ANNEX 3
CASE STUDIES NEPAL

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Acronyms and Abbreviations

ADB	Asian Development Bank
AHREP	Andhi Khola Hydro Electric and Rural Electrification Project, part of AKP
AKP	Andhi Khola (integrated development) project of UMN
AKWUA	Andhi Khola Water Users' Association
BPC	Butwal Power Company p. ltd.
DAC	Development Assistance Committee (of OECD)
Danida	Danish Development Cooperation
e.g.	*exempli gratia* (Latin), as for, or an example
EU	European Union
GDP	Gross Domestic Product
GNI	Gross National Income
GON	Government of Nepal
GW, GWh	Giga Watt, Giga Watt hour, unit of power and energy = 1.000.000.000 W
HEP	Hydro Electric Project
HMG	His Majesty's Government (of Nepal), today Government of Nepal (GON)
HPL	Himal Power Limited (owner of 60 MW Khimti HEP
ICH	International Centre for Hydropower, Trondheim
ICIMOD	International Centre for Integrated Mountain Development
i.e.	*id est* (Latin), that is
JHEREP	Jhimruk Hydro Electric and Rural Electrification Project
JIDCO	Jhimruk Industrial Development Company
JREDP	Jhankre Rural Electrification and Development Project
KPI	Key Performance Indicator
kV	Kilo Volt, unit of electricity tension (voltage)
kVA	Kilo Volt-Ampere, technical unit of electrical power, used e.g. for transformers, generators and motors, and transmission line capacity
kW, kWh	kilo Watt, kilo Watt hour, unit of power and energy = 1.000 W
MFA	Ministry of Foreign Affairs (of Norway)
MW, MWh	Mega Watt, Mega Watt hour (power and energy units) = 1.000.000 W
NEA	Nepal Electricity Authority
NGO	Non government organisation
NHAM	Norwegian Himal Asia Mission – *Det Norske Tibetmisjon*
NHE	Nepal Hydro Electric pvt. ltd.
NOK	Currency: Norwegian *Kroner*, 21 April 2007 – 1 NOK = 0.168 USD
Norad	Norwegian Development Agency
NPR	Currency: Nepali Rupee, 21 April 2007 – 1 NOK = 11.80 NPR
NTNU	*Norges Teknisk-Naturvitenskapelige Universitet* – Norwegian University of Science and Technology, Trondheim
NVE	*Norges Vassdrags- og Energidirktoratet*, Norwegian Water Resources and Energy Directorate
PEEDA	People's Energy and Environment Development Association (NGO)

PPP	Purchase Power Parity
Pvt. ltd.	Private limited (Nepal share holding company)
TA	Technical Assistance
TOR	Terms of Reference (of the evaluation, unless specified otherwise)
UMN	United Mission to Nepal
UO	User Organisation (of electricity, water, and other public service users)
USD	Currency: United States Dollar, 21 April 2007 – 1 USD = 5.96 NOK
VDC	Village Development Committee: Administrative unit below the district level
W*	Watt, basic power unit: the capacity to do work. Example: An adult man has a work capacity over an extended period of time of about 100W
Wh*	Watt hour, basic energy unit: power capacity applied over time
*Note:	Refer also to the main report for a more scientific definition
WB	World Bank

Energy Unit Definitions[1]

Power: Electrical power is the rate at which electrical energy is converted to another form, such as motion, heat, or an electromagnetic field. The common symbol for power is the uppercase letter P. The standard unit is the watt, symbolized by W. In utility circuits, the kilowatt (kW) is often specified instead; 1 kW = 1000 W. One watt is the power resulting from an energy dissipation, conversion, or storage process equivalent to one joule per second.

Energy: In electrical circuits, energy is a measure of power expended over time. In this sense, one joule (1 J) is equivalent to one watt (1 W) dissipated or radiated for one second (1 s). A common unit of energy in electric utilities is the kilowatt-hour (kWh), which is the equivalent of one kilowatt (kW) dissipated or expended for one hour (1 h). Because 1 kW = 1,000 W and 1 h = 3,600 s, 1 kWh = 3.6 x 10^6 J.

Note: Energy is power applied over a time period, and is calculated as power multiplied with time, e.g. kW x h = kWh.

[1] From: http://searchsmb.techtarget.com/

A3.1 Introduction

Nepal is situated along the Himalayan range, squeezed between China and India. It stretches about 850 km from East to West, and between 150 to 250 km from South to North, and covers an area of about 147.000 km^2. The settlement structure is mainly rural, with few cities, perhaps 20 towns, and thousands of villages in the middle hills. The main source of livelihood is subsistence agriculture. Poverty is widespread, and increasing from East to West.

Fig. A3- 1: Map of Nepal

A3.1.1 Political History

In 1951, the Nepalese monarch ended the century-old system of rule by hereditary premiers and instituted a cabinet system of government. However, this first experiment at democracy was abandoned 1960 in favour of the one-party Panchayat system that factually gave absolute powers to the monarch. Reforms in 1990 established a multiparty democracy within the framework of a constitutional monarchy. A Maoist insurgency, launched in 1996, gained traction and threatened to bring down the regime, especially after a negotiated cease-fire between the Maoists and government forces broke down in August 2003. In 2001, the crown prince massacred ten members of the royal family, including the king and queen. In October 2002, the new king dismissed the prime minister and his cabinet for "incompetence" after they dissolved the parliament and were subsequently unable to hold elections because of the ongoing insurgency. While stopping short of re-establishing parliament, the king in June 2004 reinstated the most recently elected prime minister who formed a four-party coalition government. Citing dissatisfaction with the government's lack of progress in addressing the Maoist insurgency and corruption, the king in February 2005 dissolved the government, declared a state of emergency, imprisoned party leaders, and assumed power. His government subsequently released party leaders and officially ended the state of emergency in May 2005, but the monarch retained absolute power until April 2006. After three weeks of mass protests organized by the seven-party opposition and the Maoists, the king allowed parliament to reconvene on 28 April 2006. Following the November 2006 peace accord between the government and the Maoists, an interim constitution was promulgated and the Maoists were allowed to enter parliament in mid-January 2007. Constituent elections were planned for June 2007, but had to be further postponed.

A3.1.2 Context

New opportunities linked to the revolution and opening of the country in the early fifties, led to the founding of the United Mission to Nepal as an international, interdenominational mission. The decision was based on an invitation by His Majesty's Government of Nepal to open a hospital in

Tansen and to start Women's and Children's welfare clinics in the Kathmandu Valley. In September 1954, medical work began in Tansen, incidentally in the area of the later Andhi Khola project, in a rented house in the bazaar. Soon plans were made for building a larger Tansen Hospital, and work expanded to include community health, agriculture, and other activities. The building of the new hospital made progress at a low pace because of the difficulty in finding skilled workers. Odd Hoftun, who led the construction work, had a vision for educating young Nepalese in technical skills and utilising the hydropower potential of Nepal's rivers to create opportunities for small businesses. He managed to raise support from his home country Norway, and brought 176 tons of equipment to Butwal in 1964. This was the beginning of United Mission to Nepal (UMN's) Engineering and Industrial Development work. Tinau Hydropower plant was built and commissioned in 1970, and the Butwal Technical Institute established. In 1966, Butwal Power Company was formed, first to operate diesel generators in Butwal, and later to build and operate the Tinau Khola Hydro Electric Project (HEP). This was the first of a series of companies founded by UMN[2].

For Norwegian development cooperation, the support to UMN was the entry to the power sector. While it remained focused on UMN activities for many years, the assistance portfolio gradually expanded to include other stakeholders. However, a strategy to provide assistance to hydropower development was maintained throughout the period of more than 40 years.

A3.1.2.1 Economic Situation

Nepal is among the poorest and least developed countries in the world with almost one-third of its population living below the poverty line. Agriculture is the mainstay of the economy, providing a livelihood for three-fourths of the population and accounting for 38% of GDP. Industrial activity mainly involves the processing of agricultural produce including jute, sugarcane, tobacco, and grain. Security concerns relating to the Maoist conflict have led to a decrease in tourism, a key source of foreign exchange. Nepal has considerable scope for exploiting its potential in hydropower and tourism, areas of recent foreign investment interest. However, the optimism of the early Nineties has been thwarted by uncertainty related to increasing insurgent disturbance. Prospects for foreign trade or investment in other sectors will remain poor, however, because of the small size of the economy, its technological backwardness, its remoteness, its landlocked geographic location, its civil strife, and its susceptibility to natural disaster.

In terms of economic development, the Gross National Income (GNI) over time gives an indication. It trebled in 25 years, but still holds rank 127 only, next to Uganda.

Nepal	1980	1990	2000	2005
GNI per capita (USD-PPP[3])	440	840	1,340	1,560

Table A3- 1: Development of Gross National Income[4]

A3.1.2.2 Brief on the Power Sector

Electricity has a long history in Nepal. Two small hydro schemes were built in the Kathmandu valley early in the previous century, using equipment from the UK. The first, Pharping HEP (0.5 MW) was commissioned 1912. It supplied power to a few buildings only in the Kathmandu valley, and power was used exclusively for lighting. The second, Sundarijal, also about half a MW, was built about 25 years later, and it supplied power also to some small industries.

A modern era broke when Nepal was opened to the outside world after 1950. Russia provided finance and expertise to build the 2.4 MW Panauti hydro electric project (HEP) in 1958, followed by Trisuli

[2] From the UMN website: http://www.umn.org np/main.php?m=history&a=index#begin

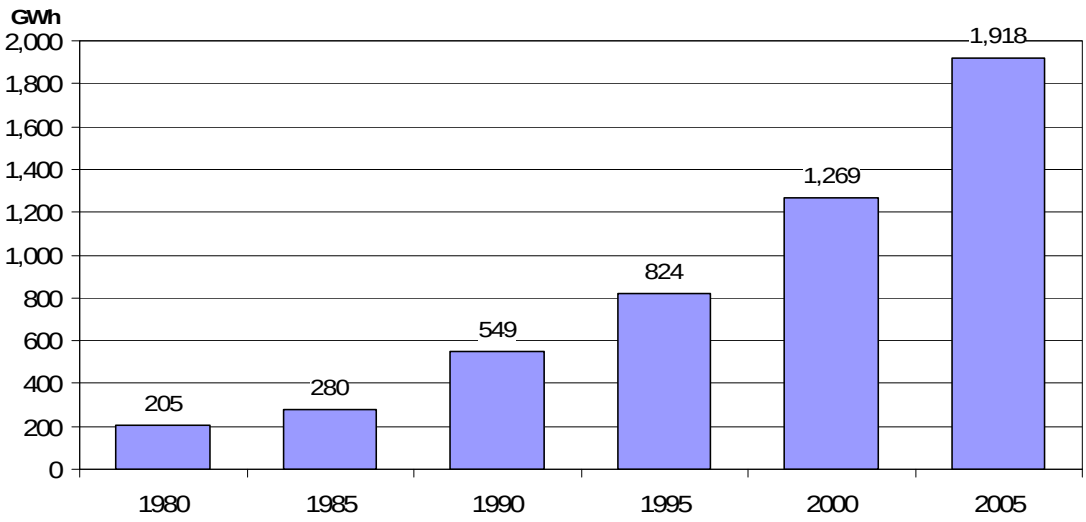
[3] Relative PPP (purchase power parity) refers to rates of changes of price levels, that is, inflation rates. USD-PPP is comparable over time and between different countries.

[4] See Global Virtual University: http://globalis.gvu.unu.edu/indicator_detail.cfm?country=NP&indicatorid=140

HEP (24 MW) sponsored by India, in 1967. China built the Sunkosi HEP (10 MW) 1972. Hence, by the early Seventies, Nepal was in possession of about 35 MW of hydro generating capacity. This supplied the "national grid", largely the Kathmandu valley. Industrial towns in the Southern Terai areas, such as Biratnagar, Janakpur, Hetaura and Butwal, were supplied from diesel generating units, or across the border from India. In Butwal, diesel power was gradually replaced with power from the Norwegian financed Tinau Khola HEP (1970).

The national grid started to take shape slowly, and the Nepal Electricity Authority (NEA) was formed 1978 by merging the previous Electricity Corporation and the Electricity Department of the Government. Nationwide electricity consumption grew steadily and at an accelerating rate from about 205 GWh in 1980 to more than 2.000 GWh in 2006. This represents a tenfold increase in a 25 year period. The illustration below shows this development. Incidentally, it is widely believed in the sector that growth is suppressed, for two reasons. Firstly, the Maoist insurgency has held back economic activity in general since the mid-nineties. Secondly, adding new generating capacity is delayed, and this resulted at several stages in load shedding[5], i.e. not all demand could be met at all times. Today, available generating capacity is estimated at 500 MW (2005/06), and import from India about 90 MW. an estimated average 100 MW could not be supplied at peak times during the dry season 2006/2007, because dry season generating capacity is considerably lower.

Fig. A3- 2: Nepal: Development of Annual Electricity Consumption



Feature	Nepal
Total Land Area	143,181 km^2
Population (2007 estimate)	28.900.000
Population Density	**201.8 pers./km^2**
Total length of transmission grid (2004)	5,154 km
Total Annual Energy sold (2004)	1,675 GWh
Total number of consumers (2004)	1.060.695
Indicator: **Energy sold per km of grid**	**325 MWh**
Indicator: **Energy sold at LV**, per customer, year	**1,579 kWh**

Table A3- 2: Features and Characterising Sector Indicators

[5] The term load shedding is used to describe the practice of cutting supply for a number of hours every week, to a part of the consumers, on a rotating basis, when total demand exceeds total supply capacity.

A3.2 Overall Power Sector Assistance

Nepal has received assistance to the power sector from its neighbours India and China, and from many international bilateral and multi-lateral donors. There is no source of systematic information on assistance volumes over time. However, extensive reading and research resulted in an informed estimate of 1.2 billion USD of assistance to the power sector over the past 25 years. Assistance has been provided by more than 20 donors and finance institutions.

A3.2.1 Major Donor Activities

Traditionally, bilateral donors sponsored the development of small and medium scale hydropower schemes by providing technical assistance and finance, often as tied aid.

- India: 24 MW Trisuli HEP in 1958
- Russia: 2.4 MW Panauti HEP in 1962
- England: 0.5 MW Pharping HEP rehabilitation in 1964
- India: 1 MW Phewa HEP in Pokhara 1967
- China: 10 MW Sunkosi HEP in 1972
- India: 16 MW Gandak HEP in 1979
- Japan: 60 MW Kulekhani 1 HEP in 1981
- India: 14 MW Devighat HEP in 1984
- Yugoslavia: 0.2 MW Doti HEP in 1987
- China: 1.5 MW Seti HEP in 1989
- Switzerland: 0.4 MW Salleri HEP in 1989
- Japan: 32 MW Kulekhani 2 storage HEP in 1989
- Austria: 0.6 MW Namche HEP in 1990
- Korea: 15 MW Modikhola HEP, approximately 1992.

With the exception of the mini projects Salleri and Namche, where local ownership was achieved, all projects were built for the owner NEA. Later and larger hydro schemes were then financed by several multilateral financing institutions, such as the Marsyangdi HEP with 75 MW in 1989, and the Kali Gandaki "A" HEP with 144 MW in 2004.

Other donor activities in the power sector include:

- Transmission system rehabilitation and expansion, with ADB finance, at present in the 7th power development project.
- Sector re-structuring and NEA unbundling, with ADB finance
- Small hydro development promotion in the private sector financed by Germany
- Rural and renewable energy promotion, financed by Danida, Netherlands, UNDP, World Bank and Norway.
- Medium Hydro Power Development Fund (PDF), sponsored by the World Bank

A3.2.2 Norwegian Assistance

Norway has supported power sector development in Nepal as early as 1965, when finance was provided for the 1 MW Tinau Khola hydroelectric project, implemented by UMN. The present evaluation however, covers the period from 1980 to 2006, which means that earlier grants are not included in the presentation of total aid.

Overall Norwegian power related assistance to Nepal		
Date	**Agreement Title**	**Amount NOK**
1982/06	Agreement HMG-UMN on AHREP	9,400,000
1983/12	Stötte til irrigasjonsanlegg, Andhi Khola irrigation system	1,928,000

Overall Norwegian power related assistance to Nepal		
Date	**Agreement Title**	**Amount NOK**
1989/02	Agreement GON-HMG/MOWR: Jhimruk JHEREP	130,000,000
1992/06	Agreement GON-HMG: Khimti Khola HEP - Feasibility study	3,780,000
1992/08	Agreement GON-HMG: Assistance on legislation for the development of water power resources	750,000
1992/12	Agreement Norad-ICIMOD-Design and testing of training programme	2,900,000
1996/02	Agreement GON-HMG: Assistance for Development of water related legislation	2,000,000
1996/07	Agreement Norad-ICIMOD: Capacity Building in Mini and Micro hydropower development, phase 2	2,800,000
1997/01	Contract Norad-NHAM, Jhimruk JHEREP IIA	4,748,510
1997/03	Agreement Norad-NHE on financial support for training of local employees and transfer of know-how, in connection with Khimti I	1,860,000
1997/04	Agreement Norad-HPL on financial support for training of HPL's contractor's local project construction workers in connection with Khimti I	3,102,000
1999/07	Agreement Norad-Statkraft, construction consortium: Jiri-Palati road	530,400
1999/12	Agreement Norad-Hydro lab: Financial assistance to institutional strengthening through coop. with ICH	7,400,000
2001/11	Agreement Norad-HPL on financial support for Jhankre JREDP	15,800,000
2001/12	agreement GON-HMG: Capacity Building for EIA assessment HEP	5,650,000
2001/12	Environmental impact assistance MOPE	5,452,000
2002/11	Agreement GON-HMG: Compensation for rehab. Costs Jhimruk HEP	22,200,000
2003/	Agreement GON-HMG: Support to rural electrification AEPC – ESAP	12,000,000
2003/	IPPAN Support, Phase I	150,000
2003/05	Agreement GON-HMG: assistance for the feasibility study UTK HEP	14,600,000
2004/	ESAP bridging phase	6,750,000
2004/01	Agreement GON-HMG: Assistance for feasibility of small & medium HEPs	2,500,000
2004/03	Training program BPC	1,346,000
2004/04	Training program REEs GTZ	91,000
2005/	Training in Hydropower for Media...	183,632
2005/11	Training in hydropower for Media and REEs	195,000
2006/	Agreement Norad-Hydro lab: Financial asst., cooperation with ICH, Ph 2	1,000,000
2006/03	IPPAN Support, Phase II	183,000
2006/06	Mitigation and fisheries	1,000,000
2006/08	Phase II of capacity building General Manager BPC	434,000
2006/08	Training rural based electrification	301,000
2006/11	Irrigation and rural electrification BPC	1,500,000
2006/11	Bridging Phase II ESAP	10,000,000
2006/11	Generator Workshop training NHE	325,000
	Total volume identified (NOK)	**272,859,542**

Table A3- 3: Major items of Norwegian Assistance disbursed to Nepal's Power Sector, 1982-2006

In the period covered, Norway has disbursed nearly 310 million NOK[6] at current value to Nepal, according to actual disbursement statistics. On this basis, the estimated share of Norway in total power sector assistance is nearly 7%. This indicates that the above table is not entirely complete. However, the table is fairly representative of overall Norwegian aid.

On average, disbursement has amounted to NOK 11.4 million on average per year, with considerable variation in actual yearly disbursements.

