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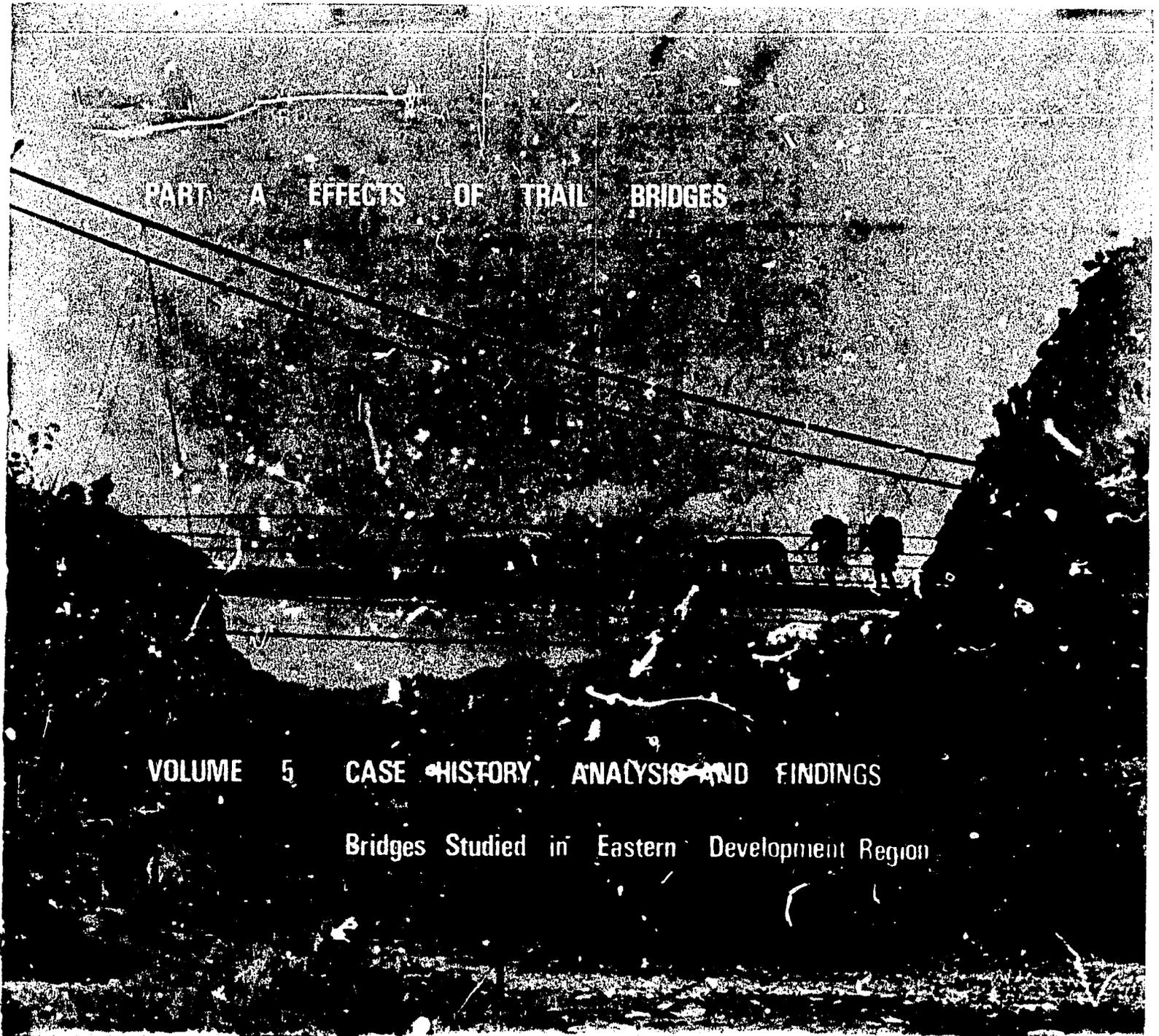
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# TRAIL SUSPENSION BRIDGE STUDY

CONDUCTED FOR

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT, NEPAL



PART A EFFECTS OF TRAIL BRIDGES

VOLUME 5 CASE HISTORY, ANALYSIS AND FINDINGS

Bridges Studied in Eastern Development Region

FINAL REPORT

JUNE 1978

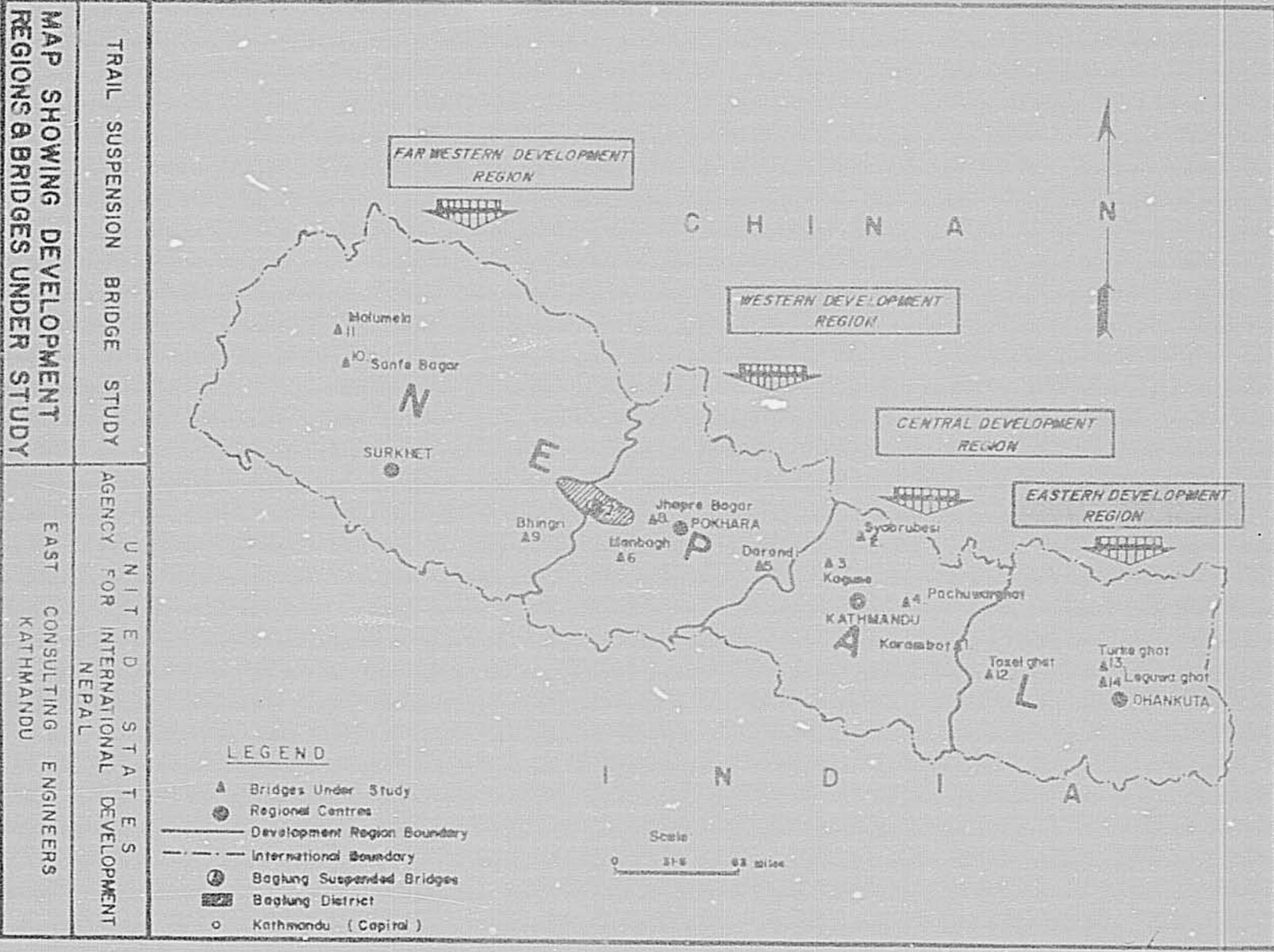
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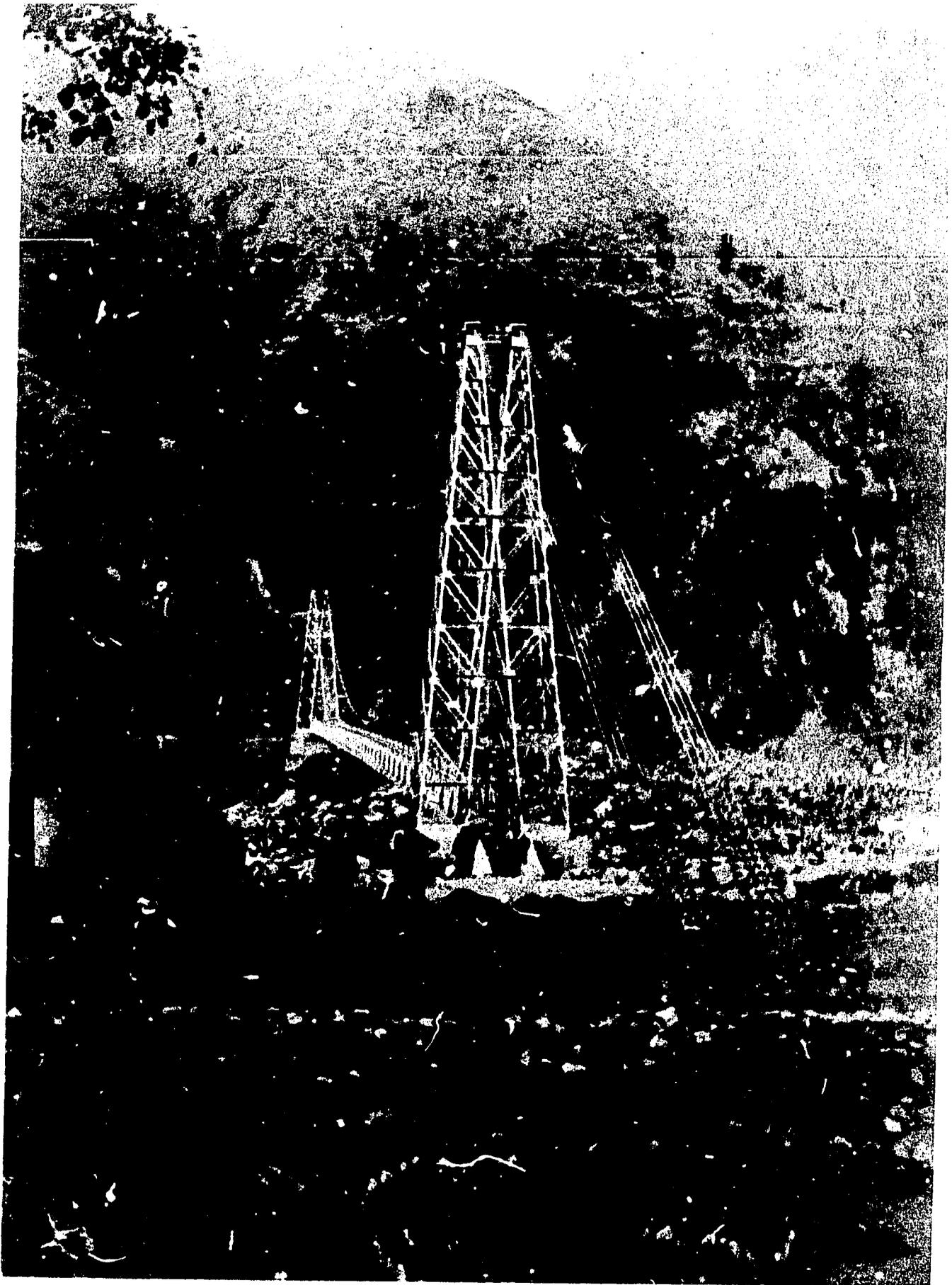
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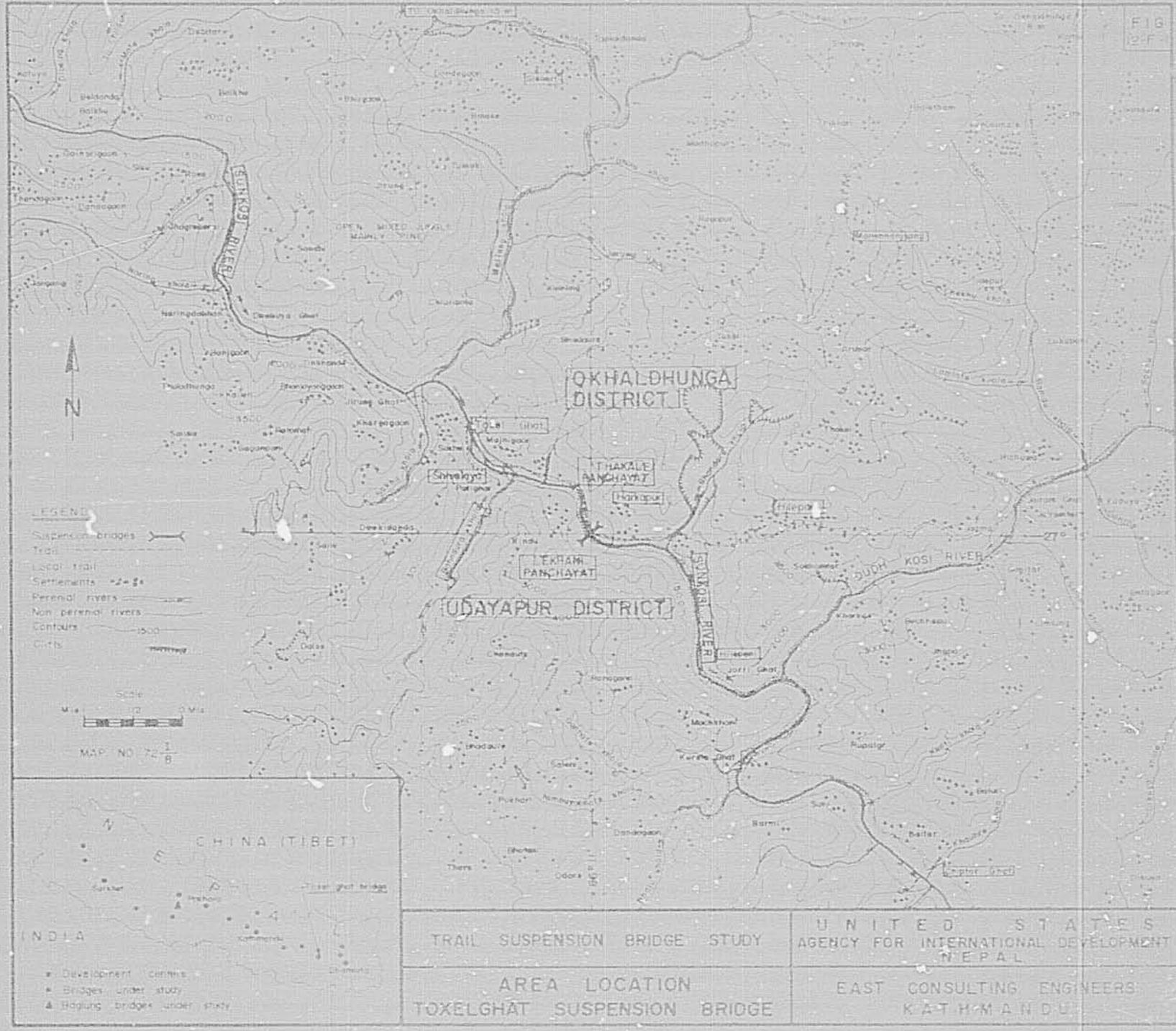
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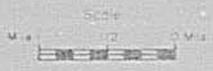


**12. TOXELGHAT BRIDGE**

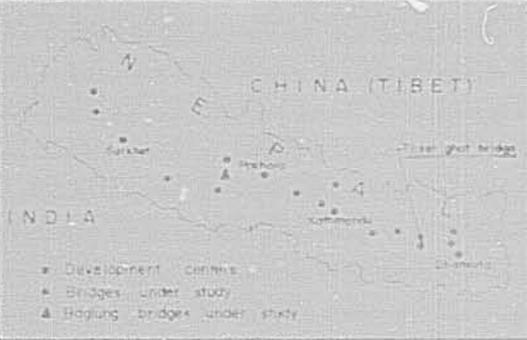


LEGEND

- Suspension bridges
- Trail
- Local trail
- Settlements
- Perennial rivers
- Non perennial rivers
- Contours
- Cities



MAP NO 72-1/B



TRAIL SUSPENSION BRIDGE STUDY

AREA LOCATION  
 TOKELGHAT SUSPENSION BRIDGE

UNITED STATES  
 AGENCY FOR INTERNATIONAL DEVELOPMENT  
 NEPAL

EAST CONSULTING ENGINEERS  
 KATHMANDU

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12.1 . CASE HISTORY

12.1.1 AREA DESCRIPTION AND HISTORY

- Geographic Setting

Located at a place called Harkapu, the Toxelghat Bridge spans the Sunkosi River. The bridge site is approximately 14 miles northwest of Katari, a market center in the southern foothills and is 9 miles southwest of the District Headquarters at Okhaldhunga. Flowing from the northwest to the southeast the Sunkosi, with its headwaters in Tibet, is a major river and unfordable throughout the year.

Near the bridge site, the river serves as the geographic boundary for Okhaldhunga and Udayapur Districts. The bridge links Lokhandi panchayat, of Udayapur District, lying on the right to Thakale panchayat, of Okhaldhunga District, lying on the left of the river.

The geography of the bridge site is marked by a small strip of paddy field on the left, and to the right there is a hill rising immediately from the main anchorage block of the bridge. A major part of the hill slope appears to be rocky but there are some patches of shrubs and a few trees. The altitude of the land surface in the vicinity of the bridge ranges from 1,100 ft. to 2,500 ft.

- Bridge Site Description

The Sunkosi flows in a fairly broad river valley at Toxelghat, and is relatively slow moving when compared to many of the other higher-gradient streams so common to the hills of Nepal.

The right bank of the site consists of fairly solid, yet somewhat weathered, rock. Downstream on the right the rock forms fairly steep cliffs. About 90 ft. upstream from the bridge on the right, a small wet-weather stream joins the Sunkosi, but it has no significant effect on the bridge. Further upstream on the right there is steep terrain consisting of soil and very weathered rock. The steep terrain

eventual waves may to the flat fields of the river valley. Except for the upstream wind cable all right bank foundations and anchorages are in solid rock.

The left bank is old river bed consisting of mixed sand and round stones and boulders. The left bank is flat near the bridge and downstream with plenty of room for small huts or Cihapros and agricultural activities. Immediately upstream from the bridge the main channel flows on the right side of the broad river bed. Upstream on the left, steep terrain consisting of soil and very weathered rock drops directly down to the river. The river flows in a very broad curve at the bridge site with the left bank at the outside of the curve. The east bank is not showing any signs of river scour now, but the foundation is only 30 ft. from where the flat bank drops off into the river (See photo 12-P-2). Even though there is no active scour now, lengthening the span by about 45 ft. would have allowed the left foundation and wind cable anchors to be placed in a much safer position, farther back from the bank.

The bridge is not very high, and once already flood waters have touched the planking on the right side of the bridge, flowing in back of the right foundation and stopping traffic for 2 to 3 hours. One of the wind cables snapped at that time by the action of the river. In 1954, before the bridge was built, high water was said to have flooded the left bank and reached a point about 9 ft. above the present walkway level of the bridge. The 1954 high water was an unusual event caused by the blocking of the Sunkosi downstream by landslides. Nevertheless, it would have been preferable to have built the bridge 9 ft. higher thus affording greater safety against flood waters.

#### -Relationship with the Regional Transportation System

The present trail, connected by the bridge, originates at Katari, the fair weather road head in the south, and for the first part, mostly follows the Kokruo Khola bank traversing small hamlets like Sangabas, and

Nayabazar Baseri, until the trail ascends and follows the steep Harithunka ridge. The trail then descends and follows the Bahadura Khola until it reaches the confluence of the Bahadura Khola and Sunkosi River, at a place called Shivalaya. There, the trail bifurcates; one trail follows the right bank of the Sunkosi which leads to the bridge, some 30 minutes walk downstream; the other goes upstream to the Toxelghat ferry where presently there are 3 ferries operating.

The ferry services are mostly used by the people residing in the western village panchayats of Okhaldhunga, particularly the ones lying across the Mailung Khola, since it is a more direct route. Normally, those people do not use the bridge because it involves approximately 3 miles of detour, and for a porter the time lost in taking this detour is considerable. The ferries operate for 9 months, during the dry season, and during the wet season when the ferries stop operating there is significant diversion of traffic to the bridge.

In many respects, the Toxelghat Ferry along with the bridge at Harkapur can be considered as the gateway to the greater Okhaldhunga and Solukhumbu Districts. The bridge and ferry combination has a special relationship with the area trail network particularly because of the fact that they lie on the major Katari-Okhaldhunga-Solukhumbu trail.

#### -General Cultural Setting

'Dharma karma gurunglo garyo chhakka paryo bahun'<sup>1/</sup>, a line of a Nepalese poem, reflects the religious activities of the Gurungs in the Okhaldhunga District as against the Brahmins. It means that the religious devotion and activities of the Gurungs perplexed the Brahmins. The Gurungs follow a variation of the Vedic rituals. Even today, we observed that some Brahmins serve as the priests for the Gurungs. Following of the Vedic rituals by the Tibeto-Burman groups such as the Gurungs and the Magars shows a vivid picture of cultural integration and

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<sup>1/</sup> Janaklal Sharma, Josmani Santa Parampara Ra Sahitya, 1963 p.88  
Nepal Rajakiya Pragya Pratisthan, Kathmandu.

a process of Sanskritisation in the study area. The Brahmins, the Gurungs and the Rais dominate the social and cultural scene in the study area.

The ethnic groups of the study area can be categorized into Brahmins, Chhetris, Matwalis (liquor consuming groups) and untouchables. The Brahmins and the Chhetris follow strict Vedic rituals and perform the Hindu rites handed down to them from their ancestors.

The Newars, who migrated from the Kathmandu Valley during the reign of Prithivi Narayan Shah, do not celebrate their own traditional fairs, and scarcely speak their own language (Newari).

The untouchables (Damais, Kamis, Sunars and Sarkis) have their own traditional ways of celebrating festivals, rites and rituals.

The people of the area generally wear a traditional form of dress. For the men this includes the long shirt or Bhoto, the short skirt or Kachhad and the loin cloth or Dhoti. The women are typically dressed in the sari and blouse but the short sari or Guniyo is also worn along with the head scarf or Mujetro.

#### -Services Available in the Area

Manebhanjyang panchayat, a neighboring panchayat of Thakale panchayat, has cooperatives which distribute fertilizer and improved seeds to several panchayats around the area. The agricultural JTA is also stationed at Manebhanjyang and his technical services are offered to the rural farmers in the neighboring panchayats.

About two hours walk from Lekhani panchayat, there is a health post at Mayankhu. However, the people prefer to go to Okhaldhunga for medical treatment.

There are 7 primary schools in Thakale panchayat and 4 primary schools in Lekhani panchayat.

In these panchayats, several organizations like police checkpost, schools, health post, cooperatives, post offices are also present.

-Bridge Location History and Decision Process

For many years prior to the construction of the Toxelghat Bridge, both the people of the area and the government had wanted a bridge built.

The local people were primarily interested in a bridge because it would make their lives not only easier but also much more secure. Many children on the right side of the river had been unable to attend the primary school across the river, either because of the expense involved in using the ferry or the danger involved in fording the river. Students from the left side of the river who had completed their primary school were prevented from continuing their education at the high school at Katari because of the lack of a bridge.

The Okhaldhunga District is a food deficient area, and the people have had to supplement their food supply with food grains brought up from the Terai region in the south. The Sunkosi has been a natural barrier to the passage of these food supplies into the Okhaldhunga District. At times, especially during the 3 months of the monsoon season, it has completely prevented these necessary supplies from arriving at their destination.

Along with the concern for education and food supply, the people in the Toxelghat area have been very concerned with the threat that the river has posed to their lives. In the past, there have been several cases of livestock and people being swept away by the Sunkosi. These incidents were especially common during the monsoon season when the Sunkosi reaches flood conditions.

The government had also been interested in the construction of a bridge in the area. The movement of officials between the District Headquarters and the Zonal Headquarters had been constantly hindered by the

absence of a bridge over the Sunkosi, which would service the Solukhumbu-Okhaldhunga-Katari trail. This absence also made it difficult to transact official business between, not only the Districts of Okhaldhunga, Udayapur, and Solukhumbu, but also between them and the Zonal Headquarters located at Rajbiraj in the Terai.

The Solukhumbu-Okhaldhunga-Katari trail, which handles a large amount of traffic and goods, has a major effect on the economy of the Sagarmatha Zone. The lack of a bridge in this area has made it, not only difficult, but at times even impossible to move materials, livestock and people from south to north and vice versa.

In a bid to relieve the problems caused by the absence of a bridge over the Sunkosi, the local people, in 1956, petitioned His Majesty, the late King Mahendra, while he was on tour of the Okhaldhunga District, requesting a bridge at Toxelghat. In 1962, a boat accident occurred and two people lost their lives, this prompted the local people to again ask the government for a bridge. Finally, in 1965, Mr. Birendra Keshari Upadhyay, Chief Engineer of the DOR, visited the area to select a feasible site. After looking the area over, he suggested that a bridge be built near the Shivalaya area, since this was near where the major trail crossed the Sunkosi. The one draw-back of this site is that it would have required a very long span. In a follow-up mission to Mr. Upadhyay's trip, an SBD engineer, Mr. Joshi, and Mr. Sorber, the engineer expert from UN/OPEX, working with DOR, visited the area in 1967. They also selected the Shivalaya site (with a span in excess of 660 ft.) over the Toxelghat site, probably because of the longer span that would have been required at Toxelghat. Later, in the same year, Mr. Manandhar, another SBD engineer, was assigned to construct the bridge. However, the construction site was changed from Shivalaya to Harkapur. It is thought that this was done because of the shorter span, of 450 ft., required at Harkapur. At the time of construction, no bridges had been built in Nepal with a 660 ft. span; this may have posed a problem for the concerned engineers, and they therefore changed the site. Even with

the shorter 450 ft. span required for the Harkapur site, it was longer than any of the available prefabricated bridges of a BRC standard design. This made it necessary for the bridge to be specially designed and fabricated. Balaju Yantra Shala, a government sponsored steel fabricator located in Kathmandu, designed and fabricated the steel units for the bridge.

