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Editorial

Review Article

The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Cost *by Thayer Scudder.*
(London and Sterling, VA: Earthscan. 2005)
Reviewed by Hari Mohan Mathur

Editorial

Time to act…

It gives us immense pleasure to continue publishing the HYDRO Nepal journal, the first of its kind in Nepal. The first souvenir edition of the journal has been circulated in 2o countries and warmly acknowledged by its readers. HYDRO Nepal's mission is to provide a network for sharing technical information and expertise on Water, Energy and Environment sector. It aims to bring people with a common interest together. We hope that the authoritative articles written by experts will be an invaluable source of resources for anyone interested in any aspect of water resources development.

The abundant water resources of Nepal hold the key for the overall socio-economic development of our nation. The development of hydro power does not only bring a social transformation at the local level but also creates a resources pool.

The escalating prices of oil, gas and coal in the international market have again emphasized the significance in developing hydro-electric power. Against a techno-economically viable hydroelectric power of 42,000 MW, the actual installed capacity is only 551.10 MW in Nepal. This scenario clearly indicates the vast underutilization of the available hydro-potential within the country, thus, inducing painful load shedding. However, there have been some recent positive initiatives in removing hurdles; such as, removing the EIA requirement for up to 10 MW projects, increasing the license fee to discourage license holdings and initiatives to amend the Electricity Act. But, these are not enough.

There are still numerous constraints, impediments and risks in addition to the political instability that hamper the growth of the hydropower industry in the country. Besides, fulfilling insatiable and vast local demands at project areas further make it a Herculean task to complete hydropower project in Nepal. The concerned governmental agencies have their own priorities and agendas to follow and enforce irrespective of national requirements. Hence, it is imperative to create an all powerful high commission to determine and define the core and priority areas of the nation for its development.

HYDRO *Nepal* calls for collective and collaborative efforts of all the stakeholders to make an effort for eliminating the constraints and hurdles, and create conducive environment in harnessing the huge hydro-potential of the country for the benefit of the nation and its people.

It is time to declare a *Hydropower Decade* (2008–18), to build a new Nepal.

Jeewan P. Thanju
Editor-in-Chief

Hydropower Development in Nepal: Lessons from Past Models

Santa Bahadur Pun

Abstract. In the last six decades since the 1951 overthrow of Rana regime, hydropower development in Nepal was implemented under various models depending on the donors. The 1950s and '60s were the era of bilateralism to be subsumed by multilateralism of the 1970s and '80s only to be trodden over by liberalization and privatization of the 1990s and 2000. If one were to scrutinize these bilateral, multilateral and liberalized models in the hydropower sector closely, certain interesting patterns emerge. Nepal could well learn lessons from them.

Bilateral model with donors' own agendas

The first bilateral hydropower project[1] (after the Rana overthrow) to provide power in Nepal was the Russian 2.4 MW Panauti Project commissioned in 1965 at a cost of 2.7 crore rupees (NC).[2] The Russians found the 22 MW Kaligandaki diversion project at Gaidakot too large.[3] Russia was keen on executing a 10 MW hydropower project and did investigate the Lower Bagmati, but due to lack of data opted for the smaller Panauti Project on the Rossi river where Nepal had already carried out studies. Not to be outdone, the Americans (Russia's cold war rival) also contributed substantially in the transmission line sector.[4] These investments were in the 66 kV double circuit Balaju-Hetauda-Birgunj transmission line, plus the

construction of the 11 kV double circuit Ring Mains in Kathmandu. The latter involved nine substations: Balaju, Teku, Patan, Thimi, Bhaktapur, Chahbel and Maharajgunj as the outside ring, and Balaju, Palace, K-Two and Patan as the inner ring.

Historically, however, Nepal's first bilateral agreements were with India on the 1954 Kosi and 1959 Gandak Projects, exclusively designed to cater for irrigation and flood control in India with small irrigation and hydropower components for Nepal. Kosi's 20 MW Kataiya Hydropower Plant, located in India, later de-rated to 13.6 MW due to siltation problems, supplied erratic power to Nepal's eastern industrial hub of Biratnagar only from 1971.[5] Similarly Gandak's 15 MW hydropower plant, located in Nepal and normally generating only about 3 to 4 MW, was commissioned only in 1979 at a cost of 17 crore rupees (NC) and handed over to Nepal in 1981.[6]

Because of the low six meter canal-fed head, both Kosi and Gandak power stations used bulb type Kaplan turbines and generators of Japanese make, indicating that India did not have the manufacturing capacity. The Indian-aided Trishuli hydropower first-phase 9 MW power plant was commissioned in 1967 with three Yugoslavian units of 3 MW each. The Trishuli 12 MW second phase, commissioned in 1971, had a different set of four Japanese units of 3 MW each. The project cost was 14 crore rupees (IC).[7] Like the American-Russian rivalry, the 1960s also witnessed the Indian-Chinese rivalry in hydropower development. China commissioned a slightly smaller 10.05 MW Sunkoshi plant in 1972 at a cost of 10.9 crore rupees (NC). The electro-mechanical equipments, unlike that of India's Trishuli, were all of Chinese make.