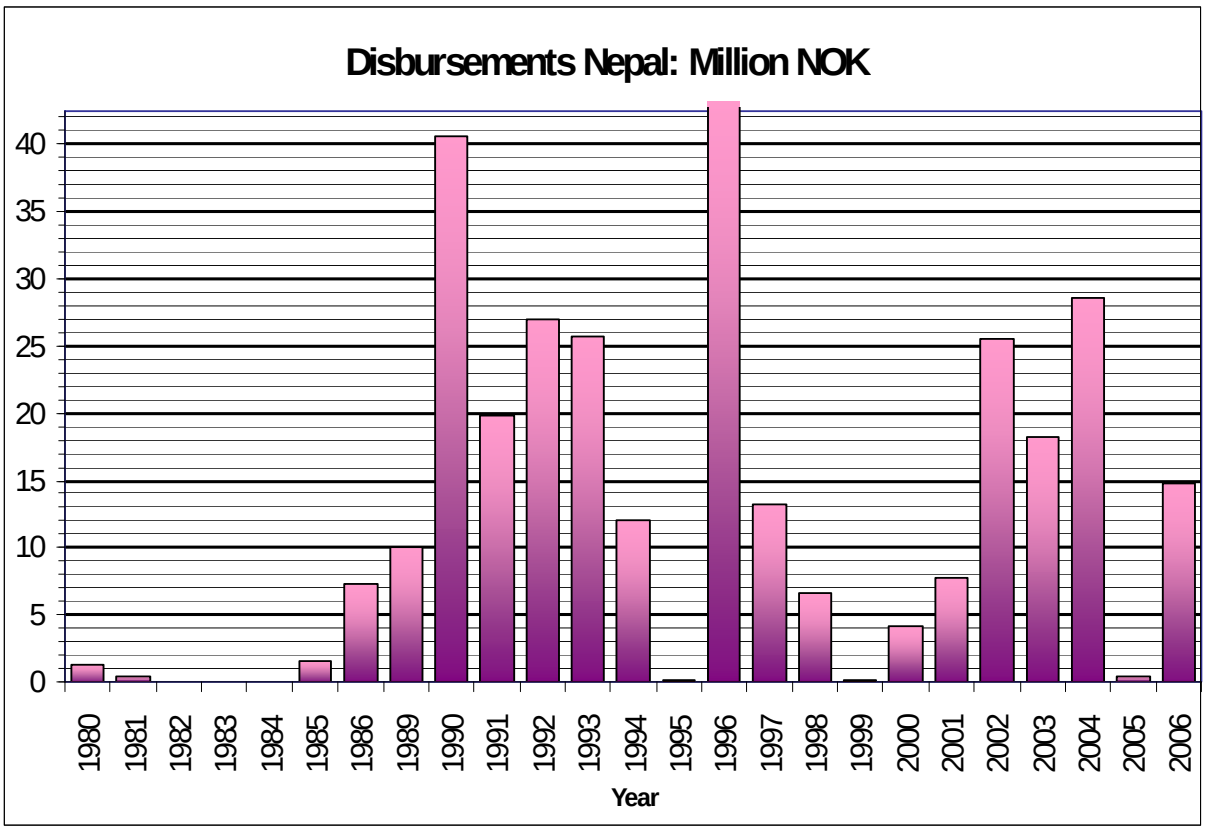


Fig. A3- 3: Annual Disbursements of Norway to Nepal Power Sector

A3.2.3 Evaluated Interventions in Nepal

Interventions included in the evaluation are listed below.

- Andhi Khola 5.1 MW AHREP
- Jhimruk Khola 12.3 MW , JHEREP, including later mitigation & rehabilitation
- Khimti Khola 60 MW Hydro Electric Project: Assistance to rural electrification (Jhankre)
- Assistance to the Ministry of Water Resources (MOWR) on legislation
- Hydro Lab pvt. Ltd. Research laboratory
- Khimti Khola 60 MW Hydro Electric Project 1990-1995: Assistance to training of personnel
- Fellowship Programme: Education of Professionals
- Butwal Power Company (BPC) privatisation
- Khimti Khola 60 MW: Feasibility Study

Total spending for evaluated interventions has amounted to a total disbursement of nearly NOK 204 million. Hence, money-wise, about two thirds are included in the evaluation.

[6] To be able to relate to total donor assistance, an exchange rate of NOK/USD of 7.20 is used, i.e. MUSD 79.20.

Very directly in the early years, and also indirectly in later and recent years, Norway has assisted in implementing infrastructure projects, more specifically hydropower development. In retrospect, it becomes apparent that a bottom-up approach was followed consequently. It all started with the plan to supply the fledgling industries in Butwal with electricity generated from the potential of the nearby Tinau Khola. The hydropower scheme was commissioned gradually from 1970 onwards till it reached its full capacity of one Mega Watt in 1978. This first project of United Mission to Nepal was implemented before the time covered by the present evaluation. However, it may be seen as the first step of an expanding development effort covering more than 40 years. The interventions selected for evaluation broadly cover the past 25 years and fit smoothly into a logical whole. This can be said to apply to all interventions, with somewhat varying success, not only those summarized here.

CASE STUDIES

A3.3 Andhi Khola Hydro Electric and Rural Electrification Project (AHREP)

The districts of Palpa in the South and Syangja to the North, lying between the major towns of Butwal and Pokhara are among the most densely populated in Nepal. Population pressure is rising, and this has an adverse effect on the land and water resources of the area. As early as 1980, forest cover had largely disappeared, and land degradation was proceeding at an alarming rate.

UMN launched an integrated district development programme with the purpose of reducing the pressure on the available natural resources. An electrification scheme and irrigation facilities were conceived to constitute the main infrastructure for district development, while road access already existed.

At a point near Galyang Bazaar, about 80 km South of Pokhara on the Siddhartha Rajmarg motor road connecting Pokhara with Butwal and the Indian border, the Kali Gandaki river comers within 2 kilometres of one of its tributaries, the Andhi Khola. The difference in water levels between the two rivers at Galyang Bazaar is nearly 250 meters, due to the fact that the Andhi Khola must flow another 65 km to reach its confluence with the Kali Gandaki. Such topography is considered ideal for hydropower development.

A3.3.1 Project Description

The AHREP is taking advantage of the particular topography mentioned. It exploits the existing power potential as part of an integrated rural development project in North Palpa and South Syangja districts of Nepal.

Water is diverted from the Andhi Khola about 1 km upstream of Galyang Bazaar with a weir of six meters height. A maximum flow of water of 2.7 m^3/s is diverted from the Andhi Khola, and is taken through a 1.340 m long headrace tunnel to the South side of the Galyang ridge to a surge tank with penstock intake at the top of a 240 m deep vertical shaft leading to an underground power house. Three Pelton turbine generator units, each with a capacity of 1.7 MW are fed with the high pressure supply, and after passing through the turbines water is exhausted to a 1.040 m long tailrace tunnel to the Kali Gandaki. In addition to the water required for electricity generation, up to 1.3 m^3/s of water is supplied through the headrace tunnel for irrigation of land in the vicinity of the power house drop shaft. The main features of the hydropower scheme are summarized in the “results” section.

Rural electrification is achieved through 33 kV transmission lines that interconnect with the gird of NEA, and a low tension distribution network. Rural electrification was started in July 1991 and since then it has been going on continuously. In the initial phase, rural electrification was intended to be extended to an approximately 10 km wide belt along the planned transmission line.

Norway’s financial assistance, including the irrigation scheme, has amounted to about NOK 21 million.

A3.3.1.1 Objectives

UMN's overarching district development aims at the conservation of natural resources, in particular land and water. A major component in this endeavour is the hydro electric project. The main objectives of the Andhi Khola Hydroelectric Centre (as it came to be called later), are:

- Generation of electric power.
- Electrifying the different areas of Syangja and Palpa districts.
- Trying out new methods and technologies suitable for rural electrification in the rural areas.
- Promote safe and efficient end uses of electricity e.g. electric cooking, rural industries

Planning and construction of the hydro plant

Planning and costing of construction was done on the basis of the 1981 preliminary design of the scheme. At that time, geological investigation was very superficial and limited, but construction time was optimistically estimated at five years.

However, even preparatory work, in particular negotiating an agreement with the government of Nepal, required a long time. Construction actually started with a two years delay. The condition of rock became known only when digging started in various places. Fault zones were met that were very difficult to deal with, and numerous further delays were caused.

By the end of 1985 it was clear that cost overruns were massive, and an exercise of revised costing took place. Even at that stage however, a number of uncertainties remained, mostly related to rock conditions as tunnelling progressed, and related engineering measures required, and its cost. Numerous other unexpected cost elements can be mentioned, and these illustrate the integrated approach taken.

- It was planned to provide a water supply scheme for the construction workers at the power house and drop-shaft site. It turned out that a suitable water source was further away than expected, and since the fast growing Galyang bazaar is very close to the construction site, it was decided in the end to include the bazaar in the water supply. Both factors increasing costs, which were however, only partly required to be covered by AHREP.
- By constructing a small 20 kW micro hydro scheme in a rivulet close to the construction site, it was intended to save on costs for the operation of diesel generators. However, the scheme was beset by landslides on the head race canal. This increased costs, and reduced the expected cost savings.
- The planned irrigation project, even though it was financed separately, required that the head race tunnel be increased in size. Tunnel lining in poor rock bears rapidly increasing costs with increasing size, and this needed to be borne by the project.
- As part of the integrated approach, manufacturing of transmission poles and lattice towers was set up in Butwal. AHREP helped this industry to get started by placing a large order for poles at a price somewhat higher than what would have been possible on the open market.
- A ropeway of one km length was constructed to move materials between the main construction site and the tailrace outlet on the Gandak river. This was done in a more elaborate manner than originally planned, in order to demonstrate this means of transportation to the general public, as a development measure.

Fig. A3- 4: Vertical shaft AHREP*

*Source: BPC web site at http://www.bpc.com np/achievement.php#3

- Himal Hydro and General Construction pvt. ltd. (another UMN initiated firm), was given the construction contract for AHREP, despite the fact that it lacked relevant experience. Again, this was part of the integrated development approach, where learning and gaining experience was valued more than absolute cost efficiency. When Himal Hydro ran into trouble with technical problems due to poor rock, AHREP agreed to raise the overhead charge from 18 to 24%. This increased cost of the project, but was of crucial help to Himal Hydro.
- In a similar way, AHREP supported the fledgling Nepal Hydro and Electric p. ltd. (NHE) Which was assigned the task of overhauling all second-hand equipment from Norway, and installing it in Andhi Khola[7]. The overhauling part was originally planned to be done in Norway, and costing done on that basis. NHE did the job more than seven years later than planned, with a slight cost overrun.

With construction cost uncertainties mentioned above, and numerous other cost elements exceeding original plans, doubling of total costs, at the minimum, was now expected.

Parallel to power plant construction, transmission lines were built, first from Tansen to Galyang, to supply construction power (1988), and then from Galyang to Syangja bazaar to the North, to which power supply began at the end of 1989.

Power plant construction was essentially completed in June 1990. Commercial operation started a year later in July 1991, about five years later than originally planned. Since then, for the past 15 years, the power plant has been in operation at a load factor generally above 80%, with insignificant interruptions. The value of energy sold to NEA has reached almost 800 million NPR in this period, an amount about 10 times the initial investment. During the same period, energy worth about 500 million NPR was distributed locally.

Rural electrification was started in earnest after 1991, reaching about 1,000 consumers with Norwegian funding in 1993. With BPC's own resources, but also with funding from USAID, rural electrification was continued through the years, reaching 20,400 consumers by the end of 2006.

A3.3.1.2 Concepts in rural electrification

In summary, the approach developed to achieve the stated objectives in rural electrification, contains five points.

- Use of 1 kV distribution voltage
- Development and use of low wattage electric cookers "bijuli deckchi"
- Use of low cost, ready-board house wiring, "tayari wiring"
- Use of non-metered house connections, using "cut-out" current limiting devices
- Formation and implementation of user's organizations.

Distribution system 1 kV

For sparsely populated rural areas of Nepal, 1 kV distribution lines were said to have the following advantages over 400 V lines:

  - Range is approximately 5 km as against approximately 1.5 km for a 400 V line;
  - Voltage drop and losses are less;
  - One person can carry small lightweight 1/0.23 kV transformers supplying a group of houses (huts) with very low demands;
  - Cost of the lines is the same, and the same hardware can be used.

[7] Andhi Khola simply means Andhi river. The term is often used to denote the project area of the AHREP

Tayari Wiring (Readymade Wiring)

It was considered to be of interest to re-think conventional house wiring, and come up with a lower-cost pre-fabricated solution:

- Simple prefabricated wiring system,
- Good quality double insulated wire,
- Joints soldered and fabricated under company's supervision,
- Simple to manufacture and easy to install,
- Easy to modify and extend, cost effective and safe.

Bijuli Dekchi (Low wattage electric cookers)

The concept is to use low-cost or free off-peak power to store heat for cooking, in a specially developed device, modelled after Norwegian early century storage cookers:

- Low wattage (200 watts) rating;
- Alternative to firewood and clean cooking environment,
- Capacities: 2. 4 & 8 litres.

Non-metered consumers

A cut-out device, which cuts off the supply when the subscribed current maximum is exceeded. There is only a fixed demand charge for these consumers. Cut-out devices used are in the range from 25 watt to 800 watt. This constitutes technology transfer from Norway, including donated second-hand hardware in large numbers, that was used in Norwegian rural electrification in the first half of the last century. Non-metered connections were considered for the poorer households because of lower cost.

Users' Organizations (UOs)

To organize people to contribute voluntary labour and locally available materials for construction, operation and maintenance of rural electrification network. Public participation is one of the principle concepts of BPC to carry out rural electrification activities on an efficient, effective and cost economic basis. The following advantages were perceived:

- Reduces line construction costs;
- Reduces administrative burden on the electric utility;
- Decentralizes line operation and maintenance responsibilities,
- Helps to unite the local community.

Procedures for Electrification

- Identification of areas is done through preliminary visits by AHREC staff and by contacts with the community through exchange of letters and informal discussions.
- Feasibility studies aim to ascertain whether the proposed electrification scheme is feasible and on what conditions. This study also contains the design of the system and a cost estimate.
- Discussions with the community are initiated with representatives of the community. BPC informs the community about its conditions for electrification of their area. These conditions mainly involve contribution of the community through the UO and kind towards the building the system and maintaining it. Concerns or suggestions of the UO are also taken in to consideration. Subject to successful discussions an agreement is signed with UO.
- Detailed design, line routing & line erection: This is done with mutual agreement. The main and branch lines are then constructed with unskilled labour and local material contributed by the UO.
- Motivation: Motivators are sent to the area to inform the people about safety and end uses of electricity by visiting houses and public meetings. This is not in use compulsorily.

– Hook up of houses is then carried out. During this activity, local persons nominated by the UO are given training; Among the persons trained servicemen are selected for the operation of the distribution system mainly for the replacement of fuses in cut-out devices and the revenue collection.

A3.3.1.3 Irrigation and other Facilities

The development of a head race irrigation scheme was an important part in the conceived project. It provided irrigation for 300 ha with water from the power plant head race (Major Norad funding: NPR 16 million of a total of NPR 24 million).

A drinking water and sanitation programme was also made part of the project. The description of 1983[8] said: "The project will aid the local communities in the area to plan, build and maintain their own drinking water and sanitation systems. The water systems will mainly be spring improvements and gravity pipelines, and the sanitation improvements will be pit latrines. The objectives are: - to provide adequate drinking water and initiate basic sanitation practices, to decrease the incidence of water borne and faecal contamination-caused disease, to increase the productivity of village women, and to encourage water conservation in the area." (Minor Norad funding: NPR 350,000 of a total of 1.7 million NPR).

An appropriate technology programme was undertaken with the objectives o soil and water conservation, improved self-sufficiency in food and reduction of the incidence of nutritional disease in the area (Minor Norad funding: NPR 60.000 of a total of NPR 275.000).

Agricultural development was targeted as another major activity, including small farmers' group promotion, animal health, and rural youth training programme (UMN funding: NPR 92,100).

Similarly, forest, soil and water conservation were addressed through non-formal teaching of basic conservation concepts, and the motivation of the local people (Major Norad funding: NPR 30,000 of a total of NPR 59,100) .

In addition, UMN funded and carried out an educational programmes (NPR 19,000).

Finally, an enterprise development programme[9] was undertaken with the aim of putting available electricity to productive use (UMN funding: NPR 71,100).

Overall it appears that Norway has funded about 63% from a total of 25.68 million NPR for the implementation of the described sub-activities[10].

A3.3.2 Results

Following is a description of the results chain, in which short-term results (outputs), medium-term (outcomes), and long-term results (impacts) are distinguished.

A3.3.2.1 Outputs

The output includes the 5.1 MW hydropower station, distribution grid, connection to the transmission grid and customer connections. Also 300 ha of agricultural land have received gravity irrigation and local personnel were trained both for construction and operation tasks. Following are the main features of the project.

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[8] Source: documents of Andhi Khola project, 1983 plans and budgets

[9] Also referred to as „Craft/Cottage Industry development"

[10] There is an uncertainty in this. Numbers shown are from approved budgets 1982-1984, and further information was not available. It may well be that more money was spent in later years. It would have been a common practice for Norway to fund further work with an equal share.

Location: Galyang, Syangja district, Gandaki Zone.
Owner: Butwal Power Company Ltd. Consultant: UMN's Development Consulting Services Butwal, DCS – BPC Hydroconsult Civil Contractor: Himal Hydro and General Construction (P) Ltd. El – mech. Contractor: Nepal Hydro and Electric (P) Ltd. Funding: HMG and UMN (19 MNOK grant from Norway) Total cost: NPR[11] 77 million
Construction Period: 1982 to 1991
Scheme type & power output: Run-of-river, 5,100 kW from 3-pelton turbine driven generators Design flow: 2.7 m^3/sec Design head: 250 m
Dam: Crest length x height: 60 x 6 m **Desilting Basin:** Length x Width x Depth: 21 x 5 x 3 m (situated before the entrance to head race tunnel **Headrace tunne**l: Length / Flow area: 1,284 m / 4.25 m^2 **Drop Shaft:** Depth / Diameter: 234 m / 4 m **Power House:** Length x Width x Height: 36.90 x 6.60 m x 10.9 m **Tailrace tunnel:** Length/ Flow area: 1,087 m / 4.88 m^2
33 kV Lines: Galyang–Nayapati: 22 km, Galyang–Syangja: 30 km, Galyang-Rampur: 29 km **1 kV Lines**: 329 Km – **0.4 kV Lines**: 117 Km **Consumers connected: 20,415 (2006)**

Table A3- 4: Salient Features of the Andhi Khola HEP

The above represents what Norwegian assistance has delivered. It is noted that several thousand connections have been done with supplementary funding from other sources over the years.

The rural development project has a considerable number of additional outputs. Irrigation of about 300 ha of land is the most important of these (also funded by Norway) while a range of others, such as drinking water, sanitation, literacy and women's rights, and enterprise development were co-funded from additional UMN sources. (as previously mentioned under A3.1.1.3).

A3.3.2.2 Outcome

Local supply is rapidly increasing as new customers are connected and electricity use per customer increases modestly. About 40 GWh of energy is being produced annually. Generation has been relatively stable in spite of technical problems with the old Norwegian equipment, because BPC and the local firm NHE have learned to cope with the issue, and carry out repairs in a timely manner. Also, agricultural production has increased due to irrigation of additional land. Intended land re-distribution has not taken place to any significant extent, due to problems with the bureaucracy.

Rural electrification has continued over the years, with successive funding from other sources. Total numbers of consumers till 2006 were more than 20.400, including 250 numbers of industries of 35 VDCs. Among these, 26 VDCs are of Syangja district and 9 are of Palpa district. 14,000 numbers of consumers are provided service through users' organizations and the rest are provided service directly by BPC.

The grid volume, i.e. the total physical assets is increasing continuously with new connections and extensions of the distribution grid. On average, electricity is available locally at a price of NPR 3/kWh.

[11] Exchange rate to the NOK at the time: approx. NPR 2.25 = 1 NOK, i.e. total cost NOK 34.2 million. However, this does not include approx. 10 million NOK worth of donated equipment and UMN, and other free services. Also, a Norad contribution of approx. NOK 2 million towards the irrigation system comes in addition.

A3.3.2.3 Impact[12]

The impact from the selling of excess electricity to the grid and thus replacing diesel power, is gradually replaced by the impact of rural electrification including replacement of kerosene, increased commercial and productive activities and indirect benefits thereof, from higher level of education, and health benefits. The irrigation impact is also significant. Net benefits are high due to the low investment cost and high O&M competence of BPC.

A3.3.3 Findings

The chapter contains general findings, an assessment of input quality, an assessment against the DAC criteria, in addition to benchmark discussion and economic benefit presentation.