The Shivalaya site would have been the most popular site and a bridge here would have facilitated a greater number of people. The greater span of over 660 ft. is today not uncommon in Nepal, and thus should not pose any problems for future bridge construction.

12.2

A N A L Y S I S

12.2.1 SOCIO-ANTHROPOLOGICAL ANALYSIS

-Land and People

Four village panchayats, namely Thakale, Manobhanjyang, Lekhani and Solpa were selected as being under the direct influence of the Tokelhat Bridge for a socio-anthropological study. Refer to Table 12-T-9 for population figures.

The main ethnic composition of the study area is as follows: in Thakale panchayat, there are Brahmins, Rais, Magars, Majhis, Kamis, Damais, Sarkis, Chhetris, Ghartis and Newars; the population of Lekhani village panchayat is made up of Magars, Brahmins, Sunars, Rais, Tamangs, Newars, Damais, Kamis, and Chhetris; similarly the major ethnic groups of Manobhanjyang and Solpa village panchayats are Rais, Magars, Brahmins, Chhetris and Tamangs.

The total estimated number of households for each ethnic group, in Thakale panchayat is as follows:

Table 12-T-1: Estimated Number and Percentage of Households by Ethnic Groups (Thakale Panchayat)

Ethnic Groups	Households	Percentage
Brahmin	399	46%
Rai	250	29%
Magar	47	6%
Majhi	39	5%
Kami	34	4%
Damai	28	3%
Sarki	28	3%
Chhotri	18	2%
Gharti	17	2%
Newar	5	below 1%
Total	865	100%

Source: ECE Field Survey

The main occupation of all the ethnic groups except the Majhis, is agriculture. The Majhis of the area do not own any farm land and are only engaged in boat operation at the Toxelghat Ferry site. About six Majhis operate ferries at Toxelghat which is about 2 mile upstream from the present bridge site. The Okhaldhunga District Panchayat has given seven ferry crossings including Toxelghat, to a local fellow on contract for Rs 4,200/- per year. But, the Majhis have signed a sub-contract with him and have to pay Rs. 10,000/- per year only for Toxelghat.

The Sunars make gold and silver ornaments while the Kamis make iron implements. The Damais are tailors and work under the Bali system. Some Matwalis and Chhetris are enlisted in the Nepalese, Indian and British armies, and they are also engaged in government services along with some Brahmans.

A schematic transect, of Lekhani village, is given below. It give a fair impression of the common settlement pattern of the area.

#### -Structure of the Family

Though some Gurungs of the area have large joint families, we observed that the average family contained only five to six members. After the construction of the Toxelghat Bridge, six families from the right side of the Sunkosi River had settled on the left side of the river and have thus separated from their joint families; and the bridge makes it easy for these families to cross the river to visit their other family units. Though 60 families on the left side of the river have broken down into nuclear family units after the construction of the bridge, only four families have settled on the right side of the river and the remaining 56 families have migrated towards the southern Terai region. This southerly migration would most likely have taken place even if the bridge was not built.

We asked several people in the bridge site area if their consanguinal relatives lived across the river; 42% of the persons polled responded positively but, infact, they had been living there since the period of ego's fathers and grandfather's. After the construction of the bridge

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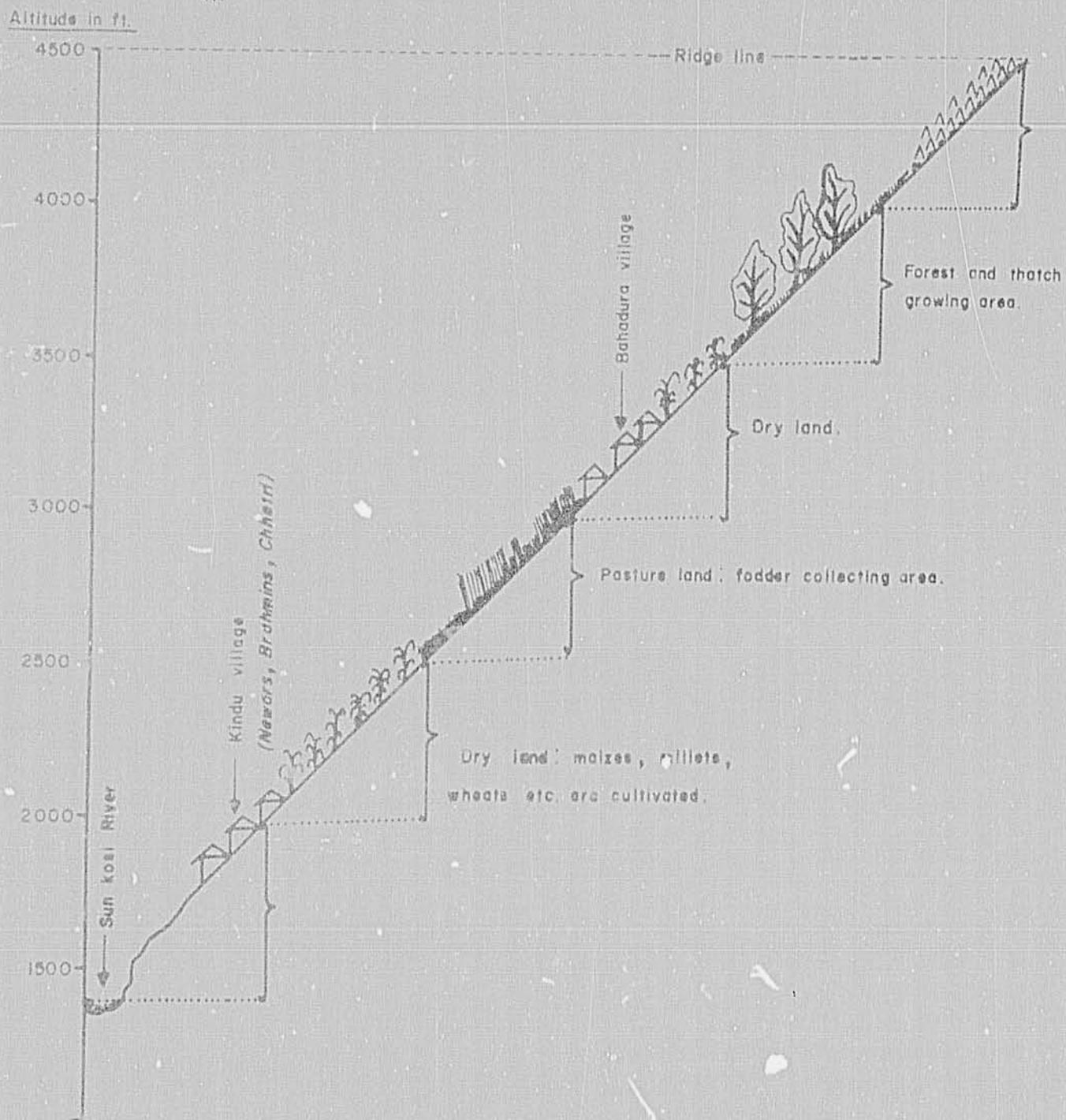


Fig. 12-F-2: Lekhani Transect (Schematic)

Source ECE Field Survey

these relatives have had opportunities to meet one another more frequently.

-Marriage Practices

The bridge seems to play a positive role in promoting marriages between families on opposite sides of the river. Before the construction of the bridge, people of the area disliked the idea of arranging the marriages of their daughters and sisters to families across the river. We asked the local people if their affinal relatives lived on either side of the river, 75% replied negatively. We also asked them if they willingly arranged their daughters' or sisters' marriages across the river before the construction of the bridge. They responded as follows:

Table 12-T-2: Percentages of Male Respondents Indicating a Willingness or Lack of Willingness to Arrange Cross-river Marriage Prior to the Construction of the Bridge

Panchayat	Not Willing	Willing
Thakalo	100%	0%
Manobhanjyang	100%	0%
Lekhani	87%	13%
Selpa	50%	50%
Average Percentage	84%	16%

Source. ECE Field Survey

The above table shows that before the construction of the bridge, it was difficult, and at times impossible, to arrange marriages across the river. The people felt that if a girl was married to a man on the opposite side of the river, without a bridge, it would become very risky and sometimes impossible for her to return to her natal home during many of the social and religious occasions, or at such a time when some member of her family dies.

The people polled were also asked whether marriages across the river have increased after the construction of the bridge. Their responses are as follows:

Table 12-T-3: Percentages of Male Respondents Indicating an Increase in the Number of Cross-River Marriages After the Construction of the Bridge

Panchayat.	Increased	Not Increased
Thakale	100%	0%
Manobhanjyang	100%	0%
Lokhani	63%	37%
Solpa	50%	50%
Average Percentage	78%	22%

Source: ECE Field Survey

Thus, 78% of the respondents hold the view that marriages have increased between families on opposite sides of the river due to the presence of the bridge.

#### -Funeral Practices

The Tamangs of the area bury their dead in the forest nearby, while the Rais bury their dead on their own land. The Brahmins, Chhetris, Newars and untouchables cremate their dead on the bank of the Sunkosi River but do not carry the dead bodies across the bridge for cremation, because firewood is easily available on either side of the river. But, relatives and friends in cases of all ethnic groups, assemble from both sides of the river, to participate in the funeral rites.

In response to the question asked to the local people as to whether the Toxelghat Bridge had brought about any changes in the funeral rites, only 40% of them replied positively. According to these, the people on the right side of the river are now able to buy shrouds or Katro at Harkapur, on the left side. Since the bridge construction, the people from both sides of the river have also been able to join together in larger groups during the funeral rites. Now, all relatives and family members of the dead are able to come together for this solemn occasion.

-Education and Health Practices

In Thakale village panchayat there were already three primary schools. However, due to the facilities provided by the bridge, one more primary school has been established at Harkapur. The new primary school is located just left of the bridge and has provided school facilities for 30 boys from the other side of the river. Since the construction of the bridge, 25 secondary and higher secondary school students have been able to attend the school at Katari, which is one day walk from the bridge site.

Two health posts have been established in Manobhanyang and Lekhani village panchayats, after the construction of the bridge. But according to the local people the bridge had nothing to do with the establishment of these health posts. The movement of sick people from across the river has not increased at all due to the bridge. This is because people are more inclined to use the local healers or Jhankris, than use medical facilities provided at the health posts. This may be the reason why 100% of the people questioned responded negatively when asked about their changes in health practices.

-Festivals, Fairs and Religious Activities

The number of people traveling to the local temple of Mahadevsthan, in the Solpa village panchayat, had increased greatly, primarily due to the bridge. Also, the number of people who use the bridge to participate in festivals and special religious ceremonies which occur on the opposite side of the river has increased. Over 2,000 people cross from the right side of the river in order to go to Dudh Kunda, for a ritual bath each year. It was also reported by the local people that more than 1,000 people use the bridge each day during the fair at Halesi. Apart from this, the local people also take part in the religious fairs that take place quite far off from their locality. For example, more than 4,000 pilgrims crossed over the bridge last year, in order to participate in the holy fairs at Jalakpur and Tribeni.

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-Changes in the Roles of Women

Like in other parts of Nepal, the women in the study area also do the daily chores, like assisting the men in agricultural duties, grazing cattle, collecting water, firewood and fodder, cooking food, etc. Apart from this daily work, women actively participate in communal dances, marriages, festivals, fairs and religious activities. In the table given below, compiled from answers given by men in the area, we have tried to categorise how these activities have been affected by the bridge.

Table 12-T-4: Percentages of Male Respondents Indicating an Increase in Womens' Activities Because of the Bridge

Panchayat	Extension of ritual friendships	Communal dances.	Marriages, festivals, fairs and religious activities	Domestic work, agriculture and portering
Thakale	0%	20%	56%	64%
Manebhanjyang	0%	27%	62%	72%
Lokhani	0%	34%	73%	85%
Solpa	0%	32%	48%	50%
Average Percentage	0% <sup>2/</sup>	29%	60%	68%

Source: ECE Field Survey

The table indicates that 29% of the men being interviewed replied that the bridge has facilitated women to participate in communal dances. In a similar way 60% informants responded that the participation of women of the area in such social occasions as marriages, festivals, fairs and religious activities has increased and 68% of the men questioned indicated a favorable change in the utilization of time to do domestic work by using the bridge. Most of the women of the left side of the river cross the bridge to collect firewood and fodder. They also take their goats and sheep to the right side of the river for grazing.

<sup>2/</sup> Regarding the extension of ritual friendship due to the bridge, 100% responses were negative.

The women from both sides of the river now have the opportunity to exchange labor, Parma, and women porters have increased in number because of the ease of mobility provided by the bridge.

To get the womens' point of view the same questions were asked to twenty local women. 76% of them responded that they use the bridge more often for participation in marriages, festivals, fairs and religious activities. 80% stated that they use the bridge for domestic work and 25% stated that portering became easier after the bridge was built.

All the women said that the bridge has saved them considerable time. We asked them how they utilized this surplus time; their responses are tabulated as follows:

Table 12-T-5: Percentages of Female Responses on Utilization of Surplus Time Saved Due to the Presence of the Bridge

Activities	Affirmative Responses
Taking more care of the children	35%
Farming	60%
Cooking better food than before	25%
Taking more rest	0%
Socializing with other women	0%
Recreation	0%
Collecting firewood and fodder	60%
Grazing cattle across the bridge	45%
Others (portering and business)	10%

Source: ECE Field Survey

The information tabulated above, indicates that the surplus time available, due to the use of the bridge, has been used in areas of work rather than for rest or relaxation.

-Changes in Beliefs and Habits

With regard to the questions asked to the local people about any changes that may or may not have occurred in their beliefs and habits as a result of the bridge. Their responses are shown in the following table:

Table 12-T-6: Percentage of Respondents Indicating a Change in their Beliefs and Habits

Habits and Beliefs	Affirmative Responses
Food	56%
Language	12%
Clothing	19%
Farming methods	40%
Celebration of festivals	35%
Religious practices	35%
Health practices	0%

Source: ECE Field Survey

Two of the most important effects that the bridge has had on the habits of the people in the area, are concerned with food and farming methods. More wheat and rice are now being brought up from the Torai, and this has started to supplement the main diet of maize and millet. Many farmers in the area are now starting to make use of improved seed and fertilizers. Both of these were unavailable before the bridge was built.

One of the local beliefs which was completely changed by the construction of the bridge, and which may play a role in the construction of bridges in the future, concerns the sacrificing of human beings. Before the bridge was constructed the local people believed that it would only be possible to build a bridge across the Sunkosi after a man or a child was sacrificed on the bridge's foundations. Since the bridge was successfully built and no one was sacrificed the people no longer hold

this belief and bridges constructed in the future will most likely receive more local support.

12.2.2 INSTITUTIONAL ANALYSIS

-Local Participation

The construction of the Toxolghat Bridge was funded through a joint agreement between HMG and USAID/Nepal, and no voluntary labor was contributed for the construction of the bridge by the local people. The porters, the unskilled and the skilled laborers were all paid by the government. The construction work was carried out largely by the use of a daily wage labor force, but some parts of the work was done on a contract basis.

For about two years after the completion of the bridge, no tolls were levied. In 1971, a toll system was introduced. The toll collection, enacted by the Okhaldhunga District Panchayat, was made through contractors and the toll rates set for livestock, prevailing then, are listed below:

Rs. 0.50/cow	Rs. 1.50/buffalo	Rs. 1.00/dog
Rs. 0.10/sheep	Rs. 0.10/goat	Rs. 0.50/yak
Rs. 1.00/pig		

Originally, a man without a load was taxed Rs. 0.10 and a man with a load was taxed Rs. 0.50. However, because of stiff resistance, from the local people, this tax was stopped for a short period of time.

The total amount of money collected for three different years, as reported; are as follows:

In 1972	Rs. 1,020/-
In 1973	Rs. 4,750/-
In 1974	Rs. 9,000/-

In 1975 and 1976, contracts could not be concluded and, therefore, no toll was raised. Recently, the Okhaldhunga District Panchayat has started collecting toll directly through its employees and the District Panchayat record shows that they could collect as much as Rs. 2,000/- a day, during heavy traffic periods. The potential for toll collection is very high and therefore, the District Panchayat has taken the responsibility for the maintenance of the bridge though no major repair is yet required.

The police checkpost, stationed at Harkapur, helps the District Panchayat employee to raise the toll. The residents of Harkapur village and Lekhani village are exempted from any toll, and instead of paying a toll, these people have to contribute free labor for the maintenance work on the bridge and to make resting places or Chautaras for travellers. This arrangement, if worked out properly, will be an effective means of using local resources in the maintenance of the bridges. However, it is sad to note that it has not been found as effective as it should have been.

#### -Institutional Impact of the Bridge

The bridge has helped the people of the area to bring in their supplies from Katari and thus has helped to establish a continuous link with the nearby market. After the construction of the bridge, a small shopping area has developed in Harkapur village, which is close to the bridge. Thus, the bridge has generated several services to the people around the area. Also, travel from the Solukhumbu region to the Terai region, across the Toxelghat Bridge, has become possible all around the year.

### 12.2.3 ECONOMIC ANALYSIS

#### -Geographic Area and Population Served

As mentioned earlier, the bridge is placed at Harkapur and not at Toxelghat proper. Now that the bridge has been built, local people

have voiced mixed opinions on the appropriateness of the bridge location, and a majority of these people agree that a better location would certainly have been at Shivalaya, which is closer to the main north-south trail.

Despite the fact that the bridge is not conveniently located, it nevertheless services a fairly large area and population. Presently the bridge serves most the panchayats of Okhaldhunga <sup>3/</sup>, Solukhumbu, and some of the panchayats of Khotang <sup>4/</sup>, Udayapur <sup>5/</sup> and Sindhuli Districts. Two hundred thousand is a good estimate of the number of people directly served by the bridge.

There are 3 ferries still in operation at Toxelghat during the 9 dry months of the year. The ferry services are primarily used by the people residing in the northwest panchayat areas of Okhaldhunga District, particularly across the Mailung Khola. The ferry crossing falls directly on the traditional main trail and provides the shortest route for people traveling from the northwest heading for Katari. People traveling this route will only use the bridge during the 3 months of the monsoon season, when the ferry ceases to operate. During these 3 months a traveler, with a heavy load, can expect a detour of a 5 to 6 hour walk, to come down from the main trail, use the bridge and then return to the main trail on the opposite side. Even though the bridge location is not the most convenient it offers the only way of crossing the Sunkosi during the monsoons.

-Estimated Traffic Flow

The local people, when asked about the nature and volume of traffic which flowed over the bridge, were unable to give any concrete answers. They did however, mention the complete shift in traffic from the Toxelghat Ferry point, following its close during the 3 months of the monsoon season, to the bridge.

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<sup>3/</sup> Thakale, Manobhanjyang, Madhanpur, Onun, Talva, Waken, Sisneri, Balakhu, Okhaldhunga, Kotkoni, Bhola, Thulachap etc.

<sup>4/</sup> Diktel

<sup>5/</sup> Lekhani, Sircalo, Sorungchabise.

An attempt was made to examine the magnitude of wet season traffic from toll records available from the District Panchayat toll record register. The average traffic flow for three successive days, selected on the basis of showing the highest toll collection, reveals that the wet season traffic is composed of, 44 animals per day, 25 porters per day and 98 non-porters per day. These figures represent long distance traffic only, since the people from Hilopani, Harkapur and Churmi are exempt from the toll and are therefore not noted in the toll records.

As far as dry season traffic is concerned, a traffic count was conducted at the bridge head for 5 consecutive days during a field visit in the month of December, in 1977. The traffic count was made separately for non-porters, porters and animals (Table 12-T-8). On the average there were 7 animals per day, 206 porters per day and 102 non-porters per day. It was indicated by the local people that of the total traffic flow, only 25% is accounted for by the local traffic and the rest represents long distance traffic.

Table 12-T-8: Traffic Counts Across the Bridge

Days	Non-Porter	Porter	Animal
First	153	340	5
Second	63	96	6
Third	63	312	10
Fourth	126	240	12
Fifth	106	42	3
Average/ Day	102	206	7

Source: ECE Field Survey (Dry Season).

An examination of the statistics concerned with the origin and destination of travelers, reveals that Okhaldhunga District and Katari are responsible for most of the travel. These two places were the destination for 85% of the travelers, 36% and 49% respectively. Conversely,

Table 12-T-8: Percentage Traffic Indicating Origin, Destination and Purpose of Travel in the Study Areas

Place of Origin and Destination	Okhal-dhansa		Solu-Khumbu		Udayapur		Nahari		Dhanusa		Siraha		Sunsari		Morang		Total Traffic		
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	
Buying	12	12	3	-	7	-	5	20	-	-	-	-	-	-	-	-	-	52%	52%
Selling	13	3	3	-	2	-	-	25	-	-	-	-	-	-	-	-	-	28%	28%
Portering	2	0	2	-	-	-	8	2	-	-	-	2	-	-	-	-	-	12%	12%
Service	-	10	-	-	-	-	-	-	3	-	3	-	-	-	2	-	-	10%	10%
Extended Period	10	-	-	-	-	2	-	2	-	3	-	3	-	-	-	-	-	10%	10%
Special	-	3	3	-	-	-	-	-	2	-	-	-	-	-	2	-	-	5%	5%
Others	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3%	3%
Total	45	36	21		9	2	13	49	3	3	3	5		3	2	2		100%	100%

Source: ECE Field Survey

they were the origin for 58% of the travelers, 45% and 13% respectively. The Solukhumbu District, where 21% the travelers originated is the only other District of the remaining six, which was responsible for any sizable number of travellers. Refer to Table 12-T-9 for the exact figures on these other six panchayats.

Of the total number of people who used the bridge, 32% were going somewhere to buy supplies, 28% were travelling somewhere to sell produce of goods, 12% were porters, 10% were using the bridge to get to their offices, 10% were travelling to their farm lands, 5% were going on social visits, and 3% for other purposes.

When the two groups of statistics are put together, i.e. the purpose of using the bridge with the origin and destination of the travelers, one can easily discern the basic mobility pattern that exists. An example of this is shown by the statistics on buying and selling purposes of bridge use. Of the 12% of the people who were on a buying mission, 12% originated in Okhaldhunga, 8% in Solukhumbu, 7% in Udayapur and 5% in Katari. There are only two places cited as a destination for these travelers; 20% were destined for Katari and 12% were destined for Okhaldhunga. Similarly, of the 28% of the travelers who used the bridge on their way to sell their goods, 18% originated in Okhaldhunga, 8% in Solukhumbu and 2% in Udayapur. From all these travelers 25% were headed for Katari, and only 3% destined for Okhaldhunga.

With 60% of the total traffic concerned with buying and selling and the majority of these with either Okhaldhunga or Katari as their destination or origin, a north-south and south-north traffic pattern is easily seen.

#### -Agriculture

The study was limited to the five village panchayats, Thakre, Manobhanjyang, Adheri Nagsthan, Solpa and Lokhani, lying in the vicinity of the bridge site. These village panchayats, however, can be taken as

representative of all other panchayats within the service area of the bridge.

By far agriculture, is the predominant means of livelihood in the study area. This is supplemented, in good measure, by income earned through porterage, labor at home and abroad in low wage occupations, pensions and remittances of soldiers in foreign armies.

The agriculture is characterized by small land holdings and subsistence level farming. A major portion of cultivated land consists of dry land, or Pakho as it is called by the local people, there is also a marginal amount of wet land, or Khet. Irrigation facilities are limited. According to local estimate, Pakho comprises 50% of the total land area in the study region, whereas only 7% consists of Khet. The forested area is estimated at 22% and barren land comprises 21% of the total land area.

The principal grain and legume crops grown in the area are corn, millet, rice, wheat, buckwheat, pulses and soyabean. Potatoes can be considered the major vegetable crop of the area. A single crop growing pattern is followed for all principal crops, this is due mainly to the poor irrigation facilities. In spite of the predominance of agriculture, this is a seriously food deficit area. About 90% of the people questioned in the area were of the opinion that the agricultural production of the area does not meet their food requirements. Therefore, considerable amounts of grain, especially rice and corn, have to be imported from the Terai.

Agriculture, is closely followed by animal husbandry as an important means of livelihood. Each household, on an average, has 3 to 4 cows and buffaloes, 2 to 4 goats, and 6 to 8 poultry. Pigs are raised only by certain ethnic groups such as the Rais, Magars, Majhis, etc. and does not constitute a major livestock animal.

Chemical fertilizers and improved varieties of seed have been introduced in the area fairly recently. The use of modern agricultural implements however, is not prevalent and farming techniques are still very traditional and to a certain extent, inefficient. A majority of the local people, 60%, said that the agricultural yield on their land, has been declining over the years, 30% said that on their land it has been increasing and 10% reported that it has remained constant over the years. It is difficult to reach any meaningful conclusion from this diverse opinion. However, it was noted that the increases in yield by 30% of the farmers questioned, were due to the application of modern agriculture inputs.

Although the bridge has not been instrumental in bringing about any discernible changes in the agricultural pattern of the area, its usefulness in terms of facilitating easier access to cooperative stores for buying agricultural inputs, access to farm lands, or to the Agricultural Development Bank for credit is quite noteworthy. However, local people felt that any changes in the agricultural pattern that have occurred are the results as much as to the drive of the various agricultural institutions as to the bridge. The frequency of visits from the JTA of the Department of Agriculture, to advise the people on methods for agricultural improvement have increased over the years. The local people indicated that after the construction of the bridge, improved varieties of wheat, corn and paddy seeds, as well as vegetables such as cauliflower and cabbage, and fruits like oranges, mangoes and pineapples, have been introduced. However, this new direction in farming exists on a rudimentary level.

