Impact Assessment on
35kW Basa Khola Micro Hydro Power Plant
in Phugmoche, Solukhumbu Distrikt

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Duration of stay on site: 01. – 08. October 2010

Location:

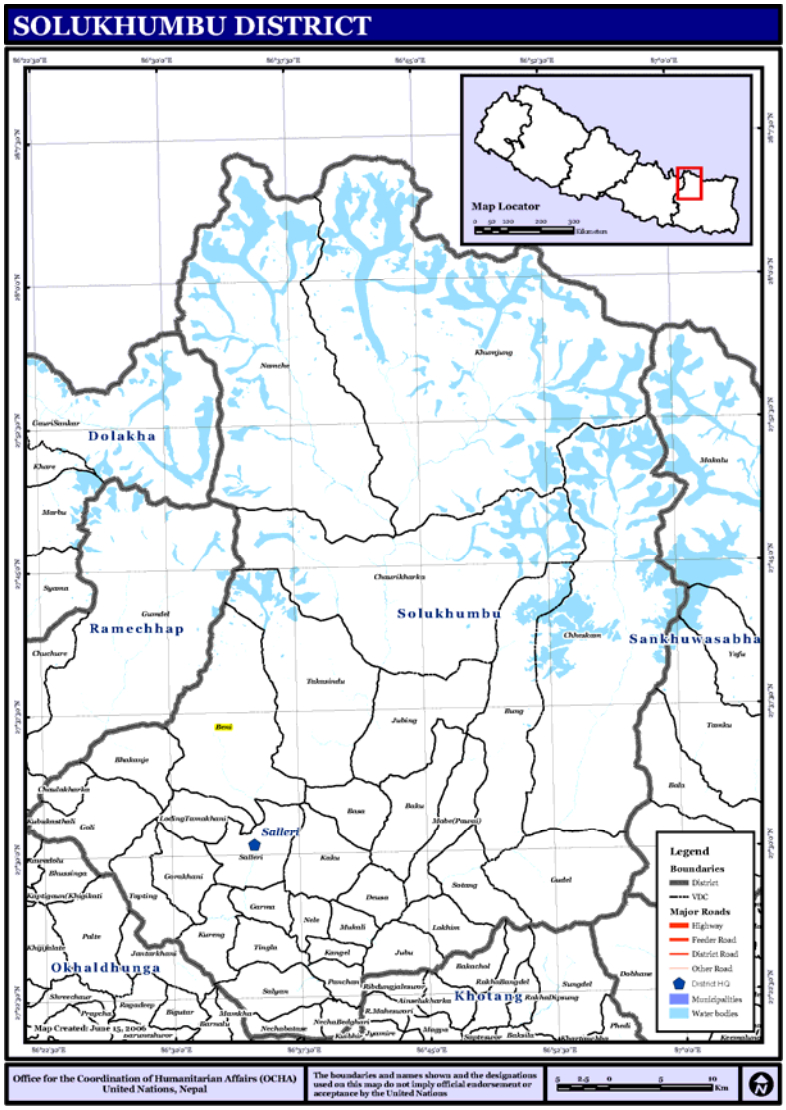
Region:	Eastern Region	
District:	Solukhumbu	
VDC:	Beni	
Ward N°:	5	
GPS:	North	27.61166°
	East	86.53900°
	Altitude	3110 meters above sea level

Survey Site:

- Himalayan Sherpa Buddhist Lower Secondary School within the complex of a buddhist monastery in Phugmoche/Phunmuche
- the villages Pankana and Tajinma, electrified by the Micro Hydro Power Plant

Journey

The "Himalayan Sherpa Buddhist Lower Secondary School, Phugmoche" attached to a Buddhist monastery is located in District Solukhumbu, VDC Beni, Ward No. 5. The flight from Kathmandu (KTM) Airport to Phaplu in Solukhumbu District takes about 45 minutes. From there one has to walk along the Basa Khola heading north-west to pass Beni and reach Junbesi after 14km. Up to here it takes about 4.5 hours. From Junbesi it takes another 2.5 hours walk to reach the destination of Phugmoche / Phunmuche (= "great mother of the cave") which is only another 6km away (see Annex I – Overview map). For further site visits please note that lodges are available in Phaplu as well as in Junbesi. Phugmoche is situated on the hillside at the northern end of the afforested Solu Valley. The monastery has its roots several centuries back and exists in its actual shape since 1935.