A3.3.3.1 General

The project addresses the cross-cutting issues[13], environment, gender and poverty. A physical environment under threat from high population pressure was the main reason for the entire project. Gender and poverty were both addressed through specific rural development project components. In view of high-caste male dominance in the society with moderate success.

The Andhi Khola Hydro and Rural Electrification Project is considered to have achieved a broad range of excellent results. Among other results, it has achieved environmentally benign hydropower development and profitable commercial operation, while at the same time managing to supply power on an expanding scale to rural areas, applying cross-subsidy to an extent through a "social tariff". To those benefiting directly, the provision of gravity irrigation for about 300 hectares of land is even more important. Agricultural production has increased considerably. In addition to access to electricity, the target population received assistance to improved drinking water and sanitation, non-formal training on agricultural and forest use subjects, women literacy and empowerment courses, and targeted individuals benefited from advice on enterprise development. The Andhi Khola project is truly outstanding.

Fig. A3- 5: Award received by BPC[14]

To the extent that it has been awarded a prestigious award, as can be seen on The BPC web site. Quote: "Andhi Khola Hydel and Rural Electrification Project (AHREP) owned by BPC, has been selected as one of the winners for the 2005 IHA Blue Planet Prize. International Hydropower Association (IHA) with the support of UNESCO's International Hydrological Programme, awards the Blue Planet Prize since 2001 in each alternate year. The aim of the prize is to increase awareness of hydropower's contribution to sustainable development and the welfare of mankind, and to promote good practice in the use of the world's hydropower resources. The prize recognizes good practice in the development and operation of a hydropower scheme, on the basis of technical, economic, social and environmental criteria, and excellence in one or more of these aspects. AHREP has been recognized for its excellence in socio-economic benefits, environmental consideration and capacity building in hydropower development of Nepal." Unquote. –

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[12] Impact, strictly speaking, is a finding, and could be discussed in the successive section. However, it is included here in summary form, because impact is also the last stage in the "results chain".

[13] Refer to section 2.2.5, last paragraph in the main report for an explanation of the diversion of the definition from the TOR.

[14] Acknowledgement of source: BPC web site at http://www.bpc.com np/awards.php

A3.3.3.2 Quality of Inputs

UMN has systematically studied rural development in an overall context for many years. Hydro power development has successively been chosen as a prerequisite for rural and overall development. The Andhi Khola project therefore is not merely an engineering project, it is the central object of a rural development initiative. It is for this reason that a high quality of inputs is visible throughout the process.

Inputs are characterised by the quality of the processes that took place to reach relevant decisions. In general, it has been participative, and highly sensitive to people's needs, and social and environmental concerns.

Technical quality of inputs has not been emphasized. In order to reduce costs, second-hand equipment from Norway has been used for the power plant, and some of it may just barely have satisfied quality requirements. However, this was a conscious choice, and was a perceived need, in order to keep costs down.

When the project ran into problems due to poor geology during construction, the question arose if the planning process had been of sufficient quality. This question was answered satisfactorily by project management. Andhi Khola was considered of insufficient project size to warrant elaborate and in-depth geological investigation in the planning phase. It could therefore not have been foreseen that tunnelling problems would be considerable. Although the problems encountered caused delays and cost increase, there was not really any other way of implementation. The evaluation supports this view.

It is notable that project management had involved external expertise from various disciplines, when uncertainties needed to be dealt with. This particularly on irrigation, hydrology, geology, new approaches to rural electrification, and rural enterprise development. Numerous studies and the work carried out by these specialists contributed considerably to the overall good quality of inputs.

The quality of administration and accounting were fully satisfactory. Reporting was frequent and detailed, even though it did not follow a specific agreed format.

In addition to general findings, four of the five DAC criteria are discussed here: Efficiency, effectiveness, relevance, and sustainability. The fifth, impact, has already been discussed above, as part of the results chain.

It appears that the volume and extent of results in the Andhi Khola project would warrant an in-depth assessment study, with specific surveys on different subjects. The evaluation did not have this possibility, but conducted a limited survey and results study related to power development only. Hence, the assessment of results may well fall short of fully appreciating all project achievements.

A3.3.3.3 Efficiency

Despite massive cost overrun, the project is assessed to have used resources in an efficient manner. Overall, costs appear to be well below comparable projects from that time, even though the evaluation is in no position to provide hard facts. With numerous voluntary and donated inputs, it is not possible to know the total cost for the power plant. A conservative estimate is about NOK 40 million, resulting in an investment cost of NOK 8 million per Mega Watt of capacity. The time delays that were encountered have had a negative impact on efficiency. Two main factors have caused the time delays: poor geology that has complicated tunnelling, and a lengthy government decision process at the outset, when a formal project agreement was required.

A3.3.3.4 Effectiveness

Andhi Khola has been an effective project. The following main objectives have been achieved:

- Construction, commissioning and operation of the 5.1 MW hydropower station
- Rural electrification operational and expanding, with a successful users' organisation model
- Gravity irrigation with water supplied from the power scheme head race tunnel implemented and successfully managed by the local water users' association

- Socio-economic improvements brought to a large proportion of the population, in particular the poor.

The reasons for success are seen mainly in the dedication and determination of the project promoters, and the many resident volunteers that learned the language and lived with the people, at a time when peace prevailed and the government was willing to collaborate.

However, the project promoters themselves have set many more goals, and these have proved elusive, negatively affecting effectiveness. The evaluations' assessment is as follows:

- Trying out new methods and technologies suitable for rural electrification in the rural areas.
  - 1 kV distribution voltage: A seemingly convincing approach. However, in the long run, the used cables do not cope well with the increased voltage, and are said to show signs of insulation failure after ten years of service. Moreover, increasing extension of distribution at the end of 1 kV lines is not possible anymore, and the system is replaced with 11 kV transmission. Locally fabricated 1kV-400V transformers have not proved very reliable. The technology has not been replicated elsewhere.
  - Cut-out system to avoid more expensive installation of meters for small consumers: This is the replication of an old Norwegian tradition. In the early days of rural electrification in Andhi Khola, it has helped to boost the number of connections for the budget available. Over time, the mechanical cut-out devices donated by Norway appeared not to do well with the humid climate, and reliability was not as expected. The development of a solid state electronic cut-out was undertaken and pursued for many years. In the end, it seems it was given up with moderate success. The wider market did not take to the technology, and fully developed mass production did not take place. Moreover, while a cut-out device may be convenient for the consumer because it offers lower cost, it is not in the interest of the utility to supply increasingly scarce power *à discretion*. It runs counter to any approach at demand-side management, which may become more important as a measure enhancing energy conservation. Hence, the verdict is that the cut-out system may be a disappearing species. In fact, BPC has announced a conversion programme from cut-out to meters, in specific areas.
- Promote safe and efficient end uses of electricity e.g. electric cooking, rural industries etc.
  - Another idea was the low wattage electric cooker (bijuli dekchi). It has had some success, but has not made it to a level of any significant replication. The reasons are many. It would deserve a full study, which was outside the scope of the evaluation. In brief, the device developed remained rather cumbersome in use because of too low wattage, it was never produced in sufficient numbers to really have a low price, and for most consumers electric cooking is out of reach because of cost anyway. As a result, fire wood remains the main fuel for cooking. In semi-urban areas it is displaced more cost-effectively by LP gas, and in rural areas ideally by biogas. The evaluation finds that electric cooking is not, and probably will not for a considerable time to come, be of any significance, and reach 10% or more of use in all cooking needs.
  - The expectation was to develop lift irrigation technology, using electricity at special rates. Apparently, this has largely failed. The evaluation could not obtain any information indicating that electric lift irrigation was in use anywhere in the project area in a sustainable manner. Information received indicates that pilot projects were eventually abandoned, because water cost were to high.
  - The development of rural industries was pursued through the enterprise development programme. The intention was to promote production units, thereby adding value to local raw materials and to electricity. Despite a promotion effort over more than five years, the results are modest. Fourteen years after the start of the activity, small industrial consumers account for a mere 1.2 % of all consumers, and average consumption per enterprise is less than 15 kWh per day.
- Redistribution of land to the landless poor.

– UMN had attempted a small land reform in the irrigation area by making land acquired before the irrigation project available to the landless after irrigation had been introduced. This is a complex undertaking and its full study is outside the scope of the evaluation. Information received is that so far, land has not been acquired by the landless. However, the chapter is not considered closed, and there is perhaps still a way of achieving the objective.

A3.3.3.5 Relevance

Needless to say at this stage, the project with all its main components was, and remains, highly relevant at several levels.

To develop small scale hydropower for rural development, and to make it viable by selling excess power to the grid, was an entirely new concept in Nepal at the time. The concept itself, and the way by which it was implemented were and is still highly relevant.

To supplement rural electrification with other development measures, such as water supply and sanitation, informal education, awareness raising and community motivation, is very relevant as an approach. It has become visible that such combination of measures answers well to the local needs, and it contributes to equitable development.

Developing the Andhi Khola HEP has been a process through which local implementation capacity has been developed. In addition to the growing BPC, Himal Hydro and General Construction Company (short: Himal Hydro), as well as Nepal Hydro Electric (NHE) were established. These companies went through an enormous learning process, on-the-job, and in this, construction problems encountered had a positive side. “the poorer the rock conditions in tunnelling, the better it is for Himal Hydro, for the experience they gain”, as the project manager put down in one of the progress reports. Hence, the learning and gaining experience were of enormous relevance.

A3.3.3.6 Sustainability

There are a number of aspects to sustainability, and in summary, they are all positive.

BPC has become a sustainable electric utility. It prospers and grows. The operation of the power plant has met with problems related to the age of the equipment. So far, necessary repairs could be done, but there is no doubt that the useful life of most equipment will be reached perhaps in less than ten years. In this connection, there is already a plan to upgrade the power plant. Without doubt, BPC will be able to manage such a process, and raise project finance, mostly on the local market. This means good prospects for sustainability.

In terms of commercial operation, BPC sold power from Andhi Khola to NEA amounting to NPR 78 million in 2005, and managed to increase this to NPR 82 million in 2006[15].

Rural electrification appears sustainable. In 2005, revenue from local distribution was about NPR 30 million, and just about covered costs of operation and maintenance. Further extension requires donor funding, but operation and maintenance seems increasingly financially viable. As the consumers move up on the economic ladder, and there are indications that this is happening, tariff adjustments to better reflect costs will become more and more feasible. This will ensure sustainability, even under an expansion scenario. In this, one can perhaps foresee a decreasing role for user organizations.

Within the limits of water availability[16], irrigation is sustainable. AKWUA has taken full charge and responsibility. It appears fully competent in keeping its affairs in good order, but it may not be able or willing to push the land redistribution issue.

A3.3.3.7 Rural Impact

As a part of the evaluation process, a rural field study was carried out by a local survey team. The purpose was to collect data on changes that had occurred, and are attributable to the project. The full

[15] All data from BPC internal sources

[16] The contract between BPC and AKWUA stipulates a permanent and continuous supply of 300 l/s

study report is attached as annex 5, where details are found. Socio-economic impact is considerable. This is summarised in the following chapter.

Poverty

The first observation is about the level of poverty. In the period from 1981 to 1993, the number of very poor families increased, while data indicate that the percentage of poor and very poor has decreased significantly by about one third between 1993 and 2007 (see Table A3- 5).

	1981 (n=145)	1993 (n=134)	2007 (n=120)
Rich	9.7	14.2	30.0
Medium	36.5	27.6	33.3
Poor	41.8	39.5	31.7
Very Poor	11.9	18.6	5.0

Table A3- 5: Households (%) Wealth/Poverty Status in Andhi Khola

In 1981, there was no piped water in the two VDCs in question. In 1993, 37 % households had access to piped water. Since then, the supply of drinking water has continued to improve. In rural areas, various water schemes have provided the majority of households with piped, gravity fed drinking water. In the semi-urban area (through the municipality's water supply), electricity is used for running water pumps that supply a large proportion of the population with drinking water. In 2007, 70 % households (overall) had access to piped water.

Sanitation has also improved quite dramatically. Today, many more of the households than before use a latrine/toilet

Livelihood

In contrast to the general decline in Nepal in people's involvement in farming, this has not been the case in Andhi Khola. The main reason for this is the provision of irrigation by the project. In Andhi Khola, as people in 2007 report the developments, involvement in farming has remained the same (66 % households before and after the project).

Electricity had been a major factor when respondents had made decisions to undertake business. Of the 48 households in the sample engaged in business in Andhi Khola, 19 (40%) felt that electricity had been a major factor.

What is to a significant degree related to the project is the increase in business. The number of households who run a business has grown by a factor of 2.5. Almost 40% of those engaging in some sort of business have stated that availability of electricity was a major factor in the decision to establish the business. A significant change took place with regard to households deriving income from remittances: The number of households has increased from 10% before the project to 33% after the project. This change is clearly not project related, as the project has not displaced people.

On the other hand, consumption data have shown that overall electricity consumption by industry and business is only 1.5% of the total. This indicates that the opportunities to use electricity productively are either limited, or else still to be developed to a larger extent.

Given the increase in money generating activities and, at the same time, the stable share of people involved in agriculture, we may conclude that people tend to diversify their livelihood strategies more than before.

Energy Use

First, there is a marked difference in electricity use in the semi-urban area Galyang and rural areas. Therefore, the study presents differentiated data. Average electricity consumption today is about twice per consumer in semi-urban than in rural areas. If it is assumed that a direct proportional benefit is derived from using electricity, for which in fact there is evidence, it follows that semi-urban consumers benefit more, because they use more electricity. The same is true for the poor, compared to the better off. Since the poor consume less electricity, due to limited affordability, the benefits

accruing is less than for the more wealthy consumers. Electricity users subscribe to different categories, according to their needs.

Subscription category	% of all consumers	average monthly charge (NPR)	average monthly consumption (kWh)	average charge NPR per kWh
cut-out (25 to 400W)	52.4%	83	34	2.44
cut-out (25 to 100W)	22.3%	59	21	2.81
meter, domestic	46.3%	198	62	3.19
meter, industrial	1.3%	634	320	1.98

Table A3- 6: Consumption and tariff pattern according to BPC data in Andhi Khola

Overall, more than 50% of all consumers benefit from a social tariff, which is about 24% lower than for the average metered domestic consumer. However, due to lower consumption and the flat rates applied for the smaller subscribers (25 to 100W), these consumers (22.3% of all), pay a higher unit price, which is only about 12% lower than the effective cost for metered consumers. This reflects the fact that BPC's overhead charge applied is the same for these subscribers, despite their lower consumption. Industrial consumers, on the other hand, benefit from the lowest tariff, 38% lower than for domestic consumers. Despite this preference there are only 1.3% in this category. This indicates that opportunities for electricity use on a larger scale are limited.

The consumption of kerosene (primarily used for lighting) has declined significantly by about 80 %, from an average of 3.6 litres/month to 0.7 liters/month on average. In Andhi Khola, with nearly 100% electricity connection rate, electric light has replaced the former kerosene lamp.

On the basis of household energy balance calculations, it can be estimated that in the semi-urban area of Galyang about 4% of all cooking is done with electricity. In rural areas, the use of electricity for cooking is practically non-existent, while about 2% of all cooking is done with LPG, and an unknown share with biogas. It is further estimated that the quantities of fuel wood that are displaced by electricity and gas, are about 50 kg per month and family, and 10 kg per month and family in semi-urban and rural areas respectively.

Another item worth mentioning is that the use of dry cell batteries is greatly reduced, and mains electricity is used instead, typically for the radio. This constitutes a considerable saving, as battery power is in general about 20 times more expensive than mains electricity. However, the total amount saved is small. Energy use for other purposes has not been found significant.

Also, with the availability of electricity, people have started to watch TV. Those families that own a TV set (roughly 60%), watched it for 1.7 hrs per day on average. This points to the importance of modern information and entertainment media in rural areas.

Indirect Benefits from Electrification

The female literacy rate is higher in areas having electricity. Similarly, availability of electricity has been instrumental to the new service of having computer classes in school.

The response to the impact of electricity on human health was similar to that of education. About 94 % respondents reported that it has helped in improving the health at the household level and 58 % reported that it has helped in improving the health at the community level.

Finally, there is also a perception that security has improved with electric light at night in the villages.

A3.3.3.8 Benchmark and Economic Benefits

The graph on the next page, shows the benchmark for various criteria and the economy of the project. In comparison with all other projects included in the evaluation, the Andhi Khola HEP shows the highest values for all criteria, meaning that it is the top performer. It is about 2.5 times more efficient than the average, (i.e. 249% against 100%), has 29% more relevance, 15% better sustainability, more than 2.5 times more impact at the overall level, and close to 3 times higher poverty impact, always as compared to the average of 100%.

The graph of accrued net benefits indicates that the project has broken even after about 7 years of operation. Since then, net benefits accrue.

Benchmark factors compared to all other interventions						Net benefit over useful lifetime: 15 yrs	
	Efficiency	Effectiveness Relevance	sustainability	impact country	impact poor		mill USD
Andhi	249%	129%	115%	273%	278%	country	80
Best	249%	129%	115%	273%	278%	the poor	6.6
Worst	16%	78%	25%	7%	18%	project	115

Table A3- 7: Andhi Khola Benchmark of DAC criteria and net benefits

Fig. A3- 6: Andhi Khola HEP Economy

A3.3.4 Conclusion

The AHREP has set the stage for sector development of a different kind. Outside the main stream of national power sector development, and with more emphasis on rural development than commonly practiced. The project is well adapted to the local context, and the main reason for significant impacts is seen in the integrated approach that has been followed with dedication and persistence.

As far as the power infrastructure put in place is concerned, it has been taken over by BPC, as one of its assets, when the utility was privatised.

The Blue Planet Award of BPC recognizes a positive environmental impact of the project. Mitigation of potentially adverse impacts of hydropower development has been successful, and overall the living and livelihood environment has been improved. One specific aspect in this is the indoor environment which is much improved by replacing smoky kerosene light with electricity.

The direct impact of electricity is increasing. There is growth of consumption across all tariff categories, although from a very low level. The main benefit is in the provision of electric light, while saving of fuel wood is marginal, and largely limited to semi-urban areas.

Indirect benefits from electrification, those that accrue in addition to impact at the household level, are perceived by the beneficiaries as important regarding public health, education, public security, specially important for females. In the semi-urban areas the supply of drinking water through electric pumps is another benefit.

Growing consumption indicates increasing affordability, and hence economic progress takes place. Indeed, poverty is on the decrease, as the field survey results show. It is not possible to say exactly what role electricity plays in poverty reduction an in generating or sustaining economic growth. However, it is certain that electricity plays an important role. Economic growth, on the other hand will result in increasing demand for electricity. If such demand is met, it will further sustain growth.

It does not make much sense to try and isolate impact from electrification alone, as the project is an integral part of a larger intervention. On the basis of the very broad approach, and the dedication and care taken to implement it, there is an overall significant impact. The main impact is from replacement of kerosene for lighting at the local level, and fossil fuel savings at the national level. Indirect benefits[17] are derived from the irrigation project and other rural development works. Also, there are significant indirect benefits coming from improved public and private services, made possible by electrification.

A3.3.4.1 Success Factors

The success criteria are inherent in the project, and are in summary:

- An excellently chosen hydropower site. In the particular situation, there is hardly any negative impact from water diversion, because the water intake happens to be where there is no arable land or habitation directly downstream.
- Integrated approach of rural development with a multitude of outputs in addition to electricity provision. The integration of the electrification project into the overall Andhi Khola Development project, implying a joint and common development philosophy is seen as a key factor.
- For the owner and operator of generation and electrification (BPC), the combination of commercial security through power sale to the national grid on one hand, and gradually developing a local market through cross-subsidy of local consumption on the other hand, is seen as the main sustainability factor for rural electricity supply.
- Overarching capacity development and institution building, and training at all levels has been extremely important. This has resulted in a high local content of inputs, and a dramatic reduction of the need for expatriate expertise in implementation and operation.

[17] i.e. those not directly related to power provision

A3.4 Jhimruk Hydro Electric & Rural Electrification Project (JHEREP)

The Jhimruk Khola[18] is situated in Pyuthan district in the central Western part of Nepal. The project site lies at an altitude of about 700 meters, hence, a sub-tropical climate prevails, and given sufficient water, the area is very fertile.