#### -Rural and Cottage Industries

Rural and cottage industries are a household affair and do not exist as organized units. These activities are mainly concentrated in the area of weaving coarse woolen mats, blankets and cloth, Radi Pakhi, bamboo goods, etc. Coarse woolen mats, blankets, made from sheep's wool, are woven

fair-sized quantities for commercial purposes. Apart from this, it has been revealed that about 30% of total households are engaged in making coarse cotton cloth, or Khadi, but it is more for domestic use, rather than for trading purposes. Local people indicated that once cottage handlooms had flourished in the area but this activity is progressively declining. Now, only a few households operate handlooms and these people bring in cotton yarns to meet their domestic needs. The decline of the handloom industry can be attributed to three factors; (1) that cotton cultivation has been abandoned due to poor soil condition and unavailability of abundant cattle manure. This lack of manure has brought about a steady decline in the productivity of the land and cotton growing has been replaced by food crops in an attempt to counter balance this drop in productivity; (2) the price of cotton yarn has soared beyond the reach of the rural poor; (3) the penetration of a plentiful supply of cheap manufactured fabrics into the area has made it economically unfeasible for the local people to weave.

While the rôle of the bridge in promoting cottage industrial development in the immediate area has not been very significant, its contribution in terms of helping the marketability of cottage industrial products especially Radi Pakhi has been quite appreciable.

#### -Labor force Situation and Employment

The total size of the population of the five village panchayats under study is estimated to be 15,849. Of this the males constitute 7,661 and the females 8,188. The size of the total labor force in the five panchayats, as represented by active participation in economic activities, is estimated to be 7,510. Of this the male labor force is 4,565 and the female labor force is 2,945 (Table 12-T-9). On this basis the crude activity rate <sup>6/</sup> can be established at 47%; the sex specific activity rate <sup>7/</sup> for the males works out at 59% and for the females, at 36%.

<sup>6/</sup> Crude activity rate: Percentage ratio of economically active population to the total size of population.

<sup>7/</sup> Sex specific activity rate: Percentage ratio of economically active population by sex, to the total population of the same sex group.

Table 12-T-9: Estimated Population and Labor Force

Panchayat	Total Population (1977)			10 years of age & above			Economically active Population <sup>8/</sup>		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Thakale	4204	2003	2201	2968	1414	1554	2092	1136	906
Manebhanjyang	2724	1314	1410	1923	928	995	1359	779	580
Adheri Nagthan	2614	1290	1324	1845	911	934	1309	764	545
Solpa	3958	1934	2024	2689	1314	1375	1720	1144	576
Lekhani	2349	1120	1229	1629	777	852	1030	692	338
Total	15849	7661	8188	11054	5344	5710	7510	4565	2945

Source: ECE Estimate based on the 1971 CBC Census.

<sup>8/</sup> The economically active population may be defined as the number of persons in the age group 10 years and above, who contribute to the production of goods and services.

The size of the labor force for individual panchayats appears to vary with the settlement pattern. Thakale panchayat registers the highest labor force with 2,692 and Likhani Panchayat has the lowest, with only 1,030 persons.

Besides agriculture, which is the primary occupation, 45% of the population in the area reported animal husbandry, 37% portering, 13% army service, and 5% retail business, as their secondary occupation.

The extent of short-term labor migration outside the area, mainly to seek employment in short-term wage earning occupations, is phenomenal. This is due to limited employment opportunities in the area and the need to earn income. Most of the labor force migrates to Katari, Kaula, Ghunch, Gaighat, and to Indian cities to work in various unskilled manual jobs ranging from simple porters to construction workers. This type of short term labor migration reflects the deteriorating economic condition in the area and an increased mobility of the surplus labor force. A migration of a permanent nature is not common.

Local people indicated that the bridge has not had any effect on generating employment opportunities at home, nor has it been instrumental in stimulating migration outside the area.

#### -Trade flow Pattern

One of the direct advantages of the bridge is its usefulness in facilitating the trade flow on a perennial basis. According to observations made during the field survey the most important exports in the area were potatoes, goats, oranges, coarse woolen mats or Radi, poultry, etc. while the imported commodities were dominated by an inflow of food grains, clothes, chemical fertilizers, salt, kerosene, edible oil and a wide range of other basic manufactured goods.

The most direct benefit of the bridge to the whole area is in enabling the easy importation of food grains from the Terai, especially

from the market center of Katari. Both Okhaldhunga and Solukhumbu are food deficient areas and the bridge has definitely benefitted the local people by making it possible to import food grains on a year-round basis to meet their food requirements.

Another important impact of the bridge is on the prices of essential consumer goods in the local markets to the north of the Sunkosi. Prior to the building of the bridge, this trade sector was completely closed during the 3 months of the wet season, due to the close of the ferry. The result was that prices went up and the people were forced to pay exorbitant prices for essential goods. Now, as a result of the bridge the trade sector is open year-round, and the seasonal increase in prices no longer exists.

#### -Environmental Effects

There are only sparse forests around the bridge site and the indiscriminate felling of trees in these forests is prohibited by both the Forest Office and the panchayats. But, regardless of this regulation people still cut the trees down, in order to meet their fuel and wood requirements. The bridge has enabled people from the less forested left side of the river to have easy access to the forests on the right side. Currently, there is not a great amount of wood being moved from the right side, but a potential for this movement exists. The bridge also has the potential for assisting the fledgling afforestation program by enabling the easy dispersal of tree seedlings to the area.

The landslides that exist in the area are old and current erosion taking place due to the thinning of forests or the collection of fodder, does not have a direct link to the existence of the bridge.

On the whole, the bridge has no direct positive or negative effect on the natural environment of the area.

12.2.4 ENGINEERING ANALYSIS

-Site Selection, Design and Construction Methods

The most popular site for a bridge in the Texelghat area is at Shivalaya, where the Bahadura Khola joins the Sunkosi. (See photo 12-P-10). The popularity of this site results from the fact that the main trail to Katari and the Terai follows the Bahadura Khola. At the Shivalaya site, there is solid rock on the right side and a hill on the left, consisting of very sandy soil, and setting the foundations well away from the river on the left bank would have given them adequate protection against river scour. The length of span required would be either around 660 ft. or slightly in excess thereof. In 1967 Mr. Joshi, then an engineer of the SBD, and Mr. Sorber, UN/OPEX expert at the DOR, did a survey at Shivalaya. Mr. Joshi felt the site was not only reasonable technically but also desirable because of its location along the main trail.

Why the long span site at Shivalaya was not chosen is not clear. Local persons were surprised when construction work for the bridge actually began about 2 miles downstream at Harkapur. Certainly the 450 ft. span at Harkapur is much shorter and therefore lower in cost and probably also less likely to have involved technical problems. At the time of design and construction of this bridge in the mid-late 1960s a span of 660 ft. would have probably been the longest in Nepal. Nevertheless, longer spans are now being designed and built in Nepal and should also have been possible at this time. The Harkapur site is technically a good one with rock on the right side, and mixed soil, sand and boulders of the old river bed on the left side. Had the span been slightly longer, say 45 ft. and slightly higher, say 3 to 9 ft. the bridge would be better protected against possible damage from river scour and high flood waters.

There is an additional feasible site about 600 to 900 ft. downstream of the existing bridge. The left and right bank conditions

are about the same as the site of the existing bridge but the span is slightly shorter. A rather long and difficult approach trail would have to be blasted out in the cliffs on the right. However, it is said that this site was not selected for that reason.

Toxelghat Bridge, fabricated by Balaju Yantra Shala of Kathmandu, is a graceful and impressive structure (Photo 12-P-1). A main feature of this bridge is its solidly built stiffening truss. As a result of the truss vortical oscillation of the bridge is practically nil. However, the bridge is subject to a certain amount of lateral sway when many men or animals cross the bridge at one time. The tower base is fixed and the saddles consist of essentially frictionless pulleys. The front and back angles of the main cables at the towers are unequal on both sides of the river and, therefore, there is considerable bending moment in the towers. However, the very substantial structure of the towers appears well designed to counter act this bending moment.

There are 8 main cables of  $1\frac{1}{2}$  in. diameter. The sag of the main cables was observed to be approximately 10.6% of span length. Calculations, using Indian Standard Specifications <sup>9/</sup> of 172 kips breaking strength for  $1\frac{1}{2}$  in. cable, show that with a safety factor of 3, the permissible load is 750 lbs/ft. Using the live load specification <sup>10/</sup> of 85 lbs/ft.<sup>2</sup> and the measured walkway width of 4 ft. the live load of the bridge is calculated to be 340 lbs/ft. Although design details which would enable an exact calculation of dead load were not available at the time of writing of this report, a fairly accurate rough estimate of dead load was made and found to be 225 lbs/ft. The full load then is approximately:  $340+225 = 565$  lbs/ft. The stiffening truss is certainly a nice feature of the bridge but is not an absolutely essential part of the structure. It might be questioned whether the benefits derived from the stiffening truss is really worth the added cost.

9/ HMG/SATA, Standard Trail Suspended and Suspension Bridges, 1977 Part A p. 5.103.

10/ Ibid, p. 2.301.

Mr. Satya Narayan Manandhar was the engineer responsible for the construction of the bridge, and Mr. Ram Bihari was the overseer. Both were from the SBD. No large outside contractors were used for construction work except for the cutting of wood and the transport of materials. Sal wood planks were portered in from Katari. Steel parts were portered from Katari with the exception of the very heavy saddles, which were transported by helicopter. It was said, there was a problem caused by the contractor's failure to make delivery of materials on time. Except for gravel breaking, construction work was done by daily wage labor. There was no voluntary labor as such, given for the bridge, but some villagers felt they contributed a sort of voluntary labor by working for low wages. For example, local people at one point received Rs. 1,400 for cable transport but it probably cost them Rs. 2,000 for food, consumed while they were carrying the cable. Local people also raised some contributions for the bridge with donations in the range of Rs. 5 to 25 per person. Almost all construction work was done by local labor under the guidance of the engineer and overseer. Several skilled workers from Ramoohap District were on the labor force and in addition to this there was one mechanic from the SBD.

The blasting of cliff rock on the right side for the main anchorage was required as well as the blasting for removal of boulders in foundation excavations on the left side. Solid rock was encountered during blasting for the right main anchorage. A rock drill was used for making the drill holes. Concrete was mostly mixed by hand, a gasoline-driven concrete mixer was also used for a short time but proved unsatisfactory and much slower than hand mixing, so its use was abandoned. Two cable pulling machines were used but were said to have been of the chain type rather than the Tirfor type, which is more useful for cable pulling. First, all the suspenders were hung and then the walkway was added. A very small amount of on-site welding was required to attach connectors to the ends of the stiffening truss.

The bridge was started in 1967, completed in early monsoon of 1969 and inaugurated in August 1969.

37

-Present Bridge and Approach Trails: Condition and Recommended Improvements

Bridge Name: TOXELGHAT	Zone: SAGARMATHA	Districts: Left: OKHALDHUNGA Right: UDAYAPUR	Village Panchayats: Left: THAKELE      Right: LEKHANI
SPAN	45- ft.		
TYPE	Suspension		
MAP 1"= 1 mile	72-1/8		
COORDINATES	27°10'12" 86°24'16"		
TRAIL	Katari to Okhaldhunga and Namche Bazar		
TRAIL TYPE	Class B		
RIVER	Sunkosi		
RIVER TYPE	Major		
COMPLETION YEAR	1969		

Toxelghat Bridge is in good condition except for the planking and paint, which are only in fair condition. The paint job consists of a coat of red primer plus an outer coat of what is evidently aluminum paint. The outer coat was thin to begin with in some places and by now has worn away in others. Almost all nuts and bolts are showing signs of initial rust. The bridge would need a new coat of paint now.

Refer to  
Photographs No.

12-P-6

Refer to  
Photograph 12.

Although nuts and bolts are generally tight, there are several places where they are loose or have been lost. Since there is a toll collector at this bridge, it would be an easy matter for him to keep the nuts tight if he had a wrench plus the training in using it.

12-P-3

In several places excess cable was cut from the bridge and taken for use elsewhere. Unfortunately it was cut too close to the bulldog grips in some places and frayed cable ends extend right up to the bulldog grips. One suspender pair and one wind tie were found loose. There were no bent parts. The stiffening truss touches lightly against the left tower at one point causing a most noticeable, musical squeaking, noise when anyone crosses the bridge.

12-P-5

The original planking of the bridge, which consists of  $1\frac{1}{2}$  in. sal planks placed crosswise, is still present, and it is only in fair condition now. Four cows were said to have suffered broken legs because of slipping through holes in the planks. Fifty-six planks with rotted-out edges need repair or replacing. Three or four planks are loose and need renailling. The planks are nailed onto longitudinal end beams on the trusswork. The nails on the bridge are interesting heavy-duty square nails, which appear to be hand made. They are big enough to keep the planks tightly nailed down, in general but allow for easy pulling up for replacement of bad planks. It should be easier for local people to replace such nailed planks than to replace those that are bolted and require removal of curb beams or fencing, loosening of nuts below

12-P-7

12-P-7

the walkway, struggling with rusty bolt threads, etc., before the planks can be replaced such as locally reported in Jhaprebagar Bridge (See Volume 3 of this report).

It was said that the walkway had a good upward camber when the bridge was first built but now it has only slightly upward or almost zero camber. It was said the bridge lost its camber about 1 to 2 years after completion, this was when 300 to 400 cattle were on the bridge at one time. It was further said that the bridge did not sway when first built, but it began to sway from the time when it lost its camber. The loss of camber most probably resulted from the structural stretch of the main cables as occurred, with much worse consequences, at Jhaprebagar Bridge. (See Volume 3 of this report)

The approach trails to the bridge are in satisfactory condition. They follow along the river bank and do not require much maintenance. There are trails upstream of the bridge on both sides of the Sunkosi and downstream on the left bank. Downstream of the bridge on the right bank there is no trail because of the cliffs there.

Local people gave it the praise it seems to deserve for being such an impressive structure. They thought the bridge width satisfactory, though two-way travel for loaded animals is not possible. They feel that the bridge sway, particularly when many people or animals are on it, does not make crossing uncomfortable and difficult. The most commonly encountered local opinion was that the bridge would have been better located upstream at Shivalaya.

Refer to  
Photograph No.

12-P-1

12-P-1

12-P-3

12-P-10

40

-Past Maintenance Work

Major: No major maintenance has yet been required at the Toxelghat Bridge.

Minor: An important minor repair was the replacement of the wind cable after it was snapped due to the action of flood waters. The damage occurred within 2 to 3 years after completion of the bridge. It was said that the original wind cable was smaller in diameter than the 1 in. diameter cable that was used for replacement.

When the damage occurred to the wind cable, the village panchayat reported the matter to the District. The result was that a technician came from the SBD to replace the cable. Action was prompt.

The planking of the bridge now needs repair, but no one seems to be taking definitive action. The local people note, with some dissatisfaction, that the District is collecting toll money but does not seem to pay proper attention to plank repair or other maintenance work. No voluntary labor has been given nor can be reasonably expected for bridge maintenance at Toxelghat.

12.3

FINDINGS

SOCIO-ANTHROPOLOGICAL

- The Sunkosi is a major river and unfordable, and as a result, boats are not safe during floods or during the monsoon season.
- The ferry operation has not changed. The Majhis (ferry operators) still paddle the boats across the river. But, they are being exploited by the contractors.
- About 10 joint families became nuclear due to the facilities provided by the bridge.
- The bridge has promoted cross-river marriages.
- Funeral rites have been slightly influenced by the bridge although there is no change regarding the burial places.
- The impact of the bridge on the roles of women such as participation in marriages, festivals, fairs, religious activities, domestic work, and portering is high.
- Students have been able to attend schools located at different places, and during all seasons due to the bridge. The bridge is also helpful for the long distance pilgrimages, but health practices, and living habits have only marginally been affected by the bridge.

INSTITUTIONAL

- This bridge is located in the eastern part of Okhaldhunga District hence it services those people who are from the eastern part of Okhaldhunga and Solukhumbu. Had it been located at Shivalaya, it would have been useful to a greater number of people.

- New services have been added after the construction of the bridge. Shops, schools and a police check post were established and a small village has grown as a result of the bridge.
- A toll is levied to cross the bridge and a police check post has helped the District Panchayat's employee to collect the toll.
- Residents on either side of the bridge are exempt from this toll, instead they have been given the responsibility of minor repairs on the bridge and to build and repair resting places for the long-distance travelers, who pay toll. This arrangement is a unique system devised by the District Panchayat. However, it is found that the system lacks proper attention, for its execution.

#### ECONOMIC

- Although this bridge can be considered as the main artery in the regional trail network, its usefulness would certainly have been greater had it been placed at Shivalaya, which is closer to the traditional ferry crossing point at Toxolhat, rather than at Harkapur. In spite of the risk, ferry charges, and waiting time involved in using the ferry services, people still seem to prefer the more direct ferry route than that provided by the bridge. Traffic diversion to the bridge from the ferry crossing point occurs only during the 3 months of the monsoon season when the ferry ceases to operate.
- The bridge has little developmental effect in as far as structural changes in the area's economy is concerned. It has had minimal effect in transforming the traditional agricultural and cottage industrial pattern. The marginal changes noted in terms of application of modern agri-inputs in the farm lands are the result as much to the drive from various agricultural improvement institutions as to the existence of the bridge. The bridge can be viewed as complementary to agricultural development programs for it

has facilitated access to the cooperative stores for the buying of chemical fertilizers and improved seed, and to Agricultural Development Bank.

- The bridge has provided access to food surplus areas of the Teral throughout the entire year and thus to some extent it has been instrumental in relieving the pressure of food shortages on the hill economy. On the other hand, it also provides an access for hill exports, such as potatoes.
- Apart from facilitating the mobility of people, the bridge has facilitated the flow of trade. As a result of the opening up of the trade sector the prices at local markets, for necessary commodities, is more competitive.

#### ENGINEERING

- The bridge is a graceful and impressive heavy-duty bridge with stiffening truss. The stiffening truss prevents vertical oscillations but is not entirely effective in preventing lateral sway. It might be questioned whether the benefits derived from the stiffening truss are really worth the added cost.
- It seems that it would have been worthwhile to build the bridge at Shivalaya in spite of the potentially greater costs and technical problems involved.
- The left bank foundation would have been better protected against possible river scour if it had been set further back from the bank.
- High flood waters have already touched the walkway of the bridge and caused the snapping of a wind cable. An added height of 6 to 9 ft. would have been desirable for protection against possible flood damage.
- The walkway has lost its original upward camber and is nearly level. The reason for camber loss seem to have been structural stretch of cables under severe load. (Also see Vol. 3 of this report on Jhaprebagar Bridge for a more detailed description on structural stretch.)

- Several nuts and bolts are loose or missing on the bridge. There is a toll collector at the bridge who could keep the nuts and bolts tight if he had a wrench and knew how to use it.
- Repair of planking appears to be an easy job on this bridge in spite of the fact that needed repair is not being done. Planks are held in place with thick, locally made, square nails which are satisfactory for keeping the planks tight. The fact that the nailed planks are easily removed will help make local repair easy.

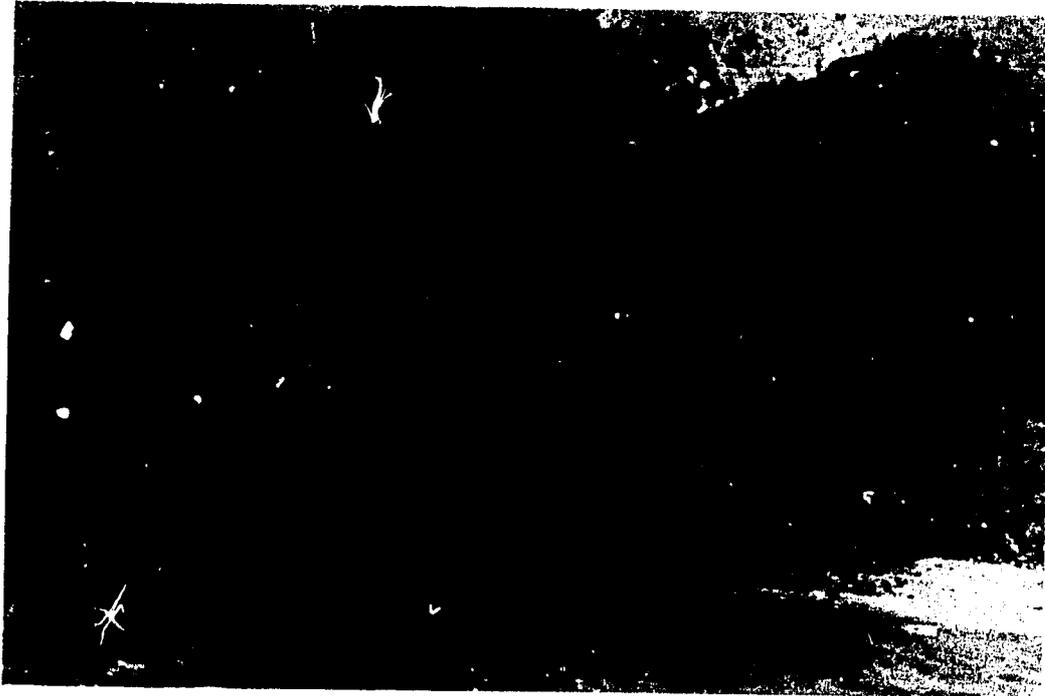
12.4

ILLUSTRATIVE PHOTOGRAPHS



12-P-1: Toxelghat Bridge is an impressive and graceful structure. This is a view towards the left bank with Markapur village in the background. Note the slightly upward or almost zero walkway camber. Flood waters have risen so far as to touch the bridge planking near the tower in the foreground, and water flowed in back of the foundation of this tower, stopping traffic for 2 to 3 hours and snapping one of the wind cables.

Date: Jan. 14, 1973



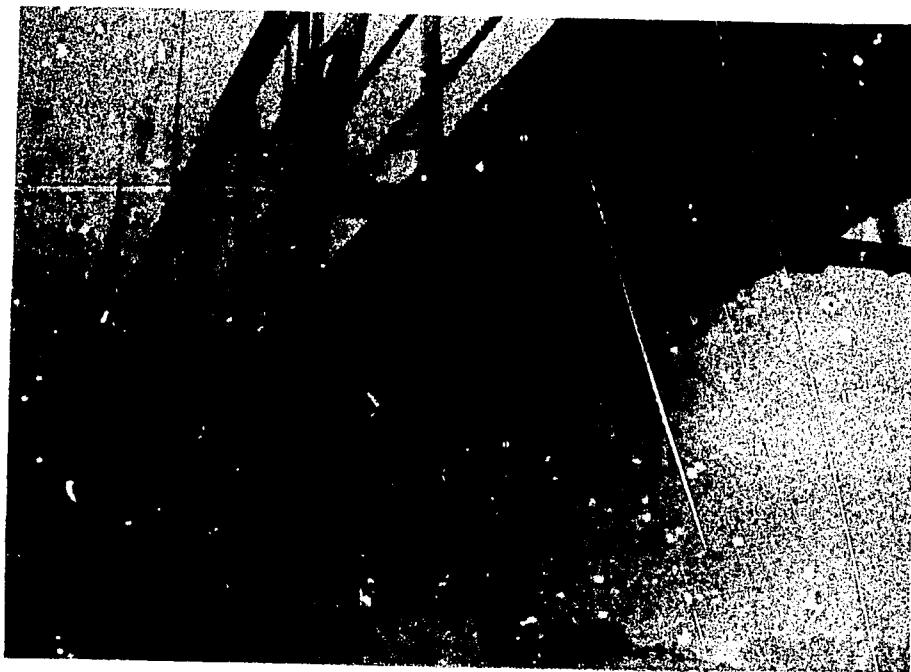
12-P-2: View of the upstream left bank of the bridge. During the monsoon season the river flows over the wide area of this left bank, shown above. There is no evident damage to the left bank by river scour, but placing the left foundation further back from the bank, say by 45 ft., would have given better protection against possible future river scour.

Date: Jan. 14, 1978



12-P-3: Due to the solidly built stiffening truss of the bridge, vertical oscillation is almost nil. However, some lateral sway occurs when many men or animals cross the bridge at one time. Note that the sag of the upstream cables, shown on the left in the photo, happens to be slightly higher (about 4 in. to 6 in.) than the sag of the downstream cables. The difference in sag has no effect on the structural stability of the bridge and is compensated for by adjusting the suspender lengths in order to make the walkway level.

Date: March 6, 1978



12-P-4: Details of walkway bracing.

Date: Jan. 15, 1978



12-P-5: In some places nuts and bolts are loose or missing. It would be an easy matter for the toll collector of the bridge to keep nuts and bolts tight if he had a wrench and the training to use it.

Date: Jan. 15, 1978



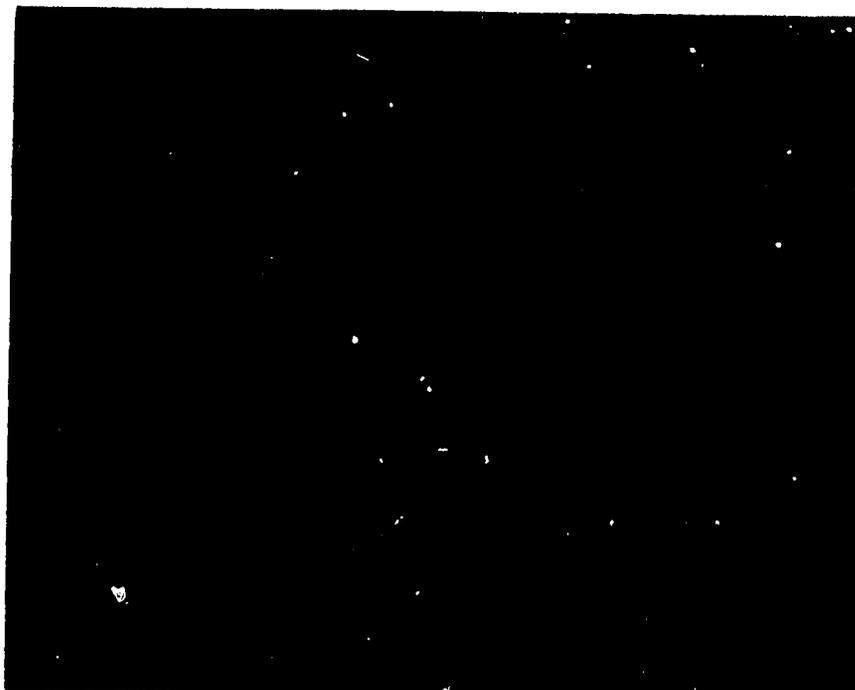
12-P-6: The outer coat of paint on the bridge is thin or has worn off in spots and almost all nuts and bolts are showing signs of initial rust. A new coat of paint is recommended.

