INTRODUCTION

When people discuss the importance of rural road access as a precondition for an efficient development process in such areas it is not without mentioning the main shortcoming of these construction activities - substantial environmental damage - especially in the rugged hilly belt of the Hindu Kush-Himalaya region.

Having worked a couple of years in the Lamosangu-Jiri Road Project as survey/design engineer and project co-manager later on during construction, I had the rare opportunity to experience such an undertaking from the beginning to the end including all the many lessons we were taught by nature or other prevailing circumstances.

The purpose of this paper is to communicate these lessons, the reactions they provoked from our side, the difficulties and problems that had to be overcome, and the conclusions we tried to draw.

In this connection I have to say that we road builders have deserved our bad reputation as destroyers of the environment. But on the other hand, I dare to say that we could do much better, and to say the least, minimise these damages to a fraction.

This introduction should explain under which framework and rules the project was implemented in order to understand both the degree of freedom and the limitations within which we had to act. Survey and Design highlights the key role of survey and design for the success of the project in terms of economy and environmental impact. Construction deals with the construction execution with special focus on erosion control, whereas Maintenance emphasises the importance of preventive maintenance as a deciding factor for the road's life span and economy. The Summary tries to summarise the key problems and lessons and presents the findings. Some supplementary data of general interest, like project cost and construction data (Appendix I) and first visible impact of the road (Appendix II), conclude the paper.

PROJECT HISTORY

Switzerland's involvement in the development of Nepal started in the late fifties and it was in these early years that the region of Jiri was selected for first activities. These activities developed into one of the most important projects of that time: the Jiri Multipurpose Development Project which was handed over to His Majesty's Government of Nepal (HMG/N) in 1970/71.

One of the major drawbacks of this project was the lack of suitable communication and transportation facilities between the project area and the economic centres of the country. This fact led to the idea of opening up the area by a road.

HMG/N proposed to the Swiss Government (SG), represented in Nepal by the Swiss Association for Technical Assistance (SATA), to conduct a feasibility study of a road connection from the already existing Kathmandu-Kodari Highway (Arniko Rajmarga) to the Jiri region considering the near forest areas as well as the magnesite occurrence at Kharidhunga. This study was completed in 1971 and gave positive results if considerable additional development efforts for agriculture and forestry would be undertaken too. (Lit. 2) In summer 1972, HMG/N requested the SG to participate in the development efforts of the concerned hill region and in the financing of the access road.

The envisaged region contains the eastern part of Sindhupalchowk District (east of Sun Kosi River) and the whole Dolakha District which includes the Jiri area. The planned access road should start shortly before Lamosangu (km 78 of the Kathmandu - Kodari Highway) and end after 110 km in the Jiri valley (see Map 1).

The following main targets formed the basis for the planned development efforts in favour of the mentioned region:

- Construction of an access road from Lamosangu to Jiri serving as a backbone for the success of the integrated rural development activities;

- Improvement of agriculture and building-up of pasture and forest management on the basis of proper land use adapted to the prevailing local conditions;

- Reduction of pressure on the available land by development of small scale and cottage industry and proper forestry;

- Improvement of relations between population and environment by education, demonstrations, building-up of awareness and public health, as a precondition for an efficient policy of population and technical measures for erosion control.

For the implementation of this package of integrated activities the two governments formulated two complementary projects:

- The Lamosangu-Jiri Road Project (LJRP) for the construction of the road and

- The Integrated Hill Development Project (IHDP) for integrated rural development activities.

For the success of both projects a very close cooperation with each other was imperatively foreseen.

The time horizon for the realisation of the projects was assumed:

- 6 years for the LJRP (1975-1981)

- 15 years for the IHDP (1975-1990)

PROJECT FRAME AND OBJECTIVES

Project Frame

As the LJRP was the first hillroad project where HMG/N actively participated, the guiding idea for the implementation was to give the Nepalese engineers a fair chance to contribute fully to the project realisation and get maximum benefit from the applied technical know-how and expertise. Furthermore, it was intended to strengthen and improve the Nepalese administrative bodies.

Counterpart System

Therefore, the two governments decided on the already known concept of partnership (See Fig. 1: Counterpart System). This concept is based on the existing administrative rules and regulations of HMG/N and a joint decision-making process at all levels (project management and site engineers in the case of LJRP) of the Nepalese and foreign counterparts.

The two contracting parties for both the governments are:

- The Ministry of Finance for HMG/N,

- The Department of Foreign Affairs for the SG.