Localization and overview of the yellow marked survey site

The Beginning of the "Project of Phugmoche Nepal Association"

In 1989, Lama Ngawang Nyingma of the Phugmoche monastery together with Anneliese Dietrich developed the initial idea to establish a religious school attached to the monastery to keep up with the Sherpa tradition. They soon came to the conclusion that religious knowledge alone wouldn't give any advantages to children in rural areas in a modern world. Therefore, in May 1992 not only the religious school (today known as the "Himalayan Buddhist Sherpa Study Centre") has been founded to train future monks but also the mentioned "Himalayan Sherpa Buddhist Lower Secondary School", to provide formal education alongside with religious education for the children in the area.

Until 2004, the boarding school has been financed and supported by the German Association FREUNDE NEPALS E.V. out of which, in August 2004, the PHUGMOCHE-NEPAL E.V. was founded to foster further development of the complex. It also promoted the establishment of a Micro Hydro Power Plant (MHP). The planning phase for the plant had already started in 1998.

Dharma school & boy's hostel in front; yellow roofed monastery; girl's hostel & Lower Secondary School in the back.

Picture: Lars Bräunig

During the first few years after the establishment of the school, the consumption of natural firewood (mainly pine) has risen to an unsustainable extend, due to the rising number of students and the lack of alternative energy sources. At that time the whole complex consumed about 120 piles[1] (approx. 21,600kg) of firewood each year. The yearly collecting fees & costs reached up to 96,000 NPR[2]. To reduce the expenses and preserve natural resources, in 1998 the idea was born to erect a school owed Micro Hydro Power Plant at the nearby Basa Khola. This river is fed by the glaciers of the Num-

[1] 1 Pile = 6 Bhari; 1 Bhari is defined by a "load" one is able to carry. In this report, a Bhari is calculated with 30kg, which makes the weight of 1 Pile equal to 180kg.

[2] According to the exchange rate of January 1st 2000 NPR 96,000 are about EUR 1,400

bur and Karyolang mountains. To generate an additional income, the 16 households of the surrounding villages in Pankarma and Tajinma were supposed to be connected to the power plant. At that time, alone the villages' consumption of firewood reached up to 23,000kg per year.

From Planning to Establishment of 35kW Basa Khola Micro Hydro Plant

From the first idea it took about three years of planning and organisation before conducting the first feasibility study. One of the very first steps was the foundation of a Community Rural Electrification Entity (CREE) by the school. A CREE has to be established by the community which is willing to get electrified. It will be the official interlocutor on local level with the government of Nepal, represented by the Nepal Electricity Authority (NEA). A CREE is an absolute necessity before requesting any kind of subsidy by the government. The entity later is also the formal owner of the MHP.

When contacted by FREUNDE NEPALS E.V., GTZ decided to support the project through SHPP (Small Hydro Promotion Project) although In April 2001, the Nepalese branch office of the partner company Entec sent a team of engineers to Phugmoche to conduct the first feasibility study, which has been completed in July the same year. The costs for the whole project were estimated for 600,000 NPR[3].

Turbine of the Basa Khola Micro Hydro Power Plant.

Picture: Lars Bräunig

After completion of the study and a positive outcome, the CREE applied for a subsidy at the ALTERNATIVE ENERGY PRO-MOTION CENTER (AEPC). AEPC is a semi-autonomous governmental org-anisation, attached to the Ministry of Environment and mainly

[3] According to the feasibility study from July 2001 the estimated costs were 5,961.899 NPR, which is equal to 79,796.3 US$ or 93,933.2 EUR (exchange rate from July 1st 2001).

financed by foreign donor organisations like GTZ and DANIDA. In autumn 2001, the subsidy of 93,000 NPR for each installed kilowatt was approved, to cover more than half of the project costs. The missing rest to realize the facility and cover additional cost of total 33,000 EUR was raised by the "Project of Phugmoche Nepal Association" from private donors in Germany.