By the time the 14.1 MW Indian-aided Devighat Hydropower Project came on line in 1984 at a cost of NRs 75 crores,[8] both the turbines and generators of 4.7 MW each were built by India's own Bharat Heavy Electricals.[9] India commissioned Bhutan's 336 MW Chukha Hydropower Plant in 1988 with each units of 84 MW built in India itself.[10] In fact, when India commissioned Bhutan's 1,020 MW Tala Hydropower Plant in 2006, each of the 170 MW units was of Indian make.[11] The message for Nepal is that over a very short span of time India graduated from being an importer of electro-mechanical equipments to a manufacturer and exporter of equipment with a single unit as large as 170 MW.

Kosi and Gandak probably taught Nepal's engineers very little except to have their eyes opened on the inequities of the project benefits and the value of Nepal's rivers drummed in. Trishuli did encourage some of Nepal's engineers at the then Department of Electricity to translate theory into practice. This gave them the confidence to design the 14 MW Devighat Project downstream of Trishuli's tailrace. Even the then Prime Minister Kirtinidhi Bista publicly proclaimed that Devighat would be built with Nepal's own skill and resources. But the Finance Ministry, already suffering from donor-driven mentality, failed to shoulder this responsibility, and Devighat was, instead, handed to India. Devighat would have done what the 20 MW Chilime Project, 30 years later, did to Nepal: catalyze precious local skills and resources to demonstrate that Nepal, too, has the capacity to build.

Multilateral model with strings attached:

With the inequities of the bilateral Kosi and Gandak Project models, Nepal decided that the next river, the Karnali, would have a different, more beneficial model.[12] UNDP was requested to help in the study of Karnali Chisapani and the Japanese consultant, Nippon Koei, was given the task. This heralded the arrival of Snowy Mountains Engineering Corporation (SMEC), Norconsult, etc., which was followed by the multilateral banks. The World Bank picked up the 60 MW Kulekhani Project while the Asian Development Bank picked up the first 132 kV Gandak-Hetauda transmission line with the Hetauda-Narayanghat road and the Chitwan Pump Irrigation. The initially estimated US$68 million Kulekhani cost escalated nearly double the amount to US$122.6 million when completed.[13,14] Badly bitten by the Kulekhani costs, the World Bank itself "escalated" the estimated cost of Marsyangdi to US$338 million to later announce that the cost on completion in 1989 at US$294 million was less than the estimated cost. The World Bank, however, admitted that this was "a very high US$4,260 per kW installed".[15]

In 1982, the Asian Development Bank (ADB) for its Fourth Power Project (Butwal-Nepalgunj line) inserted a covenant that says: "the Nepalese government was required to decide on the reorganization of the electricity supply sector and the creation of a new institutional structure acceptable to the Bank." Furthermore, in 1984, the ADB's Fifth Power Project (Duhbi-Anarmani line) stated that "the Government proposed that all these bodies (Electricity Department, Nepal Electricity Authority [*sic*, Corporation] and various semi-autonomous development Boards) be merged into a single entity, NEA." The World Bank 'integrated the same condition' of the ADB in the agreement concerning the Marsyangdi project. These two multilateral banks were working in tandem, though one could discern that they were not on the same wavelength. When the World Bank pursued the US$1,082.3 million 201 MW Arun III, the ADB, despite allocating US$127.6 million for the project, publicly stated that while Arun III was in their minds, it was Kali Gandaki-A that was in their heart! Thus when the World Bank walked away from Arun III "as the risks to Nepal were too great",[16] it was Kali Gandaki-A that catapulted to the forefront with the ADB easing out the World Bank as the lead agency from Nepal's power sector.

The multilateral banks reveled in macro and micro management of Nepal's power sector for three decades. For Kulekhani, Marsyangdi and the aborted Arun III, Nepal had to increase her tariff seven times in a decade in the following manner:[17] 1985–35%, 1986–22%, 1988–18%, 1992–61%, 1993–25%, 1994–38%

and 1995–20%. The rate of return *not* on historically depreciated assets but regularly *revalued* assets methodology was used. Foreign consultants with designs and specifications suitable for foreign contractors of developed countries ruled the roost. These foreign consultants were overseen by a panel of peer consultants. Then there was the inevitable "sleaze money" of the local agents that further pushed the project costs up to ultimately make Nepal's electricity tariff in 1999 by the World Bank's own account[18] "one of the highest in the region". However, the involvement of the multilateral banks in Nepal did have positive aspects as well, in the form of a nearly 10-fold increase in generation capacity, an east-west country length high voltage transmission line and, above all, the exposure of Nepal to the latest know-how in engineering and the construction of hydropower plants.

Liberalization and privatization model with strings in different avatar!

With the liberalization of the power sector through the Electricity Act of 1992, the Khimti and Bhote Koshi Projects, under the questionable MOU route, emerged on the scene. While many are aware of the dollar denominated and US consumer price index escalated tariff, the other subtleties of "a liberalized power sector" are yet to be fathomed. The key lenders to both these projects are the International Finance Corporation (IFC), an affiliate of the World Bank, and the Private Sector Window of the Asian Development Bank. Khimti's initial 1994 'signed, sealed and done' power purchase agreement (PPA) at US5.20 cents per unit was literally thrown out of the window by these two international lenders, though their very own representatives 'silently witnessed'throughout the night the finalization of the PPA and project agreement. The dollar-denominated loans that have been availed to the developers were all at exorbitant rates of as high as 10-11% in view of "the country risks"—the fragile political environment of Nepal. These are clearly the 'strings attached' avatar of the liberalized model.