The two executing agencies are:

- The Department of Roads (DOR) in the Ministry of Works and Transport (MWT) for HMG/N,

- SATA for the Directorate of Development Cooperation (DDC) for the SG.

The time period for the execution of the project was fixed to be 6 years but had to be extended by another 3 years in 1980:

- First project phase 1975 - 1980,

- Second project phase 1980 - 1984.

The financial means were fixed at NC 94 million and increased in 1980 to NC 225 million (for reasons see Appendix I).

Objectives

The project objectives can be divided into two categories:

- Economic, social and environmental objectives,

- Technical objectives.

a) Economic, social and environmental objectives

- In order to fulfill its function as an access road and serve the local popula-

tion best it should link as many villages as possible on the way from Lamosangu to Jiri. Therefore, the road should mainly be located on the higher parts of the slopes where most of the villages are situated. In addition to that, it should not lead through cultivated land, if possible, in order to save this non-renewable resource (Plate 1).

- The application of labour intensive construction techniques is foreseen to contain the investments in the project region and impart technical expertise of road construction activities to the local population. Besides that, it creates considerable employment opportunities and the earned money can be used for the improvement of the living conditions of the labourers.

- As the region is a food-deficit area, the farmers should not lose the very basis of their livelihood without adequate land compensation being provided for land needed for the road construction.

- It is expected that the project will attract an enormous number of labourers from outlying regions who would not be able to return home for the night. Such a situation would create a tremendous increase. in food demand on the local market, causing high inflation in consumer goods. Therefore, protective measures have to be taken by requesting the World Food Programme (WFP) for support. Under this programme the labourers are eligible to buy a fixed quantity of flour, oil and lentils for half the local market price.

Plate 1: The road links Namdu (right foreground), Maina Pokhari (centre) and Kabre (right centre) on the way to Hanumante Pass.

Plate 2: For bioengineering erosion control measures nurseries provided the needed "construction" material: project nursery at Phaphlue (km 95).

For the 2nd project phase some additional economic and environmental objectives were added:

- To generate a maximum of income out of the total investment to the local population and to improve the training opportunities and building-up of local knowledge and infrastructure, technically easy road construction activities like earthwork must be awarded to local piece-work contractors.

- To deal more successfully with the fragile slope properties the erosion control and protection measures have to be strongly intensified by enlarging the area of action according to need beyond the immediate road strip (Plate 2).

- Application of bitumen emulsion as binder for blacktopping. Whereas ordinary bitumen must be applied hot, bitumen emulsion is applied cold, thus avoiding the use of firewood for heating and therefore, supporting the efforts towards maintaining ecological balance of the region by decreasing deforestation.

b) Technical objectives

- The alignment has to be well adapted to the topographical conditions and should follow the upper parts of the slopes where they are less steep and the volume of water run-off is much lower than at valley floors (this requirement corresponds to the first one under a); (see Plate 1).

- The road has to be constructed in such a way to minimise the construction investment and future maintenance cost.

- On-the-job training of project staff at all levels and of labourers, in order to guarantee maximum know-how and expertise transfer.

For the 2nd project phase two more objectives were added:

- The initially planned gravel road will be blacktopped from Lamosangu to the Tama Kosi Bridge (km 71.5) as an erosion protection measure for the road surface. A decision which corresponds to the requirement under the second point of b). Later on, the last 38.5 kms

till Jiri were also blacktopped.

- o On-the-job training of piece contractors (see also the 3rd point of b).

All these objectives were binding for the execution of the project and had to be strictly observed even if it meant an increase of investment as e.g. the application of labour intensive construction techniques or a slow down of work progress by awarding earthwork contracts to piece contractors.

PROJECT ADMINISTRATION

Organisational Set-up

For the first phase of the project (1975-1980) the organisational set-up was rather complicated.

Both the governments appointed a Swiss consulting firm (Signat Ltd.) for the project realisation (general engineering services, survey, design, construction supervision, technical guidance and project management). This triangular relationship was not the best solution, as too many different interests had to be considered and the consultant had to serve several parties at the same time (Organisation Chart 1st Phase). In addition, the consultant appointed only the Swiss project co-manager whereas the Swiss site engineers were appointed directly by the DDC/SATA but were also responsible in technical matters to the consultant.