At the end of the same year the Maoist uprisings in the district headquarter of Salleri, close to the regional airport in Phaplu, lead to the proclamation of state emergency on November 26th. Due to the instable security situation the start of the construction works had to be postponed until spring 2003. The already approved financial support had to be applied for once again, because it was not used when requested the first time.

In August 2003 the amount was granted again. With the support of GTZ Kathmandu/Nepal, a turbine was ordered in Indonesia, while the Nepali STRUCTO NEPAL PVT. LTD. was assigned to construct the facility. Because of serious obstructions during the conflict, all parts including 200 pipes, each 2,5m long and 80kg heavy, and the dispersed turbine had to be carried by foot from Phaplu airport to Phugmoche by the benefiting people instead of having them transported by a helicopter. The local community had not risen a copayment to the project but helped constructing the building powerhouse and carrying the equipment to the construction site.

On April 4th 2005 the 35kW Basa Khola Micro Hydro Plant has been established. The plant supplies electricity not only the Himalayan Sherpa Buddhist Lower Secondary School and the monastery in Phugmoche but also the neighbouring villages Pankana and Tajinma with a total of 16 households.

Sustainability of Basa Khola Micro Hydro Plant

"Poroject of Phgmoche Nepal Association, Germany".

Picture: Lars Bräunig

In order to grant any subsidies by AEPC it had to be guaranteed by the scheme to use at least 10 percent of the generated electricity for productive end-use[4]. At the Basa Khola site, it was planned to establish small handicraft businesses and cottage industries which use electrical machineries. Since 2005, some small industries like a paper and cheese factory have been established already (see chapter: productive use). More are about to develop in future. All businesses and industries as well as the connected households of the villages Pankana and Tajinma have to pay 5 Nepali Rupees (NPR) per kWh, while the school and the monastery have nothing to pay at all.

The little generated income by the payments for electricity is not enough to cover the maintaining costs at the MHP. They are put aside and saved for "bad times" when the school and monastery has to support themselves. The maintenance costs of the facility are still covered by the "Project of Phugmoche Nepal Association", while it woos for donations on its website. Nevertheless steps have been taken by the project to make this boarding school self-supporting in the near future. The Project purchased new land in Kathmandu Valley and has plans to construct a lodge there. The generated income is meant to support the school and the monastery in Phugmoche, because the chance is seen as very limited the people are be able to cover all maintaining and distribution cost of the facility in Phugmoche.

Assuming the lodge in Kathmandu Valley generates enough income to be able to support the MHP in Phugmoche at all and assuming the money transfer from one to

[4] AEPC (2010): Renewable (Rural) Energy Subsidy Delivery Mechanism. Available at: http://www.aepc.gov.np/images/pdf/tasdm2010.pdf

another works properly and will not be interrupted by interested motives, than a possibility is given for a sustainable self-supporting System, which is not in need of foreign investments.

Rough terrain and insufficient farmland, followed by a seismic very active Himalaya which periodically leads to devastating destruction will naturally limit the development potentialities of Northern Nepal. Pointing out the fact of internal migration in Nepal from the Mountain and Hill Regions down to the Terai, an economical development of far remote regions like the one of Phugmoche is not foreseen even from Nepali people.

Productive Use by small industries

Right after the initial start-up of the MHP, electrical machineries were utilised to make the work easier for the local carpenter. To finish the interior construction and the wiring of the complex an electrical wood and stone saw, a plane and a drilling machine were purchased.

At the same time a yak cheese collection centre has been established in Tajinma, which is actually not using electricity for productive purpose but creates some jobs for the local community. The produced cheese is given time to fully mature here and sold at the next market places in Salleri (see Annex II – Detailed view on survey site).

Mixing drum for the raw materials to produce paper.