Take the case of the export-dedicated 750 MW West Seti Project pursued by Snowy Mountains Engineering Corporation (SMEC) for the last 12 years. It is reported that the private sector window of ADB has a 20% equity stake in the US$1.2 billion project.[19] Apparently, both the ADB and SMEC have impressed Nepal's Finance Ministry to pick up a 15% equity equivalent to US$45 million "to ensure that the project moves forward". At a time when Nepal is undergoing load shedding and Nepal Electricity Authority is still looking forward to government backing for the execution of the 309 MW Upper Tamakoshi Project, such generosity of the Finance Ministry to an export dedicated project is indeed very intriguing.[20] One can only say that the "charms of market forces" are really at work. Again, take the case of the 2001 hydropower policy that has a quaint definition for hydropower projects for "non-commercial" category. According to that policy, a non-commercial operation is the "generation of power by a public sector utility owned by a foreign country and the power so generated exported to that same foreign country." Project developers up to 1,000 MW built on a "non-commercial basis" need to provide only 15% energy as royalty in lieu of cash. These are some of the 'strings attached avatars' that Nepal has to face in the liberalized power sector. The successful implementation by Nepalese developers (Indrawati, Chilime, Piluwa, Chakukhola, Sunkosi, Rairang, Khudi, Baramchi, etc.) of smaller projects, the untouchables, to the tune of about 40 MW, is the silver lining in the new hydropower policy. However, both the ministries of Water Resources and Finance have their eyes and ears glued to larger projects with 'foreign investors'.

The global competitive bidding for the 402 MW Arun III and 300 MW Upper Karnali Projects resulted in an extremely good response from Indian private firms:[21] Reliance Energy, Tata Power, Larsen & Tourbo, Sutlej Power, Jai Prakash Industries, GMR India, Jindal Power, etc. On the Upper Karnali Project, GMR India has reportedly offered 33% free equity with 7.5% free energy.[22] (However, the agreement has been signed with Govt. of Nepal for the offer of 12% free eneregy and 27% free equity on 24th Jan. 2008 –*Ed.*[23]) Similarly, Jindal Power has reportedly offered 21.9% free energy throughout the generation license period on Arun III. Such offers by IPPs on run-of-river projects, set far over and above what Nepal's 2001 hydropower policy envisaged, clearly emphasize the inadequateness of that policy. Such attractive projects are not meant for Nepal's own domestic use. They are meant for export purposes to churn other industries so that their goods and services would be more competitive than those of Nepal. This, I believe, is the lacuna that needs to be rectified in our present liberalized power sector policy. It is also reported that with the government still indecisive, rightly or wrongly, over the Arun III and Upper Karnali bids,[24] the financially muscular Indian IPPs have taken the path of least resistance by purchasing major shares of Nepalese companies that already have the survey licenses in their pockets: i.e., India's GMR and Bhilwara Energy tying up with Nepal's Himtal and Triveni, respectively.

Conclusion

To conclude, both bilateral and multilateral models with strings attached did help Nepal's power sector and thus her economic activities. But they had down side effects, too, like foreign consultants, foreign contractors and foreign equipment that pushed up the electricity tariffs, at one time by as high as 61%. Both bilateral and multilateral models did very little to encourage utilization of indigenous skills and resources; or, to be fair, the government totally failed on this count. Within the last six or seven years, when the Maoist insurgency was at its peak, 40 MW of valuable power was availed by the local developers. The government, however, continues to see these local developers as 'untouchables', and is completely mesmerized by foreign investors

who are keen to export power across the border at dirt cheap rates. When Khimti's power is now pegged at over US 8 cents per unit, Nepal is forced to chip in US$45 million to West Seti that will sell peaking power to India at less than US 5 cents per unit. This, of course, does not mean non-implementation of export oriented projects.

The strategy should be, first, to upgrade the local 'untouchables' to the Vaisya or even Chhetri status; i.e., jump from 20 MW to 60/80 MW projects through local resources and skills. Secondly, fulfill Nepal's remaining domestic demands through foreign investments, if need be with government guarantees. It is intriguing why the government, despite a crippling load shedding regimen, is withholding its guarantee to NEA on Upper Tamakoshi. Without the NEA guarantee, the Employees' Provident Fund would have never financed the 20 MW Chilime Project. Then, and only then, should Nepal embark on export-oriented projects, one by one. This step-by-step approach would give Nepal the opportunity and leverage to remedy the mistakes made in the preceding projects. The World Energy Council believes that liberalization of the power sector is beneficial, but this has to be undertaken with caution and care. And in Nepal's present fragile political environment, with *extreme* caution and care!

