.770	4.035	4.189	4.382	4.104	5.681	4.079	4.156	4.208	4.377	5.364	4.738	5.509	4.884
	L	3.378	3.714	3.988	4.148	6.449	4.050	4.983	4.043	4.123	4.139	6.051	4.869	8.820	5.194	4.790
Total(MCM)		394.0	501.5	520.0	453.8	414.2	334.6	469.0	328.0	460.0	386.3	533.0	646.5	430.6	393.4	641.0

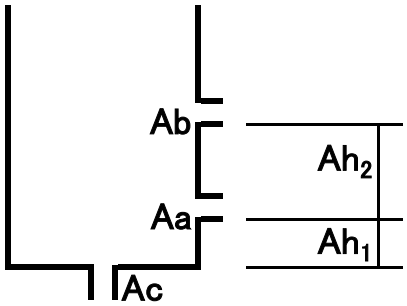
Table 9-1-2 Summary of Estimated Runoff from 1988 to 2001

Attachment

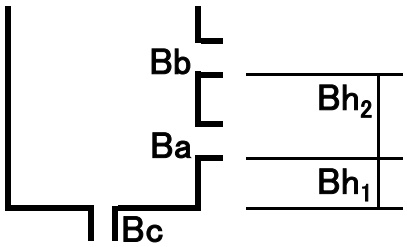
UNIT:M3/s

Month		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Average
	F	4.735	8.268	5.124	11.131	5.363	5.398	4.858	4.701	5.127	4.606	4.789	4.589	4.560	4.671	4.381
Jan.	M	4.938	8.006	5.074	6.160	5.165	5.426	9.928	4.670	9.836	4.610	4.584	4.549	4.522	4.633	4.441
	L	4.718	5.438	5.034	5.465	5.202	4.919	6.787	4.544	6.229	5.208	4.477	4.514	4.492	4.600	4.297
	F	4.655	5.025	5.000	5.176	5.067	4.808	7.134	4.862	5.086	4.835	4.415	4.483	4.913	4.568	4.561
Feb.	M	4.689	5.236	7.695	5.044	5.004	4.759	8.088	4.930	5.434	4.700	4.375	4.456	4.515	4.541	4.456
	L	7.576	6.513	6.320	5.024	4.955	4.710	5.555	4.596	4.739	4.585	4.466	4.433	4.446	4.516	4.265
	F	6.507	5.041	5.605	4.963	4.923	4.678	5.094	4.482	4.607	4.555	4.358	4.407	4.405	4.492	4.196
Mar.	M	8.901	4.896	5.272	4.899	4.890	4.647	4.857	4.416	4.521	5.152	4.306	4.380	4.370	4.465	4.132
	L	6.197	4.766	6.010	7.385	4.857	6.173	4.943	4.815	4.466	11.455	6.782	4.353	4.338	4.436	4.282
	F	4.996	4.649	7.876	5.437	4.826	5.223	5.626	4.747	4.427	9.128	8.223	4.744	4.308	4.409	4.543
Apr.	M	8.743	4.595	7.032	5.054	4.797	6.659	4.804	4.419	4.397	6.206	5.498	6.055	4.738	9.566	4.861
	L	13.460	4.558	8.006	7.007	4.962	10.956	5.479	4.331	4.763	7.875	6.321	5.374	16.268	5.258	6.729
	F	17.179	4.525	9.209	5.981	5.955	7.619	8.352	4.587	7.049	11.067	8.625	6.610	7.867	5.450	7.945
May	M	12.781	13.163	47.144	6.239	6.882	7.005	8.615	6.039	6.399	5.658	6.137	9.899	8.714	13.950	9.979
	L	12.424	22.032	20.504	14.263	14.394	9.166	11.951	9.036	7.799	6.316	6.014	22.772	33.545	30.067	9.253
	F	11.278	16.678	29.463	16.558	7.860	30.467	11.413	28.813	13.632	6.031	4.910	8.338	32.502	45.533	14.331
June	M	15.264	67.724	17.543	42.962	6.756	21.161	11.576	35.532	15.968	17.653	34.850	8.185	24.194	20.999	27.516
	L	17.181	19.320	29.260	32.164	21.879	14.014	10.657	30.422	10.770	25.633	18.930	32.541	67.673	17.615	26.904
	F	78.212	13.969	18.994	27.078	38.646	21.754	16.268	69.923	55.824	27.784	14.093	82.140	65.936	11.053	41.246
July	M	30.268	84.095	30.026	28.924	49.570	22.222	10.655	28.971	167.319	36.290	27.796	47.878	18.548	12.274	31.451
	L	24.482	61.969	25.499	20.322	34.812	40.614	30.158	13.449	35.694	13.850	105.601	17.675	15.277	45.507	50.752
	F	38.298	27.307	16.618	67.983	32.164	41.394	18.601	22.709	22.551	23.210	30.591	30.401	69.841	45.847	30.215
Aug.	M	56.507	33.000	75.026	46.693	12.955	34.522	58.962	30.715	37.334	28.933	36.511	43.441	23.419	23.119	34.718
	L	54.604	32.939	35.191	25.422	17.821	37.796	19.247	25.042	29.190	11.527	46.556	28.221	31.716	45.908	28.454
	F	40.738	57.521	22.462	54.876	15.894	18.021	28.877	14.024	20.998	12.597	32.678	17.640	23.760	37.389	26.594
Sep.	M	29.009	65.052	39.793	30.683	22.001	14.559	34.998	32.643	12.767	40.442	12.397	14.806	17.347	42.094	36.176
	L	12.451	62.464	24.112	31.018	12.375	33.937	13.424	20.007	14.485	44.946	56.243	20.718	16.015	26.684	20.549
	F	16.099	25.574	13.148	19.018	13.665	26.197	7.236	16.494	9.604	16.145	20.254	13.617	9.987	76.653	16.264
Oct.	M	7.632	15.302	9.380	9.920	25.004	27.968	5.827	30.894	6.571	8.688	19.630	18.520	9.092	28.530	15.036
	L	7.023	8.938	6.816	6.879	12.414	9.809	5.561	10.978	6.440	6.281	11.518	12.299	9.312	10.033	9.112
	F	5.641	6.554	5.832	5.924	6.946	8.918	5.524	9.923	5.551	5.243	6.847	7.985	5.967	14.884	6.460
Nov.	M	5.239	5.848	5.465	5.527	5.817	6.613	4.913	20.535	5.028	4.860	7.590	5.773	6.989	6.969	5.179
	L	5.055	5.568	5.287	5.336	5.315	5.579	4.952	6.684	4.840	4.677	5.380	5.121	5.299	5.806	4.608
	F	4.961	5.313	5.194	5.235	5.171	5.199	5.463	5.542	4.741	5.498	4.953	4.831	4.967	5.309	5.300
Dec.	M	4.901	5.211	5.812	5.175	4.979	5.016	4.778	5.045	4.684	8.741	4.756	4.689	4.810	5.075	4.461
	L	5.357	5.217	6.190	5.979	4.899	4.919	4.658	6.101	4.641	5.289	4.650	4.609	4.725	4.954	4.849
Total(MCM)		521.4	643.8	507.4	518.8	391.5	460.7	365.5	471.8	503.3	393.4	525.1	461.0	512.6	566.4	460.4