Picture: Lars Bräunig

In 2007 a former student of the school opened up a paper factory. After collecting and cooking the raw material, namely the bark of Daphne it has to be cooked and mixed with a thickening agent and soda. For that purpose he purchased a mixing drum for 13,000 NPR, financed by the Project. To cook his raw materials he uses firewood. For the annual production of 300 Kori[5], 20 piles of firewood (≈ 3,600kg) are needed. To run the mixing drum and light his shop he consumes about 3,000 Watt per year. The paper sheets are sold to Kathmandu. Because of the lack of Daphne, he didn't produce paper in 2010 A.D. but collects local herbs to sell to a single buyer.

Electric operated maize mill.

Picture: Lars Bräunig

Besides the paper factory the owner also bought an electrical maize graining machine for 7,000 NPR in Kathmandu in 2009 A.D. He provides a graining service to the villagers for which he charges 1 NPR for each kilogram produced flour. In average, he produces 1,000kg flour per month for what it takes about 16.5 hours. According to that his monthly investment for electricity is about 80 NPR.

Impacts in School

Since the completion of the 35kW Basa Khola Micro Hydro Power Plant in April 2005 severe changes have taken place. As mentioned above, the consumption of firewood before the establishment of the Basa Khola MHP has been about 120 piles (ca. 21,600kg) of firewood per year. That amount has been reduced by two third after electrification, down to roughly 40 piles (ca. 7,200kg) a year. Before 2005, firewood has mainly been used for cooking and heating. Since the electrification of the complex, electrical rice cookers are used to prepare basic foodstuff instead of firewood while electrical

[5] 1 Kori is about the weight of 200 sheet of paper with the dimensions of 50cm x 75cm

heaters warm up sleeping-, class- and dining rooms. Electricity is also used for lighting most rooms of the complex. Kerosene has been used to light up the temple and the sleeping rooms. With electricity purchase and use of kerosene for this purpose has become completely dispensable.

Class rooms without any light Picture: Lars Bräunig

Surprisingly, even though electricity is available in a sufficient quantity and free of cost, there is no electrical light in none of the eight classrooms. The given explanation to the survey team was the use of daylight for class lessons, which take place between 10 a.m. and 4 p.m.

Electricity is nowadays used to run water heater (= geezer) to make hot showers possible, especially during winter season. Electric water boilers are used to treat drinking water and to prepare tea. While considering these circum-stances not only the aspect of saving natural resources is being taken care of, but also the health issue is being addressed. By boiling the water before drinking, water borne diseases, like diarrhoea and certain parasites have been decreased significantly. One student of the Dharma school mentioned that water treatment before drinking has been introduced only after electrification.

Electricity, generated by the 35kW Basa Khola MHP, not only replaces firewood and kerosene, it also becomes useful to increase the variety of school lectures. Lama Ngawang Nyingma, the coordinator of the whole complex, has mentioned that English listening classes take place on irregular bases with cassette recorders, running on electricity. Sangre Sherpa, teacher for Dharma (= religious class) and Tibetan explained that eight desktop computers have been recently donated. Since June 2010 computer classes take place on regular bases starting from 4th grade. For the computer classes

heated classrooms especially in winter time now became a necessity, because operating computers in an environment below freezing point is almost impossible. By using computers on regular basis the total consumption of electricity might increase. But because of a maximum consumption of about 15kW in wintertime and only 11 during summer, plenty of leeway is available.

Computer class started in June 2010 on regular bases.

Picture: Lars Bräunig

Impacts in households

From 16 households, only 13 could be interviewed. 3 households (≈ 19%) have been left orphaned, because all their family members have moved up to the upland pasture to shepherd their Yak herds and produce cheese.

Due to the very small potential for income generating activities and a difficult market access of the households of the villages Pankarma and Tajinma the impacts of electrification and the use of electrical appliances remained relatively small. The most notable effect was the replacement of kerosene lamps by electrical operated compact fluorescent lamps (CFL). The total consumption in the villages Pankarma and Tajinma of 230 litres kerosene each year, equivalent to the total amount of roughly 18,000 NPR has been completely replaced by CFL and light bulbs, while the total monthly consumption of electricity almost reaches 200kWh. Every household connected to this MHP only has to pay 5 NPR per kWh accordingly to the actual consumption.