Date: Jan. 15, 1978



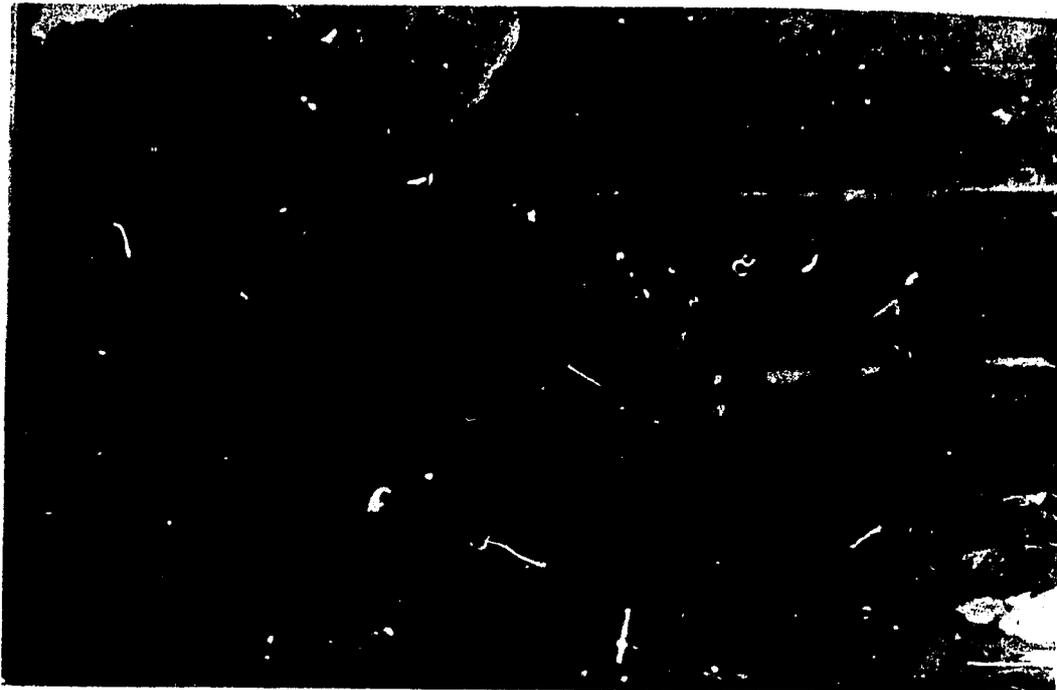
12-P-7: Many planks of the bridge need repair or replacing. Replacement of planks should be relatively easy, since the planks are only nailed and there is no problem of removing fencing or struggling with rusty, hard-to-reach bolts.

Date: Jan. 14, 1978



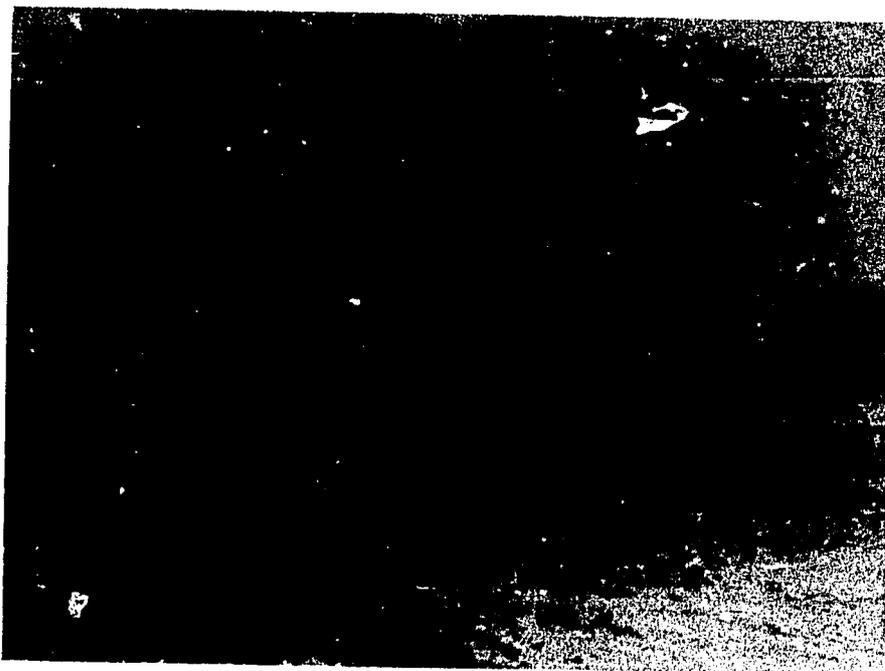
12-P-8: Cutting off of excess cable by local people resulted in frayed ends extending right up to the bulldog grips. Photo shows the wind cable anchor.

Date: Jan. 15, 1978



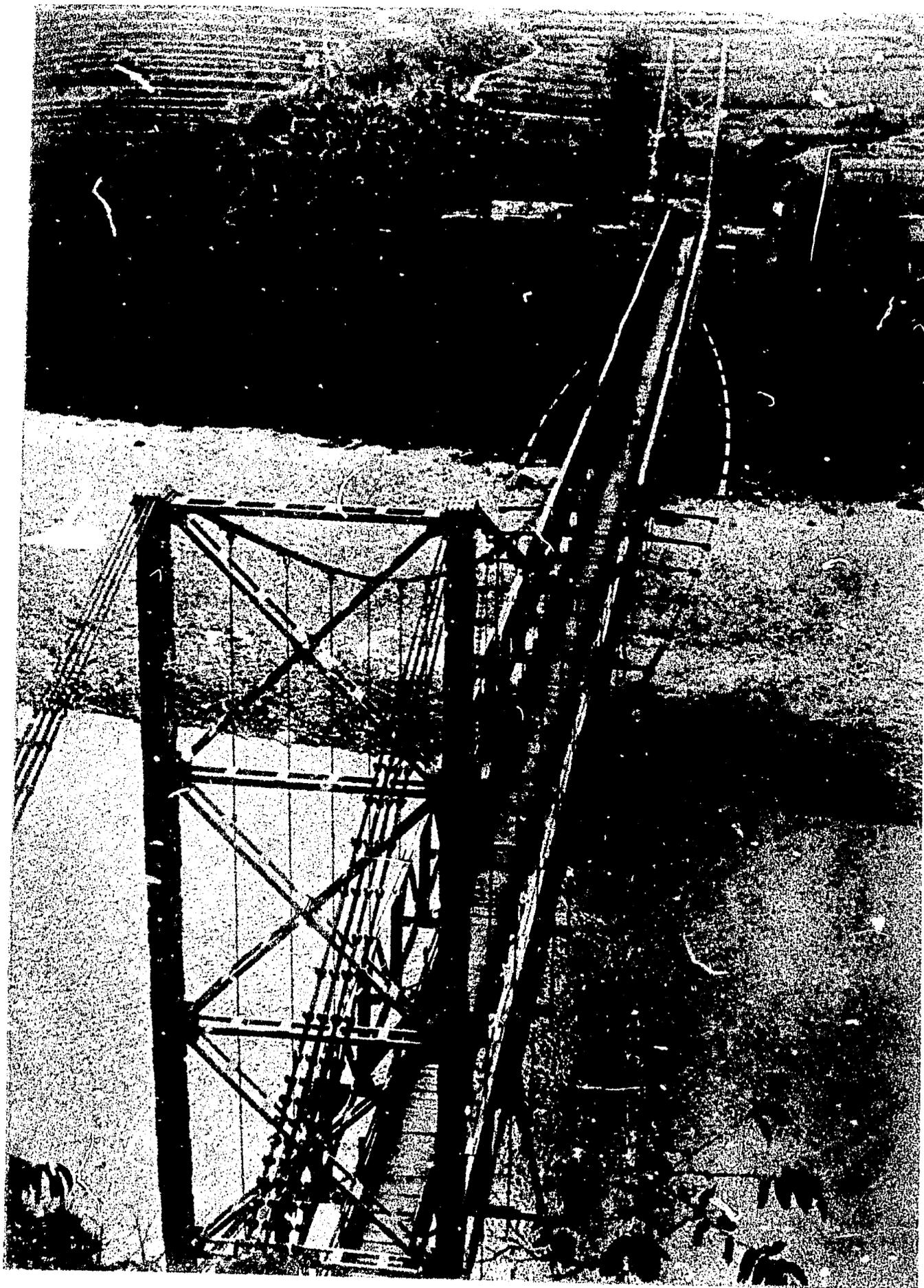
12-P-9: A boat in use for major trail (Class A) traffic at the Toxelghat ferry, about 2 miles upstream from the Toxelghat Bridge. The ferry stops operation during the monsoon season but during the dry season is said to carry much more traffic than the bridge, which is placed at a Class B trail downstream.

Date: Jan. 15, 1978



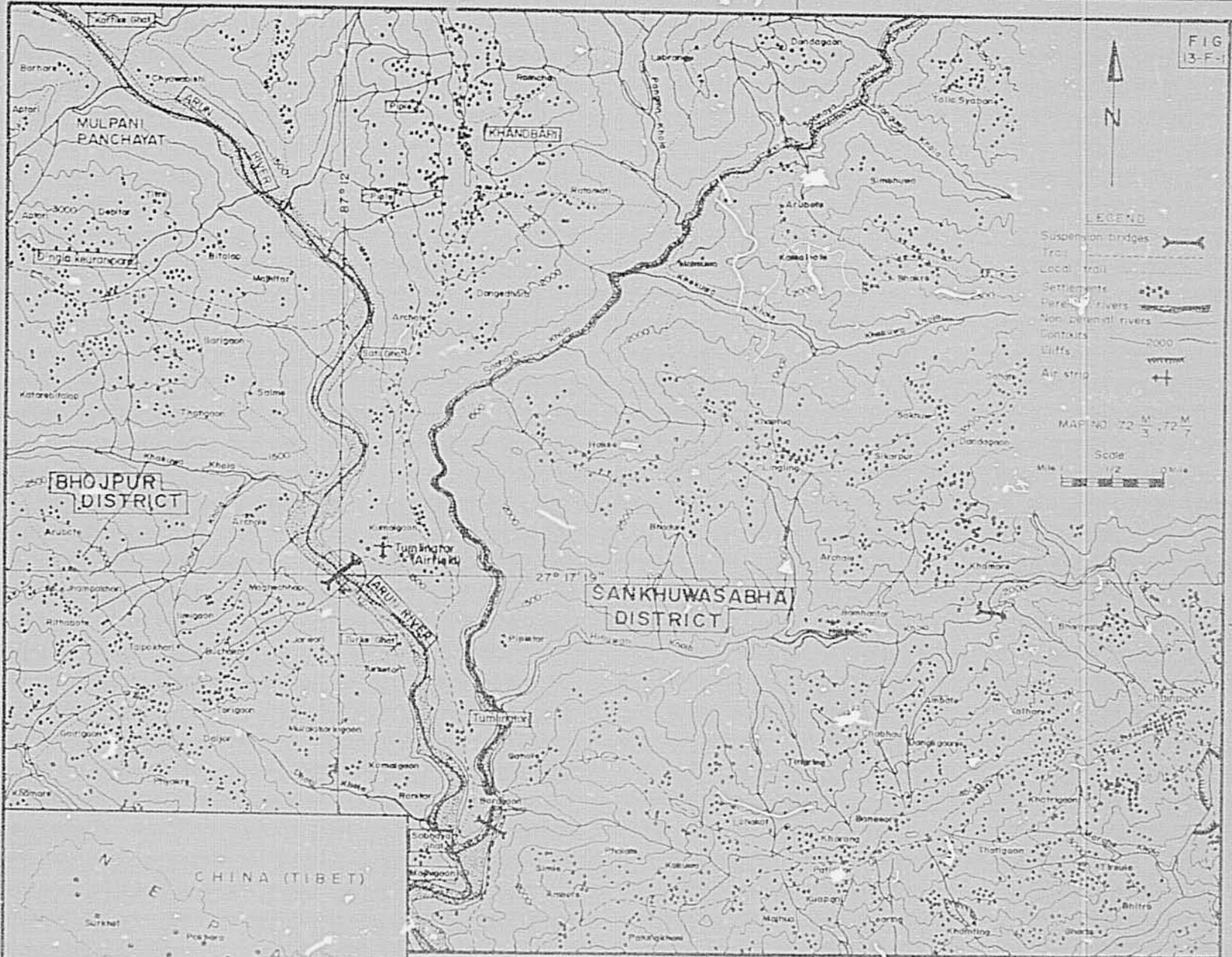
12-P-10: Looking upstream toward the Shivalaya site. The span for a bridge here would be about 660 ft., or more. The Bahadura Khola, indicated at A, joins the Sunkosi here. The nose of land at B is solid rock suitable for bridge foundation and anchorages on that side. The hill at C consists of sandy soil but is satisfactory for a bridge foundation, provided the foundation is set far enough back from the river. The Toxelghat ferry operates further upstream beyond the hill indicated at D.

Date: Jan. 16, 1978



13. TURKEGHAT BRIDGE

FIG 13-F-1



TRAIL SUSPENSION BRIDGE STUDY

AREA LOCATION  
TURKEGHAT SUSPENSION BRIDGE

UNITED STATES  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
NEPAL

EAST CONSULTING ENGINEERS  
KATHMANDU

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13.1.1 AREA DESCRIPTION AND HISTORY-Geographic Setting

The Turkeghat Bridge lies over the Arun River in the Eastern Development Region of Nepal. Originating in the Tibetan Himalayas, and fed by numerous mountain streams and rivulets, Kholas, the Arun River is one of the major tributaries of the Saptakosi River System in Eastern Nepal. It delineates most of the political boundaries of the districts along its course. Around the bridge site the river separates the Districts of Sankhuwasabha and Bhojpur. The Arun River, besides flowing very fast, is a major river and unfordable throughout the year. Like most mountain rivers, the Arun becomes tremendously swollen and turbulent during monsoons.

Located approximately 50 miles northwest of Dharan Bazar, a major township in the eastern foothills, the Turkeghat Bridge links Tumlingtar village panchayat of Sankhuwasabha District at its left, and Deorali village panchayat of Bhojpur District at its right (see Fig. 13-F-1). The landscape of the area around the bridge site consists of a rugged cliff rising immediately from the left anchorage block until it approaches the flat land, Tar, of Tumlingtar village panchayat. On the right bank there is a mild slope to Turke village of Deorali panchayat, with an altitude variation ranging from 1500 to 2500 ft. However, the uneven hill slopes rise successively to even greater altitudes.

A major portion of the land mass in the vicinity of the bridge site appears to be barren with the exception of a few trees and shrubs. Due to a lack of irrigation facilities, the land is not fully used and much of the land is left uncultivated. Local people told us that landslides periodically occur in the area.

-Bridge Site Description

The Arun River near Turkeghat Bridge flows about 300 ft. below the broad, flat land Tar, called Tumlingtar. The high, flat land of Tumlingtar

drops abruptly down to the river. The left foundation and anchorage of the bridge have been cut into cliff rock consisting of somewhat soft, but solid, micaceous schist. Further up, above the cliff rock, the left bank consists of steep, but stable, consolidated soil and fragmented rock. The approach trail on the left side abruptly descends from Tumlingtar and is cut into the steep left bank. At some places the trail is very steep and slippery, even in the dry season.

The right bank consists of soil and rock on the bedrock of micaceous schist. The bedrock is soft, broken and fragmented but appears, nevertheless, to contain the river effectively. The right foundation is set well back from the bank and rests on bedrock. There is a small settlement on the right bank consisting of 4 to 5 shops and houses. Further up on the right bank are gently rising, cultivated terraces. The approach trail on the right side passes through agricultural land.

The span of the bridge is 459 ft. The flow of the river, during the dry season, is on the left side and occupies about 1/3 of the river bed. It is said that during monsoon the river completely covers the approximately 300 ft. wide bed.

Both the left and right foundations are well situated and safe from river scour. The bridge deck is about 24 ft. above high flood-level and thus, safe from any threat of flood damage.

#### -Relationship with Regional Transportation System

The bridge commands a special importance in terms of its relationship with the regional transportation network. One of the important features of the location of the bridge is the STOL airfield at Tumlingtar, situated east of the river, approximately a 20 minute-walk from the bridge site. The people residing in the villages to the right of the river in Bhojpur District, have to use this bridge to reach the airfield.

The trail system that the bridge serves is also important because it is one of the major trails, connecting Bhojpur with the neighboring districts of Sankhuwasabha, Dhankuta and Sunsari. In addition to the main trail, the bridge also serves the local access trails which merge with the main trail. The main trail, defined here as the one with the highest long-distance traffic density, originates in Dharan, the terminal point of an all-weather motorable road, and traverses Chiuribas, Phedi, Mulghat and Dhankuta, and continues through Hilay, Pakhriabas, Diyale Mangmaya, Loguwa, Beltar, Surtibari, Sattare and Sabha Khola, until it reaches the bridge head. Other trails served by the bridge are the Bhojpur to Khandbari trail, as well as other local access trails leading to small market centers at Chainpur, Dingla etc.

#### -General Cultural Setting

Before 600 A.D., this region of Nepal was known as the country of the Kirati people, the Kirat Desh.<sup>1/</sup> Later on, it was divided into two regions: Limbuwan and Khambuwan. The area east of the Arun River was known as Pallokirat and the area west of the river, as Majhkirat. Pallokirat lies in Sankhuwasabha District, and Majhkirat lies in Bhojpur District, according to the present division of Districts in Nepal. The socio-cultural traditions of Bhojpur and Sankhuwasabha present similar characteristics.

The people of this area can be broadly categorized into Brahmin, Chhetris, Matwali (liquor-consuming groups), and untouchable as in other parts of Nepal.

#### -Services Available in the Area

A health post is located at Tumlingtar, and a district hospital at Chainpur, about a five hour-walk from the bridge site. The people of Degruli panchayat of the Bhojpur District go to Tumlingtar and Chainpur when

<sup>1/</sup> Janch Bujh Kendra, Mechi Dekhi Mahakali, Vol. 1 p.295  
Department of Information: HMG-Nepal, Kathmandu 1974.

in need of medical facilities. Deorali panchayat has three primary schools and a middle school.

At the bridge site, immediately on the right bank of the bridge, is a small tea stall. However, in Tumlingtar, close to the airfield there are a few shops, lodges, Bhattis, and tea stalls. It can be deduced that the growth of these activities is due to the airfield rather than the bridge.

#### -Bridge Location History and Decision Process

According to official records, Mr. Yogendra Prasad Singh, a local person of note, filed a petition to His Majesty, the late King Mahendra in 1967, requesting that a bridge to be built across the Arun River near Tumlingtar. His Majesty commanded the DOR to take immediate action on the construction of this bridge. The DOR, in turn, requested the Bhojpur District Panchayat to propose a suitable site for the construction of a bridge around Tumlingtar. This was done with the help of technicians available in the District. The first report was drawn up without conducting a detailed survey and recommended that the bridge should be constructed at Chikhuwa Khola. The Bhojpur District Panchayat was asked to reconsider the matter, and a joint meeting of the 16 village panchayats of Bhojpur District along with the Bhojpur District Panchayat was convened. They decided to propose a bridge site near Tumlingtar, over the Arun.

Following this, a detailed technical survey was made by the SBD of DOR. Steel parts for the bridge were ordered from a steel company in Calcutta, Martin Burn Ltd.

Unfortunately, the bridge collapsed just after its completion. An investigation committee later stated that this was due to the incorrect placement and tightening of the bulldog grips on the main cable (see photo 13-P-6). It took nearly a full year to rebuilt the bridge after its collapse. Finally in 1972, reconstruction was completed and the bridge was commissioned for use.

The Bhojpur District Panchayat was more involved than the Sankhuwasaba District Panchayat in expressing the demand for the bridge, as well as the choice for the site. As stated earlier, there was an extensive discussion among the village panchayats. This is a unique case in the decision-making process of bridge site-selection and probably results from the fact that this bridge is more vital to the people of Bhojpur. It provides easier access to Dhankuta, Dharan and the Sankhuwasabha District. Many neighboring panchayats of Bhojpur now have easy access to the health post, market place, school and airstrip at Tumlingtar. This bridge also serves the people of Dingla and Kulung, as well as providing an alternative link between Bhojpur and Dharan and Dhankuta. Thus, this bridge links two major Districts of eastern Nepal and supplements the efficient transport system established by the air service at Tumlingtar.

The Arun River has a steep gradient and flows very fast even during the dry season. Every year, during the monsoon floods, people were swept away. There were also cases of boats being overturned and passengers drowned. A bridge would certainly minimize such loss of human life and property as well as providing a means of communication for broader social and cultural intergration of the people of Pallokirat and Majkirat.

The bridge was constructed during the Fourth Plan period (1970-75). One of the main reasons for the demand that the bridge be built at Turkeghat, was that the traditional ferry point at Kartikeghat (about a four-hour walk upstream from Turkeghat) stopped functioning during the monsoon due to the extreme turbulence of the river. This totally disrupted the traffic flow and caused hardships to the people. The major economic consideration, appears to be that the bridge facilitates the flow of people and trade on a continual basis; and allows easy access to the market centers at Jhyau Pokhari, Dingla, Dharan, Khadbari, and Chainpur. The people of Bhojpur District now have a consistently open route to the Tumlingtar airstrip and are able to sell their cash crops and buy necessary goods, not locally produced, such as salt, spices, fabric, and kerosene. Tumlingtar has now become a marketing center of importance in the area.

It is said that the first survey party visited the site about 15 years ago. Eventually, a survey party was assigned the task of selecting the best of the three traditional crossing points: at Mankamana, Sabhaghat, and Turkeghat; and through the previously mentioned process, Turkeghat was selected.

The site is very good from an engineering point of view; the river narrows at this point and the banks are stable on either side. The site is only a 10 to 15 minute-walk upstream from the traditional Turkeghat ferry-crossing. Finally, before the bridge was built, the ferry was used only for local traffic; Turkeghat has now become the main trail crossing point since the construction of the bridge.

13.2

A N A L Y S I S

13.2.1 SOCIO-ANTHROPOLOGICAL ANALYSIS

-Land and People

Four village panchayats Tumlingtar, Khandbari, Dingla Kouranipani and Deorali were selected for socio-anthropological study.

The ethnic groups of Tumlingtar panchayat consists of Kumhale, Brahmin, Chhetri, Tamang, Rai, Magar, Kami, Damai, Majhi and Newar. The ethnic groups of Deorali village panchayat are Chhetri, Brahmin, Magar, Newar, Rai, Tamang, Damai, Kami, Sarki, Ghale, Kumhale and Majhi. Similarly, in Dingla Kouranipani and Khandbari village panchayats, the major ethnic groups are Brahmin, Newar, Chhetri, Magar, Rai, Kami, Damai and Sarki.

The total number of estimated households by each ethnic group is as follows.

Table 13-T-1: Estimated Number and Percentage of Households by Ethnic Group (Tumlingtar and Deorali Panchayats)

Ethnic group	Households	Percentage
Chhetri	472	33%
Brahmin	225	16%
Magar	154	11%
Kumhale	127	9%
Rai	117	8%
Tamang	115	8%
Kami	71	5%
Damai	66	5%
Sarki	22	2%
Ghale	20	2%
Majhi	10	below 1%
Newar	3	below 1%
Total Households	1402	100.0

Source: ECE Field Survey

Rais are normally known as Kirati in the area. They are an endogamous group. They follow their own traditions, rites and rituals. In most cases, they bury their dead. The Kirati people are generally non-vegetarian and consume liquor, or kaksi.

The different sub-groups among the Rai in the study area are; Thulung, Kulung, Yankhukung, Bantawa etc. Intercaste marriages among them are commonly observed. It is also accepted practice for a Rai widow to marry her brother-in-law. The Yakhas are also called Dovans, and during the reign of King Prithvi Narayan Shah, acted as the tax collectors and administrators of the area. They followed these occupations until the landowners' license system, or Kipat, was legally abolished. The Kiratis normally wear distinctive hand-woven clothes.

Rais speak their own dialects but also speak Nepalese. Besides Rais, the other Matwali (liquor-consuming) groups of the area are Tamangs, Magars, Kumhales, Ghales, Sherpas and Majhis. All these ethnic groups are basically farmers, owning some land and raising livestock. The Magar and Ghale practice cross-cousin marriages. Like most Matwali groups, they are non-vegetarian.

Unlike the other ethnic groups, the Kumhale do not bury or cremate the dead. They simply throw the dead bodies into the river, and as a memorial to the dead, they install a stone on the top floor of their houses. They honor the stone and sacrifice a chicken to it twice a year. Like the Rais, it is also customary for a Kumhale widow to marry her brother-in-law. A Kumhale woman is accepted by the society even if she has had several husbands. The Kumhales make earthen pots and sell them. They also own some dry land, Pakhe, in the Tar areas.

There is a small community of Newars who had long ago migrated to these areas from the Kathmandu valley or Banopa. They speak Newari within their family and follow their own customs and traditions.

Sherpas in the area worship the Arun River and sacrifice black goats, chickens and pigs to please the river deity.

The untouchables of the area are the Kami, Sarki and Damai groups. They practice their traditional caste occupations; iron working, shoe-making and tailoring, respectively. These workers are paid in grains, rather than in cash, a system known as Bali. They also work as farm laborers and porters.

Thus the field area is comprised of a variety of ethnic groups who derive their cultures from both the Indo-Aryan and Tibeto-Burman groups. Though these groups have different customs and social values, nevertheless they live as neighbors, peacefully bound by common Nepalese values, beliefs and traditions. Indeed, the statement "...on one hand the different caste-ethnic groups of the area have maintained their traditional values and ethnic identity and on the other hand they are united among themselves by the medium of tolerance and adjustment",<sup>2/</sup> holds true.

The Brahmins and Chhetris in the area are basically farmers, though some are also employed in government services. Few are also engaged in business. Some of the Chhetris are also enlisted in the Nepalese, Indian and British armies. The poor among the Brahmins and Chhetris do portering.