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Notes

1 Great Britain provided the electro-mechanical equipment to both the 500 kW Pharping (1911 AD) and the 640 kW Sundarijal (1935 AD) power stations.
2 Nepal Electricity Authority, *Generation Report*, August 2004. Throughout the article, All rupee figures given as 'NC' refer to Nepalese Rupees, and as 'IC' indicate Indian Currency.
3 Ram Prasad Nepal, former Chief Engineer of Electricity Department.
4 Mihaly, E.B., 1965, *Foreign Aid and Politics in Nepal,* London: Royal Institute of International Affairs. Oxford University Press.
5 Record of Discussion between Madhusudan Dhakal, Secretary/MOWR, HMGN and MG Padhye, Secretary/irrigation, GOI at Kathmandu from 19th to 24th April 1983.
6 *Op.cit*., footnote 2.
7 *Ibid.*
8 This figure is from Nepal Electricity Authority's *Generation Report* of Bhadra 2061 (August 2004) and is substantially different from ICRs 29 crores as published in *Partnership in Economic Development, An Enquiry into the Indian Aid Policy to Nepal 2005,* by B.P. Koirala, published by the India Nepal Foundation, Embassy of India, Kathmandu.
9 *Op.cit*., footnote 2.
10 www.ptcindia.com
11 *Ibid.*
12 *Op.cit., footnote 4.*
13 World Bank, 1985 (July 1), *Kulekhani Project Completion Report.*
14 *Ibid.*
15 World Bank, 1996 (May 20), *Marsyangdi Implementation Completion Report.*
16 World Bank's Press Release on Arun III cancellation, August 3, 1995.
17 World Bank, 1994 (August 29), *Staff Appraisal Report* on Arun III Hydroelectric Project.
18 World Bank, 2000 (June 27), *Implementation Completion Report of Power Sector Efficiency Project.*
19 *Kantipur* (Kathmandu), Baisakh 14, 2064 (April 27, 2007).
20 In fact, *Kantipur* (Magh 28, 2063/February 11, 2007) quotes Dr. Ram Saran Mahat, Nepal's Finance Minister: "electricity is a commercial sector and foreign investors will come on Upper Tamakosi." It is nearly a year now and despite having numerous hours of load shedding each week, no investors have come to the rescue of NEA!
21 *The Kathmandu Post*, December 4, 2006.
22 *Kantipur* (Kathmandu), Baisakh 2, 2064 (April 15, 2007).
23 Kantipur (Kathmandu), Magh 11, 2064 (Jan 29, 2008).
24 *Nepal* (Kathmandu), Poush 8, 2064 (December 23, 2007).

Banker's Perspectives on Hydropower Development in Nepal: Problems & Prospects

Anil K. Shah

Abstract. Nepal is currently facing a power shortage that, it is feared, will get worse if we do not start working to enhance our capacity for energy generation. Hydropower, as a clean and renewable source of energy, is the right solution for our country, with its topographical advantage and the availability of more than 6,000 rivers. In addition to local demand, there is ample scope for export of electricity to India. The process has already begun for infrastructure development to pave the way for export. This is the right time to move forward for the development of this sector by all involved stakeholders; viz., investors, financiers, government, the local public, political parties, etc. This combined effort will give momentum for further developing the hydropower sector.

The financial sector must work on building in-house expertise as well as developing coalitions with other experienced international financial institutions to enhance the knowledge base and the lending capacity for project financing. Several tools for financing, including debentures, bonds and mutual fund, etc., can be introduced. We must now move forward to enhance our strength and mitigate the risks involved to realize: *Nepal ko pani, pragati ko khani* (literally: *'Nepal's water, source of national development'*).

Key words: Hydropower development, hydropower financing.

Nepal as a country is facing power shortage and we now realize that if the scenario of energy generation remains *status quo* we may shortly be facing load shedding of 12 hours or more per day.

Energy is a basic requirement for economic development. Every sector of the national economy needs energy, be it agriculture, industry, trade, transport, tourism, health, or service sectors. Planned economic development about to be implemented demands increasing energy inputs. As a result, the consumption of energy in all forms has been steadily rising all over the country.

The growing consumption of energy has resulted in increasing dependency on fossil fuels such as coal, oil and gas. Rising prices of these fuels along with their short supply are, together, causing concerns about the continuation of energy supply for sustainable economic growth. Environmental hazards due to increased use of fossil fuels are also attracting public concern, both on local as well as global scales.

Against this background, there is an urgent need for the country to develop a sustainable path for the generation of energy.

The financial sector has identified hydropower development as a lucrative financing opportunity. The success stories of few hydropower projects developed by independent power producers in the recent past have also helped to create positive market interest and response. On the other hand, the risk is relatively high in this sector due to its technical nature, the necessity of huge funds and longer gestation as well as repayment periods. The financial sector is entering the energy sector gradually by taking small exposure, preferring to share the risk amongst various banks and developing consortium financing.

Various national and international level seminars, as well as a few small exposures mainly in small hydropower projects, have imparted some experience to various commercial banks.

Prospects

Nepal has more than 6,000 rivers and rivulets with an overall average annual run of 225 billion cubic meters of water flowing to the south. The gradient of Nepal, which varies from 200m above sea level in south to 8,848m in the north, enables considerable hydropower potential. We have hydropower generation capacity of above 43 GW, which is economically viable. The actual capacity, however, is much higher than this.