Nepalese authorities requested funding from Norway for the Jhimruk HEP in 1987, and Norway agreed in principle on the condition that it was accepted to channel grants through the Tibetmisjon, also known as the Norwegian Himal Asia Mission (NHAM) associated with UMN. The understanding was that BPC would plan and implement the project, and that it would contract Himal Hydro and Nepal Hydro Electric to carry out construction and equipment supply and installation, respectively. The Norwegian Water Resources and Energy Administration (NVE) was given the follow-up responsibility on the project, in the function of Norad's professional adviser in hydropower development.

The government had seen Jhimruk's role as an addition to the national power system, adding capacity and more importantly, provide peak power to the main grid. When BPC reviewed the early concept, and started detail planning, it added the rural electrification component, which was eventually accepted by the government.

A3.4.1 Project Description

Similar to the Andhi Khola project, which takes water from the Andhi Khola and returns it to the Kali Gandaki after passing through the turbines, the Jhimruk project also is an inter basin water transfer project. It takes water from the Jhimruk Khola, through a more than one kilometre tunnel to the other side of the mountain, an down through a steel penstock to the power house on the bank of the Madi Khola, to which the water is returned. However, in the case of Jhimruk, water diversion from the Jhimruk Khola has, unlike in Andhi Khola, negative downstream consequences, because there is land that has lost irrigation water. In this respect, the site selection is not optimal. The "project" cannot be blamed for this, because the site had been selected earlier by the government.

The JHEREP has been implemented following an agreement in 1989 between HMG and UMN, under grant finance from Norad. Its construction was completed on time and commercial power production started on 17 August 1994. Under the agreement, the project was to be handed over to the government after completion. This took place in August 1995, after the warranty period was up. The government then handed it back to BPC against shares of UMN in the company. By this, BPC came to own Jhimruk, in addition to Andhi Khola, and HMG became the 97% owner of BPC.

The total installed capacity of the power station is 12 MW, and annual production about 60 GWh. The station is connected to the national grid through a 41 km long 132 kV transmission line. 180 km of 33 kV lines were also built to connect Jhimruk with Andhi Khola, and to take power to the districts of Rolpa, Pyuthan, Arghakhanchi, Gulmi and Syangja.

A3.4.1.1 Objectives

Three equally important objectives were formulated for the project:

- To generate electricity for the national grid, with special emphasis on peaking capacity during the dry season.
- To provide electric power to four hill districts: Pyuthan, Rolpa, Arghakhanchi and Gulmi.

[18] To be consistent with name use at Andhi Khola, the project here would need to be called Jhimruk Khola project, where Khola simple means river. However, throughout project history, the name short name given was simply Jhimruk project, and the evaluation follows this.

- To develop Nepal's capability to plan and construct hydropower projects and to manufacture and repair equipment for these by strengthening the three Nepali organizations which were to be involved in the project: BPC, Himal Hydro and NHE.

By and large, the same approaches and procedures were followed in rural electrification as in Andhi Khola, but on a much smaller scale. Other rural development activities, such as water & sanitation, and agricultural and enterprise development were not prioritised during the construction period of the hydro scheme. The scheme was completed under budget, and funds left over (about NOK 500.000) were used to establish JIDCO, the Jhimruk Industrial Development Company to work on rural development.

Including funding for a follow-up phase, financial assistance from Norway has amounted to NOK 134.75 million.

A3.4.2 Results

Following is a description of the results chain, in which short-term results (outputs), medium-term (outcomes), and long-term results (impacts) are distinguished.

A3.4.2.1 Outputs

The output includes the 12 MW hydropower station, reservoir, distribution grid, connection to the transmission grid and customer connections, commissioned as per the plan. On the down side, 150 hectares of land lost irrigation for the pre-monsoon crop due to the diversion of water from the Jhimruk Khola. Local personnel were trained both for construction and operation tasks. In a follow-up phase, plant modifications, repair of abrasion damage on turbines, the provision of drinking water to project affected communities, river training and some other mitigation works were carried out. JIDCO has been established with the objective to promote electricity-based enterprises, and implement rural development initiatives in various sectors.

Following are the main features of the project.

Location: Ramdi Besi, Naya Gaon and Khaira VDC of Pyuthan District, Lumbini Zone.
Owner: Butwal Power Company Ltd. Consultant: BPC Hydroconsult Civil Contractor: Himal Hydro and General Construction (P) Ltd. El – mech. Contractor: Nepal Hydro and Electric (P) Ltd. In collaboration with Kvaerner Energi, and ABB Energi Funding: HMG (NPR 26 million), and UMN (129.2 MNOK grant from Norway) Total cost: NOK[19] 134 million.
Construction Period: 1989 to 1994
Scheme type & power output: Run-of –river with daily pondage, 12,000 kW from 3 Francis turbine driven generators Design flow: 7 m^3/sec Design head: 201.5 m
Power Production: 72 GWh (in normal hydrological year)
Dam: Crest length x height: 205 x 2 m **Two Desilting Basins:** Length x Width x Depth: 42 x 5.5 x 5 m (situated before the entrance to head race tunnel **Headrace Tunne**l: Length / Flow area: 1,100 m / 5.5 m^2

[19] Exchange rate to the NOK at the time: approx. NPR 5.48 = 1 NOK, i.e. NPR 26 million converts to NOK 4.7 million, i.e. total cost about NOK 134.

Surge Shaft: Height / Diameter: 25 m / 3 m **Underground Penstock Shaft:** 381 m x 1.5 m diameter **Tailrace:** 200 m gabion lined open canal
33 kV Lines: Jhimruk–Andhi Khola: 110 km, Jhimruk–Libang: 34 km, Jhimruk-Malabang: 20 km **132 kV Line**: Jhimruk - Lamahi: 41 Km to interconnect with the national grid
Consumers connected: 5,987 (2006)

Table A3- 8: Salient Features of Jhimruk HEP

The above represents what Norwegian assistance has delivered.

A3.4.2.2 Outcome

The scheme has been in operation since August 1994. Local delivery is gradually increasing as new customers are connected and electricity use per customer also increases. The number of customer connections has just reached about 6.000 by the end of 2006. The cost of electricity is about NPR 4.40/kWh in average.[20] Production has been stable except for 2003 when the station was out of service due to Maoist sabotage. The reservoir was silted up in a few years operation, so that peak power supply could no longer take place. Farm production was reduced due to the loss of irrigation water. Not all mitigation measures have had the desired effect, others, such as pump irrigation, were postponed, and only recently introduced. This has led to a strained relationship with the local people. It has in this situation not been possible to introduce electricity users organisations as was done in Andhi Khola.

Fig. A3- 7: Jhimruk Diversion Dam, seen in downstream direction

A3.4.2.3 Impact

The most important impact comes from the selling of excess electricity to the grid, but there are also benefits from local electrification, including replacement of kerosene, and commercial activities. The loss of irrigation water gives a significant negative impact, apparently not fully mitigated at this point.

[20] See Rural Field Study Jhimruk, in annex 5 for more details.

Considering that the average yield would be 2.1 metric tonnes/ha, total production loss is on the order of 315 tonnes. Support to mitigate this loss is ongoing under a new project financed by Norway that supports efforts to increase the area under irrigation through reduction of seepage of water in gravity channels, and other measures. The following chapter provides more information on the socio-economic impacts.

A3.4.3 Findings

Environment gender and poverty were important cross-cutting issues: An environmental impact study was done at a late stage, after NVE had pointed out its lack. Measures were recommended, but not completely implemented. Rural development projects that were initiated as part of the mitigation measures included gender and poverty reduction components, which were only moderately effective.

The chapter contains general findings, an assessment of input quality, an assessment against the DAC criteria, in addition to benchmark discussion and economic benefit presentation.

A3.4.3.1 General

Jhimruk river is considered by people to be valuable in terms of irrigation, and its diversion to hydropower meant that people in the down stream areas have faced problems in cultivating rice in the dry season (April-July). In other seasons, there is no shortage of water. Even though the project stops supplying power to NEA for a month during the dry season, there is still a shortage of water for irrigation. About 150 ha of land is now deprived of irrigation water for a dry season crop.

The settlements in Jhimruk area are mainly located along the river bed, and the most affluent locations are the villages located on the Jhimruk river and Madi river, above the power plant. Irrigation by the river is good for two crops of paddy and a crop of either maize or wheat. The pre-monsoon crop is affected by water diversion for the hydro scheme.

With regard to providing benefits at the local level, the project is less successful. It was not designed for that purpose in the first place, and when rural electrification and development were considered as an add-on, it was done with a limited effort in analysing and addressing local needs, and mitigation of adverse effects of water diversion has lagged behind considerably. JIDCO, which was established to promote enterprises, appears to be more active in agricultural extension, as a reflection of severe limitations of such development outside of the agricultural and horticultural sectors. Also, JIDCO's competence in "industrial" development has been questioned over time. For example, BPC records show that of the total of 52 "industries", 48 are grain mills, that have been promoted by JIDCO. Industrial power use has increased by a factor of 3.5 over the past 8 years, but it is still at a very low level of about 12 kWh per day and enterprise only. From the point of view of market demand, there are too many mills, and it has not been sound advice to the owners to go for it. On the other hand, there are now 12 pump irrigation schemes that use electricity at a preferential rate. This helps in developing cash crop agriculture, which is seen as being best able to compensate for the income loss due to reduced gravity irrigation water, which was used for rice growing before the project.

In its advisory capacity, NVE pointed out that Norad had violated its own environmental guidelines when it accepted funding of the project without stipulating any conditions regarding environmental mitigation and maintaining a minimum residual flow in Jhimruk Khola. The conclusion was that possible environmental and adverse economic impacts should have been evaluated and mitigation measures should have been included in the project plans before Norad approved the application for funding. Without this omission, one can argue that it would have been better possible to implement more effective mitigation measures.

Hence, environmental concerns in the end were addressed. Other cross-cutting issues such as poverty and gender were addressed through rural development initiatives, with mixed results.

A3.4.3.2 Quality of inputs

From an overall planning perspective, the Jhimruk project was not an entirely happy choice. The impact of diversion of water was not taken as seriously as to look for alternatives to the project, and providing local benefits in the first place was not a consideration. Central government clearly planned "over the head" of the local population. In doing so, planners were insensitive to the plight of local

people, and acted irresponsibly by today's standards, even though it was said to be within the law. Conceptually therefore, the project started off with a considerable quality deficit.

The situation improved when Norway agreed to provide a grant for the implementation of the project. This not only meant that BPC, Himal Hydro and NHE would get involved with their background from implementing Andhi Khola, but also that NVE would be available as an external adviser. Involvement of these organizations is considered to have made a significant difference to the quality of inputs.

With its background in rural development from Andhi Khola, BPC embarked on rural electrification planning, and wrung acceptance for this from the government.

NVE instigated an environmental impact study, which was not previously deemed necessary, because it was not a legal requirement. This has helped in identifying necessary mitigation measures, and a fish ladder was integrated into the dam. On the down side, mitigation measures were poorly implemented, a fact that still puts a strain on the relationship between BPC and the local people.

BPC is said to have made a number of changes and improvements to the initial project design. It appears that some design flaws persist, such as for example the problematic generator cooling system using sediment-laden river water, instead of an alternative such as air cooling or another water source.

A model test and research project for the Jhimruk project has been undertaken at the Kathmandu hydraulic research laboratory under separate funding. Sediment has been recognised as a major problem in the Jhimruk river, and a lot of effort has gone into devising ways of improved sediment handling.

Training has been a very important input throughout the project. A professional training coordinator has been engaged part-time, and external expertise was called on when needed. Much of the training has been on-the-job, and strictly work related, but other training activities have covered life skills, and have included workers wives and local people.

The quality of implementation, in general, has been of a high standard, borne out by the fact that the project was completed on time and within budget.

Accounts for the project at BPC and the Tibetmisjon have been audited periodically by an external auditor, and found in order.

In the process, and thanks to continuing integrated training efforts, the involved companies BPC, Himal Hydro and NHE implemented the project to a high standard, and gained considerably in competence and capabilities.

A3.4.3.3 Efficiency

The Jhimruk project of 12 MW capacity has been implemented in the specified time and within budget. At a total cost of NOK 129.2 million, including 15.7 million for transmission and distribution networks, the investment cost for the power plant comes to NOK 9.5 million per MW of installed capacity. This compares favourable to international cost levels at the time. The project is therefore assessed as highly efficient regarding the power plant. Overall, including rural electrification and other measures, the conversion of inputs into outputs has been somewhat less efficient, but still quite favourable.

A3.4.3.4 Effectiveness

The original purpose of the project was to provide additional generating capacity with daily water storage capacity for peak power production, as quickly as possible. The project has been effective in achieving this purpose. However, daily water storage volume was quickly reduced due to the accumulation of sediment. Today, there is no storage capacity to speak of left, indicating that this part of the purpose has not been achieved.

Rural electrification has been achieved, along with the provision of other facilities such as water and sanitation, and some community work. The objective of mitigating the negative impact of loss of irrigation water has not been fully achieved for a number of reasons. Further, the promotion of productive power use has largely failed, again for a number of reasons. Overall therefore, the effectiveness criteria shows a mixed result.

A3.4.3.5 Relevance

The power scheme has been very relevant in terms of adding to the national generating capacity, within the stipulated time. It has further been a relevant experience for the companies involved in its planning, construction and operation. At the local level, the project is also relevant, despite marginal growth and improvements in living. Whatever limited growth has taken place has been aided by the availability of electricity, and by other project benefits provided.

A3.4.3.6 Sustainability

Jhimruk HEP is sustainable, as it generates a major portion of BPC's income and profits. However, Maoist bombing of the hydro-power plant rendered it non-operational in 2003, and this shows the high degree of vulnerability of rural infrastructure in politically instable situations.

Rural electrification in the Jhimruk area requires subsidy for operation. BPC data of 2005 from the Jhimruk distribution centre show that revenue was about NPR 6 million per year, while costs for distribution operation and maintenance are stated at almost 18 million. This means that each customer is subsidised with about NPR 2,000 per year, or NPR 167 per month, just double the prevailing average monthly electricity bill. In other words, consumers pay about one third of the costs, and this, by definition, is not sustainable. BPC pays for the difference with profits from bulk sale of power to NEA, which are considerable. Incidentally, sales to NEA in 2005 have amounted to NPR 209 million.

It is not clear at this stage if and how a combination of operational efficiency gains, increase in energy sold and increases in tariffs charged to customers can achieve full cost coverage of Jhimruk distribution.

A3.4.3.7 Rural Impact

There is no perceptible change in the wealth rank status of households before and after the project. It seems that in the electrified area, the proportion of households under the very poor and poor category after the project is slightly reduced. In non-electrified area, there is no perceptible change.

Water Supply and sanitation has been improved, with increased access to piped water, both in electrified and non-electrified areas. Before the project, 17% of all households required 30 minutes or more to get water, while one third required five minutes or less. Today, half of the households require five minutes or less, and only 4% take 30 minutes or more.

Sanitation has also improved, but still about 50% of the households in the project area do not have their own latrine.

Livelihood

There has been some changes in the sources of income, with a marked increase in the percentage of households deriving income from business and remittances. The households deriving income from agriculture have declined more significantly in non-electrified area, probably because of their out-migration for work and for business.

The increase in exploiting business opportunities is higher in the electrified area as compared to the non-electrified area. Electricity is seen as a factor for increasing business and enterprises.

Loss of agricultural production due to diversion of water is about 8 % in the down stream area, on average. Only 22 % of households within that area were directly affected by this diversion, and their production loss equals about one-third of their production.

On the other hand, there is a group of farmers of unknown numbers, who reap additional benefit by farming the silted up reservoir upstream of the dam. Unfortunately these are different from those that lost irrigation water. Hence, to an extent, the project may be said to have contributed to increased local inequalities.

Energy Use and Electrification

There is no marked difference in fuel wood use in electrified and non-electrified areas, given the inaccuracies of the collected data. Whatever reduction in fire wood use that may still have been

achieved is attributed to the use of improved cooking stoves. Neither electricity nor LPG play a discernible role in saving fuel wood.

Kerosene has almost entirely vanished from use in electrified areas, while it is also considerably reduced in non-electrified areas, due to the introduction of solar PV.

The share of income needed to pay for energy has increased from roughly 3.5% to almost 7% in electrified as well as non-electrified areas. One use of electricity of growing importance is for irrigation water pumping, which is promoted with a preferential tariff.

The structure of electricity subscriptions in Jhimruk is such that more than 2/3 of all consumers have a metered domestic connection, and only about 23% benefit from a social tariff. This is shown in Table A3- 9.

Subscription category	% of all consumers	average monthly charge (NPR)	average monthly consumption (kWh)	average charge NPR per kWh
cut-out (50 - 400 W)	29.0%	74	28	2.64
cut-out (50 + 100W)*	23.4%	63	25	2.52
meter, domestic	69.9%	101	23	4.39
meter, industrial	1.1%	1,151	260	4.43

* sub-group of overall cut-out subscribers

Table A3- 9: consumption and Electricity cost in Jhimruk

The social tariff consumers consume on average 28 kWh, for which they pay NPR 74 per month. Interestingly, domestic consumers do not consume more on average, but rather a bit less, but pay NPR 101 per month. As a result, the tariff is very pro-poor, but limited to less than one third of all consumers. Moreover, about 58% of all households do not have an electricity connection. Lastly, indirect benefits do also accrue in Jhimruk, at a similar level to Andhi Khola in education, health and regarding security.

A3.4.3.8 Benchmark and Economic Benefits

In commercial terms, the JHEREP is a successful project, if not quite to the extent planned. It was expected to generate about 70 GWh per year, but has actually generated 46 GWh on average, with a maximum of almost 60 GWh in 2006, and a full year of shut-down due to sabotage. About 98% of the power generated has been sold to the national grid, at a profit. This has allowed cross-subsidy for rural electrification which runs at a considerable loss.

The benchmark in Table A3- 10 indicates that the project is better than average in terms of efficiency. This is due to the fact that the project was completed under budget, at relatively low unit cost. Effectiveness and relevance, as well as country impact, are assessed as average. Sustainability is less than average, while impact on the poor is below average. This latter low ranking is because Andhi Khola set a high standard.

Benchmark factors compared to all other interventions						**Net benefit** over useful lifetime: 25 yrs	
	Efficiency	effectiveness Relevance	sustainability	impact country	impact poor		mill USD
Jhimruk	175%	101%	79%	99%	87%	country	49
Best	249%	129%	115%	273%	278%	the poor	3.5
Worst	16%	78%	25%	7%	18%	project	481

Table A3- 10: Jhimruk Benchmark of DAC criteria and net benefits

Fig. A3- 8 (next page) shows that the project will accrue net benefits over its life time. Economic benefits have been greatly affected by the damage caused to the plant by sabotage.

A3.4.4 Conclusion

The hydro project has been completed in 1994, within the planned time frame, at a cost below budget, and in this respect it has fully met the expectations of the government. Rural electrification and mitigation of adverse impacts of the scheme was largely done in the period from 1994 to 1997, and in recent years BPC has continued the efforts of extending rural electrification. To date, more than 5.000 electricity connections have been provided. These resulted in considerable impact at the local level, and other rural development works carried out contributed significantly to such impact. The Jhimruk HEP is a commercially successful project. It has contributed 5% to national generating capacity at that time, and it has had good performance in terms of supplying power to the national grid, up to the day that the plant was sabotaged by Maoist rebels in 2003, and from the day of its successful rehabilitation more than a year later.

The scheme has successively become the most important asset of the privatised utility BPC.

Rural electrification and development had not been part of early planning, it was included at a later stage. It has been implemented in a manner quite different from Andhi Khola, with less time available, less professional inputs, and less enthusiasm on the side of recipients. As a result, direct and indirect benefits are limited. Economic growth and improvements in living conditions are discernible, but the rate of growth is slow, starting from a very low level.