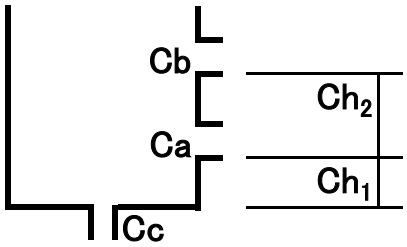
Table 9-2-1 dimension of Tank Model



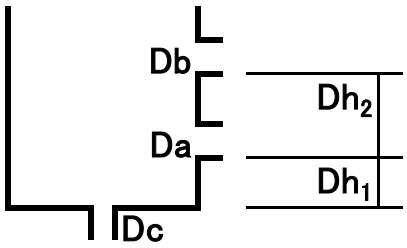
Aa	Ab	Ac	Ah1(mm)	Ah2 (mm)
0.300	0.150	0.350	25	80



Ba	Bb	Bc	Bh1(mm)	Bh2 (mm)
0.150	0.100	0.300	0	45



Ca	Cb	Cc	Ch1(mm)	Ch2 (mm)
0.030	0.010	0.050	0	30



Da	Db	Dc	Dh1(mm)	Dh2 (mm)
0.00040	0.00020	0.00000	0	0

Initial Water Depth (mm)
- First Tank 0
- Second Tank 0
- Third Tank 0
- Fourth Tank 1500

Catchment Area 300 km2

Evaporation Rate
- First Tank 0.80
- Second Tank 0.00
- Third Tank 0.00
- Fourth Tank 0.00

Annual Evaporation (mm)

January	Februaly	March	April	May	June
1.5	2.1	3.1	4.3	4.2	3.6
July	August	September	October	November	December
3.2	3.3	2.9	2.5	2.0	1.5

Table 10-1-1 Distribution of Probable Rainfall by each 10 days (Biratnagar)