The Nowars are basically engaged in business, but they also own farms. The Majhis are fishermen and also operate ferry services at Kartikoghat and Sabhaghat. The toll collector at Turkeghat Bridge is a Majhi.

It was reported by the local people that, excluding Brahmins and Chhetris, the people of all ethnic groups were employed as laborers during the construction of the Turkeghat Bridge. The majority of employees were Kumhalos.

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<sup>2/</sup> Ibid. p.305

The majority of the people live above 1000 ft. There are no irrigation facilities in the area. Landslides and soil erosion are commonly observed. A transect of Tunlingtar and Khandbari villages is given in Fig 13-F-2.

#### -Structure of the Family

We observed different family sizes in the study areas and found that there are more joint families than nuclear families. However, the size of a joint family is only slightly larger than that of a nuclear family. The average family size appeared to be six for both joint and nuclear families.

After the construction of the bridge, thirty-three joint families, residing on the left side of the bridge, broke away to form nuclear families which have now settled on the right side of the bridge. Among them, twenty families are Brahmins, seven families are Chhetris and six families are Rais. Similarly, fifty members of joint families, previously living on the right side of the bridge, have separated and are now settled on the left side. They belong to the Tamang, Brahmin, Majhi, Rai, Kumhale and Magar groups. It is therefore, immediately clear that consanguinal relatives of many families live on either side of the river.

Local people indicate that the bridge has facilitated communications, and the sharing of sorrow and happiness among the separated families.

#### -Marriage Practices

We asked informants about their willingness or lack of willingness to arrange cross-river marriages for their daughters' or sisters' marriages prior to the construction of the bridge. Their responses are tabulated as follows.

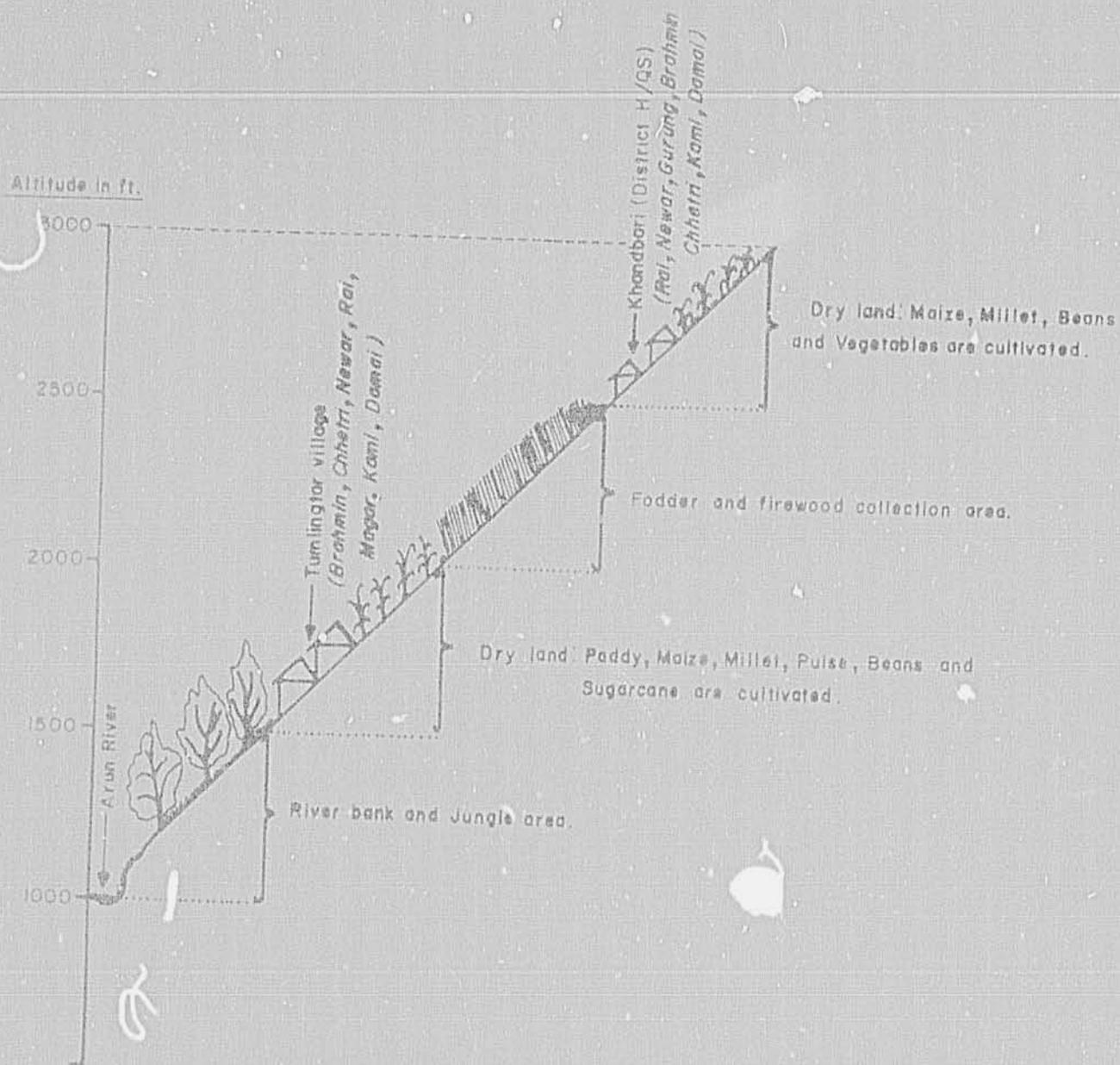


Fig. 13-F-2: Tumlingtar and Khandbari Transect (Schematic)

Source: ECE Field Survey

Table 13-T-2: Percentage of Male Respondents Indicating a Willingness or Lack of Willingness to Arrange Cross-river Marriage Prior to the Construction of the Bridge

Panchayat	Not Willing	Willing
Tumlingtar	84%	16%
Khandbari	56%	44%
Dingla Keuranipani	100%	0%
Deorali	80%	20%
Average Total	80%	20%

Source: ECE Field Survey

The above figures indicate that people were reluctant to arrange the marriages of their daughters or sisters across the river before there was a bridge.

They were further asked whether the number of marriages had increased between the villages on either side of the river after the bridge was constructed. Their responses are tabulated in the following table.

Table 13-T-3: Percentage of Male Respondents Indicating an Increase in the Number of Cross-river Marriages After the Construction of the Bridge

Panchayat	Increased	Not Increased
Tumlingtar	100%	0%
Khandbari	56%	44%
Dingla Keuranipani	100%	0%
Deorali	90%	10%
Average Total	87%	13%

Source: ECE Field Survey

87% of the respondents replied that they had noted an increase in the number of cross-river marriages per year in the area. This is indicative of the better communications facility; the bridge offers.

-Funeral Practices

As mentioned earlier, the Kumhalas throw their dead into the Arun River at the nearest available place. The Tamangs bury theirs in the forest, and the Rais bury the dead on their own land. The Brahmins, Chhetris, untouchables and some of the Matvalis cremate their dead on the banks of the Arun. However, they do not carry the dead bodies across the river. Firewood for cremation is collected on the same side. We asked informants about uses made of the bridge during funeral rites. 81% of the informants replied that the bridge is rarely used during these occasions. The 19% who live near the right side of the bridge, said that the bridge has been useful because they can now reach the market at Tumlingtar to buy shroud cloth, Katro, quickly.

The bridge does not seem to play noticeable role in the observation of funeral rites. However, the consanguinal and affinal relatives to assemble together at the funeral place, to extend help and to express sympathy to the family of the dead; in this the bridge has provided for faster communication and easier access.

-Education and Health Practices

There were already two primary schools in Tumlingtar village panchayat before the construction of the bridge and there were 124 boys and 26 girls enrolled in these schools. After the construction of the bridge one primary and one middle school were added and now there are a total of 207 boys and 110 girls studying in these schools.

It was reported by the local people that boys and girls from other village panchayats also use the bridge, to attend schools across the bridge. In all, 109 students use the bridge which means that the bridge has played an important role in providing easy access for the boys and girls on the right side of the river to attend schools on the left side.

There was only one health post in the area, at Keuranipani, before the bridge was built. There are now two dispensaries at Khandbari, and one health post at Tumlingtar. The increased number of dispensaries suggests that the local people have started to realise the benefits of using western medicines. However, it was observed that the majority of the population still believe in, and use the local shaman, Dhami or Jhankri.

The informants were asked whether they have changed their health practices since the bridge's construction. Their responses are as follows:

Table 13-T-4: Percentages of Respondents Indicating a Positive Change in Health Practices

Panchayat	Affirmative Responses
Tunlingtar	8%
Khandbari	11%
Dingla Kouranipani	15%
Deorali	14%
Average Total	12%

Source: ECE Field Survey

The above figures show that only a negligible percentage of people have changed their health practices and it was observed that even those who go to dispensaries or the health post prefer to use the treatment of the Dhani or Jhankri first.

There are 50 to 70 Dhamis in each village panchayat. Most of them are either Kumhale or Tamang. The usual per case charge of a Dhani is Rs 5.00 cash and 6½ lb. of rice, or 2 to 3 chickens.

-Festivals, Fairs and Religious Activities

We asked informants if the number of participants at fairs and festivals had increased. Their responses are tabulated below:

Table 13-T-5: Percentages of Respondents Indicating an Increase in participation in Fairs and Festivals

Panchayat	Increased	Not Increased
Tunlingtar	100%	0%
Khandbari	44%	56%
Dingla Kouranipani	100%	0%
Deorali	95%	5%
Average Total	85%	15%

Source: ECE Field Survey

Thus the bridge has facilitated the people to cross the river to participate in fairs and festivals. It was also observed that the bridge was used more during religious festivals than during fairs or Mela.

Asked if the construction of the bridge had increased the number of devotees at the local shrine or temple, the informants replied as follows:

Table 13-T-6: Percentage of Respondents Indicating an Increase in the Number of Devotees at Local Shrines or Temples

Panchayat	Increased	Not Increased
Tumlingtar	80%	20%
Khandbari	56%	44%
Dingla Keuranipari	92%	8%
Deorali	62%	38%
Average Total	72%	28%

Source: ECE Field Survey

There are two temples dedicated to Hanumana and Mahadevthan, in Tumlingtar village panchayat. In Dingla, there are two shrines of Ramchandra and Shiva. Similarly, in Khandbari there are shrines of Radhakrishna, Bhimsen, Shiva and the Buddha. The above table indicates that the number of devotees to these temples has increased since the construction of the bridge.

-Changes in the Roles of Women

We asked men in the area whether the bridge had helped to change the roles of the women. Their responses, which give a fair impression of their opinion in the changing roles of women after the advent of the bridge are tabulated below.

Table 15-1-7: Percentages of Male Respondents Indicating an Increase in Womens' Activities because of the bridge

Panchayat	Extension of ritual friendship	Communal dances etc.	Marriages, festivals, fairs and religious activities	Domestic work, agriculture and portering
Tumlingtar	0%	8%	33%	85%
Khandbari	0%	6%	30%	56%
Dingla				
Kaupani	0%	7%	70%	92%
Doorali	0%	8%	60%	90%
Average Total	0%	7%	50%	81%

Source: ECE Field Survey.

When the same question was asked of twenty local women, only 35% replied that their participation in marriages, fairs and festivals had increased as opposed to the male response, which was 50%. 85% of the women said that the bridge facilitated them in their visits to their natal homes, and in their domestic work.

When the local women were asked if the bridge has saved them time, 30% replied positively, 10% replied negatively and 60% had no opinion. Regarding the utilization of surplus time, all of the women replied that now they have more time to look after the livestock, work the land, cook better food, and collect firewood and fodder. Having observed how hard the women work, during our field survey, we asked some women whether they ever spent their surplus time resting. Their immediate reply was that they rest only at night; for them, their workday begins at dawn and ends at late in the night.

All respondents rejected the idea that the bridge has had any negative effects in their society. On the contrary, they said that they worship the bridge.

-Changes in Beliefs and Habits

Before the construction of the bridge many people in these areas believed that a bridge built over the Arun River would displease the Arun River deity, and when, with a thundering explosion, as the villagers recall, the bridge collapsed just after its completion, people who did not believe in this taboo, had to change their view. However, the successful reconstruction of the bridge has changed this belief, and people now understand that the cause of failure was a technical one rather than a religious one.

Unlike some other places, the people in the area let their animals cross the bridge. We did not observe any notable changes regarding their habits after the erection of the bridge.

13.2.2 INSTITUTIONAL ANALYSIS

-Local Participation

Bhojpur District Panchayat was more involved than Sankhuwasabha in the demand, as well as in the selection of the bridge site. As stated earlier in page 4, extensive local discussions among the representatives from 16 village panchayats occurred during the site selection. This is a unique and rare case of the involvement of local people in the decision making process.

The cost of the bridge construction was entirely borne by the Central Government, which was in turn funded by USAID. No voluntary labor was used in the construction of the Turkoghat Bridge, nor was it sought by the Central Government.

After five years of continuous use, the bridge needs some repairs including the replacement of the walkway planks, although no repairs have been done as yet.

About a year ago a certain person began serving as an "honorary watchman" of the bridge. He was appointed to that position, by the CDO of

Bhojpur District, to look after the bridge and make reports to the CDO concerning any damage or need for repairs. The "honorary watchman" has received temporary rights to build a small house on the land at the bridge site, but otherwise receives no salary for his job. Around last October he sent a report to the CDO's Office at Bhojpur, concerning the need for plank repair. Thereafter Bhojpur District Panchayat approved a budget of Rs. 428/- for plank repair; the replacement of a certain number of planks, probably about 30. Following the correspondence between Bhojpur and Sankhuwasaha Districts, instructions have been given to the bridge contractor to do the plank repair. However, at the time of the field visit of this study no one had done the repairs.

Tolls are raised at this bridge on a contract system. The contractor is employed by the Bhojpur District Panchayat. However, Sankhuwasaha and Bhojpur Districts receive equal share of the contracted amount. It was noted that the contract was given for two years at Rs 12,350/-. The toll charges are fixed and are as follows:

Categories of Traffic	Toll rates
Travellers	Rs. 0.20
Cattle	Rs. 1.00
Horses and Buffaloes	Rs. 1.50
Goats and Sheep	Rs. 0.25
Poultry	Rs. 0.10
Pigs	Rs. 0.25

According to the toll collector stationed at the bridge, an average of Rs. 25/- a day is collected from travellers alone. This gives a total figure of Rs 18,250/- in two years, plus about Rs 4000/- from animals, giving a total of Rs 22,250/-. In view of the repair needs of the bridge, even the contracted amount of Rs 12,350/- would be sufficient for maintenance. However, nothing has been done. This may be because of lack of proper institutions and defined responsibility for undertaking the repairs and maintenance of the bridge.

-Institutional Impact of the Bridge-

A rapid communication system has been introduced, linking Bhojpur and Sankhuwasabha District. The mobility of the people across the river has increased. Services such as health and educational facilities have become more available to the people of the area.

13.2.3 ECONOMIC ANALYSIS

-Geographic Area and Population Served-

The bridge directly serves most of the village panchayats, lying in the northeastern part of Bhojpur District, such as Dingla Kouranipani, Mulpani, Doorali, Sompang, Fulikot etc., as well as Tumlingtar, Bungedhara and Khandbari panchayats in Sankhuwasabha District.

Currently, the bridge offers the best alternative to the ferry crossing at Satighat (an hour and a half-walk upstream from Turkeghat), which operates only during the dry season, for eight months of the year. During the monsoon period, when the ferry ceases to operate, there is a traffic diversion from the ferry to the bridge. The service area of the bridge is extended to a wider geographic area and population during the monsoon. When there was no bridge, there were four ferry crossings; Turkeghat, Satighat, Kartikeghat and Kunduloghat. Only two of these four, Satighat and Kartikeghat, are still operative.

All local people interviewed felt that the bridge was constructed at a suitable site. However, because of the available alternatives such as the ferries, a majority of respondents, about 60%, replied that the bridge is used more during the monsoon season. The bridge has definitively contributed in terms of users' time-savings; 88% of the respondents replied that the bridge has yielded a time-saving of about 2 hours, in reaching different destinations across the river. This is due to the fact that using the bridge requires fewer detours.

For the people residing across the river in Bhojpur District, the bridge provides access to the STOL airfield at Tumlingar, and to the market centers of Khandbari, Chainpur, Jhyau Pokhari, Dingla and Dharan. Similarly, the bridge has provided easy access to the schools and health posts situated at Khandbari and Chainpur. It also serves the people residing in Tumlingar, Dhungodhara and Khandbari panchayats, on their trading journeys to Dingla and other villages.

-Estimated Traffic Flow

The volume of traffic flow differs from the dry season to the rainy season. Local people say that during the dry season, most of the people living near the ferry points use the ferry services and avoid the long detours to the bridge. In their opinion only 25 to 50 people per day use the bridge at this time. During the monsoon, when the ferry ceases to operate, people said the traffic automatically swells to an average of 125 persons per day. Thus it is evident that the bridge is used mostly during the wet season.

A traffic survey was conducted for a period of 4 days at the bridge head (Table 13-T-8). The traffic count was made separately for porters, non-porters and animals. During the four-day survey, the flow of non-porters varied between 40 and 65, the flow of porters varied from 12 to 65 and animal traffic between 5 and 20. The average traffic flow for non-porters was 51, porters 31, and animals 9 per day. Reliable sources in the area indicated that out of this total flow, only about 35% had distant destinations and that a major percentage of traffic is local.

The frequency of bridge use appears to be as follows. Out of the 40 questionnaires administered at the bridge, 48% reported that they seldom use the bridge, 22% reported that they use the bridge once a month, 28% indicated once a week use, and only 2% reported using the bridge daily.

Table 15-T-8: Traffic Counts across the Bridge

Day	Non-porters	Porters	Animal
First	50	65	20
Second	65	32	6
Third	50	15	5
Fourth	40	12	6
Average/day	51	31	9

Source: ECE Field Survey (Dry Season)

The purpose, origin and destination of traffic flow have been processed separately in order to ascertain the direction and purpose of traffic flow (Table 13-T-9).

Of the total traffic, 17% is represented by buying purposes, 27% selling, 7% portering, 3% seeking employment, 8% domestic work, 23% social reasons and 10% accounted for unspecified purposes of travel. Of the 17% on a buying mission, 10% were going to Dharan Bazar followed by Deorali (3%), Tumlingtar (2%), and Dingle (2%). Similarly, of the 27% traffic flow for purposes of selling their produce, 10% were destined for Tumlingtar, again 10% for Dharan closely followed by Deorali (5%) and Khandbari (2%).

7% of the bridge users were working as porters. Of these, 3% were destined for Deorali, 2% for Bhojpur, and 2% for Dharan. Of the 8% traffic for purposes of seeking employment, 5% were destined for Dhankuta and 3% for Biratnagar. The most common destination was Dharan, 27% terminating their journey there, closely followed by Tumlingtar with 25%.

With respect to the origin of traffic, 26% appears to have originated from the many villages of Bhojpur District (referred to as the 'rest of Bhojpur' in Table 13-T-9.), Deorali (25%), and Dingle (17%), all of which fall within Bhojpur District. It is evident from these figures (68%) that the bridge is used mostly by the people of Bhojpur District.

Table 13-T-9 : Percentage Traffic Flow Indicating Origin, Destination and Purpose of Travel in the Study Areas

Place of Origin and Destination	Tumlingtar		Khand- Lodi		Rest of Sankhuva- sabha		Decorali		Dingla		Rest of Bhojpur		Solu- Khumbu		Dharan		Dhan- Kuta		Birat- nagar		Total Traffic	
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D
Buying	2	2	-	-	-	-	5	3	2	2	5	-	-	-	3	10	-	-	-	-	17%	17%
Selling	5	10	-	2	-	-	12	5	-	-	3	-	2	-	-	10	-	-	-	-	27%	27%
Portering	2	-	-	-	3	-	-	3	2	-	-	2	-	-	-	2	-	-	-	-	7%	7%
Seeking Employment	-	-	-	-	-	-	-	-	3	-	5	-	-	-	-	-	5	-	3	-	8%	8%
Domestic work	-	3	-	-	-	-	-	-	5	-	5	-	-	-	-	-	-	-	-	-	8%	8%
Social	-	5	5	3	6	-	3	-	2	3	5	10	-	-	-	2	-	-	-	-	23%	23%
Others	2	-	-	3	-	-	5	-	3	-	-	-	-	2	-	3	-	-	-	2	10%	10%
Total	11	25	5	8	11	0	25	11	17	5	26	12	2	2	3	27	0	5	0	5	100%	100%

Source: FCT Field Survey

Only 27% of total traffic appears to have originated from the panchayats of Sankhuwasabha lying on the left bank. On this side the highest count is contributed by Tumlingtar (11%), followed by other villages in Sankhuwasabha, (11%) (referred to as the, rest of Sankhuwasabha), and 5% of the total traffic seems to have originated from Khandbari, the District Headquarters of Sankhuwasabha. Of the remaining 5%, 3% seems to have originated from Dharan and 2% from Solukhumbu.

#### -Agriculture

The study was limited to four panchayats in the neighborhood of the bridge. The economic structure of the area is dominated by agriculture farming being the major occupation of the people. The characteristic features of the area are marginal farm land and subsistence farming; a large percentage of food crops are portered in. The greater proportion of cultivated land consists of dry upland, Pakho, where there are no irrigation facilities. Therefore, agricultural production is almost totally dependent upon the monsoon rain. The major crops grown in the dry uplands are maize, millet, legumes and tobacco. There is only marginal wet lowland, Khot, where some irrigation facilities exist. However, during the dry season, most of the irrigation canals cannot be used because the streams which feed them dry up. The principal crops grown in the wet land are paddy and wheat. Maize, millet and pulses are grown in the dry land simultaneously in the months of March/April, paddy is cultivated during June/July. Wheat is grown in November/December.

Animal husbandry is an integral part of farming. Most households, on the average, own 2 to 5 cows and/or buffaloes and 2 to 5 goats. The majority of households do not raise sheep and pigs. Local people estimated that only about 15% to 20% of the families own sheep, and about 25% raise pigs. Cattle dung is mostly used as fertilizer on the farms.

It was observed that some local farmers use chemical fertilizers and improved varieties of seed in their farmland. This practice is a recent

phenomenon in the area. However, the local people have affirmed that the recent use of modern farm inputs is not due to the existence of the bridge alone, but rather a result of the area's pressing need to grow more food. The bridge has, however, facilitated access to the market centers and cooperative units where these agri-inputs are sold.

It appears from local interviews, that the agricultural productivity trend of the area, has in general, remained more or less static over the years. This indicates that the overall agricultural production, despite some application of modern agri-inputs, has not registered appreciable improvements. The local people attribute the declining agricultural productivity trend to the exceptionally heavy rains during monsoon season in one year in which the heavy rains washed away a good part of the fertile top soil from the farmland. This is followed by insufficient rain or drought the next year. The cycle of climatic fluctuation in recent years has had far-reaching repercussions on the agricultural situation.

Apart from food crops, some local farmers also grow oranges, tangerines, a medicinal herb Churoto, limes and peanuts. The area appears to be richly endowed with resources for horticultural development. Unfortunately due to the limited size of the market, this activity has not received adequate stimulus. The bridge has had minimal impact in changing these market patterns, or in bringing about any tangible shifts or improvements to the agricultural pattern.

While it is evident that the bridge has not been instrumental in improving the agricultural yield of the area, it has nevertheless been of some help to some farmers. It is now easier to obtain modern agri-inputs from the area's agricultural co-operatives.

#### -Rural and Cottage Industries

Rural and cottage industries in the study area are generally located in the households. Most of the households make bamboo baskets and

ropes for their own use, not for commercial purposes. Apart from bamboo goods, some of the families own handlooms for weaving coarse cotton fabrics. Cotton is not cultivated in the area and they have to import the cotton yarn. The weaving, as with the bamboo and rope manufacture, is oriented towards household use. Most local people believe that this is a vanishing industry, due to the unavailability of cotton in the area, and the increasing prices of cotton yarn, which the rural poor cannot afford. In addition, the availability of imported cotton fabrics and their competitive prices, have had a negative impact on the growth of the handloom industry in the area.

In the area of cottage industry, one notable craft is the pottery. The Kumhale ethnic group make earthen pots for commercial purposes. They take their products primarily to the weekly bazars, or Hat-Bazaar and the sale of these items helps to supplement their meager agricultural production.

As yet, there is no modern mill for grinding food grains. However, it is hoped that a mill for rice, oil and flour will be established soon in Tumlingtar panchayat. Presently all households grind or dehusk the food grains using the traditional hand-turned millstone, Janto.

The bridge has not had any noticeable positive effects on the existing pattern of rural industries. However, it has indirectly benefitted the Kumhales (to sell their earthen pots) by providing easy access to the various Hat Bazars.

#### -Labor Force Situation and Employment

The total population of the four village panchayats under study, Tumlingtar, Khandbari, Deorali and Dingla Kouranipani, is estimated to be 13,367 (Table 13-T-10). Of this, the males are 6,587 and the females 6,980. The total population in the active age group, 10 years and over, is estimated to be 9,546, of which the males constitute 4,543 and the females 5,003. However, the total size of the labor force in terms of their active participation in economic activities, in the age group 10 years and over, is estimated to be 5,416. Of this, 67% are males and 33% are females. See following Table 13-T-10.

Table 13-T-10: Estimated Population and Labor Force

Panchayat	Total Population (1977)	Male	Female	Population 10 years and above			Economically Active Population <sup>3/</sup>		
				Both sexes	Male	Female	Both sexes	Male	Female
Dudlingtar	2,851	1,371	1,480	2,050	985	1,065	1,271	804	467
Khandbari	2,588	1,434	1,454	2,076	1,050	1,046	1,299	841	458
Deorali	4,264	2,031	2,233	3,030	1,433	1,597	1,601	1,141	460
Dingla- Kauranipani	3,364	1,551	1,813	2,390	1,095	1,295	1,245	872	373
Total	13,367	6,387	6,980	9,546	4,543	5,003	5,416	3,658	1,758

Source: ECE Estimate based on the 1971 CBS Census.

<sup>3/</sup> The economically active population may be defined as the number of persons in the age group 10 years and above who are engaged in activities contributing to the production of goods and services.