Currently, we are facing load shedding, which shows that the electricity supply is not enough to meet demand. Furthermore, the annual country demand is increasing at about 50 MW per annum, which further increases the demand/market. In addition to current demand, there is every possibility that huge industries like cement, steel rod manufacturing, trolley bus and cable cars, etc., each of which needs high energy input, may develop once peace prevails in the country. This will further increase the demand of electricity.

In addition, we have a power hungry giant neighbor, India, where there is also a high demand. India's installed capacity is reportedly 135,000 MW. Peak demand is 105,000 MW and peak availability is only 86,000 MW. Thus, there is a huge demand/ supply gap. Further demand is growing at 8-9% per annum, which is widening the gap every year.

One of the major hurdles seen for export to India is a lack of transmission lines. Recently, the Nepal Electricity Authority and the International Leasing & Finance Services (IL&FS) of India have entered into an agreement to form joint venture companies'(JVCs) for development of the following transmission links

infrastructure development :

- Butwal-Gorakhpur: 400 kV T/L to be completed by the end of 2008/09.
- Duhabi-Purnea: 400 kV T/L to be completed by the end of the 2008/09.
- Dhalkebar-Muzaffarpur : 400 kV T/L to be completed by the year 2010/11
- Anarmani-Silgudhi: 400 kV T/L to be completed by the year 2010/11.

The funds available in the local market are able to support projects with a capacity of 20-50 MW only; for mega projects we will have to seek help from foreign institutional investors. As such, a new market for debentures, bonds or even mutual funds will open up. This will spread the return to the mass. In the event of an open market, by the year 2010 international banks will also enter Nepal. This, in turn, will increase the capacity of the financial sector. Therefore, now is the right time to start lending in this sector to gain required experience and hold in the market.

Nepalese Banks have also started to make alliances with Indian counterparts who will not only increase their capacity to lend but will also provide the technical expertise. Recently, PTC India, Ltd., has agreed to enter into an agreement to work together with Nabil Bank Ltd. for power sector development in Nepal. They have further appointed Nabil Bank Ltd. to liaise with other local banks to enter into similar agreements, which they intend to sign up with Nabil Bank Ltd. This has opened up a new avenue for sharing of expertise and has also increased the total capacity to lend.

Furthermore, a memorandum of understanding has been signed to establish an Infrastructure Development Bank, which will focus on project/infrastructure financing. This has brought a ray of hope both to the financers and the entrepreneurs.

Our Central Bank, Nepal Rastra Bank, has recently increased one obligor limit and has also provided some relaxation on provisioning of loans sanctioned to hydropower projects. This has increased the financing capacity of commercial banks and has also created a favorable market for new financing, by lowering provisioning requirement in genuine cases.

Problems

Despite of various benefits to the financial sector, to developers, and to the entire nation in the form of the development of infrastructure, education, economic standard upliftment, employment generation, and the like, there has been very slow growth in hydropower sector. Only a few new projects have come up.

Hydropower projects can be developed by the NEA, local independent promoters and foreign direct investments (FDIs). In any case, improvement in the law and order situation in the country is a must. Our country is facing political turmoil that must be settled if we are to attract FDIs. An example can be taken from the Russian government, where they have provided their own political risk cover to projects with the aim of increasing outside investments in the country. Furthermore, there should be a one window policy or easy procedures for implementation of the project licensing, etc., to attract more FDIs.

Another problem is the requirement of huge capital investment and financing. Project financing is a relatively new concept in our country, as collateral and personal guarantee-backed lending are mainly done. It will be meaningless to ask for additional comfort in the form of properties (land and building) for any project whose cost is NRs 1 billion and above. As such, limited recourse financing or project financing is only possible. There is lack of transparency in accounting due to various reasons; e.g., banks are finding it very difficult to go for project financing. Furthermore, there is a lack of expertise. Financial institutions must gradually increase their expertise, either through hiring of consultants or making coalitions with foreign (mainly Indian) financial institutions for sharing of expertise.

Matching funds are also problematic. Since banks collect major deposits for short periods of one to two years only, it is very difficult for them to finance a fixed rate for an entire loan tenure of 10 to 15 years for hydropower projects. Therefore, floating interest rates are offered to minimize the risk on the part of the financers, which leaves the developer with a higher risk.

Banks also face problems due to inexperienced promoters who tend to hire lesser numbers of technical consultants for cost reduction purposes. This ultimately leads to major cost/time overruns due to technical deficiencies in the project. Promoters also tend to compromise on quality for cost minimization, which may also jeopardize viability of the project.

Another hurdle is related to problems created by local communities. As soon as some developers start survey works, local community members tend to come forward with various demands, such as donations to the local schools and temples, for building roads, etc. Various clubs and other parties treat developers like milking cows. At present it has been almost impossible to construct projects without satisfying such local demands. Therefore, promoters are left with no other option but to satisfy their demands, in order to complete the project in time. This is one of the reasons why some promoters have become shy on development.

Various ministries, departments and other government authorities are involved in granting approvals and licenses at various stages of project development. This results in a lengthy decision-making process, which ultimately translated into time/cost overruns. Banks fix their commitment of finance and tenure of loan

repayment at the time of financial closure. Any rescheduling of repayment attracts higher provisioning as per regulations of the central bank. Bureaucratic delays as well as delays due to various strikes and *bandhs* are also major causes of time overruns. This is a serious issue that many small hydropower financers are facing. While fixing loan provisioning, the central bank should consider the issues on a case-by-case basis for viable projects, noting logical reasons regarding project delays.