Unit : mm

Probability (%)		50	60	70	80	90	Average of Obseved
Jan.	F	4.2	3.9	3.7	3.4	3.2	4.3
	M	3.9	3.7	3.4	3.2	3.0	4.0
	L	2.0	1.9	1.8	1.7	1.6	2.1
Feb.	F	1.9	1.8	1.6	1.5	1.4	1.9
	M	4.3	4.0	3.7	3.5	3.3	4.4
	L	5.0	4.7	4.4	4.1	3.8	5.1
Mar.	F	2.2	2.1	1.9	1.8	1.7	2.3
	M	4.7	4.4	4.1	3.8	3.6	4.8
	L	8.5	7.9	7.4	6.9	6.5	8.7
Apr.	F	6.2	5.7	5.4	5.0	4.7	6.3
	M	17.6	16.5	15.4	14.4	13.4	18.0
	L	25.8	24.1	22.5	21.0	19.6	26.3
May	F	37.1	34.6	32.3	30.2	28.2	37.8
	M	58.4	54.5	50.9	47.6	44.4	59.5
	L	77.7	72.6	67.8	63.3	59.1	79.3
June	F	94.7	88.4	82.6	77.1	72.0	96.5
	M	100.9	94.2	88.0	82.2	76.7	102.9
	L	113.1	105.6	98.6	92.1	86.0	115.3
July	F	201.0	187.7	175.3	163.7	152.9	205.0
	M	168.1	157.0	146.6	136.9	127.8	171.4
	L	163.2	152.4	142.3	132.9	124.1	166.4
Aug.	F	124.6	116.4	108.7	101.5	94.8	127.0
	M	113.2	105.7	98.7	92.2	86.1	115.4
	L	138.4	129.2	120.7	112.7	105.2	141.1
Sep.	F	109.2	102.0	95.2	88.9	83.0	111.4
	M	117.0	109.3	102.1	95.3	89.0	119.3
	L	85.4	79.8	74.5	69.6	64.9	87.1
Oct.	F	60.9	56.9	53.1	49.6	46.3	62.1
	M	36.6	34.2	31.9	29.8	27.9	37.4
	L	5.4	5.0	4.7	4.4	4.1	5.5
Nov.	F	8.8	8.2	7.7	7.2	6.7	9.0
	M	1.9	1.7	1.6	1.5	1.4	1.9
	L	0.4	0.3	0.3	0.3	0.3	0.4
Dec.	F	1.2	1.2	1.1	1.0	0.9	1.3
	M	2.1	1.9	1.8	1.7	1.6	2.1
	L	5.1	4.7	4.4	4.1	3.8	5.2
Total		1910.8	1784.3	1666.3	1556.0	1453.0	1948.2

Note) F means First 10 days, M means Middle 10 days and L means Last 10 days

Table 10-1-2 Distribution of Probable Runoff by each 10 days (Sunsari River)

Unit : m3/s

Probability (%)		50	60	70	80	90	Average of Estimated
Jan.	F	4.876	4.397	4.176	4.048	3.805	4.953
	M	5.049	4.553	4.323	4.191	3.939	5.128
	L	4.620	4.166	3.956	3.835	3.605	4.693
Feb.	F	4.700	4.238	4.025	3.902	3.667	4.774
	M	4.763	4.295	4.079	3.954	3.717	4.838
	L	4.631	4.176	3.966	3.845	3.613	4.704
Mar.	F	4.449	4.012	3.810	3.694	3.472	4.519
	M	4.479	4.039	3.836	3.719	3.495	4.550
	L	4.929	4.445	4.221	4.093	3.846	5.007
Apr.	F	4.982	4.493	4.267	4.136	3.888	5.061
	M	5.278	4.760	4.520	4.382	4.119	5.362
	L	6.978	6.292	5.976	5.793	5.445	7.088
May	F	7.782	7.018	6.665	6.461	6.073	7.905
	M	10.466	9.438	8.963	8.689	8.166	10.631
	L	12.189	10.992	10.439	10.120	9.511	12.382
June	F	16.242	14.647	13.909	13.484	12.673	16.498
	M	25.565	23.055	21.894	21.225	19.949	25.969
	L	25.515	23.009	21.850	21.183	19.909	25.918
July	F	39.390	35.522	33.733	32.703	30.736	40.013
	M	36.207	32.652	31.007	30.060	28.253	36.779
	L	42.303	38.149	36.227	35.121	33.009	42.972
Aug.	F	31.935	28.799	27.348	26.513	24.919	32.439
	M	36.048	32.508	30.870	29.928	28.128	36.617
	L	29.465	26.572	25.233	24.463	22.992	29.931
Sep.	F	27.035	24.380	23.152	22.445	21.095	27.462
	M	32.291	29.120	27.653	26.809	25.196	32.801
	L	23.664	21.341	20.266	19.647	18.465	24.038
Oct.	F	17.912	16.153	15.339	14.871	13.977	18.195
	M	15.225	13.730	13.038	12.640	11.880	15.465
	L	8.859	7.989	7.587	7.355	6.913	8.999
Nov.	F	6.743	6.081	5.774	5.598	5.261	6.849
	M	5.936	5.353	5.083	4.928	4.632	6.030
	L	4.889	4.409	4.187	4.059	3.815	4.966
Dec.	F	5.156	4.649	4.415	4.280	4.023	5.237
	M	4.772	4.304	4.087	3.962	3.724	4.848
	L	4.920	4.437	4.213	4.084	3.839	4.997
Total (MCM)		466.7	420.9	399.7	387.5	364.2	474.1

Note) F means First 10 days, M means Middle 10 days and L means Last 10 days

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