In the individual panchayats, Doorali has the largest population with 4,264, followed by Kouranipani 3,364, Khandhari 2,888 and Tuliogbar 2,851.

All the respondents in the area listed agriculture as being their primary occupation. The secondary occupations appear to be as follows: about 62% reported animal husbandry as being their secondary occupation, 17% portering, 5% fruit farming, 8% service and 1% business.

Local people indicate that the extent of migration out of the area especially to seek work, is quite significant. This is apparently related to the existence of widespread underemployment in the agriculture sector. Most of the local people were of the opinion that agricultural activities require only 100 full working days in a year, these being centered around the sowing, cultivating and harvesting seasons, when all the family members are engaged. During the rest of the year, a substantial part of the family can cope with the farm work, and the laboring of the remaining members is virtually unnecessary. Therefore, normally, during the off-season, most of the agricultural laborers migrate to Dhatu, Biratnagar or work as porters or unskilled laborers in the construction sector. Quite a few also go to India, especially to Assam, to work as low-paid manual workers. In addition to seasonal migration, there has also been migration of a permanent nature over the last decade; mostly to the Terai Districts such as Morang and Jhapa. This outflow of people from the hills to the Terai gained momentum after the eradication of malaria in Terai areas. The phenomenon of migration is directly associated with the deteriorating economic conditions in the hills, which is primarily due to the pressures of supporting an increasing population with declining agricultural productivity.

-Trade Flow Pattern

As in many hill economies, the pattern of trade in the area is characterized by exports of agriculturally-based products, and imports of

manufactured consumer goods and food grains. The trade flow pattern of the area appears to be as follows: oranges, tangerines, limes, Ghev, medicinal herbs, and livestock are the main commodities being exported. The major commodities imported into the area are; cloth, salt, food grains and kerosene. These commodities have been ranked in order of frequency of load carried across the bridge during the field observation. Oranges and tangerines dominated the export category; they were carried from the area to the market centers of Dharan, Khandbari and Tulingtar. The inflow of commodities was dominated by salt, closely followed by foodgrains, mainly corn and rice.

The bridge has certainly been instrumental in facilitating the flow of trade on a continual basis. However, its impact on commodity and trade diversification appears to be marginal. The local people indicated that there have not been any changes in the commodity outflow pattern or the trading centers. Tulingtar appears to have increased in importance as a seasonal market center. However, as already mentioned, this is the result of the airfield rather than the bridge. Nevertheless, the usefulness of the bridge in economic transactions on a perpetual basis is unquestionable.

#### -Environmental Effects

The effect of the bridge on environment cannot be defined very clearly. From local interviews, it appears that the bridge has helped the people residing on the left bank to cross the river to collect fuelwood and fodder which are not readily available in Tulingtar panchayat. The forested area is comparatively small. People of this panchayat normally cross to Deorali panchayat to collect fuelwood and fodder. The local panchayat, as well as the forestry office, have prohibited the felling of trees, but there is no serious program for afforestation in the area. The environmental deterioration, to a certain extent, can be associated with the declining trend of agricultural productivity as a result of wide-spread soil erosion. But again, this is related to a host of other factors, rather than the bridge alone.

13.2.4 ENGINEERING ANALYSIS

-Site Selection, Design and Construction Methods

Turkoghat was selected as the best site among the traditional crossing points at Mankana, Sabhaghat and Turkoghat, all of which were under consideration. The particular site decided on at Turkoghat is very good, since the river narrows there and both banks are stable. The site is better than any other nearby. The detailed survey of the site was carried out by Mr. Hari Prasad Sharma of SBD.

The bridge parts were designed and manufactured by Martin Burns Ltd., of Calcutta. All parts are of galvanized steel. This bridge is undoubtedly the heaviest of all the bridges of this study. The tower is of the pinned-hinge type and there are 8 main cables of 1 1/2 in. diameter. The outstanding feature of the bridge is its very heavy stiffening truss, with lateral bracing. The truss is very deep and wide. Although the planking on the bridge is now of only normal width for trail bridges, the truss actually has a clear width of 7.75 ft. With minor modifications to permit laying of planking across the full width of the truss, the bridge could be used by lightweight motor vehicles of limited width. The lateral bracing of the bridge somewhat resembles the wind cable layout of the BRG design (Photo 13-P-3). Instead of cables, however, parallel steel angles are anchored on both sides of the tower. The illustrative photographs of section 13.4 will give a clear idea of the arrangement of this lateral bracing. Instead of steel rods for wind ties, the parabolically-laid parallel steel angles are connected to the walkway with steel channels. Turkoghat bridge is the only suspension bridge in this study of which it can be said that there is essentially no lateral sway.

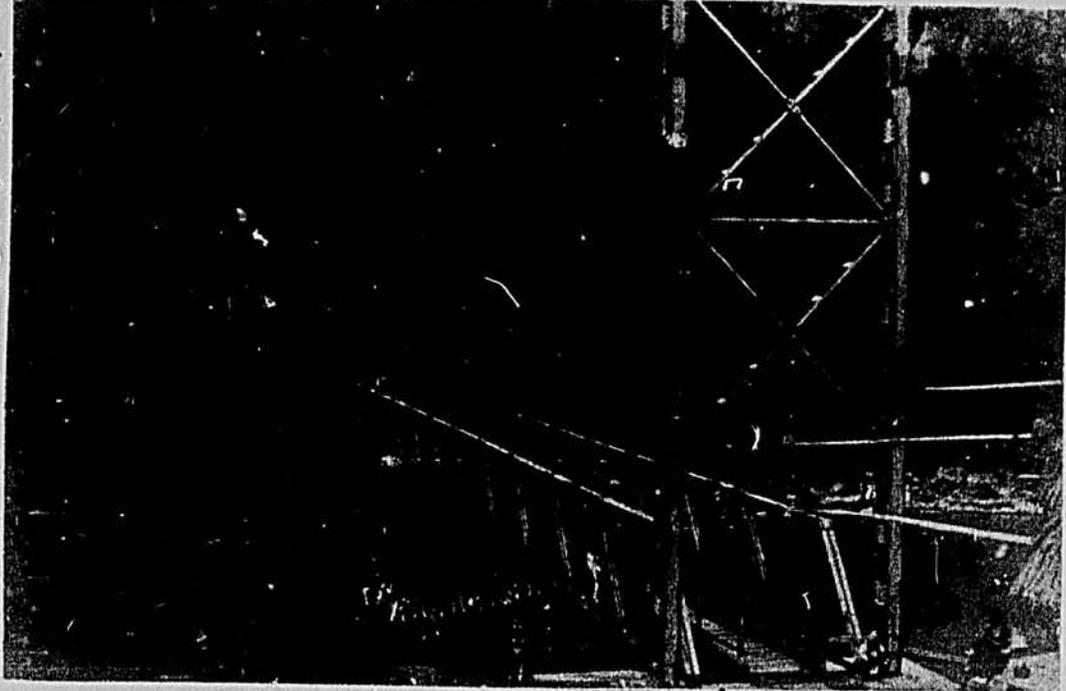
It is possible that at some time in the future, it may be desirable to modify the walkway of Turkoghat Bridge so that light vehicles

can cross the river. Under its current use as a trail suspension bridge, it is questionable whether the benefits from the very heavy-duty design of the bridge can justify the added cost.

After completing the detailed survey Mr. Hari Prasad Sharma proceeded with the construction of the left tower abutment. He was later replaced by Mr. Mishra of the SBD. The steel parts of the bridge were transported, under contract, by Mr. Tek Bahadur of Dharam. Blacks, the belonging to the Kani ethnic group in Tumlingtar, and Magar carpenters from Archale village in Bhojpur District were the local skilled workers used during construction. The craftsmen were supervised by a foreman of the SBD. Mr. Randal of Dingla was the contractor for all timber works. The left bank approach trail was originally built by the bridge construction crew but has since been repaired by local persons.

In late August 1971 Mr. Mishra accomplished what was thought to be completion of construction of the bridge. On the evening of, or during the night of the day after the construction was thought to be completed, (some accounts say after 3 days) the main cables came loose from the left anchor and the tower fell. It is said that the investigation committee agreed that the collapse of the bridge occurred because of incorrect tightening and placement of the bulldog grips. Mr. Mukunda Upadhyay of the SBD was present at the time, and later did the reconstruction work necessary to complete the bridge. The properly completed bridge was handed over to the District Panchayat in August 1972.

-Present Bridge and Approach Trails: Condition and Recommended Improvements

Bridge Name: TURKEGHAT	Zone: KOSI	Districts: Left: SANKHUWASABHA Right: BHOJPUR	Village Panchayats: Left: TUMLINGTAR Right: DEURALI
SPAN	459 ft.		
TYPE	Suspension		
MAP 1"=1 mile	72-M/3		
COORDINATES	27° 18' 43" 87° 11' 27"		
TRAIL	Khadbari to Bhojpur and Dhankuta to Dingla		
TRAIL TYPE	Class A		
RIVER	Arun		
RIVER TYPE	Major		
COMPLETION YEAR	1972		

Refer to  
Photographs No.

The bridge is in good condition except for the  
woodwork which is in fair to poor condition.

The galvanizing of the parts is in generally good  
condition. However, some rusting of suspenders was noted in  
spots, evidently as a result of poor galvanization. The  
galvanizing is flaking off the stiffening truss members in a  
few spots, evidently where the members were straightened  
after being bent when the bridge collapsed. Almost all bolts  
are showing signs of rust. Painting of the entire bridge is

probably unnecessary but painting is highly recommended for the rusty spots, and spots where the galvanizing is flaking off or in poor condition.

The woodwork of the bridge consists of planking and handrails, and is in fair to poor condition. Repair involving about 30 or more planks, plus various sections of the handrail is required to restore the woodwork to good condition.

Many more than the required number of building grips have been fixed to the main cables. Specifications <sup>4/</sup> call for 7 grips for each 1 1/2 in. cable, however, over 20 grips have been attached to some of the cables. The excessive number currently in use, were undoubtedly installed in an over-reaction to the disastrous collapse of the bridge, due to the slipping of the grips. An important precaution in the use of the grips in addition to its specified numbers, is that they must be tightened in a correct fashion. <sup>5/</sup> They should also be retightened after the completion of the bridge.

The left bank approach trail is so steep that it is difficult to negotiate in some places. The trail could be improved by re-digging the steeper sections and making a gentler grade. The Central Government is unlikely to become involved in such trail improvements and it was said that it would probably be difficult to do such work with local voluntary labor. A small district grant could accomplish this trail improvement.

<sup>4/</sup> Tiger Brand Wire Rope Handbook, U.S. Steel USA, 1973, p. 76 and Standard Trail Suspended and Suspension Bridges, IMG/SATA, 1977 p. 5.202.

<sup>5/</sup> Tiger Brand Wire Rope Handbook, U.S. Steel USA, 1973.

Refer to  
Photogram.

13-P-2

13-P-9

13-P-7

-Past Maintenance Work

Major: There has been no necessity for major maintenance work since the final completion of the bridge, when it was turned over to District Panchayat in 1972. The collapse of the bridge in 1971, just after its initial completion, and the subsequent reconstruction and final completion have already been described in the preceding section of this report.

Minor: In early April 1973 maintenance work was done on the supports connecting the stiffening truss to the foundation on the right bank. Bolts holding the supports in place had become bent, and nuts had slipped off because of uplift force and horizontal push resulting from expansion and contraction of the truss at different temperatures. The situation was remedied by breaking the old bolts out of the concrete foundation, and installing new ones in a better position, slightly behind the old ones. The work was performed by Mr. H. Aschmann, Civil Engineer and then, SAMA advisor to SBD, together with Mr. C. L. Rai, an overseer from SBD.

Repair to the planking of the bridge was made in early 1978 at 5 or 6 places where it was most urgently needed. The repairs were made by the "honorary watchman" of the bridge (See also Section 13.2.2 page 17). The remainder of many bad places of the planking and wooden handrails still need repair.

In the middle of last January the Santhuwastha District Engineer visited the bridge. He was concerned about the repairs. He was not able to make a satisfactory arrangement for repairs, but gave the honorary watchman a personal contribution of Rs.5/- with instructions at least to do something about patching up the worst of the holes in the planking. The watchman found some rough planking in the village and replaced 5 or 6 planks, the worst places on the deck.

In this case, both Districts involved are sharing a yearly income of about Rs. 6,000/- from bridge tolls. That amount should be more than adequate to cover routine maintenance for planking, and still leave extra income for the Districts. As with most of the bridges of this study, the lack of an effective administrative process seems to be the reason for the current condition of the woodwork of Turkaghat Bridge.

No other maintenance work has been done on the bridge.

13.3

## FINDINGS

### SOCIO-ANTHROPOLOGICAL

- Before the bridge was constructed, the Arun River used to sweep away people and animals during the rainy season.
- While the bridge has provided easy and continuous access across the river, it has had some repercussions on the structure of the family; it has been instrumental in nuclearization of about 83 joint families.
- Since the construction of the bridge, the people of the area do not hesitate to arrange cross-river marriages of their daughters or **sisters**. As a result, the number of this type of marriages has increased.
- The bridge has facilitated a change in the roles of women. It has also helped to improve the schooling facilities for 109 students of the area. The bridge has increased the number of participants in festivals, fairs and religious ceremonies. Moreover, it has expanded the socio-cultural interaction among the people on either side of the Arun River.

### INSTITUTIONAL

- Bhojpur District Panchayat was active in putting forth the demand for, and the site location of Turkoghat Bridge. More concern was shown by the local people who needed the bridge. This bridge was demanded by a convention of delegates from sixteen different village panchayats of the area who also selected the proper site. This is a unique and rare example of local participation in the decision-making process.
- Because of the appropriateness of the location of the bridge, the people in the area could make use of the services across the bridge.
- A person has been appointed "honorary watchman" to look after the bridge and make reports to the CEO of Bhojpur District concerning any damages.

or need for repairs. This person recently repaired the planking in several of the worst spots on the bridge.

- A toll system has been introduced and there seems to be no resistance to payment. The amount of money raised from the toll is sufficient to provide a regular maintenance service, though nothing has been done, mainly due to the lack of an effective administrative process and clearly-defined responsibilities.
- The importance of the bridge has increased because of an STOL airfield at Tunlingtar. Thus, the usefulness of a bridge could be increased if it is accompanied by other construction of suitable transport facilities around the area.

#### ECONOMIC

- Like many other bridges in this study, the usefulness of this bridge is conditioned by the seasonal nature of the river, and the alternatives available in the vicinity of the bridge. In the case of Turkeghat Bridge its usefulness, and hence its service area increases more during the wet season, as a result of the traffic diversion due to the closing down of the ferries. During the dry season, people of some panchayats still prefer the ferry services because crossing points lie on the more direct routes, and consequently there is a considerable decrease in the bridge traffic.
- The bridge has indeed facilitated the movement of people for economic transaction on a continual basis. It is now easier for people to reach different market centers all year round. A perennial flow of trade has been established.
- While the bridge has provided easier access to agricultural cooperatives for the purchase of modern agri-inputs, it has had a marginal impact on the area's economy in bringing about tangible changes in agriculture and

the cottage industries. It has not been instrumental in opening up areas of potential economic activity for a better regional trade relationship based on factor endowment. For example, the area appears to be endowed with the resources needed for the development of cash crops like oranges, tangerines, and limes, but this has not been encouraged by the construction of the bridge.

#### ENGINEERING

- The site of this bridge is technically good. It is located at a narrow place in the river where the banks are stable on either side. The span length is appropriate to the site and the foundations are well-situated and safe from river scour. The bridge is high enough to be safe from high flood waters and furthermore, is well situated with regard to the traffic flow.
- The bridge is the heaviest of all the bridges in this study. Its design includes a wide and very heavy stiffening truss with lateral bracing, of structural steel. With minor modifications the bridge could be used by lightweight motor vehicles of limited width. It is questionable whether, under current usage as a trail suspension bridge, the benefits of the very heavy-duty design can justify the added cost.
- At time of the initial completion of construction, the bridge collapsed when the main cables came loose from the left anchor. The cause of collapse was said to be incorrect placement of the bulldog grips. The bridge was virtually reconstructed and handed over to the District Panchayat about one year after the collapse. Persons involved in bridge erection must be fully aware of all specifications about bulldog grips. In particular, grips should be fixed in a correct way during erection and retightened after the completion of erection.

- The woodwork of the bridge consists of planking and handrails which are now in fair to poor condition. Sufficient tolls are collected from the bridge users to cover minor maintenance such as woodwork repair, and still leave income enough for the Districts receiving the toll money. The lack of an effective administrative process seems to be the reason for failure to perform these necessary repairs.

13.4 ILLUSTRATIVE PHOTOGRAPHS



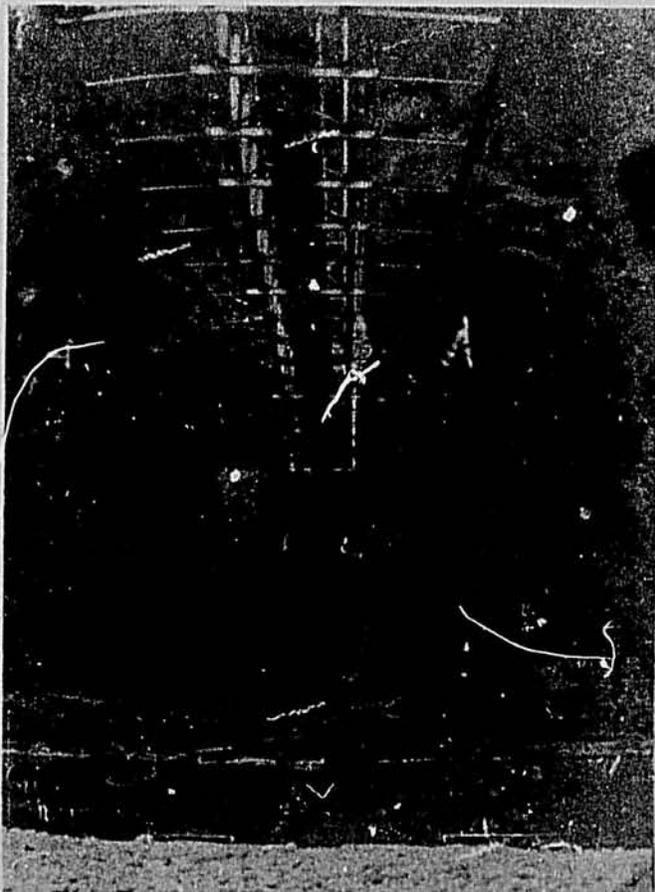
13-P-1: Toll collector, travellers and bystanders at the right side of the bridge. Tolls are collected under a contract system and provide about Rs. 6,000 per year, as fixed tax, for the districts concerned.

Date: Feb. 21, 1978



13-P-2: Porters with loads. The clear width of the heavy stiffening truss is 7.75 ft. It is felt that with minor modifications, the bridge could admit light motor vehicles. Note the pinned hinges of the tower visible at lower left and lower right.

Date: Feb. 21, 1978



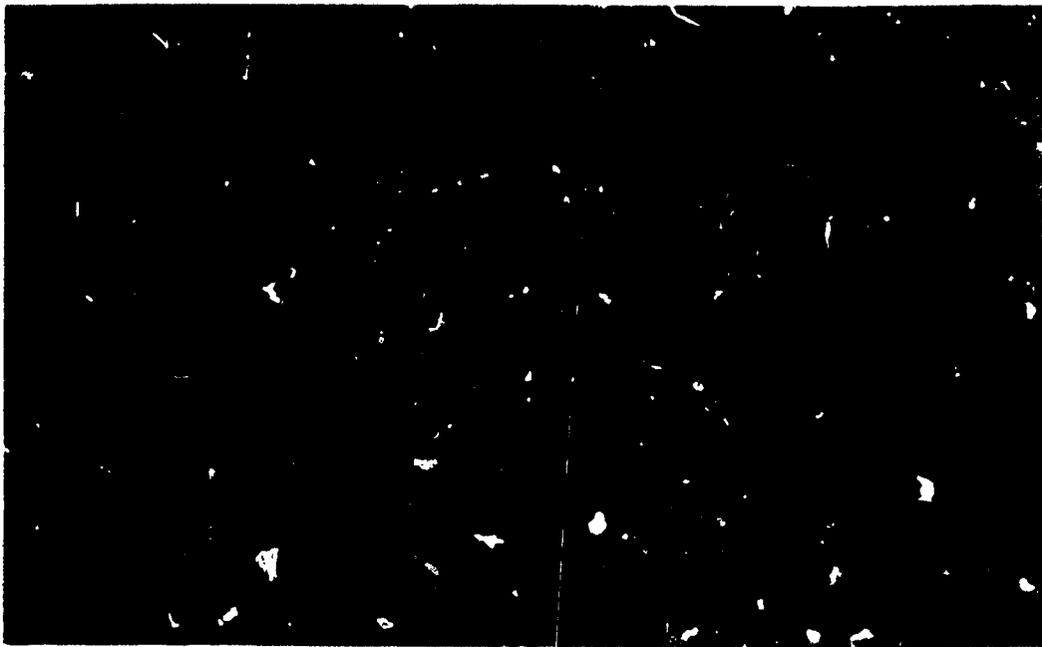
13-P-3: View of the underside of the bridge, taken facing left bank. Note the lateral bracing anchored at both sides of the tower and crossing under the walkway in a fashion somewhat similar to the wind cables of the bridges of BRC standard design. The bridge has essentially no lateral sway.



13-P-4: Details of lateral bracing and its anchor. The bracing is built up of steel angles laid out parallel.

Date: April, 1973

Source: H. Aschmann,  
Civil Engineer (SATA)



13-P-5: Details of stiffening truss, connecting channels for lateral bracing, and sponder plus connectors. Note that the channels connecting the lateral bracing to the crossbeam are analogous to wind ties of bridges having wind cables.

Date: April, 1973

Source: H. Aschmann

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13-P-6: Maintenance work was done in April 1973 on supports connecting the stiffening truss to the foundation on the right bank.

Date: April, 1973

Source: H. Aschmann



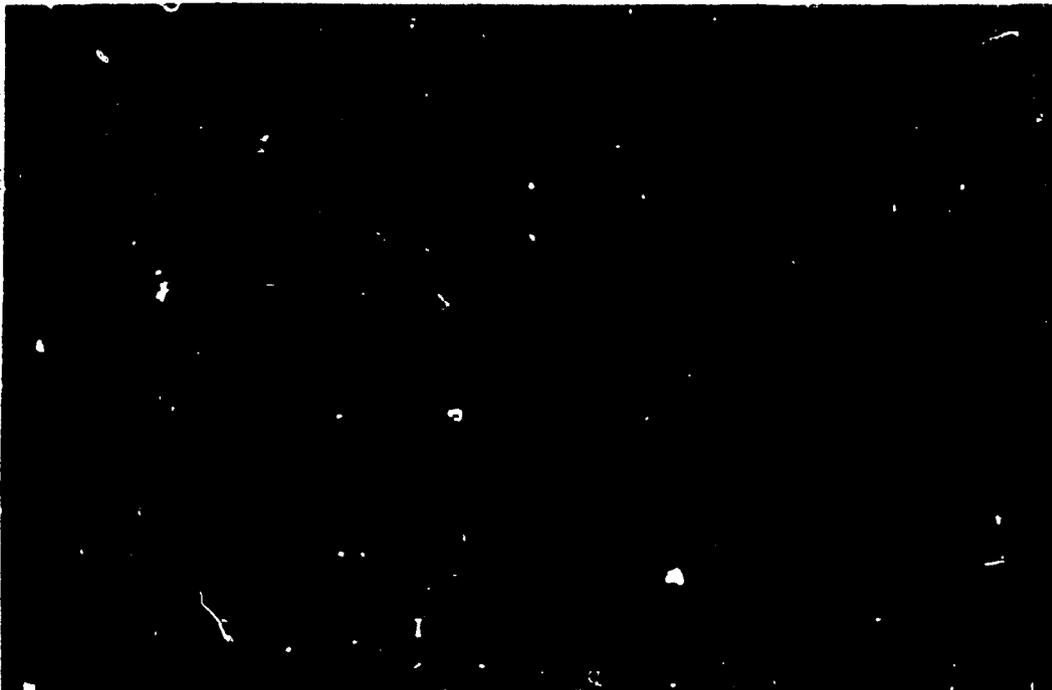
13-P-7: Collapse of the bridge at the time of initial completion of construction occurred when main cables came loose from the left anchor. It was said that the bulldog grips had been tightened incorrectly in an upside down position. Undoubtedly as an overreaction to the disastrous collapse, a much larger number of grips than necessary, according to specifications, were installed on the cables at the time of repair.

Date: Feb. 21, 1978



13-P-8: Young users of the bridge.  
Note rough plank in foreground  
indicated by arrow. The  
honorary watchman of the bridge re-  
placed 5 or 6 such planks on  
the bridge in places where  
they were most urgently needed.

Date: Feb. 21, 1978



13-P-9: Repair  
involving  
about 30 or more  
planks is recommended  
to bring the planking  
into good condition.

Date: Feb. 21, 1978



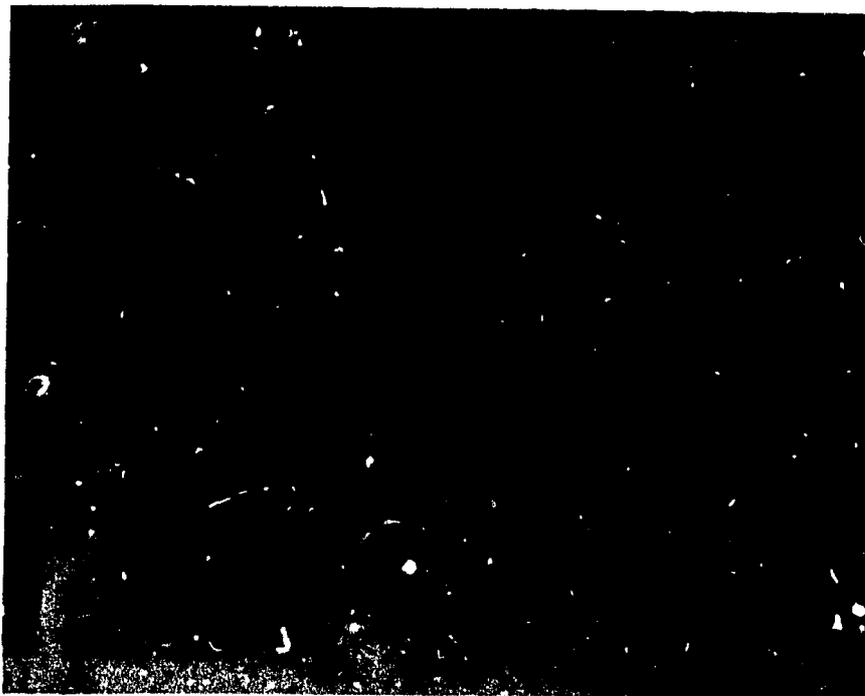
13-P-10: Sabhaya Khola Bridge about  $1\frac{1}{4}$  hours walk downstream along the Arun River from Tumlingtar, on the main trail from Khadbari (Sankhuwasabha District Headquarters) to Dhankuta. The bridge, of approximately 344 ft. span, was built less than a year ago by SBD. Even though the bridge is directly on the main trail some people find it easier to cross by fording the river just slightly upstream from the bridge.