Way forward

Despite of all above cited problems, a conducive environment has been created for developers, financers. Every political party as well as the government has recognized development of the hydropower sector as a key for country's development. Now, the need is to identify the barriers to the development of hydropower resources, followed by a development strategy and a set of activities to remove those barriers. This is possible through extensive consultations with all the relevant stakeholders, including government authorities, local and international financing institutions, bilateral donors, hydropower companies and end users of electricity.

More specifically, the following steps are suggested to be taken by the concerned stakeholders:

1. Demonstrate economic, financial and environmental feasibility for developing hydropower in Nepal. This should be done through one or two pilot projects.
2. Assist in developing supportive legal and an institutional framework to develop hydropower.
3. Involve local and international financing institutions to support development and implementation of a supportive financing mechanism for hydropower financing.
4. Train local stakeholders to develop project proposals.
5. Train the owners and personnel of the hydropower companies to manage and operate their enterprises on a commercially viable basis.

Expected Outcomes

1. Successful implementation of pilot projects, thereby demonstrating feasibility of such projects.
2. Supportive legal and institutional framework in place, creating more confidence.
3. Supportive financing mechanism in place, enabling hydropower investments with reasonable terms and, thus, reducing the risk of potential investors and financial organizations to finance the hydropower development in Nepal.
4. Local stakeholders trained in project management and business skills.
5. All of the above leading to increased power generation in Nepal. This will improve electricity supply to all parts of Nepal, including the rural and remote areas. Power export will also be feasible. The result will be an increase income generation and economic development at a faster pace to built the 'New Nepal'.

The local as well as the export market is readily available and infrastructure required for export is also being constructed. This is the right time to start financing hydropower projects. Banks should move forward by financing small hydropower projects in consortium and gradually go for financing middle-sized projects, joining hands with foreign financing institutions. Initially, some consultants can be hired for cross verification on technical aspects. This will gradually build up expertise and confidence of the banking sector. After the year 2010, when international banks will be allowed to work here, the capacity of the financial sector will increase immensely. Nepalese banks should be prepared for financing big projects by that time.

Let us all work together to make Nepal's water a source of national development *(Nepal ko pani, pragati ko khani*) a reality.

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A Decade of Legally Practicing the Environmental Assessment Tool

Batu Krishna Uprety

Abstract. Two and half-decades of experience in implementing environmental assessment (EA) tools through policies and legislations have contributed to integrating environmental aspects into development projects in Nepal. The *Enforcement of Environment Protection Act* (EPA) of 1996 and the *Environment Protection Rules* (EPR) of 1997 have expanded the application of EA tools for the prescribed proposals. After the enforcement of EPA and EPR, the government has approved the EIA reports of 72 projects. In 2006 alone, EIA reports of 22 projects were approved. In general, however, approval of EIA reports has no meaning unless they are effectively implemented. The benefits of EA could be realised after environmental monitoring and auditing that helps to know the level of compliance and effectiveness of mitigation measures. This article outlines the causes of delay decision and major initiatives taken to make the EA more effective, realistic and practical.

Nepal is implementing policies, laws and guidelines for project-level environmental assessment (Initial Environmental Examination, or IEE, and Environmental Impact Assessment, or EIA) with a view to make development projects environment-friendly. The conducting of EIA begon in the 1980s along with the policy of the *Sixth Plan* (1980-85). From *Six Plan* to *Eighth Plan*, the policies focussed on carrying out EIA of major development projects. EIA reports for some development projects were prepared during this period. The government implemented the *National EIA Guidelines* of 1993, and separate EIA guidelines for the forestry and industry sectors since 1995, to assist the proponents in preparing the EA reports. The *Ninth Plan* (1997-2002) emphasised participatory EIA, while the current *Tenth Plan* (2002-07) has also realised the need for carrying out environmental monitoring and *Strategic Environmental Assessment* (SEA). Sectoral policies and strategies also emphasise the importance of EIA. They include: (1) the *Nepal Environmental Policy and Action Plan* of 1993, (2) the *Tourism Policy* of 1995, (3) the *National Solid Waste Management Policy* of 1996, (4) the *Public Infrastructure (Build, Operate and Transfer) Policy* of 2000, (5) the *Hydropower Development Policy* of 2001, (6) the *National Wetlands Policy* of 2003, (7) the *Irrigation Policy* of 2003, (8) the *Sustainable Development Agenda for Nepal* of 2003, (9) the *Water Resources Strategy* of 2002, and (10) the *Nepal Biodiversity Strategy* of 2002. Most of the policies formulated after 1990 and Rio Earth Summit of 1992 have urged using EA tools.