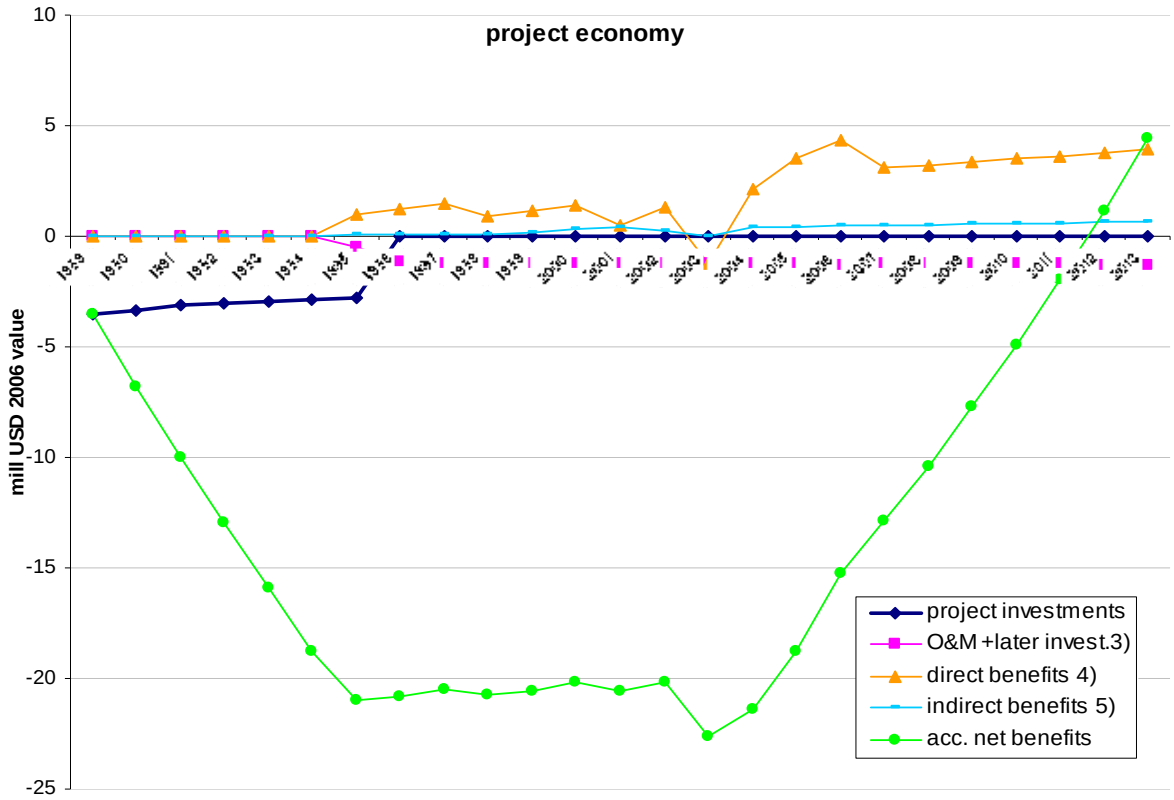


Fig. A3- 8: Jhimruk HEP Economy

In a comparison with Andhi Khola, the Jhimruk project is doing well commercially, but shows a rather poor performance in environmental and socio-economic terms at the local level. An environmental impact assessment had not been planned, but was later included on the suggestion of NVE, who also supported the finding of the study that the effect of water diversion would need to be mitigated. This resulted in mitigation and compensation efforts, but it proved difficult to fully offset the negative impacts. In addition, sediment in the Jhimruk river proved to be problematic, and the accumulation of problems make the Jhimruk power plant site not a very favourable choice. It is debatable if at that time not a more favourable site could have been located.

In all fairness, it should be noted that the standards of Andhi Khola are high, and have generally not been achieved elsewhere. There are still more recent small schemes in Nepal where no adverse impact mitigation or benefit sharing at all has been done at the local level.

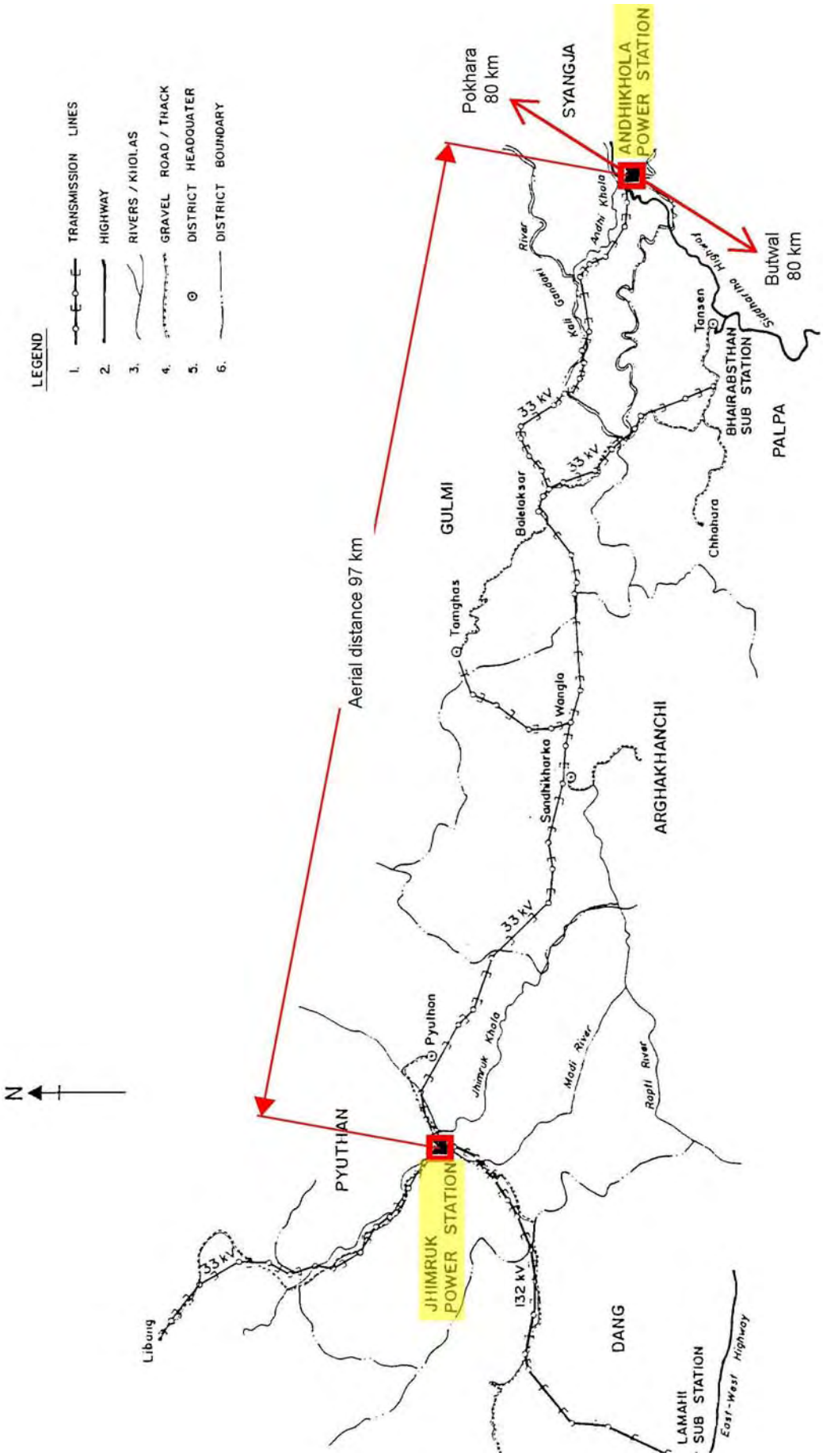


Fig. A3- 9: Situation map AHREP and JHEREP with transmission lines

A3.5 Jhankre Rural Electrification and Development Project

In this project no full evaluation was undertaken. Outputs of the project are well documented, and the purpose of including results of rural development interventions is to compare with the two in-depth studies carried out.

A3.5.1 Project Description[21]

The Jhankre Rural Electrification and Development Project, Phase II (JREDP II) is a continuation of JREDP I (1996-2000). The first project phase was started parallel with construction of the 60 MW Khimti I scheme, with an objective to support the local people and raise the living standard by providing electricity within the project affected area and conducting other community development activities. The 500 KW Jhankre Minihydro Power Plant, funded by Norway, had been commissioned in 1996.

Altogether 350 households and 8 small enterprises were provided with electricity and some community development activities were carried out under JREDP I. But the scope of work could not satisfy the demand of the local people. After commissioning of Khimti I, local people regularly kept demanding extension of the electrification system in their area. These demands even turned into violent protests. Ultimately, in October, 2000 - nine months after JREDP I was phased out, Himal Power Limited (HPL) resolved to continue the rural electrification work with its own resource and started the JREDP II. However, with the limited internal resources allocated, the demand of the local people could not be met. Hence, HPL submitted a comprehensive proposal to the Norway for electrifying 3,966 households, conducting various community development activities and basic infrastructure development including establishment of an entity that would take over the entire infrastructure built during the project implementation, with a full responsibility of operation and management by the beneficiaries themselves. Thus the JREDP II (2000 – 2005) agreement was signed in May, 2001 between Himal Power Limited and the Norwegian Embassy to Nepal on behalf of the Norwegian Agency for Development Cooperation.

At the completion of the project in December 2006, 4,160 households had been connected to the grid. Various community development activities in the sector of health and sanitation, non-formal education, agriculture, forest conservation and environment, skill development and income generation to women and youth and support for building needed basic infrastructures such as water supply schemes, schools, irrigation schemes and roads/trails/bridges had been carried out.

The 500 kW Jhankre Minihydro Power Plant has also been refurbished and the capacity upgraded to 635 KW.

The entire infrastructures constructed has been provisionally handed over to the Khimti Rural Electric Cooperative (KREC) – an entity established and owned by the users themselves. The final handover has to be done after six months of successful operation/management of the rural electrification system by KREC and is due to take place in the near future.

Due to the insurgency and unfavourable political situation in Nepal, the planned activities could not be completed in the previously set time, and the project period was extended by one year. The project was completed in December, 2006.

A3.5.1.1 Objectives

The main objective of JREDP Phase II was to improve the quality of life of rural people within the project area by extending rural electrification and development activities. Upon completion, JREDP II was able to achieve the following objectives:

- It provided access to clean energy to 4,160 households. 66 small enterprises were established which are providing services to the entire 25,000 people residing in the project area. It created

[21] Source: JREDP II Completion Report, HPL, March 2007

awareness among the users regarding safe and proper use of electricity for income generation activities and ownership of the entire system.

- The Jhankre power plant, after it had been completely destroyed by Maoist rebels, was refurbished and upgraded with increased generation capacity and production efficiency,
- 35,000 people from the project area and adjacent locations have been directly benefited from the construction of basic infrastructures such as toilets/biogas plants, water supply & irrigation schemes, schools and trails/roads/bridges.
- 151 women and 47 youth received skill enhancement trainings and empowerment and have access to alternative income generation sources.
- Awareness was raised particularly among the scheduled caste people and ethnic groups and specially among women, on various social issues, HIV/AIDS, family health and sanitation, environment protection and management of local resources and productive uses of electricity, through Non-Formal/Wide Literacy program,
- Local markets were developed with the help of road access improvement and supportive environment created for self promotion of income generation activities.
- Establishment and institutional development of KREC have improved the beneficiaries capabilities for managing the electrification system as well as other future endeavours.

Norway provided financial assistance estimated at NOK 19.3 million for producing the planned project outputs.

A3.5.2 Results

Following is a description of the results chain, in which short-term results (outputs), medium-term (outcomes), and long-term results (impacts) are distinguished. The assessment is based on a desk study. The weakness is that at the higher levels of the results chain, no reporting has been available. Secondary information, i.e. a mid-term review report[22] from 2004 is also used.

A3.5.2.1 Outputs

The output includes the 500 kW hydropower station, rehabilitated after Maoist sabotage, and upgraded with funding from HPL to 635 kW, an extensive distribution grid, connection to the NEA network. This fell short of the original plan of 4,650 connections by about 10%, and was reported to be due to the implementation difficulties encountered, mainly due to political disturbances.

In addition, the project has produced a range of rural and social development outputs.

Location: Jhankre, Thulopatal VDC, Dolakha & adjoining VDCs of Dolakha & Ramechap districts
Owner: KREC, Khimti Rural Electric Cooperative
Implementing agency: BPC Hydroconsult in phase I, HPL project unit in phase II
Funding[23]: Norway, NOK 19.3 million, HPL contribution NOK 4.7 million. Total cost: NOK 24 million.
Construction Period: 1996 to 2006
Scheme type & power output: Run-of –river, 500 kW, later upgraded to 630 kW
11 kV Lines: total 70.35 km
400 V distribution Lines: total 42.08 km
220 V distribution Lines: total 172.09 km
Consumers connected: 4,160 (2006)

Table A3- 11: Salient Features of JREDP

[22] Mid-term review of JREDP II, Scanteam 2004

[23] Amount of Norwegian funding for phase I was not available and is estimated at NOK 3.5 million. HPL contribution is also an estimate.

This ranged from literacy classes for low caste women to enterprise development and road construction. And also included institutional and organisational development, such as the formation of mothers groups, forest user groups and water users groups, and most important, the rural electric cooperative.

A3.5.2.2 Outcome

Provision of electricity to 4,160 households. There is a high connection rate of households, almost 100%, according to information from the project. Electricity and other services such as drinking water, sanitation, and improved schools have become a reality, and are used increasingly by the population. The rural electric cooperative is functional, with a democratically elected managing board. It is gradually taking over the management operation and maintenance tasks of a rural utility. Electricity is available to the local people at a cost of NPR 3.0 per kWh on average.

A3.5.2.3 Impact

It is reported that the overall living standard has been lifted above the level of areas outside the project. There is evidence of improved sanitation, a steep increase in improved drinking water provision, more diversified energy provision and use, including electricity, biogas and better managed forest use, and a broad diversification of income possibilities. Overall, poverty is said to be reduced to a level below the district and the national average.

A3.5.3 Findings

A3.5.3.1 General

The project has unfortunately only reported on outputs at the end of the second phase, not on outcomes of the measures implemented, such as effect of imparted training, the use of electricity, actual production from forest nurseries, increase in yields due to better irrigation, etc. This has put a constraint on the evaluation in assessing impacts, and only a cursory description of perceived results can be given.

The project has implemented all planned activities and achieved almost all the outputs. The period was unfavourable for conducting the necessary activities due to the adverse situation created by the insurgency in the country. This has been the most severe project risk, which could not be avoided, and resulted in severe damage due to sabotage. However, broad community participation enabled the planned activities to be completed, but due to the environment created by the security situation in the project area and in the country overall the desired outcome could not be achieved fully. Most NGOs and CBOs either abandoned their planned work in the area or limited these activities to the district headquarters, and government institutions were non-existent during the project period. Despite all these factors, the project continued to function and it was successful in implementing most activities.

All activities under the rural development programme have been formally handed over to the beneficiaries. The user committees are now managing the development works since the take over. Proper mechanisms for their long term operation/management, such as setting up of revolving fund, training to service providers supplemented with necessary tools/equipment for repair/maintenance of these systems has been completed. Regular collection of user fees and timely repair/maintenance of the systems have been monitored and found functioning well.

After the recent restoration of peace in the country, the environment is more conducive to carry out the planned activities in the upcoming follow-up project. The following lessons have been learned.:

- Coordination with the concerned line agencies, I/NGOs, CBOs and beneficiaries for planning, management and execution of the planned activities is conducive to project success.
- Follow-up and monitoring of rural development activities implemented in JREDP II is needed to achieve long-term sustainability.
- Institutional development of KREC is not complete, it needs to be continued

Jhankre has three challenges that it must address:

- Generating its own power introduces a level of technical complexity far greater than buying power in bulk, or having the service provided by a professional utility. Staff training and continued capacity building is still required.
- The status today is that NEA refuses to buy surplus power from Jhankre generation. This reduces the mini hydro load factor, and is a missed opportunity to generate additional income.
- The organisational form and ownership is through a local cooperative. The model is as yet untested, and its success depends on competent and motivated staff. To achieve long-term institutional sustainability is a challenge, and the risk of failure exists.

A3.5.3.2 Quality of inputs

The first phase of the project has been implemented by BPC, under a contract with HPL. It is not surprising therefore, that the quality of work done was of the standard that BPC had adopted earlier. A weakness of the concept was to define a corridor along the transmission line for electrification. This resulted in completely arbitrary borders been electrified and non-electrified areas, and was difficult to defend vis-à-vis non-electrified households across the border. It led to dissatisfaction within communities, and in phase 2 of the project, more acceptable political boundaries of the villages were adopted to demarcate electrified and non-electrified areas to the largest possible extent.

For the second phase of the project, HPL as the project implementing organization, decided to build up its own dedicated project unit that was fully staffed, and professionally managed. This was a move to bring the project under more direct control of HPL management, and it may have been a factor in further improving input quality.

There wee three categories of activities in the second phase of the project: Rural electrification, institution development and rural development works.

The project distributes power from its own small hydro plant that was originally built to supply construction power for Khimti, and has built the distribution network to connect individual households in the covered village communities. The original plant was completely destroyed by Maoist bombing in 2003, and there were various problems in its rehabilitation. A new upgraded scheme was commissioned only recently, but this is still ridden by problems of intake and penstock stability. There is therefore an issue of engineering quality.

The sub-project "rural development works" covered 12 thematic areas. The main objective of conducting these programmes was to support the local populace to conduct various awareness raising and income generation activities and helping to build various basic infrastructures to raise the living standard of the people living in the project area. Some of the activities appear to have lacked focus, affecting the quality of inputs. A main reason for this is seen in the impossibility to conduct a full socio-economic base line survey, due to the Maoist threat.

Institutional development had the formation of a rural electric cooperative (KREC) at its core. This proved difficult for several reasons. Election of the KREC executive committee was severely delayed due to the non-conducive environment for conducting the election. Later the election was carried out in coordination with the security forces stationed at the Khimti plant. KREC is also the first electric cooperative in the country, and this raised many questions and delays with the registration authorities. The employment and qualification of KREC staff is an issue that is not entirely resolved. Due to the delays, not all quality inputs required in institution building could so far be provided.

A mid-term review of the Jhankre Rural Electrification and Development Project[24] found it to be in full compliance with emerging international guidelines such as proposed by the World Commission on Dams. In the absence of the fully developed and functioning legal framework in Nepal – and the sub-continent – regarding the rights of project-affected populations, it is a pilot scheme of Good Governance. In the opinion of the review, the model should be adopted on a mandatory basis and improved upon, in all future hydropower developments in Nepal. The evaluation endorses this view,

[24] Midterrm Review of Jhankre JREDP, Scanteam 2004

and finds that this also reflects the quality of inputs. The project is a good example of a successful public private partnership in which private sector owners of the Khimti HEP and Norwegian development cooperation joined hands.

A3.5.3.3 Efficiency

The project was implemented according to plan, despite political disturbances in the area, and resources have been efficiently used. It was possible to raise considerable community participation, over all resulting in very high project efficiency.

A3.5.3.4 Effectiveness

Across more than 12 different activity areas, effectiveness has been variable. Construction works, for example, such as small bridges, foot trails, school houses and drinking water supply works, effectively addressed local needs, while the services provided in health, literacy and forest use, have been considered less well targeted, and of lower quality, hence less effective.

A3.5.3.5 Relevance

The relevance of the project is seen under several aspects. The project falls largely into the time period past the World Commission on Dams report[25]. In this connection, the project is very relevant because it is an early and good example of local benefit sharing. It is of high relevance under this aspect. Formation of a rural electric cooperative is also relevant, because it can be a pilot approach to local ownership of rural electrification. In the national context, the project is relatively small, and is therefore only modestly relevant.

A3.5.3.6 Sustainability

Rural electricity services are considered sustainable in technical terms. Institutional sustainability is expected, but there is a risk of failure of the cooperative. Economic sustainability is severely affected by the fact that the project cannot sell excess power to the national grid. In terms of an adequately protected environment, the project is considered sustainable.