Date: Feb. 22, 1978



13-P-11: Piluwa Khola Bridge about 4 hours walk downstream along the Arun River from Tumlingtar, on the main trail from Khandbari (Sankhuwasabha District Headquarters) to Dhankuta. The bridge, of approximately 450 ft. span, was built about two years ago by SBD. The bridge is used during the monsoon only, since the Piluwa Khola is easily fordable during the dry season and the bridge lies slightly off the main trail.

Date: Feb. 22. 1978



13-P-12: The Akkar trail, about 5 hours walk downstream along the Arun River from Tumlingtar on the main trail from Khandbari (Sankhuwasabha District Headquarters) to Dhankuta. Akkar means difficult. The narrow, old trail here was improved by blasting a new trail in the cliff rock and adding protective fencing as shown above. The project was completed about three years ago by Sankhuwasabha District under the Small Area Development Program. Trail improvement of this nature is rarely found in the country. Note the railings and the heavy slab culvert, and the extra widening of the trail. It might be questioned as to whether the benefits derived from this over-designed trail is worth the extra cost.

Date: Dec. 1977



14. LEGUWAGHAT CABLEWAY

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14.1.1    AREA DESCRIPTION AND HISTORY-Geographic Setting

The cableway is constructed over the Arun River which is a major, unfordable river throughout the year. As the river approaches the cableway site it becomes fairly wide, since to the south of the Turkoghat Bridge site, many rivers such as the Sabha Khola, Piluva Khola and Loguwa Khola, and a number of wet-season streams, merge with it. The river serves as the natural boundary for Bhojpur and Dhankuta Districts. On the immediate left bank of the cableway lies the Loguwa village panchayat of Dhankuta District and on the right is the Jarayotar Palpale village panchayat of Bhojpur District.

The hill slope, on both sides of the river forms a suitable anchorage for the cableway. The landscape in the immediate vicinity of the cableway site consists of flat strips of cultivated land and mild hill slopes contoured by terraced farm lands. At the cableway site the altitude ranges from 1500 to 2500 ft. The hill slope rises to successively higher elevations outside of the immediate vicinity.

-Cableway Site Description

The Arun River flows into a fairly broad valley near the Loguwaghat Cableway. The bed of the river is very wide. The span of the cableway is 1377 ft. There is a large amount of fairly flat, fertile agricultural land along the left bank of the Arun River at the point where it joins the Loguwa Khola, a ten-minute walk north of the cableway. Unlike the Arun River, the Loguwa Khola is a minor river which has no effect on the cableway located downstream. The river does, however, occasionally prevent traffic flow during the monsoon and also claims lives nearly every year.

The Loguwaghat Ferry, which crosses the Arun River only during the dry season, is located a 5 to 10 minute walk downstream from the cableway. The Khorsanoghat Ferry, which also crosses the Arun River is

operable throughout the year except in times of extremely high floods. The Khorsanoghat Ferry is often called the Boguwaghat Ferry since it replaces the services of the Loguwaghat Ferry during the monsoon. The Khorsanoghat Ferry is absolutely essential to the local people for carrying on agricultural activities during the monsoon. It is noteworthy that fatal accidents rarely occur during the monsoon.

Along the left bank of the Arun River, where the cableway is anchored, are medium-steep hills of fairly solid cliff rock, consisting of mica schist of medium hardness, interspersed with quartz. The cableway crosses over fields at the base of the hills on the left bank, and then extends over the riverbed. The cableway support pillar and anchor are located on solid rock on the left bank.

The right bank consists of fairly fragmented rock with thin, alternating layers of schist and quartz. The rock fractures easily, and tends to decompose into coarse sand and fine gravel. The exposed rock of this bank breaks into medium-sized blocks and pieces. The right anchor of the cableway is placed on relatively flat ground. Small landslides have occurred on this bank just below the cableway support pillar and anchor since the cableway was built. However, the support pillar and anchor are set safely back from the edge of the bank. The cableway itself is high above the river and safe from any flood danger.

In March 1976 a consulting firm, German Consult, surveyed the area and proposed that a suspended bridge of a 984 ft. span be erected about 450 ft. downstream from the cableway site. <sup>1/</sup>

At the proposed bridge site, rock conditions are about the same on both banks as those at the cableway site. The German Consult study also reported, finding solid rock at a depth of 50 ft. on the right bank of the

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<sup>1/</sup> German Consult Report, Trail Suspension Bridge Feasibility Study 1976 Vol. 2, Part A, p. 155.

proposed bridge site. However, the hills on the left bank at the bridge site form a cliff which drops abruptly into the river. The landslide action noted at the right bank of the cableway site has not occurred downstream at the bridge site. The site for the proposed bridge is good though the right foundation should be set well back from the edge of the bank because of the fragmented condition of the exposed rock.

The cableway is easy to reach from either side. On the left bank, the cableway is situated near a trail leading to a village higher up the hill. There is no road approach trail on the right side since the cableway has never been in use. The main trail from Dhankuta to Sankhuwasabha runs along the left bank of the Arun and is in generally good condition, though the crossing at Leguwa Khola is still a weak link in this trail system. A bridge on Leguwa Khola can be highly recommended, but the right foundation would have to be placed on the low-lying fields of the old flood plain of the river in order to avoid an excessively long span.

#### -Relationship with Regional Transportation System

Had the cableway been functional, it would have served the main trail to Bhojpur which originates in Dharan, the terminal roadhead in the southern foot hills of the region. The trail runs through important places such as Dhankuta, the Eastern Development Region Center, and Pakhriabas, the Agricultural Demonstration Farm. Judging from the long-distance porter traffic, this trail is a primary trade route to Bhojpur. Since the cableway is inoperable, a major proportion of traffic originating in Bhojpur, especially from the northwest and southern parts, and destined for Pakhriabas, Dhankuta and Dharan, is served by the ferries which operate near the cableway at Leguwaghat and Khorsanoghat, situated about a half-hour walk upstream from the Leguwa village settlement. The Khorsanoghat Ferry operates throughout the year except on certain days during the monsoon, when the river becomes too turbulent. Local people say that no accidents have been recorded so far.

-General Cultural Setting

Before 600 A.D. the whole area both east and west of the Arun River, was governed by the Kirati rulers.

The current socio-cultural background of the area is similar to that of the Turkoghat Bridge site. The people settled in the area belong to both the Indo-Aryan and Tibeto-Burman groups. The Indo-Aryan ethnic groups of the area are Brahmin, Chhetri, Maghi, Damai, Kami, Sarki and Gaine. The Tibeto-Burman ethnic groups are Rai, Limbu, Tarang, Magar and Gharti. The dominant ethnic groups of the area are Brahmin, Chhetri and Rai.

-Services Available in the Area

Around Loguwa, the services of a sub-branch of the post office and a police post are available. Loguwaghat is a link between the Dhankuta and Bhojpur Districts. The Headquarters of both Districts are about a day's walk from either bank of Loguwaghat. People of Loguwa and Palpale village panchayats have to go to Pakhriabas, about a 5-hour walk, to sell their surplus products (such as vegetables, fruits etc.) and to buy their domestic needs. If they need supplies in large quantities, they have to go to Dhankuta or Dharan, a 1-or 2-day walk.

-Cableway Location History and Decision Process

His late Majesty, King Mahendra commanded a bridge be built at Loguwaghat in 1957. This proposal was actively supported by the Council of Ministers. It was hoped that after the construction of a bridge, transportation between Dhankuta, Bhojpur, Chainpur, Torahathum and Khotang would be significantly improved. It was also thought that upon the completion of the STOL airstrip at Tumlingtar, a bridge would be needed to facilitate the crossing of the Arun River for those people travelling to, or through Loguwaghat. However, the river width at this point was so wide, that construction of a suspension bridge proved to be too difficult. The

construction of a cableway, as an alternate plan, was proposed and accepted. Also a year earlier, the Kathmandu-Netauda Ropeway, another USAID project had been completed, and the technical knowledge was available prior to the Loguwaghat construction period.

In March 1964, a design for a cableway was prepared, and H. D. P. Sharma of the SBD was placed in charge of the construction team. Mr. Phillip Bryn of USAID was particularly helpful during the construction of the cableway. The overall responsibility for its construction was entrusted to the Dhankuta District Office. Towards the end of 1965, a 1377 ft. long cableway was constructed, but because of technical errors, it could never be used.

According to the people of the area, Loguwaghat is the main ferry crossing. Most of the people from areas such as Khotang, Dhankuta, Champur, Terahathum and Dharan cross the Arun River at Loguwaghat.

Since many families are scattered across the Loguwaghat area, the people needed additional transportational facilities in order to maintain communications with their consanguinal and affinal relatives. Also a bridge would provide easier access to their farmlands which often lie across the river.

Loguwaghat, a traditional ferry-crossing point, is considered an important trail linkage between Dhankuta and Bhojpur, and is also a trade and postal route. A bridge at Loguwaghat could provide the people of Bhojpur with easier access to the markets, a faster postal system, and a continuous flow of commodities. Also the Tumlingtar STOL airfield needs to be supplemented by a more modern crossing facility at this point. As mentioned earlier, this would also be more convenient for the people traveling to Bhojpur, the District Headquarters.

Since the traditional trail still attracts a large amount of traffic flow via Loguwaghat, a suspension or suspended bridge would have

been preferable when compared to the facilities provided by a cableway. But due to the enormous width of the river, a longer span would have been needed. This certainly would have involved much higher cost, as well as additional technical problems, as the span at Leguwaghat was far too long for any of the pre-fabricated bridges of BRC standard design, which are for spans of 220 ft., 260 ft. and 300 ft. Presumably the cost factor was also one of the critical aspects leading to a decision favoring the manually-operated cableway rather than the bridge.

The 1962 project agreement<sup>2/</sup> between HMG and USAID envisioned the use of cableways for spans over 300 ft. Leguwaghat cableway was the first attempt at this plan. This is similar to the experiment of erecting steel truss bridges for short spans ( 200 ft.). (see Vol. 2 of this study on Kaguno bridge).

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<sup>2/</sup> See Section 0.1.2 Trail Bridges: History and Assessment of this Study Vol. 1 p. 7.

14.2 ANALYSIS

14.2.2 SOCIO-ANTHROPOLOGICAL ANALYSIS

-Land and People

The study was conducted in three village panchayats, Loguwa, Jarayotar Palpale and Chanuwa, all in the immediate vicinity of the cableway.

The population of Loguwa village panchayat is made up of Chhotri, Brahmin, Sanyasi, Rai, Damai, Kami and Sarki ethnic groups. The ethnic groups of Chanuwa village panchayat are Chhotri, Rai, Kami, Newar, Brahmin, Damai, Tamang, Gharti and Sarki. The ethnic groups of Jarayotar Palpale are Rai, Chhotri, Brahmin, Kami, Newar, Gaine, Sarki and Majhi.

The total estimated number and percentage of households and the ethnic groups of the Chanuwa and Jarayotar Palpale village panchayats are given in the following tables:

Table 14-T-1: Estimated Number and Percentage of Households by Ethnic Group (Chanuwa Panchayat)

Ethnic group	Households	Percentage
Chhotri	156	36%
Rai	68	16%
Kami	51	11%
Newar	45	10%
Brahmin	40	9%
Damai	38	9%
Tamang	25	6%
Gharti	13	3%
Sarki	3	below 1%
Total	439	100%

Source: ECE Field Survey

Table 14-1-2: Estimated Number and Percentage of Households by Ethnic Group (Jarayotar Palpale Panchayat)

Ethnic group	Households	Percentage
Rai	189	38%
Chhetri	93	18%
Brahmin	77	15%
Kami	56	11%
Nevar	53	11%
Gaino	15	3%
Sarki	9	2%
Majhi	8	2%
Total	500	100%

Source: ECE Field Survey

The above tables show that Chhetris and Rais are the dominant ethnic groups in Chanuwa and Jarayotar Palpale panchayats respectively. The Rai culture is predominant in the area. Rais are also called Kiratis. They have their own traditional festivals, rites and rituals. It is said that the Kiratis have a tradition of assimilating the members of any caste or ethnic group into the Kirati culture. In the traditional ceremony, the newcomers touch sacred grass, called Dubo, and a holy stone called a Saligram. After this is done, a group of respected community members, the Pancha Bhaladmi, assume responsibility for the further integration of the new Kirati.<sup>3/</sup>

The untouchables of the area are the Damai, Kami, Sarki, and Gaino. They are the lowest caste groups in the Hindu social hierarchy. They have continued to practice their own traditions and caste defined occupations.

The main occupation of all ethnic groups in the area is primarily farming. The secondary occupation varies from one ethnic group to another.

<sup>3/</sup> Hark Raj Chongwang Hamro Sanskriti 1967 Year 1/No. 3, Kathmandu.

Some of the Brahmans are employed in the government services. Most of the Chhetris, Rais, and Magars are enlisted in the Nepalese, Indian or British armies. The Newars are basically the businessmen. The Majhis fish and operate the ferries at Leguwaghat. The Damais are tailors, the Sarkis make shoes and the Kamis make iron tools and other iron implements.

Unfortunately the Leguwa Cableway never became functional, so, the impact of the cableway or the facilities provided by it in terms of social interaction are non-existent.

#### -Changes in Beliefs and Habits

Among the people all along the Arun River there is a strong religious superstition that no bridges should cross the river. When the cableway failed to function, this taboo seemed to acquire some basis in fact. This belief was reinforced when a bridge at Turkeghat (one of the study bridges) collapsed immediately after its construction. However, this superstition is now fading since the successful reconstruction of the Turkeghat bridge and the later construction of several other bridges over the Arun.

### 14.2.2 INSTITUTIONAL ANALYSIS

#### -Local Participation

About 19 village panchayats on either side of the river at Leguwaghat contributed voluntary labor as well as about Rs 2,700/- towards the construction of the cableway. Mr. Phillip Bryn donated Rs 500/- and a local person donated Rs. 1,500/- towards the cost of the cableway. Bhojpur District Panchayat made available six people for transporting materials from Dharan to the site. This project, like the others, was funded under the HMG/USAID suspension bridge program.

Because the cableway failed to operate initially, people were convinced that it would not be worthwhile to try to make it operable, nor was there any effort forthcoming from the government. Possibly people did

not show interest, because the technology was foreign and very peculiar to them. Also, because alternate facilities were available, (the all-weather ferry services at Khorsaneghat), people were not hard pressed.

-Institutional Impact of the Cableway

Since the cableway has never been in operation, there has been no impact on the institutional growth in the area.

14.2.3 ECONOMIC ANALYSIS

-Geographic Area and Population Served

This study is limited to only 3 village panchayats; Loguwa, Jarayotar Palpale and Chanuwa, all in the immediate neighborhood of the cableway site.

Had the cableway been functional it would have served the area and population of both the immediate vicinity, and the more distant ones. It was found, from interviews with the local people, that the cableway, besides serving the many village panchayats of the immediate Districts of Bhojpur and Dhankuta, would also have served the distant panchayats of the Terhathum, Khotang and Okhaldhunga Districts. Among the neighboring village panchayats of Dhankuta District, the cableway would have effectively served Chanuwa, Danda Gaon, Namphu, Loguwa, Arkauli Jitpur, Muti Dunga, Hattikharka, Saune, Ghorle Kharka and Jarayotar Palpale, Yaku, Charambi Pyauli, and Ryang village panchayats. The cableway would also have attracted the people residing in the more distant geographic areas since it would have provided an easy crossing facility and a more direct access to the market centers of Dhankuta and Dharan, thus yielding a definitive gain in time-savings, an important consideration for a people whose primary mode of transportation is by foot.

At the present moment, however, the ferry is doing what the cableway is not. About 60 to 70 families, residing on the right bank in

Jarayotar Palpale and other village panchayats of Bhojpur, have farm lands in Leguwa and they use the ferry services each day to reach their land. The ferry services are also used by 60 to 70 school children of Jarayotar Palpale who attend the schools at Lalghari, Jitpur and Leguwa, all situated on the river's left bank. Also all the important centers of economic transaction are situated on the left bank, and to reach them one must use the ferry. Finally, the ferry helps the movement of essential commodities and the flow of the postal service.

Leguwa village, consists of about ten houses and huts and is situated on the left bank of the river. There is one sub-branch of the Post Office and 2 tea stalls which also sell assorted commodities like cigarettes and matches. These small economic activities have grown because of the village's locale; it is situated on the main trail originating in Khandbari. Both this trail and the one originating in Bhojpur merge at this point. Leguwa is also served by the ferry.

#### -Estimated Traffic Flow

This study did not record the traffic flow at the ferry points. However the local people stated that on an average of about 300 people use the ferry during monsoon and 500 people use it in dry season. The traffic count in the German Consult's report is much less, giving a dry season average traffic count of 225 persons and the wet season an average of 51 persons for the ferry crossing-points at Leguwaghat and Khorsanoghat.<sup>4/</sup>

#### -Agriculture

Agriculture is the primary occupation and source of livelihood for the people in the area. Local people indicate that out of the total land area, about 18% is wet land, Khet, 29% dry land, Pakho, 23% is forested and about 30% is barren or rocky. Thus, less than half of the

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<sup>4/</sup> German Consult Report, Trail Suspension Bridge Feasibility Study, 1976, Vol. 2, Part A, p. 163.

total land area is presently under cultivation. However, due to the lack of proper irrigation facilities, agricultural production is completely dependent upon the uncertain monsoon rains.

The major crops grown in the area are maize, paddy, millet, pulse, buckwheat, potatoes, peanuts and tobacco. Maize and peanuts are planted in April/May, and harvested in September/October; paddy, millet, buckwheat and tobacco are sown in June/July and harvested in November/December. The application of improved varieties of seed and chemical fertilizers is of recent origin in the area, and the use of these modern inputs have produced a higher agricultural yield. However, because of the lack of education and its accompanying reluctance to abandon known, traditional methods for unproven, modern ones, not all farmers use these new agri-inputs. Local people indicate that the overall food production of the area has not shown positive improvement over the years. The area, however, is only marginally food deficient.

Animal husbandry is another significant feature of village farming. Cows and buffaloes are raised mainly as a source of manure, the most common fertilizer in the area. These animals are also raised for commercial purposes in order to generate needed cash income.

#### -Rural and Cottage Industries

As in other similar areas, here again, cottage industries generally produce only for household needs. There is no organized cottage industry in the area. Bamboo baskets, ropes etc. are made, again, primarily for household use. It is reported that there are 6 to 8 families engaged in making homespun fabric or Khadder. There are also about 25 households which engage in making pottery during the slack agriculture season. In order to earn a cash income, these families normally sell their earthenware at village fairs.

-Labor Force Situation and Employment

The total population of the 3 panchayats, Leguwa, Janayotar Palpale and Chanuwa, is estimated to be 8505, of which males constitute 4,231 and females 4274 (Table 14-T-3). However, of the total population, the age group 10 years of age or older, is estimated to be 6,066; 3,017 are males and 3,049 females. Since all persons falling in this age group are not active income-earners, the total working population and hence the size of the labor force, appears to be 3,391, of which 75% are males and 25% females. Of the 3 panchayats under study, Chanuwa has the smallest population (2,020) and labor force (855). The other two panchayats, Palpale and Leguwa, are almost equally populated, and have a work force of 1,126 and 1,410 respectively.

Local interviews indicated that this area, like most other hill areas in Nepal, suffers from the underemployment syndrome. The people say that agricultural activities keep the family fully-engaged for a maximum period of six months per year. During the remaining part of the year, only a few family members are required to care for the livestock and perform the other tasks necessary for maintaining the household. There are very few other work opportunities and a sizable proportion of the local labor force migrates to other areas seasonally to work in low-wage occupations, such as portering or other unskilled manual jobs. They migrate primarily to the southern townships of Dharan, Biratnagar, and to Assam in India. In more recent years the permanent migration of a few families to the Terai area has been noted. The migration phenomenon is apparently the result of the deteriorating economic opportunities in the hills reinforced by population pressure on the marginal farm land.

Table 14-T-3: Estimated Population and Labor Force

Name of Village Panchayats	Total Population (1977)			10 years of age or above			Economically active population <sup>5/</sup>		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
Leguwa	3215	1583	1632	2299	1132	1167	1420	978	432
Palpale Jarayotar	3270	1653	1617	2323	1174	1149	1126	935	191
Chanuwa	2020	995	1025	1444	711	733	835	614	241
Total	8505	4231	4274	6066	3017	3049	3391	2527	864

Source: ECE Estimate based on the 1971 CBS census.

<sup>5/</sup> The economically active population may be defined as the number of persons in the age group 10 years and over who are engaged in activities contributing to the production of goods and services.

-Trade Flow Pattern

The major export items of the area are clarified butter, Ghee, livestock, poultry, chickens, chillies and tobacco. These go to the market centers at Pakhriabas, Dhankuta and Dharan. The area imports salt, kerosene, cloth, spices, edible oils and all other essential manufactured consumer goods.

-Environmental Effects

The area has limited pasture land and the supply of fodder for the animals has already been seriously depleted. Although an estimated 23% of the total land area is forested, there are still not sufficient quantities of fuelwood and fodder for local needs. This deforestation, in combination with the tendency towards top soil loss, common to the sloping terrain, indicates imminent soil erosion and its accompanying negative effect on agricultural production. The afforestation program has not been well planned. However, as the cableway is not operative, it has nothing to do with the deforestation and soil erosion problems.

14.2.4 ENGINEERING ANALYSIS

-Site Selection, Design and Construction Methods

It is not clear why a long span of 1377 ft. was chosen for the cableway. The much shorter span of 984 ft. surveyed by the German Consult about 450 ft. downstream, as described in an earlier section, seems more suitable. The soil conditions of both banks in the narrower downstream site are as good as or even better than the site chosen. Choosing the narrower site would have allowed the cableway to be constructed with a gentler incline and the cable could have been set with less sag which would have permitted easier operation of the cableway. When considering the possible alternatives, the selection of the long span seems to have been a poor one. The general location of the site, only 5 to 10 minutes

stream from Loguvahat ferry is good, when one considers the existing trail system of the area.

Local skilled laborers who installed the mechanical parts, were supervised by Mr. Hira Kaji, a feroman from SBD. Erection of the cableway was completed on June 2, 1965, though the cableway was finally completed towards the end of 1965.

The track cable of the cableway is made of  $1\frac{1}{4}$  in. galvanized spiral strand with socketed ends similar to those used in Kathmandu-Hetauda Ropeway. It rests on simple stone masonry support pillars on either side of the river. Sockets were used in making the connection from the cable to the steel rods anchored in concrete. The cablecar appears to be of rather heavy design. There is a winding mechanism on the left bank which drives a light haulage cable attached to the cablecar. The cablecar runs along the track cable, pulled by the haulage cable, which in turn rides on a system of wheels located on either side of the river. There is no functional means of communication between the two banks. A prospective user on the right bank would find it difficult to convey his or her wishes to persons operating the cranking mechanism of the left bank.

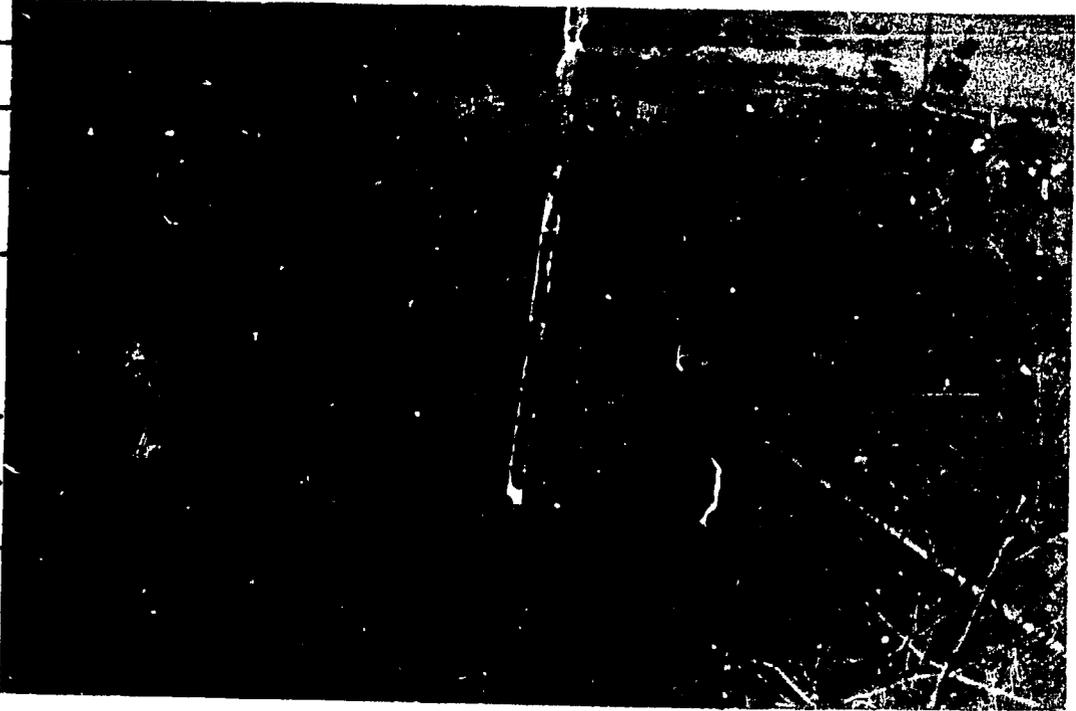
Unfortunately the cableway was never put to use. It is said that after completion of the cableway, two Americans flew in, in a helicopter, to test it. One American got into the car and rode from one bank to the other, while the other American operated the cranking mechanism. Next fifteen Nepalese got into the car and four Nepalese ran the cranking mechanism. They crossed from the left to the right bank. The force required to wind the cable increased greatly as the car neared the left bank on its return trip. The number of people winding the cable was increased from 4 to 10, but the gear mechanism slipped and the car could not be brought back to the left bank. The cableway has not been used in the ensuing 13 years, and remains hanging over the river, on the track cable about 150 ft. from the left bank support pillar.