Because not only kerosene but also firewood is generally used for lighting in the villages, the consumption of firewood also decreased by some extends. Before electrifica-

tion, the 16 households consumed about 23,000kg wood per year. The amount has been decreased by 7.5 percent, down to about 21,300kg per year.

Before electrification, batteries have mainly been used for small electrical devices like radios and torch lights. Due to the models this has not changed until today. All households together still use about 40 pairs of batteries each year.

Wood harvesting north of Phugmoche.

Picture: Lars Bräunig

Spite the fact, the local community law only allows collecting already dead bio mass and cut small branches from the forest after paying a certain amount per pile, this rule is generally ignored. Instead of collecting fallen branches the households systematically fell whole trees from the community forest. Even the "Himalayan Buddhist Sherpa Study Centre" cuts down branches from juniper trees for their daily ceremonies.

Putting the monthly expenditures together for firewood, batteries and kerosene before electrification and compare them with the monthly costs for firewood, batteries and electricity after electrification, it can be concluded that electrification decreased the household expenditures by 15.6 percent.

Experienced circumstances and challenges for the future

According to UN-ENERGY REPORT (2005) with enduring access to sustainable energy a region has a general potential for further development. In Phugmoche with the erection of a MHP this potential is used to preserve natural forest on one hand and develop the regional education of the youth on another. By developing a comparably advanced education centre the population has increased.

Before the "Project of Phugmoche" started its work, only 15 monks studied Dharma in the monastery. Today 115 boys and girls are taught altogether in eight classrooms of

the secondary school and in the monastery while 76 pupils and 13 teachers live permanently within the boarding school complex.

In an altitude above 3,000m agriculture is almost not possible. Besides growing some vegetable all food has to be brought up from Salleri on mules. The survey team realised the enormous expenses of bringing the necessary goods up and noticed the lack of refuse disposal to become a problem. Like everywhere in rural areas of Nepal harvest leftovers or easy decomposable rubbish is still used for livestock feeding or fertilize the fields, but modern packaging material has to be either burned or put in land fill sites somewhere. Through absorption by livestock like goats and cows and processing the milk and meat it will effect the health situation of the local population. Furthermore pests' und disease-causing agents will increase.

Careless waste disposal close to school and monastery.

Picture: Lars Bräunig

Conclusion

The realization of the 35 kW Basa Khola Micro Hydro Plant has only been possible with the financial and technical support of foreign aid and the dedication of private partners. The two chief objectives have been achieved.

1. The people benefitting from the sustainable energy of the hydro power plant use less traditional energy sources like wood and kerosene. Therefore the depletion of natural forest has decreased.

   Subordinated achievements are the reduction of CO_2 emissions due to less deflagration of wood and kerosene. Due to less kerosene for lighting less indoor pollution occurred and the general health situation has improved.

2. The educational environment has decisively improved by supporting the construction of the Lower Secondary School and enclosed accommodations for students who are living further away. By equipping the class- and sleeping rooms with electrical heaters and supplying the complex with geezers for warm showers the environment for proper studies has also improved and attracts more and more students.

   Careless waste disposal resulting from a population increase is a subsequent issue, which will most probably cause health problems in future.

Further Information

ALTERNATIVE ENERGY PROMOTION CENTER (AEPC):

Energy Sector Assistance Programme (ESAP):
http://www.aepc.gov.np/index.php?option=com_content&view=article&id=85&Itemid=121

ENERGY DEVELOPMENT SERVICES P. LTD. (2001):

Detail Design of 35 KW Basa Khola Micro-Hydro Project, Kathmandu.