A3.5.3.7 Benchmark and Economic Benefits

The benchmark in table and economy diagram shows about average relevance for the project, but considerably higher than average efficiency and impact. Sustainability is below average, because of uncertainties in relation to the operation of the rural electric cooperative.

Benchmark factors compared to all other interventions						**Net benefit** over useful lifetime: 25 yrs mill USD	
	Efficiency	effectiveness relevance	sustainability	impact country	impact poor		
Jhankre	170%	98%	80%	149%	187%	country	34
best	249%	129%	115%	273%	278%	the poor	3.5
worst	16%	78%	25%	7%	18%	project	108

Table A3- 12: Jhankre Benchmark of DAC criteria and net benefits

The net benefits of the project, accruing over time, are expected to be considerable. One reason for this is that broad community mobilisation and participation has resulted in considerable indirect benefits, in many sectors.

The economic situation of the project can be seen from Fig. A3- 10.

[25] published 2000, it makes recommendations as to mitigation of impacts and local benefit sharing at the locations of large infrastructure projects such as hydropower development and dams.

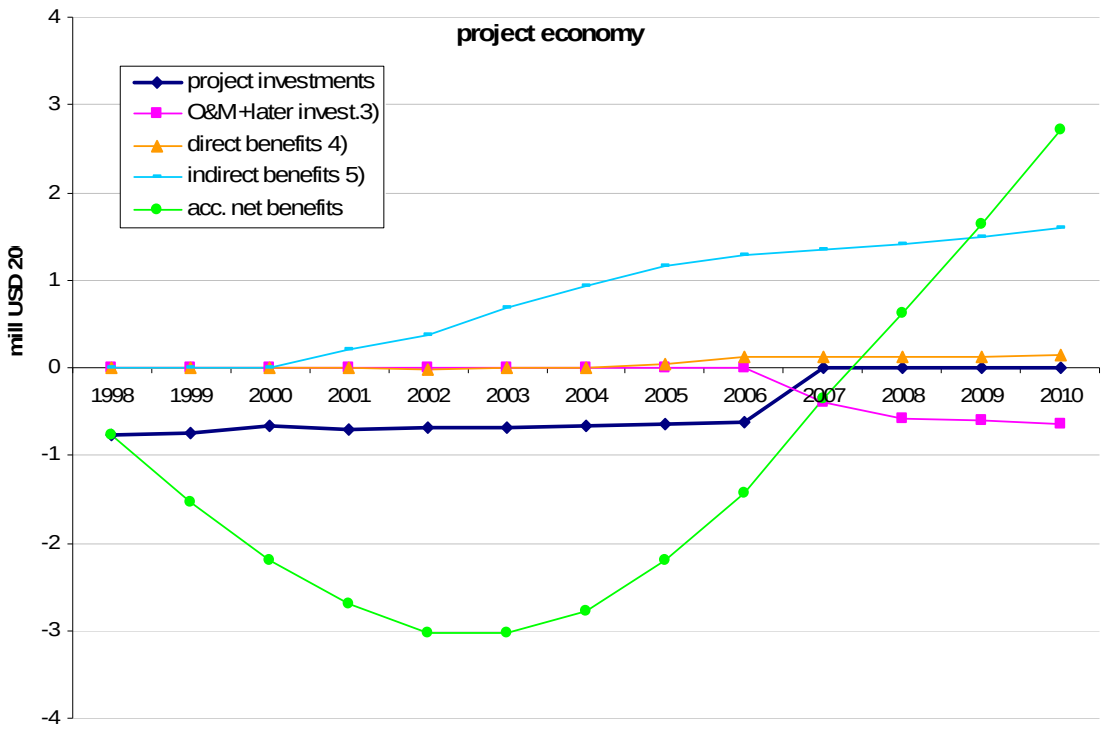


Fig. A3- 10: Jhankre Rural Electrification and Development Project Economy

A3.5.4 Conclusion

Considering both phases, the project has been going on for 11 years, and this seems like a very long time for a physical output that is relatively modest. This is put into perspective when it is noted that a population of about 35.000 has benefited, and that all activities have been carried out in a participative manner. The period coincides with about as many years of Maoist activity, which at times was violent and disruptive. The project has prevailed, and in essence, it has delivered perhaps more than could realistically be expected under the circumstances.

The main direct benefits come from the replacement of kerosene for lighting, and the replacement of fossil fuel for thermal generation, which would be the only realistic alternative in a situation of limited and insufficient hydro capacity. Significant indirect benefits accrue at the local level from the broad range of development works implemented, the institution building efforts, and improved production and public services, made possible by electrification.

The project is expected to result ion considerable net benefits over its life, but there is some uncertainty as to the sustainability of the institutional arrangements, i.e. the economic survival of the electric cooperative.

A3.5.4.1 Success Factors

- A 10 year perspective: Appears important. Success often does not come about in a linear manner. The crucial factor is therefore to provide assistance for a time period
- A broad-based approach addressing a large range of needs in a pro-poor manner.
- Institution building and people's ownership principles applied

A3.5.4.2 Challenges

The project's strength, local institution building, is also its weakness and greatest risk. Rural cooperatives in Nepal have a history of becoming politicized, and a tendency of directing benefits to those few in power. A rural electric cooperative, in which all families are a member, has a different character. It thrives from providing service to as many as possible. Adverse developments may therefore be less critical. Nonetheless, given an ambitious task, which needs to be carried out under less than ideal circumstances remains a major challenge. This in no way implies a critical stance of the evaluation of the institutional concept implemented, on the contrary: It is commended as forward-looking and progressive, but it is felt that the institutional risk needs to be pointed out.

At the national level, so to say at the interface to the outside world, KREC, the rural electric cooperative, faces the challenge of being allowed to sell surplus power to the NEA grid. The mid-term review carried out in 2003[26] has briefly shown that it may be very difficult for KREC to achieve economic sustainability if it cannot sell its surplus power. However, unfortunately, exactly this is the case, because of the refusal of NEA to buy.

A3.5.4.3 Lesson learned

The project made the early experience that the geometrical demarcation of a project area, i.e. a corridor of a determined number of kilometers to the left and right of the transmission line, is not understood or well received. The fact that this was based on the legal requirements of Nepal at that time, points to a problem at that level, that should be addressed Project area demarcation is a sensitive matter. It must be done in a participative manner to be accepted by the local people. It appears that existing administrative boundaries should be respected, in order to find acceptance.

[26] *ibid....*

A3.6 Butwal Power Company Privatisation Effort

The intervention is not an actual project, but a process assisted by Norway. Therefore, only a brief assessment is made, based on document study and interviews. The purpose is to answer a specific question that has been raised in the TOR: What are the effects of privatization of BPC on the local community and other stakeholders? In addition, it is of interest to look at the BPC experience as a development model.

A3.6.1 Introduction

The Butwal Power Company Private Limited was registered in December 1965. The owners were the government on one hand and UMN, with a slight share majority, on the other. This remained so for thirty years. Then, in 1995, HMG handed over the Jhimruk power plant to BPC, against most of the shares held by UMN. Hence, the government took over the company almost entirely, with the declared intention however, to privatise it as early as possible.

The initiative to drive the process forward was later taken by UMN, who eventually was able to motivate a group of Norwegian as well as Nepalese potential investors to join hands in bidding for the company.

A3.6.1.1 Objective

The objective of the intervention was to enable privatisation of the company, which had long been intended and agreed to with the government.

The process of BPC privatisation took a very long time, mainly due to political manoeuvring of the relatively inexperienced democratic governments at that time. After more than four years of effort, in spring of 2002, on the basis of a bid on HMG's fourth privatisation tender notice for BPC, the consortium of Interkraft Nepal and Shangri La Energy Limited, was declared the preferred bidder, and negotiations started in the middle of March. The sale of BPC shares, thus seemed to have come to a successful conclusion, when, at the end of March, both of BPC's power plants, Andhi Khola and Jhimruk, were attacked and damaged by Maoist insurgents. The damage to Andhi Khola, was limited, and it could be repaired speedily, but Jhimruk suffered major damage and was shut down for an indefinite period. In this situation, the sale proceedings came to an abrupt halt. The bidders took the position that they would now not get what they had bid for, and HMG, citing tender requirements, refused to accept any discount on the selling price, or agree to deferred payment on account of the damage.

After a deadlock of more than half a year, Norway stepped in and agreed to provide financial support through an agreement with the government of Nepal, signed in December 2002, regarding compensation for the loss caused by the damage of Jhimruk. Norway made available a grant of NOK 22.2 million to HMG, for the purpose of compensation of Jhimruk power plant damage. This amount was to be transferred immediately to BPC, and then to the buyers of BPC shares, who agreed in a parallel agreement to carry out complete repair works to bring Jhimruk back to its full operational capacity, regardless of the actual cost. A completion report was to be submitted no later than within 15 months of signing the grant agreement.

All objectives and conditions in the various agreements were successfully met. It was reported upon timely completion of the repairs that it had been possible to increase Jhimruk output by more than 25%, thus, the condition to achieve full operational capacity was regarded more than fulfilled.

The agreement to rehabilitate Jhimruk against the grant received was regarded as a lump sum contract. Direct costs for the rehabilitation however, was less than half of the funds provided, and after setting aside amounts for taxes to be paid and NPR 40 million for equipment still to be provided to carry out further enhancements, almost one third of the grant was left over to pay for the loss of income during the repair period. According to the proponents, this compensation covered somewhat more than 20% of the actually experienced loss of income.

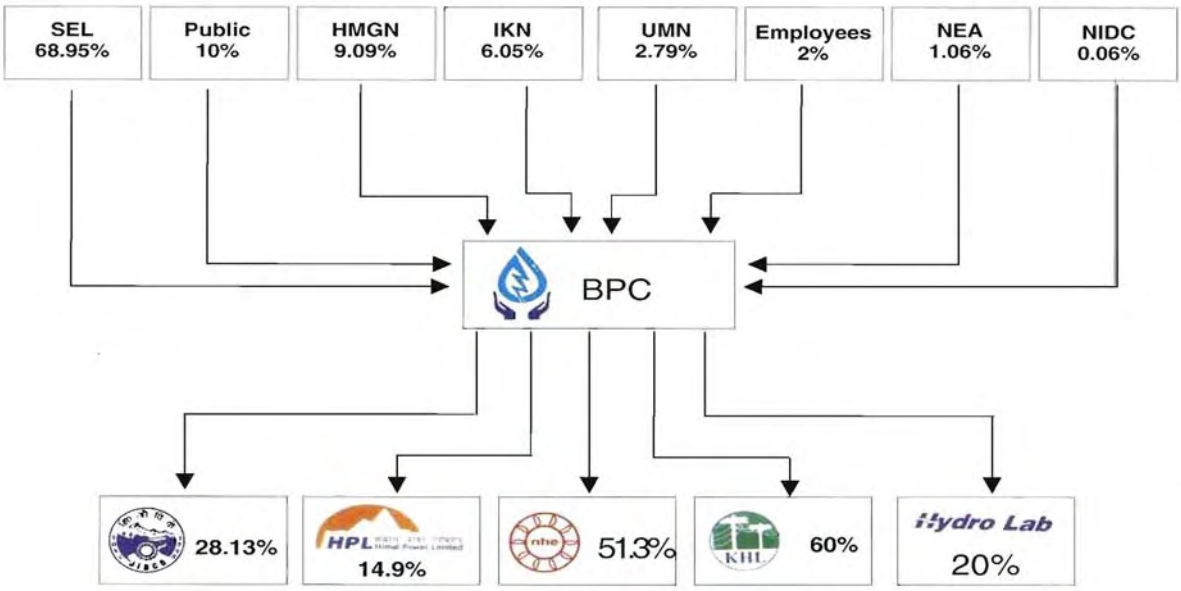
Financial assistance provided by Norway amounted to NOK 22.2 million (as mentioned above).

A3.6.2 Results

There is no full assessment according to DAC criteria here, because the subject is not a real project, but a process, to which assistance was provided. Nonetheless, the results chain is briefly described.

A3.6.2.1 Output

Thanks to the grant from Norway, the government of Nepal received the full price for BPC, which was bid on the basis of fully operational power plants, when in reality the company had no production, and had to pay for operation expenses without income. Thus, HMG was compensated fully, and did not have to take any rehabilitation or other responsibility. Also, there was no need to expose the bidding process to possible investigation in the event of lowering the price, as the government officials were afraid of.



SEL	=	Shangri-La Energy Limited	IKN	=	InterKraft Nepal AS
NEA	=	Nepal Electricity Authority	NIDC	=	Nepal Industrial Development Corporation
HMGN	=	His Majesty's Government of Nepal	UMN	=	United Mission to Nepal
BPC	=	Butwal Power Company Limited	NHE	=	Nepal Hydro and Electric Pvt. Ltd.
HPL	=	Himal Power Limited	JIDCO	=	Jhimruk Industrial Development Centre
Hydro Lab	=	Hydro Lab Private Limited	KHL	=	Khudi Hydropower Limited

Fig. A3- 11: Shareholding structure of BPC

A3.6.2.2 Outcome

Private investors committed themselves to buy all BPC shares from government at the full price, when Interkraft Nepal and SEL were enabled to make the down-payment for BPC, thanks to prompt receipt of the grant. However, they also took the risk and responsibility for the complete repairs. As shown above, taking this risk paid off handsomely. On the other hand, there was still a considerable amount of income loss to be borne by the buyers.

Ultimately, Norway has provided crucial assistance to privatisation of BPC, which was an objective formulated many years earlier. The outcome is a broad based local engagement in the power sector, as illustrated in the shareholding structure of BPC in Fig. A3- 11 above.

A3.6.2.3 Impact

The impact of the privately owned utility company BPC is considerable. It has become a player in its own right, is able to attract donor funding for support to more rural electrification, and it also brings about new investments from local sources in small hydro development, without donor assistance. Its impact appears sustainable.

A3.6.3 Findings

DAC criteria do not apply for the BPC privatisation effort, and there are no cross-cutting issues involved. Therefore, such assessment is not possible. The following are general findings.

Not all stakeholders and observers are of the opinion, that the process was entirely fair and justified. Questions are raised why the grant was so high in the first place, why the government did not carry at least some of the consequences of damage caused to its own property, and why the whole grant was claimed as a lump sum by the owners-to-be of BPC, all implying that Norway may have been too generous. The evaluation has no opinion of its own, but it wishes simply to establish, that:

- The grant was agreed to only after earlier efforts, including legal advice and mediation that had been provided, failed to produce a result.
- There is no shady deal. All agreements and transactions are documented, and on record, and it appears that presented facts, that were the basis for decisions, are credible.

The process of BPC privatisation was lengthy and tedious. Despite this, many regard it as the most successful privatisation effort that has been undertaken in the country. There remains the question of what difference it makes to the various stakeholders. What is the impact of a privatised BPC? Based on documented information, stakeholders perceptions obtained from interviews, and analysis of the overall situation, the evaluation attempts to give some answers:

- The hypothetical case of a fully government owned BPC: Why should it have been allowed to co-exist alongside the large NEA? There is little doubt that forces would have been at work to annihilate it by integration, and that this could have happened at the whim of NEA. In such an event, the distinctly different company culture of BPC would have eroded over time.
- If not integrated into NEA, a perceived disadvantage of a government-owned BPC is the politically motivated staffing policy that would have prevailed. Most stakeholders would agree that this happens in government entities, to the detriment of performance.
- Whatever the case may be, BPC has in fact made appreciable progress after privatisation, and it has become more efficient as can be seen from key performance data in

Nepal power system development: BPC						
Data/KPI	1992	1995	1998	2002	2005	2006
Energy available (GWh)	25.88	77.62	83.66	85.24	97.82	102.08
Energy sold (GWh)	25.16	75.15	81.04	80.95	93.25	97.06
Losses %	**2.8%**	**3.2%**	**3.1%**	**5.0%**	**4.7%**	**4.9%**
Total No. of customers	754	1,822	6,405	19,354	22,935	26,543
growth against prev. Year		43.4%	79.0%	16.3%	5.3%	11.0%
total Revenue from sales (Mill. NPR)	29.57	46.72	183.221	236.278	323.134	358.418
O&M expenditure (MNPR)	11.138	19.33	68.977	107.397	128.025	128.185
Net profit Mill. NPR (Loss)	**18.432**	**27.39**	**114.244**	**128.881**	**195.109**	**230.233**
Number of staff	93	229	304	343	306	312
Customers per staff	**8**	**8**	**21**	**56**	**75**	**85**
MWh sold per staff	**270.54**	**328.17**	**266.58**	**236.01**	**304.74**	**311.09**
Revenue (NPR) per staff	**317,957**	**204,017**	**602,701**	**688,857**	**1,055,999**	**1,148,776**

Table A3- 13: KPIs of BPC, Nepal

A3.6.4 Conclusion

- Norwegian funding for the rehabilitation of the damaged Jhimruk hydro scheme has ultimately made privatisation possible.
- There is evidence that as a privately owned company, BPC is proud of its history and holds up values that are different from those prevailing in government, other local businesses and NEA, for example visible in approaches to rural electrification that are more pro-poor. Non-metered low consumption connections with a very low-cost tariff category is a BPC innovation, and NEA has not adopted it. On the other hand, it is exactly this approach even within BPC that is eroding the effort to make rural electrification more profitable.
- Some of the consumers in rural areas complain that BPC is increasing tariffs and is charging for services that earlier were free of cost. The reason for this is believed by many to be the fact that the privatised BPC is attempting to increase profits. BPC is proposing a general tariff increase to the authorities, and this may have more to do with compensation for inflation. Overall, the evaluation's impression is that BPC customers get slightly superior service compared to what NEA provides. This impression is based on own assessment and not on a representative customer surveys, or similar.
- At the macro level, a private BPC is clearly resulting in private investment in the power sector, in excess of NPR 1 billion, which otherwise would not have taken place. It can be argued that this reduces the debt of the country by a similar amount.
- An indirect and not necessarily intended impact is the leverage on the Nepalese private investment in the power sector. The investors in BPC have made it credible for others to invest, mostly in smaller, other projects. One of the most recent projects, the 4 MW Khudi HEP, most notably, was finally implemented because BPC took the lead and signed up for 60% of the share capital. Other private sector hydro schemes, meanwhile, amount to a generating capacity of 8 MW with a local investment of the equivalent of NOK 85 million.[27] Another 30 MW of capacity is under construction, and for more than an additional 100 MW power purchase agreements have been signed with NEA.

A3.6.4.1 Success Factors

It appears that timing has been the single crucial factor. If Norway had not been willing and able to provide assistance promptly, things may have taken another turn, for better or for worse. Hence, it is actually the flexibility with which assistance could be provided that has made the difference between success and possible stalemate.

[27] Source: GTZ Small Hydro Promotion Project. The referenced amount of USD 14.7 million is converted at the exchange rate of 5.96 NOK/USD

A3.7 Hydro Lab Pvt. Ltd.

Beginning with model testing for the Jhimruk HEP in 1989, the Norwegian Institute of Technology (today: Norwegian University of Science and Technology, Trondheim – NTNU) and the Engineering Institute of Tribhuvan University (IOE-TU) had cooperated for many years, before the Hydro Lab was established as a private sector entity. Norway has provided funding for research on the Jhimruk study. The second "Norwegian project" that benefited from the laboratory testing facilities was the Khimti I, 60 MW scheme, investigated in 1996. The tests were instrumental in the understanding of complex water handling and sediment issues and it was possible to improve the design of intakes significantly.

When dealing with water, first experiment, then use judgment … Leonardo da Vinci[28]

A3.7.1 Project Description

The key term to understand the need for the Hydro Lab is *"Steep, sediment laden Himalayan rivers"*, which indeed are special with regard to the complexity of problems they pose.

It was necessary for Nepal to initiate a research centre to study and solve the complex issues and problems associated with hydraulics and sediment in its Himalayan rivers for sustainable water resources development. Institute of Engineering, Tribhuvan University (IOE-TU) in mid eighties planned for a Water Resource Research Centre in Nepal. A hydraulic laboratory was set up with joint co-operation between the Norwegian University of Technology and IOE-TU to carry out physical hydraulic model study of headworks of 12 MW hydropower project. The study continued for the period from1989 to 1991. Professor Dagfinn K. Lysne from NTNU was instrumental in establishing this hydraulic laboratory. Similarly, the physical model study for the headworks of 60 MW Khimti I hydropower project was also performed in the same laboratory in 1996 to 1997. In order to provide continuation to this work, Hydro Lab Private Limited was established with the financial support from the Norwegian Agency for Development Cooperation. Since its establishment Hydro Lab has cooperated with NTNU and the International Centre for Hydropower (ICH) Norway, who both have been providing scientific and technical support to the Hydro Lab.