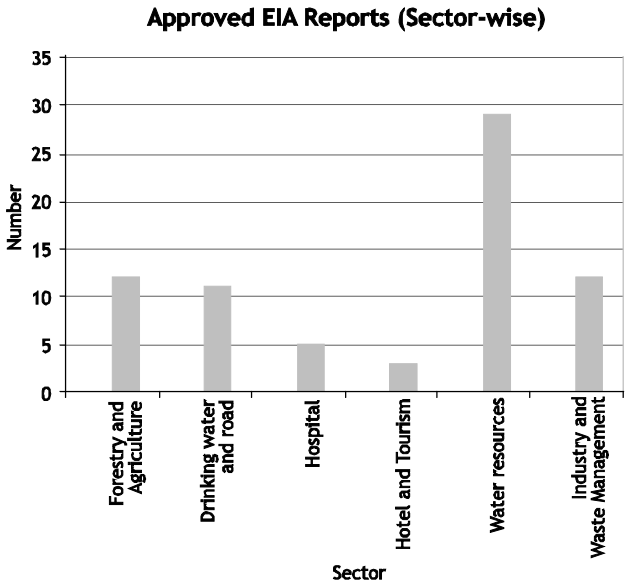
Realizing the benefits EIA in making projects environment-friendly and sustainable, the IEE and EIA were made mandatory to prescribed projects after the enforcement of the *Environment Protection Act* (EPA) of 1996 and the *Environment Protection Regulations* (EPR) of 1997, in June 1997. The Act and Rules have provisions for approval processes of IEE and EIA reports, and for conducting environmental monitoring and auditing. Based on the legal provisions, the concerned ministry (i.e., the ministry related to the proposal) is empowered to approve the IEE report. In case of EIA reports, the Ministry of Environment, Science and Technology (MOEST) is legally empowered to approve the EIA and its associated reports (scoping document and TOR), and to conduct environmental auditing. However, the concerned ministry is legally responsible to conduct the environmental monitoring. Details of the approval processes are included in the EPA and EPR.

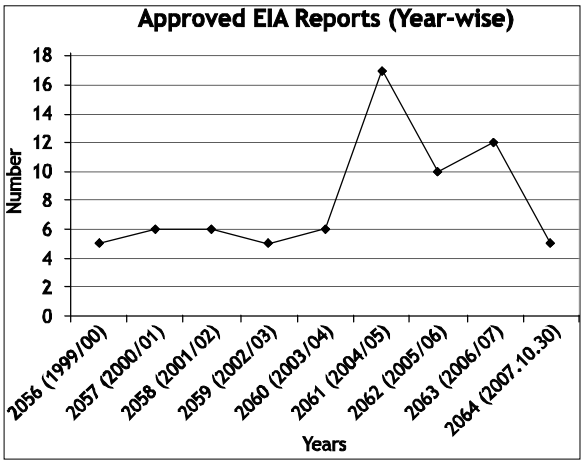
The quality of EIA reports has improved over the years, but there still are problems of copying and pasting. There are ample opportunities to make the EIA report practical, realistic and implementable. The urgent need is to maintain professional ethics while preparing the EIA report. The linkage amongst the baseline data and information with impacts and corresponding environment protection measures, monitoring and auditing parameters/indicators also improves the report quality. Environmental monitoring and auditing also contributes towards making EIA reports practical, by knowing the level of environmental compliance and the effectiveness of the environment protection measures. This will, in turn, help in refining assessment tools and in selecting practical, realistic, and implementable measures.

Approved EIA reports

After enforcement of the environmental laws, up to the end of October 2007 the MOEST has approved EIA reports for 72 projects. In the year 2006 alone, 22 such EIA reports were approved. This means that the projects were given environmental clearance for construction and/or implementation. Most of the EIA reports were prepared for water resources (hydropower generation, transmission line and irrigation projects), forestry (mostly pine resin collection), roads and drinking water projects. Some EIA reports for hospitals, sanitary landfill sites and waste management projects have also been approved.

See Tables 1 and 2.





About eight EIA reports are under refinement, as of October 2007. The EIA report of four projects (hydropower generation, irrigation and transmission line projects) planned for implementation in the national park areas are pending for approval due to attraction of the *National Parks and Wildlife Conservation Act* of 1973.

Reasons for delay approval

The MOEST is often 'blamed' by different interest groups as the institution that takes the most time to approve EIAs and associated reports. In most cases, EIAs and associated reports are prepared by the consultants on behalf of the proponent; in some cases the proponents do not know what is included in them. However, as the environmental law does not recognise consultants, the question arises: who owns the report, the consultant or the proponent. Only when proponent is fully convinced about what is written in the EIA report, its implementation could be ensured. At present there is a practice of sending low quality EIA reports, thereby creating a problem in processing their approval. In a number of EIA reports, copying and pasting has created the problem. The result is mixed data—e.g., information related to a cement factory included in the EIA report of a hospital. The proponents might be unaware of these realities.

The MOEST has taken a varied time period for review and decision. For example, the former Ministry of Population and Environment took 295 days to approve the scoping document (SD) and Terms of Reference (TOR) of the Upper Tamakoshi Hydroelectricity Project, and the MOEST took 103 days to approve its final EIA report. The proponent took nearly three years and five months, between the approval of SD & TOR and receipt of EIA report in MOEST, to prepare the EIA report of this project. In case of the Kawaswoti 132 kV Sub-station Project, the SD and TOR was approved within 12 days and EIA report within 86 days. This gives an indication that approval process timeline depends upon the legal compliance and quality of the report submitted for approval.