Project Organisation

For the second project phase (1980-1984) the organisational set-up was slightly changed in order to eliminate the disadvantages of the first set-up. As the advisory engineering services were mainly completed the consultant's position was changed to a back-stopping task. Therefore, all the Swiss project staff was now directly employed by DDC/SATA. Their responsibility was now to SATA/DDC and no longer to the consultant (See Fig: 2 & 3 Organisation Chart 1st and 2nd Phase).

Project Management

The Nepali manager and the Swiss co-manager were entrusted with the project management and jointly deciding as counterparts. They were responsible for the execution of the project under the rules and regulations of the DOR. Their main activities were to:

- o Coordinate and administer all internal project matters,
- o Prepare the yearly budgets,
- o Prepare and supervise the construction programmes,
- o Procure the necessary equipment and construction material,
- o Handle all technical and financial matters,
- o Prepare recommendations for contract awards,
- o Supervise the survey, design, and construction activities including the work quality.

For the execution of these tasks they were supported by administrative and technical staff operating from the head office in Kathmandu.

The survey/design was conducted by a survey/design team consisting of one or more Nepali engineers and one Swiss engineer (counterpart system). It was completed in 1978.

The road construction was supervised by 2 (1975/76) to 5 site engineer teams (1981-1983), consisting again of one Nepali assistant engineer and one Swiss resident engineer (counterpart system). During the construction peak seasons 1981/82 and 1982/83 two additional earthwork sections were opened under the piece contract system, guided by a single Nepali assistant engineer each, to respond to the much higher need of supervision for the piece work system (one contract having a size of only 20-200 m road length).

These engineer teams were supported by technical and administrative staff like overseers, supervisors, surveyors, draftsmen, storekeepers, accountants, etc. operating from their respective site offices along the road.

To respond to the strong emphasis on erosion control measures during the 2nd project phase a Swiss forest engineer was responsible for structural and bioengineering protection activities (1981-1983). He was supported by technical staff (overseers, supervisors) operating along the whole road.

During the years 1981-1984 a Swiss mechanical engineer had to improve the situation of vehicle and equipment maintenance and build up an efficient spare part management system. He, too, was supported by mechanics and operators working at our main workshop Charikot.

Special Aspects

Some few special aspects of the project administration have to be mentioned here which had a rather dominant influence on the implementation of the project. (See Fig: 4).

a) Equipment and Material Procurement

During the first phase of the project HMG/N rules and regulations were applied. This fact led to some delays in the construction programme as these rules were rather inappropriate and the decisions for procurement contract awards were not taken in time. For the second project phase it was agreed that the SG will procure through SATA all the materials and equipment from abroad, whereas for local procurements HMG/N rules and regulations remained valid.

b) Construction Contract Awards

Here too, HMG/N often did not process these contracts in time. In exceptional cases, contracts were delayed upto 1 full year causing, again, considerable delays in the construction programme and loss of money due to inflation. With the introduction of certain special regulations this situation could be improved considerably.

c) Land Compensation

HMG/N was able to pay only for the land taken along the first 4 kms within the first project phase. This shortcoming created tension between the unpaid land-owners and the project. This problem was solved when the SG agreed to pay for all the remaining land from km 4 to 110 out of the Swiss project funds if certain conditions were met (deadlines for administrative procedures).

d) WFP Support

The interest among the project labourers for this food support was very great, emphasised by the fact that many labourers disappeared from their work if the food rations were not distributed. HMG/N was responsible for the transport of the food to the project sites and its distribution to the labourers. This arrangement created many