Norway agreed in 1999 to fund the cooperation between the newly established Hydro Lab, and the International Centre for Hydropower (ICH), with a budget of NOK 7.4 million for a period of five years, with the purpose of implementing the development plan for the Hydro Lab. A further contribution of NOK 6.5 million was agreed on in 2006 for a continuation phase. Of this, one million was disbursed in 2006.

Norwegian financial assistance amounted to a total of NOK 8.4 million in the evaluated period.

A3.7.1.1 Objective

The importance of physical hydraulic scale model is accepted and recognized because of the fact that empirical formula and computer simulation are not sufficient for a reliable hydraulic design of headwork structures. As every river is different from the other in terms of hydraulic behaviour and sediment transport, model study becomes essential to ensure the sustainability of designed headworks in a proposed location.

Water resources are the most important natural heritage of Nepal. Nepal's economy can be uplifted only through harnessing the abundantly flowing steep rivers in Nepal. Rivers are exploited by building structures for hydropower, irrigation and drinking water projects. For the successful growth of water resource development projects, it is important to have a centre which can fulfil the technical need for safe and reliable design and operation of the projects. Hydro Lab was founded to meet this urgent need. It is worth mentioning that Hydro Lab is the only and first research organisation in Nepal which

[28] From Hydro Lab brochure

is capable of performing physical hydraulic model studies for water resources development projects. Besides, it has developed expertise in hydro turbine efficiency measurement and sediment studies.[29]

A3.7.2 Results

Results assessment by the evaluation has been limited to document study and interviews with staff of Hydro Lab and its board. A review report of 2003[30] is available and was used for pertinent information.

A3.7.2.1 Outputs

The project provided training and consultancy by top and high level Norwegian staff. With this, the objective of a well qualified staff, was achieved.

The objective of "a modern, well equipped research laboratory in operation", was fully achieved. Previously existing lab facilities were upgraded, crucial lab instruments were procured, and an adequate and representative office building was constructed.

A3.7.2.2 Outcome

Hydro Lab is today a leading research lab in the region. It is recognized far beyond the borders of the country. It conducts crucial research and builds knowledge relevant for water resources development. Despite this, its business is in a delicate position, as it depends entirely on sector activities actually taking place, and Hydro Lab's ability to position itself at the centre of attention.

It may be appropriate to represent the results of Hydro Lab development through their own mission statement,[31] quoted in the text box below -

The objective of Hydro Lab is to carry out research and provide consulting services in hydraulics and sediments. Its main aim is to assist water resource engineering related professionals through physical hydraulic model studies in achieving successful design and operation of headworks. Along with the above mentioned objective, Hydro Lab has its vision, mission and values as follows.

Our Vision: Hydro Lab strives for a sustainable development of the water resources in Nepal for the benefit of the Nepalese people.

Our Mission: To be an ethical and professional research consultant, promoting innovative techniques for the water resources development.

Our Values:

Integrity - We seek to be truthful and transparent. We will act honestly in handling contracts, respect others and show responsibility in fulfilling our duties. We will live by our agreements and commitments.

Fairness - We strive to treat fairly our staff, our customers, our suppliers and the communities in which we operate. We do not try to get the most out of a negotiation or transaction at the expense of others.

Professional Competence - We desire to excel in our work and to improve our competence. We expect to achieve demonstrable results.

Training - We are committed to the daily task of training others and to passing on our skills and values.

Teamwork - We achieve our greatest success by working together as a learning organisation. We respect new ideas no matter who brings them up.

Service - We seek to identify people with, their needs and aspirations, sharing our time and capabilities without considering any tasks too menial or demeaning.

Alliances - We strive to achieve innovative, responsive and productive partnerships with institutions or organizations having common area of professional interest.

Environment - We value the conservation, management and enhancement of the environment.

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[29] from Hydro Lab's web site: http://www hydrolab.org/about htm

[30] review of Hydro Lab pvt. Ltd, Norad/NCG March 2003

[31] Source: Hydro Lab web site

The statement is an expression of Hydro Lab's high professional standards. However, it fails to convey the claim to a sizable chunk of the market, commensurate with its competence.

A3.7.2.3 Impact

Hydro Lab has had a significant impact on water resources development in Nepal, and perhaps in the entire Himalayan region. When using water from Himalayan rivers, sediment handling is of crucial importance. Effective water intake and sediment separation designs are the trademark of Hydro Lab and its basis for an increasing impact on the industry. Knowledge gained has the potential of making water resources use more sustainable, and at the project level, economic benefits accrue due to reduced investment costs and lower operation costs.

A3.7.3 Findings

Discussion of general aspects and DAC criteria assessment follows.

A3.7.3.1 General

Development of water resources bears many risks: hydrological, geological, environmental, financial, etc. Nepal's response in addressing some of the severe risks is the knowledge that Hydro Lab builds about the local and specific conditions for water resources development.

Through its work, Hydro Lab explicitly addresses the cross-cutting issue of environment. Gender and poverty are not considered as applicable to the context.

Hydro Lab is doing excellent work, but largely fails in using the good results to its maximum own advantage. For example, it may not seem very informative for potential clients, when Hydro Lab claims that it could "save a lot of money" for its client, by making certain suggestions for design changes. This should be much more concrete, with hard facts, and, in mutual agreement with the client, broadly publicised reports.

A3.7.3.2 Quality of inputs

In addition to the experience gained in the two model studies that had already been carried out, and the modest infrastructure already existing, the following inputs were provided.

- A credible ownership structure, with BPC, Institute of Engineering of TU, Hydroconsult pvt. Ltd. another UMN company, and PEEDA, the People's Energy and Environment Development Association, an NGO associated with UMN, as shareholders.
- The prospects of recruiting competent Nepali staff. At that time, already more than 25 students had passed from the NTNU master course. In addition, NTNU would provide specific training.
- The agreement with ICH provided for the part-time assignment of a responsible professor, a part-time technical manager from NTNU, and a laboratory research engineer, as well as a senior laboratory technician, to be made available as needed.
- Staff training to be provided through continuous on-the-job training, structured training at the laboratory, and a training programme at NTNU and other relevant institutions.

Judged by the results, the inputs provided were of satisfactory quality. A review carried out in 2003 had conducted interviews with users of Hydro Lab services. The results are encouraging. All users were fully satisfied with the work done, some going to the extent to state "as good as in Norway", when asked about work quality. This reflects the high quality of inputs.

A3.7.3.3 Efficiency

The close cooperation with ICH and NTNU has resulted in high cost-efficiency both with regard to the use of Norad grants, as well as paying customers funds. In the process, the infrastructure of the lab was built up, training was provided, on-the-job, as well as more formally, and, most importantly, actual problem solutions in water resource development were elaborated in a timely manner.

A3.7.3.4 Effectiveness

The project has achieved its institution building objectives. It has not achieved its business objective of becoming economically independent and profitable.

A3.7.3.5 Relevance

Hydro Lab is of extraordinary relevance for Nepal, and perhaps for the region. It can play a major role in the economically sustainable development of Nepal's and the Himalayas water resources. With its hands-on approach, it is relevant for the training of professionals.

The cooperation with ICH and NTNU, and the links to formal training, are highly relevant for the stakeholders and students alike.

A3.7.3.6 Sustainability

Over the past four years, Hydro Lab has produced modest profits. This is not necessarily a proof of sustainability, as turnover is highly variable. For example, it was more than seven times lower in the financial year ended in mid 2006, compared to the previous year. Business depends too much on big projects in Nepal.

It has been frequently mentioned by the review, by the appraisal report for a new phase, and in minutes of meetings, that sustainability is a key issue. Reference is made to the difficulties that Hydro Lab faces in a sector that is highly politicised, unpredictable and in general slow moving. All this is outside the sphere of influence of Hydro Lab, and therefore further discussion is actually not helpful.

A3.7.3.7 Benchmark

Table A3- 14 summarises the benchmarks for the Hydro Lab. It is shown that efficiency achieved in project implementation is better than average, and effectiveness and relevance are at the average level. It is not possible to benchmark this project against other interventions in terms of sustainability and impact criteria. In general, there are no data for the calculation of sustainability factors in institutional support projects, and a calculation of impact is only possible in the longer term, and it involves research at the level of projects which were influenced by work and testing carried out specifically by Hydro Lab.

Benchmark factors compared		
	efficiency	effectiveness relevance
Hydrolab	125%	100%
best	249%	129%
Worst	16%	78%

Table A3- 14: DAC criteria benchmark for Hydro Lab

A3.7.4 Conclusions

In the good tradition of Norwegian assistance to Nepal, that followed a bottom-up and integrated approach, the Hydro Lab is a useful and necessary institution. It performs work of high value and quality, and through this, it has earned considerable recognition.

A3.7.4.1 Success Factors

The close institutional cooperation between Hydro Lab and NTNU is clearly the key success factor. It has provided benefits to both sides. NTNU gained a local partner for carrying out challenging empirical field research, and Hydro Lab benefited and learned from NTNU's expertise.

A3.7.4.2 Challenges

The main challenge is economic sustainability. Hydro Lab must improve its marketing, and adapt it to its declared strategic needs, even under adverse conditions. It means probably to be active regionally, if not internationally, and to be more assertive in marketing nationally. The fact is that there are a number of operating hydropower schemes that have not used services of Hydro Lab, such as

efficiency testing of turbines, as an example. It is noted in this context, that there appear to be no professional staff in this area, nor any experienced marketing advisers.

A3.8 Assistance to MOWR on Legislation

Norway entered into two agreements for the purpose of providing legal assistance to the government of Nepal. In August 1992, the agreements purpose was "assistance for the establishment of legislation concerning development of water resources"… Later, in February 1996, an agreement was signed, as a follow-up, with the purpose of "assistance for development of water related legislation in Nepal."

The first agreement was the result of two earlier visits by NVE, in November 1991, when a seminar was organised with the purpose of sharing the Norwegian experience, and a follow-up visit in March requested by HMG, in preparation for the later agreement.

A3.8.1 Project description

Norway provided an advisory team to provide high level policy advise to the Nepal authorities, who, at that time, had embarked on drafting legislation in various areas. It may be recalled, that this was the time when Nepal had one of its first democratic governments. Drafts of the Electricity Act under preparation were based on the recent Power Policy in India (1991).

When the NVE team first arrived in Nepal in 1991, there also existed a draft of a Water Resource Act. The prevailing intention was to focus on a general Water Resources Act, taking care of all kinds of use and management of the water resources in the country. The Norwegian experts advised against this strategy, as it was regarded to take too much time. The suggested alternative was to develop a special act for the Khimti project (work title "Lex Khimti"). The Nepalese authorities decided against this advice, and focused on an "Act on promotion of hydropower projects". The advisory teams' legal expert was asked to provide an input to this. It was in the end integrated into the "Electricity Act", as this was already tabled on the parliamentary agenda. The Water Resources Act 2049 (1992), and The Electricity Act 2049 (1992) were both passed by parliament in September 1992. An NVE status report of January 1993 called this "the first concrete result of the assistance".

Subsequently, the expert team advised and commented on adjacent legal areas, stressing the point that legislation required to be adjusted and harmonised as soon as possible.

During a further experts' visit in January 1993, the team assisted in drafting Regulations to the new Acts, through a three day seminar. This was followed by a broader information seminar. At the same time the team also advised on the preparation of a project agreement for Khimti. This concluded the activities in the first phase.

For the preparation of a second phase of legal assistance, an NVE team made three visits to Nepal, in 1994, 1995 and finally in April 1996. An agreement was then prepared with the Electricity Development Centre (EDC, today DOED, Department of Electricity Development),as the partner institution.

The strategy was the same as before, to "provide services of an advisory team from NVE… for the joint discussion of problems, and … outlining of important principles and possible solutions by the advisory team". Specific engagements, chiefly on the review of various acts, policies and related papers were determined, and a visiting and seminar programme for the staff of the partner institution were included. The total budget provided by Norad was NOK 2 million for this second phase.

A3.8.1.1 Objective

In broad terms, the objective was to assist Nepal in the elaboration of improved Water Resources Use Legislation.

Norway provided financial assistance for this project in two phases. The grant provided were of NOK 750,000 and NOK 2 million, respectively. Hence, total project cost amounted to NOK 2.75 million.

A3.8.2 Results

The results need to be seen in the light of unstable government due to the struggle for power of contending political parties. This affected the administrative reform process, which eventually was discontinued.

A3.8.2.1 Outputs

Top and high level advice was provided as well as training for department employees.

- Various policy papers, seminars and workshops.
- Advice provided on various legal matters

A3.8.2.2 Outcome

Norwegian expert advice has had a marked influence on the following policy documents, laws and regulations: Hydropower Development Policy 1992, Water Resources Act 1992, Electricity Act 1992, Water Resources Regulation 1993 and Electricity Regulation 1993. The only visible outcome of the second phase is added competence through training and advice.

- Legislation passed on Electricity and Water Resources
- Regulations passed on Electricity and Water Resources
- Khimti Project Agreement successfully signed

A3.8.2.3 Impact

Assistance provided in the first phase has made it possible to launch the Khimti HEP with private sector ownership. Successful conclusion of the Khimti agreement between the investors and the government is directly attributable to the „ground work“ done under the legal assistance.

Other developments include:

- Private sector development of hydropower has become possible
- Two medium sized power plants totalling 100 MW were built by private sector promoters under project finance.
- Another 6 small scale (1 to 10 MW) schemes were implemented, thanks to changed legislation.
- The need for amendment of the new legislation is recognised.
- The lack of harmonisation is increasingly causing investor uncertainty.

None of these impacts is attributable to second phase Norwegian legal assistance.

A3.8.3 Findings

A3.8.3.1 General

No specific risk or cross-cutting issue has been addressed by the project.

The first phase of legal assistance on water resources utilisation has been provided at a crucial point in time. It has been efficient in terms of use of high level resources, effective in terms of achievement of the immediate objectives, and highly relevant, to make private sector hydropower development possible.

A second phase has shown poor cost-efficiency when measuring concrete outputs against the cost of inputs. Effectiveness has been limited, and for this reason, it was of little relevance.

Two distinct reasons could be identified for this:

- Government in Nepal was not politically stable, affecting administrative efficiency.
- Norway assumed that the same strategy would be appropriate in a second phase, namely to provide limited and sporadic advice on a “on call” basis, as had proved successful in the first phase. However, the perception of officials from that time is that Nepal needed hands-on assistance and day-to-day coaching, to bring forward the various processes of formulating, discussing and modifying Acts and Regulations in various area. Incidentally, such assistance was provided for many years from about 1994 to 2005 by USAID. As a result, various draft laws and regulations exist. Any Norwegian influence in such documents is not evident.

A3.8.3.2 Quality of inputs

The Norwegian adviser team provided high quality input at a crucial moment in time. The Hydro Power Development Policy 1992, The Electricity Act 1992 and the Water Resources Act 1992 appear strongly influenced by the advice received. This was all achieved in the first phase of assistance, and concluded early in 1993 with a high quality seminar, as stated by persons interviewed.

Inputs in the second phase are uncertain, and cannot be assessed in a satisfactory manner. The evaluation has found that NVE lacked a working partner for three years. Several draft agreement versions were not signed. Finally, EDC was chosen to cooperate. By that time, USAID had taken over a strong role by providing a resident adviser team to work on the legal framework.

A3.8.3.3 Efficiency

The translation of advisory input into a legal product, was very efficient. This relates to the first phase of the project, during which the political framework conditions in Nepal were highly conducive.

In a second phase, the project "produced" knowledge through lectures and conferences. No further legal product was found to have been influenced by Norwegian assistance. This is due to the political turmoil that had set in those years. Efficiency for this second phase, when comparing inputs to output, was low.

A3.8.3.4 Effectiveness

The first phase was highly effective: A legal framework that permitted private sector involvement in power development was established, and put into practice through the Khimti HEP. From this, both Norway and Nepal benefited. Nepal achieved additional, much needed generating capacity, and Norwegian investors were enabled to enter the sector, and participate in a majority position in a lucrative project.

In a second phase, the political environment was not conducive to effectiveness, but it was also found that Norway did not provide what Nepal wanted most. Norway offered high level policy advice on an occasional basis, while the ultimate partner, identified two years into the project, is reported to have required hands-on substantial implementation assistance. Effectiveness of the second phase was therefore low.

A3.8.3.5 Relevance

The first phase was highly relevant. It helped Nepal in moving ahead with private sector hydropower development.

A second phase had little relevance, as evidenced by the lack of effectiveness.

A3.8.3.6 Sustainability

Political turmoil over the past 10 years has severely undermined sustainability. Today, drafts of new legislation exist, but these in effect, will "wipe out" earlier Norwegian influence, for better or for worse. Hence, from the point of view of Norway's intervention, it was not sustainable.

A3.8.3.7 Benchmark

The computation of efficiency, relevance and effectiveness shows average results, well in line with qualitative assessment.

Benchmark factors compared		
	efficiency	effectiveness relevance
MOWR	93%	78%
best	249%	129%
worst	16%	78%

Table A3- 15: DAC criteria Benchmark Legal Assistance

A3.8.4 Conclusion

The intervention of Norway in the legal area was initially an important contribution to a democratic government that had initiated political reforms. Unfortunately, for reasons explained above, continuation of Norwegian advice was later not effective, and drafts of revised legislation are heavily influenced by other donors, in particular USAID.

A3.8.4.1 Success factors

Good timing and appropriate inputs in the first phase.

A3.8.4.2 Lessons learned

In a situation of political instability, the risk of project failure is very high.

Whether Nepal communicated clearly what it needed, and/or whether Norway could not or did not want to provide it, may be irrelevant in retrospect. The lesson that can be learned from the experience is that complete clarity and mutual understanding early in the process is essential.

A3.9 Khimti Khola Feasibility Study

This is not a full evaluation, but discussion of the leverage effect of Norwegian assistance that ultimately raised private sector finance for project implementation of the 60 MW hydro scheme. An answer is also sought to the question: Was BPC up to coping well with the complexity introduced by the larger scale project?

Information was extracted from various project documents[32], and cross-checking of some of the facts was possible in interviews with stakeholders.

A3.9.1 Project Brief

The objective of the Feasibility Study was "to prepare a feasibility report which meets the requirements of the Asian Development Bank and the World Bank for the Khimti Khola Hydro Power Project by the latest 31 October 1992". This overall objective was achieved in the 4 volumes of a presentation Feasibility Report. The Draft Final Report was submitted in November 1992. Following receipt of comments from many parties, the final report was dated April 1993.

A3.9.1.1 Objective

To produce a study and related documents that make it possible to raise finance for project implementation,

In conducting the Feasibility Study, technical economic and environmental aspects were considered, in an integrated manner. The Feasibility Report incorporated an Environmental Impact Assessment. Specific tasks that were carried out were:

- **Topographic survey** of key sites for project design, including establishing control survey throughout the project area.
- **Geological mapping** as an extension of work done previously by Nepal Electricity Authority (NEA)
- **Borehole drilling and geophysical investigations** in the critical area at the top of the pressure shaft.
- **Hydrology:** A comprehensive review of existing data and establishment of a reliable database for the size and design of the scheme and for energy output calculations.
- **Power market studies** to determine the appropriate connection point to the national grid.
- **Engineering design** sufficient to produce layout drawings for all significant components of the scheme, and to prepare a cost estimate.
- **Economic and financial analysis** to determine the viability of the project.
- **Environmental impact assessment** to establish the impact of the scheme on the biophysical and social environment, and recommend any necessary mitigation measures.
- **Implementation:** Prepared a summary of the organisational and legal basis on which the scheme could proceed as a private sector development under the new FM/MN policies for the power sector.