The failure of the cableway appears to be attributable to the deep sag necessitated by the long span, and to the heavy weight of the cablecar. With the cablecar at its present position, the track cable is inclined  $15^{\circ}$  from the horizontal at the left bank support pillar. This steep angle becomes even steeper as the cablecar nears the support pillar and more force is required to wind the haulage cable. It seems that the design of the winding mechanism requires a minimum of 4 persons to operate the cranking mechanism, assuming that it is working properly.

The problem of communication between banks could perhaps be solved by having personnel develop a signaling system. This would require workers on both banks at all times.

At most cable crossings in Nepal the span is shorter, the track cable is nearly horizontal, and the cablecar is light. A single person sitting in the car can propel him or herself across the river. At Raighat, further downstream on the Arun, there is a locally-made cable crossing used during the monsoons. Locally-made haul ropes are tied to the cablecar and held by attendants on either side of the river. Persons using the car slide down the track cable on one side, and are hauled up the other side. The span at Raighat, however, is much shorter than that at Leguwaghat. In any event, it seems that the technical details of the Leguwaghat cableway design were not given proper attention.

-Present Cableway and Approach Trails: Condition and Recommended Improvements

Cableway Name: LEGUWAGHAT	Zone KOSI	Districts: Left: DHANKUTA Right: BHOJPUR	Village Panchayats: Left: LEGUWA      Right: PALPALE
SPAN	1377 ft.		
TYPE	Cableway		
MAP 1"=1 mile	72-M/8		
COORDINATES	87°16'15" 27°08'48"		
TRAIL	Dharan and Dhankuta to Eastern Bhojpur District		
TRAIL TYPE	Class B		
RIVER	Arun		
RIVER TYPE	Major		
COMPLETION YEAR	1966		

The cableway is non-functional and has been ever since the first day it was tested. The winding mechanism for the haulage cable is rusty and the gear train does not work. The haulage cable has come off of some of the wheels on which it should run. The cable car hangs uselessly about 150 ft. from the left bank support pillar and the track cable at the support pillar is inclined steeply at about 15° from the horizontal. Anchorages and track cable support pillars are in good condition.

Refer to  
Photographs No.

- 14-P-3
- 14-P-4
- 14-P-8
- 14-P-1
- 14-P-5

Refer to  
Photograph No.

There is minimal value in trying to reactivate the cableway. The people need a means of transporting their draft animals to their fields during monsoon. A bridge appears to be the best way this service can be provided. If the cableway requires a large number of attendants for operation, say more than 2, or is in any other way difficult to operate, then people will prefer to use the Khorsanoghat Ferry, as often as river conditions permit. During the dry season, the Leguwaghat Ferry would certainly be more convenient to use than the cableway. One probable reason the government has made no effective repairs is that the local people no longer have faith in the ability of the cableway to operate smoothly. Also a bridge rather than a cableway would better serve their needs. There has been no local pressure placed on the government concerning the repair of the cableway.

14-P-6

Nevertheless, if a bridge can not be built at Leguwaghat, the cableway could be used for crossing the Arun during extreme monsoon flooding, when the Khorsanoghat Ferry stops operation. It might be advantageous to move the cableway about 450 ft. downstream to the proposed bridge site in order to take advantage of the shorter span available there. The track cable should be rehung with as little sag as possible and a new, very lightweight cablecar should be designed. This should hold a maximum of 4 persons and be self-propelled by the people in the car.

14-P-7

14-P-8

Refer to  
Photograph No.

Unfortunately no check was made during the field visit to ascertain whether the track cable support pillars are at equal elevation. If not, it might be necessary to modify the pillars in order to obtain equal elevation and avoid a steep slope in the track cable at the higher support pillar. Tests should be made with the new, lightweight cablecar to determine the maximum cable slope over which a car can be easily self-propelled. If the car is made of sufficiently lightweight materials, the problem of track cable deflection would be minimized. Of course, the above recommendations for putting the cableway into operation require a thorough design analysis, and are irrelevant if a decision is made to build a bridge at Loguwaghat in the near future.

-Past Maintenance Work

After the failure of the cableway on the second of its initial test runs, no maintenance work has been done nor has any effort been made to put the cableway back into operation. Perhaps the evident necessity for a complete redesign of the cableway and the minimal interest in the cableway by the local people are among the determining factors.

However, it was reported that an investigation was made by SBD/USAID in 1967 to determine why the cableway did not work, and possibly, to attempt repairs. The repairs were unsuccessful and plans were made to use the cable at some other site on or near the Arun River. For unknown reasons, no further action was taken on the matter.

14.3

## FINDINGS

### SOCIO-ANTHROPOLOGICAL

- The people around the area needed a bridge built at Loguvaghat mainly to have access to their farm lands, and also to have a better communication between their consanguinal and affinal relatives residing on either side of the river.
- Unfortunately the Leguva cableway was never functional, so the impact of the cableway or the facilities provided by it on the area's social interaction are non-existent.
- There was a strong superstition among the people along the Arun River that no attempt to span the Arun would ever be successful. This belief was strengthened after the failure of the Loguvaghat cableway. Opinions have now changed since the subsequent successful bridge constructions over the Arun.

### INSTITUTIONAL

- Nineteen village panchayats on either side of the river at Loguvaghat contributed cash as well as voluntary labor during the construction of the cableway.
- Because of the introduction of a foreign technology, people did not understand the operation of the cableway. Therefore, the people did not attempt to repair the cableway.
- Because of existence of an all-weather ferry crossing facility available nearby, people were not hard-pressed enough to either repair the cableway, or put effective pressure on the government to do the repairs.
- People have lost interest in the cableway. They have no faith in the ability of the cableway to operate smoothly. Moreover the real local need is for a bridge rather than a cableway.

ECONOMIC

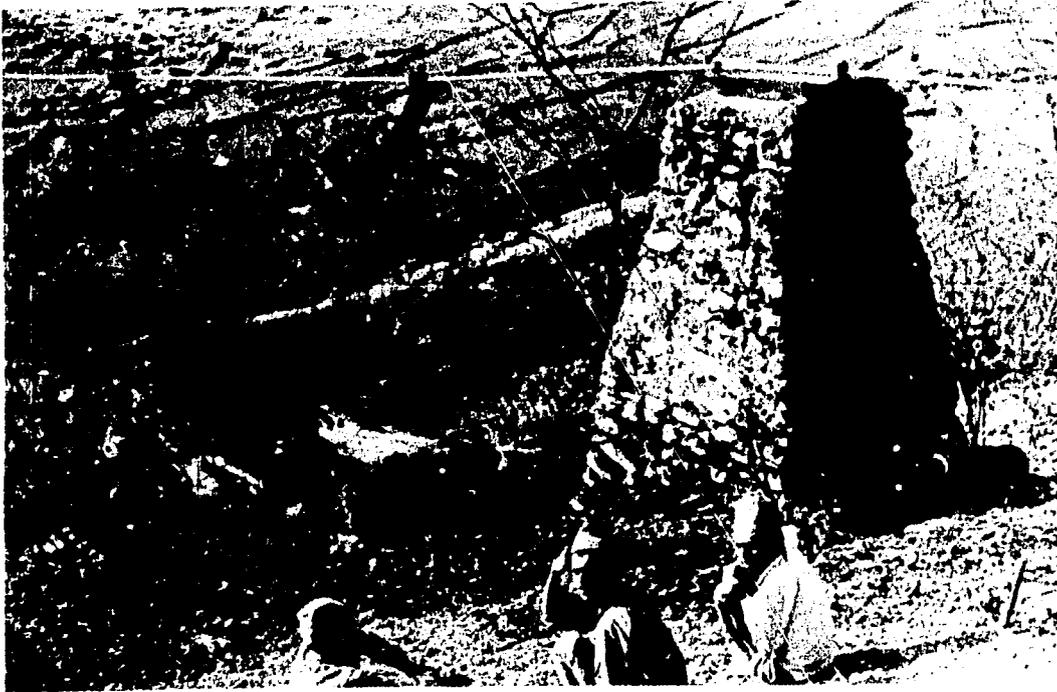
- Had the cableway been functional it would have served a large area and population both in the immediate vicinity, and in the distant areas. Its capacity, however, is very limited when compared to that of a bridge.
- The traffic estimate made by the German Consult, though very conservative when compared to local opinion, seems to justify the construction of a bridge in this area.

ENGINEERING

- It is not clear why a long span (1337 ft.) was chosen for the cableway instead of the much shorter span (984 ft.) available about 450 ft. downstream. The selection of the long span site over the short span site was a poor one.
- The failure of the cableway appears to be attributable to the deep sag necessitated by the long span, and to the heavy weight of the cablecar.
- At many other locally-made cable crossings in Nepal, the span is shorter, the cable is nearly horizontal, and the cablecar light enough to be self-propelled.

14.4

ILLUSTRATIVE PHOTOGRAPHS



14-P-1: Left bank support pillar for track cable of Leguwaghat Cableway. Cranking mechanism is in the background. Haulage cable passes over the wheel mounted on track cable.

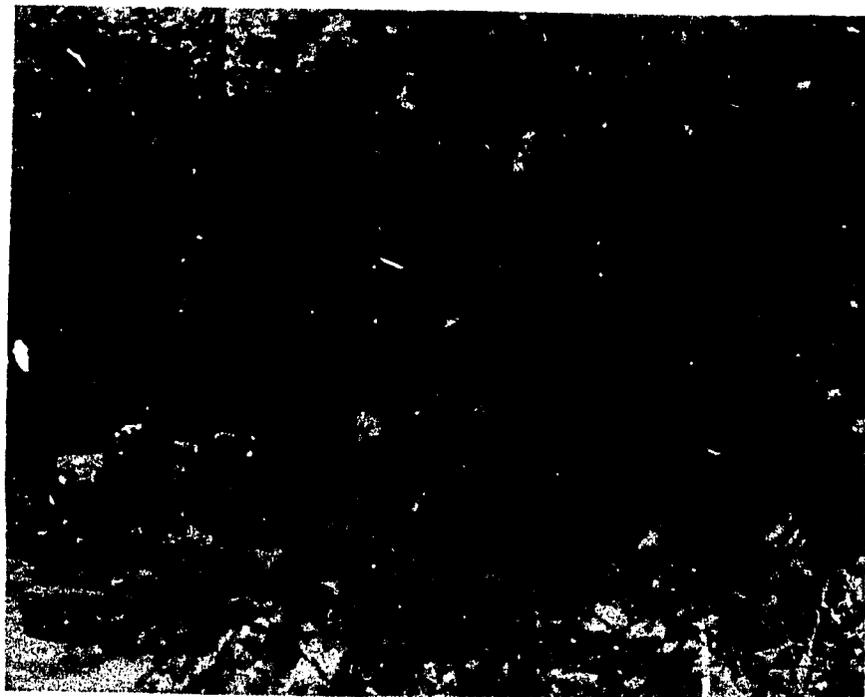
Date: Feb. 24, 1978



14-P-2: The non-functional cranking mechanism on the left bank.

Date: Feb. 24, 1978

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14-P-3: Close-up of cranking mechanism on the left bank. The mechanism is rusty and the gear train does not work.

Date: Dec. 1977



14-P-4: The wheel system for haulage cable on the left bank. The haulage cable has slipped off the lower wheel at A. Leguwa Khola enters the Arun near B. Note the wide flood plain of the Arun River in the background. Fertile agricultural land on the left bank of the Arun at and above Leguwa Khola is indicated by arrows C. The approximate location of Khorsaneghat is about 30 minutes walk upstream from the cableway indicated at D.

Date: Feb. 24, 1978



14-P-5: Details of anchor for track cable. The socket on the end of the cable is the same as sockets in use on the Kathmandu-Hetauda Ropeway, also a HMG-USAID project.

Date: Dec. 1977



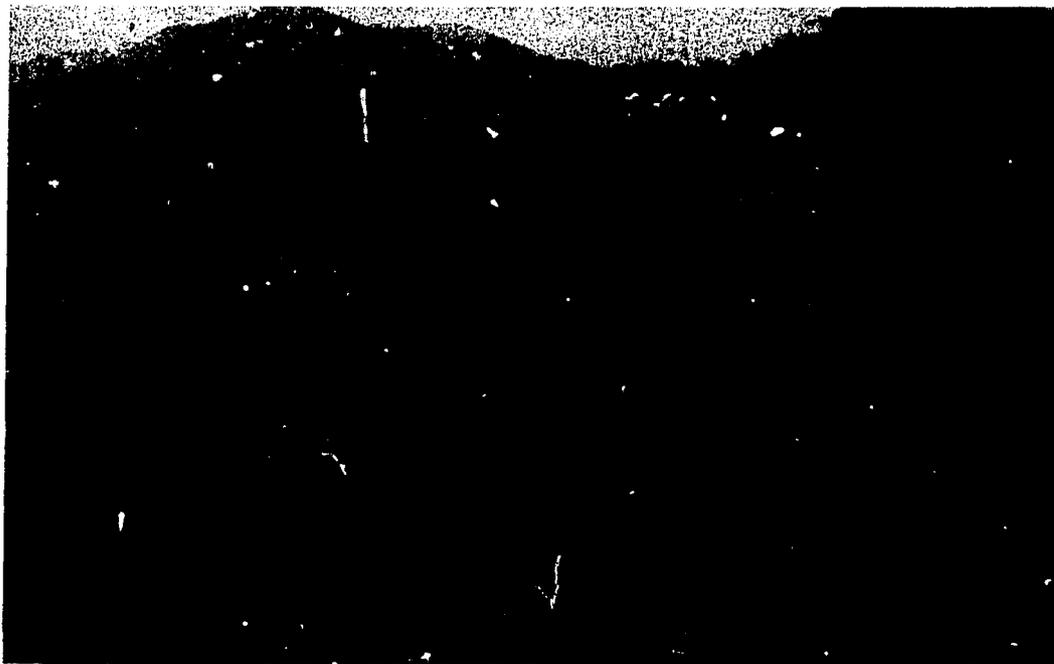
14-P-6: The Leguwaghat Ferry, 5 to 10 minutes walk downstream from the cableway. The loat is made of sawn planks instead of being dug out from a log, as is common elsewhere in Nepal, (cf. photo 12-P-9 of Toxelghat Ferry Vol. 5, of this report.)

Date: Dec. 1977



14-P-7: View towards the right bank of Arun just upstream from Leguwaghat Ferry. Support pillar for the cableway track cable is located at A. Approximately location of right foundation for the bridge proposed by the German Consult is indicated at B.

Date: Feb. 24, 1978



14-P-8: View towards the left bank of the Arun just upstream from Leguwaghat Ferry. The approximately location of left foundation for the bridge proposed by the German Consult is indicated at A. The support pillar for the track cable of the cableway is indicated at B. The cablecar is hanging uselessly from the track cable about 150 ft. from the support pillar, as indicated at C.

Date: Feb. 24, 1978

LIST OF ABBREVIATIONS

CEDA	Center for Economic Development and Administration
CDO	Chief District Officer
CDR	Central Development Region of Nepal
DOR	Department of Roads
DAP	District Administration Plan of 1975
DP	District Panchayat
EAST or E.	
ECE	East Consulting Engineers
EDR	Eastern Development Region of Nepal
FWDR	Far Western Development Region of Nepal
GON	Government of Nepal
HFL	High flood level
HMG	His Majesty's Government
IBRD	International Bank for Reconstruction & Development
IRR	Internal Rate of Return
JTA	Junior Technical Assistant of Department of Agriculture
LDD	Local Development Department
MWT	Ministry of Works and Transport
NCCN	National Construction Company of Nepal
NPC	National Planning Commission
PWD	Public Works Department
PCV	Peace Corps Volunteer
RNAC	Royal Nepal Airlines Corporation
SADP	Small Area Development Program
SATA	Swiss Association for Technical Assistance
SBD	Suspension Bridge Division
STOL	Short Take Off and Landing
USOM	United States Operation Mission
USAID/ Nepal or USAID	United States Agency for International Development, Nepal
UNDP	United Nations Development Program

## LIST OF ABBREVIATIONS

WB	World Bank
WDR	Western Development Region of Nepal
3-A-1	Bridge Study Number - Appendix - Appendix Number
3-T-1	Bridge Study Number - Table - Table Number
3-F-1	Bridge Study Number - Figure - Figure Number
3-P-1	Bridge Study Number - Photograph - Photograph Number
0-A-1	Summary Volume - Appendix - Appendix Number
0-T-1	Summary Volume - Table - Table Number
0-F-1	Summary Volume - Figure - Figure Number
0-P-1	Summary Volume - Photograph - Photograph Number

## GLOSSARY

- Akhar - very difficult, particularly used for a bad place on a trail.
- Asad - Nepalese month roughly corresponding to June/July.
- Ayurvedic - traditional natural remedies, specifically herbal.
- Babiyo - a type of grass from which ropes are made.
- Bada Hakim - the district governor.
- Badi - the entertainment caste
- Basar - river bank;
- Basar ko dhunha - stones from the river bank.
- Bajseri Miteri - ritual friendship
- Bali - a system in which the laborers of certain castes are paid in grains rather than in cash.
- Bakhoo - coarse, handloomed woolen material worn by men.
- Bana-Jhanduri - shaman
- Bensi - low-lying river valleys.
- Bhaili - group singing done during the festival of Tihar.
- Bhanera - rough handloomed cloth.
- Bhatti - small wayside lodge where liquor is served.
- Bhawani - a Goddess' name
- Bhoto - a short man's shirt
- Bidi - a type of cigarette whose wrapping is made from leaves (also called Biri)
- Champ - a wood indigenous to certain areas of Nepal
- Char Jat - the four castes; Brahmin, Chhetri, Vaisya, and Sudra
- Chautara - a resting place along a hill trail.
- Chaukidar - see Chowkidar
- Chour - wide, flat area
- Chhapre - hut
- Chiura - beaten rice, usually eaten as a snack
- Chokho Jat - the clean caste, upper caste Hindus
- Cholo - short women's blouse, usually worn with a sari
- Chota - a young man of marriageable age; specific to western Nepal
- Chota Chotti
- Khelne - a place young people meet to sing and dance; similar to the Rodighar.
- Chotti - a young woman of marriageable age, specific to western Nepal

- Chowkidar - watchman, also Chaukidar
- Choya ko Jholunge-a suspend bridge made by turned bamboo
- Chunnam - bamboo or wood workers caste group
- Chureto - medicinal herb, 'cinchona'
- Danda - hill
- Dalo - small basket
- Darban - Hindi word for watchman
- Darji - tailor
- Dasain - the most important festival of the Hindu Nepalese
- Daudaha - an inspection committee which periodically tours the district and is empowered to make on-the-spot decisions concerning issues such as land disputes, etc.
- Dauda - a folk circle dance; specific to the far western districts.
- Devalli - a Nepalese festival celebrated in October/November
- Devalli - a place where shamans are initiated
- Dhara - spring water tap
- Dharu - approximately 5.28 pounds
- Dhiki - manually operated husking machine
- Dhoti - a single piece man's clothing usually of white cloth wrapped around the lower half of the body
- Dhule Pul - a temporary multi-span bridge made of wood, bamboo, logs etc.
- Doko - a large basket used by porters carried on the back, slung from a rope strap placed over the forehead.
- Doli - a wooden sedan chair used to carry a bride during the wedding procession.
- Ekadasi - the eleventh day after the new or full moon, considered a holiday by Hindus
- Gado - a long plain garment tied at the shoulder, generally worn by women
- Gahat - a kind of bean or pulse
- Gau Panchayat - village legislative body
- Ghagar - a long frock-like garment worn by women
- Ghaleko - a kind of local dress
- Ghatia - water mill
- Gheo - ghee
- Godhuwa - a Hindu marriage ritual in which the bride's parents wash the feet of the groom and give him a gift.

<u>Ghyang</u>	- shrine of the Tamang people
<u>Gunnyi</u>	- women's clothing similar to a sari
<u>Gya</u>	- women's blouse
<u>Hat-bazaar</u>	- weekly market
<u>Hulaki</u>	- postman
<u>Jai</u>	- caste
<u>Janto</u>	- manually operated grinding machine
<u>Janai</u>	- sacred white thread worn by the high caste Hindus
<u>Jatra</u>	- religious fair
<u>Jhankri</u>	- shaman
<u>Jholunge</u>	- suspended bridge
<u>Kacchad</u>	- sash
<u>Karmi</u>	- skilled laborer
<u>Kaun</u>	- kind of millet
<u>Khadder</u>	- handloomed cotton coarse cloth
<u>Khadi</u>	- handloomed cotton coarse cloth
<u>Khampa</u>	- people from Kham, a province in northeastern Tibet
<u>Khas</u>	- the Chhetri people, a term indigenous to the western areas
<u>Khet</u>	- wet farm land
<u>Khola</u>	- a stream or a small river
<u>Kipat</u>	- collective ownership of land, also a parcel of land bestowed by royal command.
<u>Kirana</u>	- miscellaneous retail goods
<u>Kot</u>	- hillock
<u>Kumain</u>	- a sub-group of the Brahmin caste
<u>Lohar</u>	- blacksmith
<u>Lahure</u>	- a person working outside Nepal and also one serving in the foreign armies
<u>Lal Mohar</u>	- royal decree; literally, the 'red seal'
<u>Lama</u>	- a priest or teacher of Tibetan or northern Buddhism
<u>Lekha</u>	- high land, usually ridge areas of a mountain.
<u>Maita</u>	- natal home
<u>Malami</u>	- one who participates in a funeral procession or a funeral procession
<u>Malla</u>	- the ruling family of the Kathmandu Valley between the 16th and 18th centuries.

<u>Manu</u>	- a volume measure roughly equivalent to half a kilogram
<u>Mandir</u>	- temple
<u>Mandro</u>	- bamboo mat
<u>Mang</u>	- Nepalese month corresponding to November/December
<u>Mas</u>	- black pulse
<u>Matwali</u>	- liquor-consuming; applied to certain castes or ethnic groups
<u>Mola</u>	- fair
<u>Miteri</u>	- ritual friendship
<u>Mistri</u>	- skilled laborer
<u>Mujetro</u>	- woman's headscarf.
<u>Nuri</u>	- a volume measure equal to 20 <u>Pathi</u> or 150 lb.
<u>Naike</u>	- foreman of labor crew
<u>Nali</u>	- tobacco pipe
<u>Naya</u>	- new
<u>Naya Pul</u>	- new bridge
<u>Neba Aba</u>	- social father
<u>Neba Ama</u>	- social mother
<u>Pakho</u>	- dry farm land
<u>Pan</u>	- sin
<u>Panchas</u>	- political workers of Panchayat system
<u>Parbate</u>	- a term primarily used by Kathmandu Valley Newars to refer to other Hindu caste groups
<u>Parma</u>	- system of labor exchange
<u>Pathi</u>	- volume measure roughly equivalent to $7\frac{1}{2}$ lb.
<u>Patwari</u>	- land revenue collector
<u>Paudri</u>	- local folk dance
<u>Phadke</u>	- temporary log bridge
<u>Pradhan Pancha</u>	- head of the village panchayat
<u>Punya</u>	- virtue
<u>Pujari</u>	- priest of a temple
<u>Radhi Pakhi</u>	- coarse woolen mats and blankets
<u>Raksi</u>	- distilled locally made liquor
<u>Ram</u>	- fair; term used in the far western areas of Nepal
<u>Rodizhar</u>	- community meeting place where people sing and dance.

<u>Roti</u>	- unleavened bread made of wheat or millet flour
<u>Rastriya</u>	- national, as in <u>Rastriya</u> Panchayat, the national legislative body
<u>Sabar</u>	- suede leather
<u>Sahi Sena</u>	- the Royal Army
<u>Saligram</u>	- black stone worshipped by Nepalese Hindus as a manifestation of the Divinity; found mostly in the Kaligandaki River in Nepal.
<u>Salsar</u>	-
<u>Sanskar</u>	- cultural values
<u>Sari</u>	- woman's garment
<u>Sanad</u>	- government decree
<u>Shora Jat</u>	- sixteen castes
<u>Taluk</u>	- tax collection area
<u>Tar</u>	- flat, low-altitude land in hilly areas
<u>Terai</u>	- the southern plains of Nepal; borders India
<u>Tika</u>	- red mark placed on the forehead as a sign of good women
<u>Tuni</u>	- a wood indigenous to certain areas of Nepal
<u>Upa Pradhan</u>	
<u>Pancha</u>	- deputy head of a village panchayat
<u>Varna</u>	- the four major classes of the Hindu caste system
<u>Veda</u>	- the oldest literature of the Hindu religion
<u>Zamidar</u>	- land revenue collector
<u>Zilla Karyalaya</u>	- district office
<u>Zilla Panchayat</u>	- district legislative body
<u>Zimaval</u>	- land revenue collector

TRAIL                      SUSPENSION                      BRIDGE                      STUDY

This report contains seven volumes in three different parts as follows :

PART A : Effects of Trail Bridges

Vol: 1 Introduction, Summary and Recommendations

Vol: 2 Case History, Analysis and Findings (Bridges Studied in CDR)

Vol: 3 Case History, Analysis and Findings (Bridges Studied in WDR)

Vol: 4 Case History, Analysis and Findings (Bridges Studied in FWDR)

Vol: 5 Case History, Analysis and Findings (Bridges Studied in EDR)

PART B : Baglung District Bridge Construction Study

PART C : Annotated Bibliography and General Informations on Trails and Trail Bridges in Nepal.

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FINAL REPORT 1978

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