FREUNDE NEPALS E.V.

http://freunde-nepals.de/

MAPS FROM THE UN:

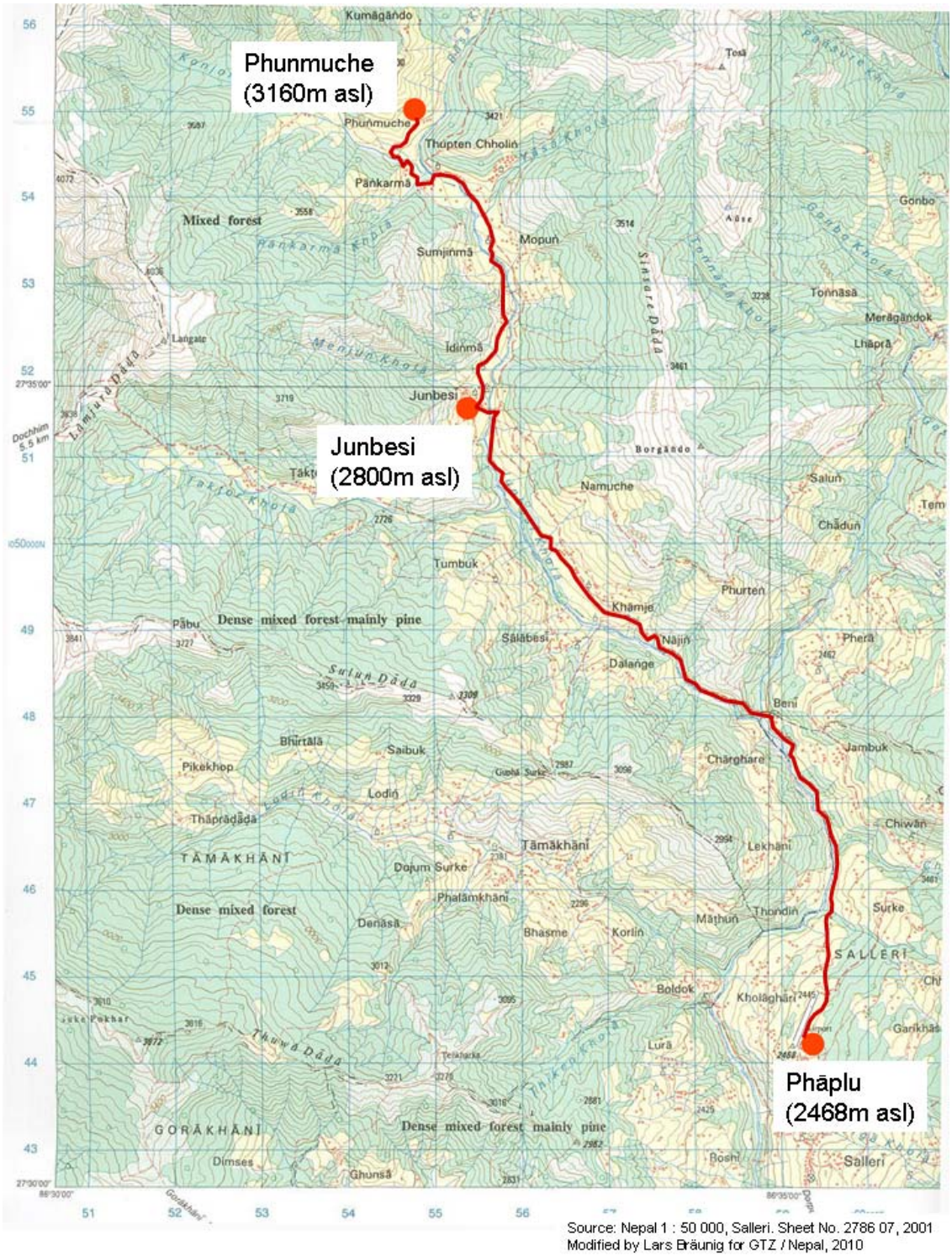
http://www.un.org.np/maps/district-maps/eastern/Solukhumbu.pdf

PHUGMOCHE-NEPAL E.V.

http://www.phugmoche-nepal.de/

UN-ENERGY (2005): The Energy Challenge for Achieving the Millennium Development Goals. http://esa.un.org/un-energy

Annex I – Overview map



Explanation: The original legend of the topographical map has been cut out, since this detail is only meant to visualize the travelling route. This detail is north orientated. Each 1cm x 1cm square of the graticule within the map defines an area of 500m x 500m or 500m^2. The altitude references to the mean sea level (s.l.) of India.

Annex II – Detailed view on survey site