Norway provided financial assistance amounting to NOK 3.78 million for the project. “Delivery” of Norway has been the provision of finance for both, the international consultant, and BPC, the local consultant, to carry out the study.

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[32] a) BPC Completion Report (not dated), b) Joint Committee meeting minutes, dated August 1992, c) Comments on Khimti Fesaibility Study, NVE Memorandum „Feasibnility Study Khimti Khola“, February 2003

A3.9.2 Results

A3.9.2.1 Outputs

The principal output of the project has been the Feasibility Report, which has been widely circulated and accepted, and is the basis on which scheme financing has been initiated with the Asian Development Bank (ADB) and the International Finance Corporation (IFC), along with other funding agencies. Thus the project has achieved its objective of producing a report suitable for this purpose.

A3.9.2.2 Outcome

A positive financing decision on Khimti I hydro scheme has been taken as the major outcome of the study. BPC also made wide use of Nepali consultants, particularly for site investigations and environmental work. This has ensured that the benefits of the study, in terms of capability building, have spread beyond BPC. This has become the basis of an ongoing working relationship with some of these consultants.

As an outcome of the study, and in parallel with it, BPC was able to take a significant role in assisting the Government with the implementation of their policy for encouraging the private sector in hydropower development in Nepal. Khimti has been the first project under this new policy, and from the feasibility study onwards has been a means for both Government and the private sector to find practical solutions to new problems, and establish precedents which will help future projects under this policy.

A3.9.2.3 Impact

The impact of the intervention is the implemented Khimti HEP, which added much needed generating capacity to Nepal's national grid. At the level of NEA, the buyer of power from Khimti, it is reported that, while the power available from Khimti is crucial, its cost is felt to be excessive.

A3.9.3 Findings

A3.9.3.1 General

Among the cross-cutting issues, environment has been specifically addressed as a crucial issue in the project. Gender and poverty were not considered applicable concerns.

The potential risk of failure, i.e. a sub-standard study result, has been avoided by setting up a partnership between a Norwegian consultant with experience, and BPC.

In addition to the primary output, the project has been beneficial to the development of human resource capability in Nepal, and to the building and enhancing of Nepali institutions, particularly in the private sector. Some of the evidence:

- **International Co-operation:** BPC in conducting the study, was able to learn a great deal from the association with Norpower, including having one Nepali engineer work in Norpower's Oslo office on design aspects for a short time. The challenge of producing a report acceptable to an international level enabled BPC to develop its skills in a number of areas, and new staff were taken on locally to ensure adequate expertise was available.
- **Environmental:** BPC has strongly developed its capability in environmental assessment and mitigation work, and this is providing valuable in the setting up of the Khimti site work. One aspect of this was the emphasis on looking at the existing local community, and the position of women in particular, to see how the benefits of the project to the local community could be maximised. Another was the issue of low flow hydrology and fishery requirements, and this work has continued even after the feasibility study.

A3.9.3.2 Input Quality

Judged by the success of the project, i.e. a bankable report, input quality has been excellent.

A3.9.3.3 Efficiency

The conversion of inputs to output appears acceptable, but is has been affected by the learning cost of BPC. Which, strictly speaking, have reduced purely economic efficiency.

A3.9.3.4 Effectiveness

The objective has been fully met. Hence high effectiveness can be assigned.

A3.9.3.5 Relevance

The initiative to carry out the feasibility study was highly relevant with a view to leverage private investment and the later HEP implementation.

A3.9.3.6 Sustainability

The end result, in the form of the Khimti HEP is well anchored and fully sustainable.

A3.9.3.7 Benchmark

In comparison to other interventions, the Khimti feasibility study shows an efficiency a little below normal, while effectiveness and relevance are between average and the top of all interventions (Table A3- 16). The benchmark appears well in line with qualitative assessment.

Benchmark factors compared		
	Efficiency	effectiveness relevance
c-khimti	91%	115%
best	249%	129%
worst	16%	78%

Table A3- 16: DAC criteria benchmark Khimti Study

A3.9.4 Conclusion

The project was implemented primarily within the Butwal Power Company, as part of HMG's policy of encouraging private sector power development. The project has thereby provided the "seed" for the ongoing development of Khimti Hydropower Project. BPC has taken the lead in continuing the investigations after the feasibility study. It has entered into co-operation agreements with Statkraft of Norway, both for the design, and the construction site, has started under local funding, and will continue to completion once the full project financing is finalised.

The Project has enabled BPC’s engineering and consulting department, and other consultants, to learn and develop their capability in project implementation at this scale. Previous projects have been on a smaller scale, and have therefore not received the degree of critical review which came with Khimti. As a result, the company is now better placed to undertake work of this type, which also means that the Nepali capability is enhanced, over a wide range of disciplines.

A3.10 Training of Personnel in Khimti Implementation

The following is not a full evaluation of the intervention, but an attempt to identify the impact of training provided on important actors' capabilities, seen in the overall strategic context.

A3.10.1 Project Brief

Training was provided to local companies involved in the construction of the Khimti Khola I HEP; including Himal Power Limited (owner), Nepal Hydro Electric and Himal Hydro, both sub-contractors to the international main contractors.

The programme was carried out in the period from 1996 to 2000. Training took place abroad and at the site. In addition, large numbers of semi-skilled and unskilled construction workers were trained on the job.

A3.10.1.1 Objective

The objective was to recruit, train and qualify the owners' personnel to handle the different aspects of hydropower projects, including operation and maintenance. Its main goal was to build up an operational set up within the owners' organisation, which is competent in all aspects to run the newly built power plant.

Norway provided financial assistance of total NOK 4.962 million to several partners.

A3.10.2 Results

A3.10.2.1 Output

Outputs included a large volume of training for workers, skilled workers and technicians. The following categories of personnel were included: Operators, tradesmen, technicians, supervisors and engineers. The value of on-the-job practical training may be summed up as follows:

> Statement from an interviewed construction supervisor: "The most impressive and effective working method was to assign a group of workers to a two person team of Norwegian and Nepali foremen, and assign daily work targets to them. This resulted in optimum learning and efficient work performance".

A3.10.2.2 Outcome

The capability and competence of contractors and utility at the operational level was significantly improved, and they are using the acquired competence and capacity to the benefit of the Nepalese economy, specifically the power sector.

A3.10.2.3 Impact

The companies supported have become industry leaders in their respective fields. The training provided in this project has contributed significant to this.

A3.10.3 Findings

A3.10.3.1 General

The tradition of assigning high importance to training and capacity building was continued in this project. The comprehensive training package that was financed may be regarded as another strategic building block in an overall sector development strategy. It may not have explicitly been conceived as such, but this is the perception of participating stakeholders.

The inherent risks of difficult construction projects, such as fatal accidents, has been successfully countered by the project, as training included safety aspects at all levels.

No specific cross-cutting issues have been addressed by the project.

A3.10.3.2 Input Quality

It appears that all inputs were of fully satisfactory quality. This is supported by the high technical standard evident in the Khimti power plant.

A3.10.3.3 Efficiency

The choice of training in Norway was an opportune and solution-oriented decision, but cost for this were high. While time efficient, this has somewhat affected cost efficiency.

A3.10.3.4 Effectiveness

The project has been effective in addressing training needs in the context of implementing an ambitious project. The objectives have been successfully met.

A3.10.3.5 Relevance

Stakeholders involved assign high relevance to both, formal and on-the-job training received. The relevance has two aspects: a) successful completion of the project with a high content of local manpower, and b) the gain in competence and confidence in their own abilities of the contractors involved.

A3.10.3.6 Sustainability

The Khimti hydro scheme is economically successful, and of high technical standard. It is long-term sustainable.

A3.10.3.7 Benchmark

Benchmarked efficiency, indicates less than average efficiency (Table A3- 17. This may be influenced by a lack of firm results data, so estimates imply some uncertainty. Effectiveness and relevance are better than average, and this supports the qualitative assessment.

Benchmark factors compared		
	efficiency	effectiveness relevance
t-khimti	79%	112%
best	249%	129%
worst	16%	78%

Table A3- 17: DAC criteria benchmark for Khimti Training

A3.10.4 Conclusion

The most vivid account of benefits was verbally provided by the management of Himal Hydro. It can be summed up as follows: “The material, moral and professional support of our Norwegian partners has enabled the company to become the market leader in complex construction and tunnelling projects, in Nepal, and perhaps in the region. The financial support provided for training has been crucial in this. In combination with specific education provided for many staff in Norway, it has built the capacity of the firm to a sustainable and extraordinary level .” The evaluation finds this summary a good and valid account of the achievements.

A3.11 Education and Training of Professionals

The Norwegian Fellowship Programme has been evaluated by others, not related specifically to the power sector. The present evaluation however, attempted to identify impacts on the sectors' human resource base. Information was obtained through a number of interviews of both, training participants, and their superiors. In all, of more than one hundred members of the Norway – Nepal Alumni Association, of which about 95% have participated in courses at NTNU, the evaluation has interviewed 9 participants, and several superiors of participants.

The method applied was to extract some relevant statements and findings from the evaluation[33], and then to cross-check these with respondents perceptions of training received, without however, disclosing to those interviewed what their responses would be compared with. This was done in order to avoid asking leading questions.

The cost of training Nepali professionals under the Fellowship programme is estimated at NOK 30 million. This is outside specific power sector assistance finance.

A3.11.1 Evaluation Statements[34]

1. …NFP, with its development aid focus, targets mature applicants with 2 or more years of working experience and a secure link to an institution or bureaucracy in their home country considered to be a relevant development cooperation partner for Norway.

2. …NFP contributes with capacity building in government institutions and NGOs. Fellows return to their institutions with new, updated relevant methodologies and understanding of how to address prioritised development cooperation issues. The secure link to their home base institution results in virtually all fellows returning to their home country institution.

3. …Such a selection process also enhances the "value added" potential of the programme, because returnees represent a "brain gain" as opposed to a "brain drain". From this perspective, NFP fellows are prospective "change agents".

4. …With a small number of fellows from a large number of countries and institutions, it is difficult to achieve development effectiveness and impact.

5. …One undisputed extra benefit obtained from studying in Norway is status, as a master's degree from most developed countries confers more status than a master's degree from a university in the South. Another benefit is personal development. By studying in an international environment, candidates broaden their perspective and international perception.

6. … Are courses in Norway better from a professional standpoint? Some probably are, and by a good margin. In fact, the majority may be better, particularly from a Norwegian perspective, but not necessarily from a developing country's point of view. The question of relevance is crucial, and a number of fellows interviewed express concerns about the lack of relevance to their home situation.

A3.11.2 Findings from Interviews

In general, all respondents were full of praise for the courses that they had the opportunity to attend. There were two subjects of study of the participants: a) Hydropower Engineering, and b) Electrical Power Systems Engineering. Early participants had attended post graduate one year courses, while later, it was M. Sc. two year courses.

For the Alumni interviewed, and many others who's CVs are known to the evaluation, the criteria of selection as given in statement one above applies. All had previous work experience in the sector, and most had been associated with a Norway assisted project before and after their training. It is strongly felt that the complementarities of measures, practical project implementation here (in Nepal), and

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[33] Evaluation of the Norad Fellowship Programme, Norad/NCG, June 2005

[34] *ibid*: The following are quoted from the evaluation report

higher level training there (in Norway), was of benefit to both, the individual and the project implementing organisation at home.

What more than half the interviewees brought up without being prompted, is their high appreciation of the mix of subjects, across disciplines, and both theory and practice, that was provided. This established a strong link to the employment held, and most returned to their previous employer, while a few changed jobs later, but remained in the sector. Hence, statement 2. is confirmed, with the variation that many of the students were actually employed in business entities such as BPC, Himal Hydro, Hydro Lab, and others.

There is definitely a perception among alumni, their superiors and stakeholders in general, that a considerable brain-gain has happened (confirming statement 3).

Fortunately, the situation in Nepal is not such that participants in training in Norway have remained a small number over time. More than a hundred alumni is a considerable number for the size of the power sector in Nepal, and a development impact is discernible in the perception of observers, contrary to statement four above.

Status as an extra benefit and personal development is invariably felt and treasured.

Alumni in Nepal feel no concern about the relevance of their training to the home situation. On the contrary, the perception is that the experience of staff and faculty at NTNU is highly relevant to the Nepal context, and in fact it has not been an uncommon experience to meet lecturers and other resource persons who have a professional link to Nepal and its power sector. Hence, statement 6. is rejected as not applicable.

A3.11.3 Benchmark

Despite the fact that not a full evaluation was done, a benchmark was attempted also for the Fellowship programme. This was done by quantifying the results in terms of trained personnel (masters degrees and other higher level training), using generally applied monetary values, and comparing this to the average cost of NTNU courses.

Efficiency has been found to be better than average, while effectiveness and relevance benchmarks are just slightly above average (Table A3- 18).

Benchmark factors compared		
	efficiency	effectiveness Relevance
fellowship	112%	101%
best	249%	129%
worst	16%	78%

Table A3- 18: DAC criteria benchmark for Fellowship Programme

A3.11.4 Conclusion

Based on the evidence of an apparently only limited need for expatriate power sector consultants in Nepal, and the perceptions of interview respondents, the Norad Fellowship programme is considered another highly relevant building block in the country's power sector development. Some shortcomings or weaknesses found in the overall evaluation cited above, have not been found applicable to results and impacts in Nepal.

A3.12 The Macro Level View

The evaluations' estimate is that Norway has contributed about 7% of total donor funding to the power sector over the past 25 years. In terms of tangible output, the direct contribution consists of 17 MW and the indirect contribution of an additional 60 MW of generation capacity. The 60 MW has received seed funding for the feasibility study from "official" Norway, and the investment has been done by Norway/Nepal private sector investors, unless Statkraft must be regarded as publicly owned?

The total of 76 MW has not caused Nepal any debt, which is different from many other investments in the sector.

In the dry season, at the time when generation capacity country-wide is greatly reduced due to water shortage, to about 545 MW (including thermal and storage capacity), "Norwegian capacity" available is about 30 MW, i.e. about 5%.

In terms of contribution to energy supply, the total capacity of 76 MW produced 470 GWh (2005/2006), against the 2,521 GWh of the national total. This means that more than 18% of total energy is provided by these projects. It also indicates that the projects in question have above national average performance.

Nepal is in a situation of load-shedding in the dry season, since capacity expansion could not keep pace with demand growth. In the most recent dry season, (winter 2006/2007), capacity not supplied amounted to 100 MW on average, and a peak of 170 MW. Without the supported projects Andhi Khola, Jhimruk and Khimti, the shortage would have amounted to an additional 30 MW, about 30% more than actual.

It is possible to calculate the value of energy not supplied. However, the value assigned to such opportunity cost varies widely, depending on how important and vital power is assessed to be in any specific situation. Such a value is not readily available for Nepal, so instead, the estimated cost of using backup diesel power, at US cents 30 to 35/kWh is used. This converts to about NOK 2 million/GWh.

Effective energy not supplied last winter[35] amounted to an average capacity of 100 MW, and to 6.58 GWh. Hence, the 30 MW higher load-shedding that would have taken place without the Norwegian projects amounted to a rounded 2 GWh. This gives a value of NOK 4 million, and can be taken as a minimum economic saving for Nepal, resulting from reduced load shedding in a single dry season. The main contributor to this saving is the privately owned Khimti project.

The evaluation argues that such benefits from Khimti should at least in part be attributed to Norwegian development assistance. If so, any adverse impact that Khimti might have should also in part be attributed to Norwegian assistance. NEA is the buyer of Khimti power, and it complains that it must pay a price that is too high. The price has of course been agreed to by NEA when it was initially negotiated, but the perception of local stakeholders today is that unfair advantage was taken of the relative inexperience of the Nepalese side in such negotiations at that time. A participant present in the negotiations whom the evaluation had the opportunity to interview, confirms that impression. Nepal ultimately had to accept what was offered, and it had little negotiation power or skills. In fact, the participant recalled that a first price settlement to which the Nepalese side and investors agreed, was rejected by the multilateral finance institutions, who insisted on an increase of 0.7 US cents/kWh. All this is history, and the price agreed to, is based on a long-term contract.

Taking 0.7 US cents/kW of excess price, and taking average production figures for Khimti of 350 GWh annually, results in an excess cost of USD 2.45 million, or about NOK 15.9 million.

[35] NEA dispatch centre data of winter 2006

A3.13 Overall Conclusion

One of the previous ministers of Water Resources finds that there is a distinct *Norwegian Model* of assistance to the power sector. It is characterised by:

- Capacity building, and…
- …upstream and downstream linkages

The evaluation finds it appropriate to add:

- Long term assistance strategy

The somewhat cryptic characterization may deserve more elaborate interpretation. This is drawn from the interview conducted, and other stakeholder discussions.

A3.13.1 Merits of the Approach

Capacity building has clearly been at the core of all interventions. Through the broad UMN approach, a number of entities have been established with the purpose of training people and providing them with an organisational base necessary to use in daily work what they had learnt. Based on this philosophy, BPC, Himal Hydro and NHE were set up and are operating successfully today, dedicated entirely to the power sector. These companies employ several hundred skilled personnel, far more than a thousand have been trained over the years, on all levels, including more than 100 at the Master level and a handful at the PhD level. In projects that these companies are engaged in, thousands are employed on a temporary basis, often with the provision of basic training, including in life skills.

Upstream linkages refers to the philosophy that hydro resources are not just there to be used, but need to be protected and managed, including watershed conservation, rural development in the adjoining areas, mitigation of impacts, and benefit sharing. Upstream linkages in summary embraces the local context in which a hydro resource can be developed and used. From it are derived the major benefits for the rural people.

Downstream linkages refers to the notion that developing power needs an economic purpose to be affordable. Nepal needs to develop such economic opportunities, and addressing downstream linkages means to foster and promote, and where possible to initiate small and larger scale industries and economic activities, based on available electricity.

In particular the projects implemented through UMN have taken the approaches described with success.

Perhaps not intended at the outset, but certainly how it appears in retrospect, Norway has followed a long-term strategy. In addition to support to the core activity of implementing hydropower schemes, a number of flanking measures have been supported, such as in:

- Legal and regulatory framework
- Hydraulics and sediment research
- Education and training
- Environmental assessment capacity building, and…
- …private sector institutional support

Any individual intervention area may have constituted a worthwhile undertaking in its own right. However, there is a lot of evidence that it is the combination of projects, carried out at the right time, and complementary to other ongoing activities, that is the formula of success.

A3.13.2 Overall Success and Failure Factors

A precondition for any one donor to have a “lucky hand” in aid portfolio selection, is in depth sector- and country knowledge, from various angles. Resources spent on acquiring, maintaining and documenting such knowledge appears well-spent.

Conversely, it has also been shown that a lack of success has a lack of knowledge and investigation at its roots. In other words, intervention designs on the basis of insufficient information and knowledge have a high risk of failure. This could be observed in two of the projects evaluated: a) Jhimruk, for which the evaluation finds that alternative sites/projects should have been investigated, and b) the second phase of legal assistance that did not really provide the Nepalese partners what they needed at that time.

A3.13.3 Comparative Advantage of Norwegian Assistance

The hydropower potential of Nepal is often given with 40.000 MW of capacity (technically possible). It is often called huge, while in fact it is not. On a per capita basis, it is less than 1.5 kW. In terms of energy needs in India it is just what is needed within the next ten years. There are two schools of thought in Nepal:

1. To develop hydropower on a large scale quickly for export to India, and earn considerable income from export.
2. To develop hydropower on a small and medium scale predominantly for domestic use, and in order to make it viable, develop the economy, in particular industry, as large power consumers.

The first strategy has been voiced over and over. Not much (in fact nothing) has been achieved, but propaganda is on the increase. The main remaining hurdles are political. If those are removed and revived in a situation of peace, democracy and improved Good Governance, benefits will be long in coming, and trickling down to the people.

The second strategy is perhaps less popular. It is not as grandiose and glamorous, but it makes a lot of sense in terms of overall development.

The Norwegian experience of assisting the power sector in Nepal over the past 25 years is a manifestation of success in implementing the second strategy mentioned, rather than the first.

The comparative advantage of Norwegian assistance in this is its long term persistence in pursuing a consistent vision.