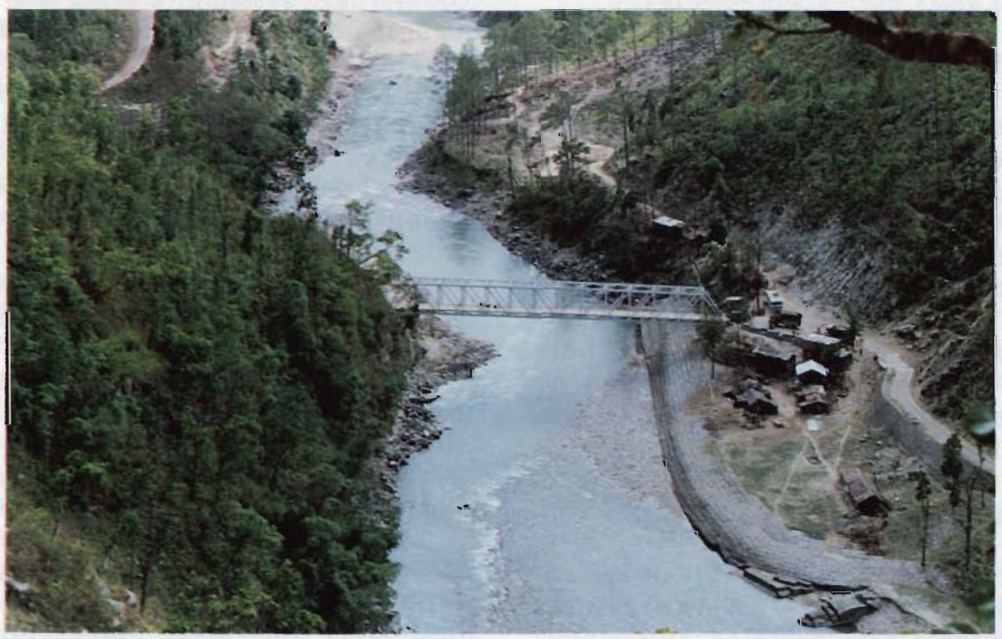

Plate 3: The road crossing the narrow Tama Kosi valley at km 71.5.

Plate 4: Deforested and slide-prone area beyond the Halaule Khola.

difficulties for our project because only about 40-50% of the foreseen food quantity could be distributed and more often than not, with considerable delay. It is evident, that this shortcoming caused delays in the construction programme and mainly affected the earthwork sections where the majority of workers were engaged.

NATURAL PRECONDITIONS

Road construction infrastructures are very much dependent on the natural preconditions. Favourable preconditions generally result in modest construction volume per km, whereas unfavourable preconditions can bring enormous work volume and be very expensive, being not only limited to the road itself but including works in the farther vicinity of the alignment (erosion control works).

In the hilly belt of Nepal the following preconditions have to be considered:

- Climate
- Geology
- Topography
- Environment

Climate

The climate in Nepal is mainly dependent on the altitude and varies from sub-tropical in the Terai to alpine and tundra in the Himalayas. The annual rainfall differs from place to place, ranging from less than 250 mm (Central Himalaya) to more than 4,000 mm (near Pokhara). Most of the precipitation occurs during the monsoon period from June to September and is concentrated in the Terai and on the Hills to the south of the Himalayas.

For the project region the temperatures rarely drop below 0°C, thus causing no frost penetration into the upper soil surface layers (frost penetration results in loss of bearing capacity of the road structure if no protection measures are taken). The precipitation varies slightly in the area but is enormous. The IHDP meteorological station at Bonch registered the maximum annual rainfall in 1985 at 3,745.6 mm over the last 7 years whereby the maximum record within 24 hours stands at 155 mm. Approximately 80% of the annual rainfall is concentrated in 4 months only, creating tremendous problems for the road builder and one can truly state that road building in the hills of Nepal is mainly a battle against water.

Geology

Nepal's mountain ranges are affected by a constant tectonic uplifting which is accompanied by a down cutting of the river systems. The result of these natural forces are slopes which become steeper and steeper and therefore unstable. This phenomenon is supported by rock of doubtful quality, being mostly soft and deeply weathered. Very often such rock surfaces are blanketed by thick masses of loose soil and boulders, thus adding to the instability of the terrain.

It is evident that such conditions make road building a difficult task.

Topography

The hilly belt of Nepal generally consists of rugged topography with tremendous differences in elevation ranging from approximately 500 m.a.s.l. to 3,500 m.a.s.l. The resulting steep slopes are divided into many gullies and small valleys and the valley floors are mostly extremely narrow (Plate 3). Such extreme conditions demand a very careful and well adapted location of the road alignment.

Environment

The local population is still largely unaware of the importance of forests and vegetation cover for a balanced ecosystem. But, on the other hand, it is mainly the strain of overpopulation which leads to a depletion of the forest reserves, by cutting of trees for firewood (the only source of energy) and the extension of farmland into too steep and unsuitable areas. Such deforested and abandoned land has an accelerated water run-off in volume as well as in speed and is prone to slides (see Plate 4). During the last ten years the project area is still increasingly threatened by deforestation and land degradation, a fact which has not only its negative influence on road construction, but also on road maintenance.

These four above mentioned natural preconditions all have a negative influence on road construction and make it on the whole very difficult to find an alignment which becomes not too costly for construction and maintenance and brings no discredit upon the environment.