There are several reasons that hindered timely approval of the EIA and its associated reports. However, decisions have been made within a very short time, to the extent possible. The causes of delayed decisions are related to a number of aspects. There are ample opportunities to minimise the cost of delay decisions, but they requires the joint efforts of the proponents and consultants, and the reviewing and approving institutions. Based on the review of EIA and associated reports, some of the reasons for delayed approval are

summarised below:

1. In the case of the scoping document, the MOEST may receive the report with none, or incomplete, or unclear copy of the 15-days public notice. It may also not include the priority issues that should be considered during the preparation of the EIA report. In some cases, the MOEST has found the public notice published in the name of the consultant, not the proponent. In some of the water resource projects, approval has been delayed due to inconsistent information about the project implementation area, such as a list of VDCs or municipalities included in the survey licence and public notice for scoping.
2. Schedule 4 of the EPR of 1997 provides a format for the preparation of the TOR. In many cases, the TOR is not submitted following this Schedule. The MOEST sometimes also issues a revised TOR as per Rule 5 (3) of the EPR of 1997. But again, the report preparers have started copying the approved TOR. This is an ethical issue.
3. There are two bases for the preparation of the EIA report. One is the approved TOR and the other is by following Schedule 6 of the EPR of 1997. Three legal requirements should be complied with, before the approval of EIA report: (1) the proponent should submit the EIA report along with the proof of public hearing as per Rule 7 (2) of the EPR of 1997, (2) the proponent should submit the recommendation letter(s) of the concerned Village Development Committee(s) or Municipality(ies) along with the EIA report, and (3) the EIA report should be prepared consistent with the approved TOR.

In general, the MOEST has faced the following problems during the approval of the EIA report:

   a. The public hearing is not done in the VDC or Municipality where the project will be implemented. This contradicts with Rule 7 (2) of the EPR of 1997.
   b. The proof of public hearing is not attached in the EIA report; compliance with the legal provision is a pre-requisite for approval.
   c. The proof of public hearing is attached but it may be technically questioned. For example, the proponent conducted public hearing at five districts in one of the project planned for implementation in 31 VDCs. A total of 53 participants attended the 'so-called' public hearing. Of them, 19 participants were either from the proponent's side or from district or VDCs where the project will not be implemented. Although the proponent complied with the legal provisions, it is very difficult to be convinced that a structured public hearing conducted in five separate districts was attended by only 33 local participants.
   d. As per Rule 10 of the EPR of 1997, the MOEST has additional problems when considering the submitted recommenda-tion letters, in cases where the VDCs issue a letter mentioning 'approval (*swikriti*) for project implementation', or 'reaction (*pratikriya*) to the EIA report', or 'permission (*anumati*)' for project implementation or (*sahamati*) for project implementation. In general understanding, recommendation, approval, reaction or *sahamati* have different meanings.
   e. There are also cases where the proponents have not addressed the comments and suggestions from the public hearings, the EIA Report Suggestion Committee or the MOEST itself, while revising/refining the reports. Weak responses and illogical or unclear or confusing write-ups have also delayed the approval process. Then the question arises: who should be 'blamed', and for what?
   f. In some EIA reports, disjointed write-ups about baseline data and information, impacts, environment protection measures, and monitoring and auditing requirements have created additional problems for timely approval.
   g. In some proposals, the Scoping Document, TOR and the EIA report have been submitted for approval *after* the construction stage of the project. Furthermore, proponents sometimes construct a project after the approval of Scoping Document and TOR but *before* the approval of EIA report. This is also an example of non-compliance of the environmental law.

4. Some of the impacts identified and predicted in the EIA reports are theoretical, unrealistic and non-site specific. This is also validated from the field study. For example, an urban housing project submits scoping document with information on forest biodiversity.

The proponents must rectify these sorts of problems and submit their reports in compliance with the legal provisions. Their reports should be prepared based on the EIA principles and practices.

Recent initiatives

The MOEST is making every effort to improve the quality of EIA and associated reports. Lack of environmental monitoring reports, however, has made it difficult to know the level of compliance and effectiveness of the mitigation measures included in such reports. Lack of established mechanism for reporting about implementation of approved EIA reports has also limited the applicability of such reports, although the EPR has provisions for environmental monitoring and evaluation. Furthermore, lack of

information about completion of the project construction stage has limited their effectiveness by neglecting to include information on programs and allocated budgets for environmental auditing, as per Rule 14 of the EPR of 1997.

Realizing these constraints, the MOEST made several decisions in 2006 to facilitate timely approval of EIA and associated reports. Some of the recent initiatives are summarized below:

1. Once the EIA and associated reports are received at MOEST for approval, MOEST directly inform the proponent to submit additional information if required. Previously, the proponents were required to submit necessary information, including legal documents or revised report, through the concerned ministry. The new approach saves over three months of time.
2. All pending EIA reports are approved, including necessary conditions, if there are no legal complications.
3. In case the project affects resources such as forests, land and properties, compensatory measures have been adopted that, in general, are the last option in the EIA process. The basic purpose is impact avoidance, minimization and compensation.
4. The proponent is required to submit an annual report on environmental monitoring and evaluation to demonstrate level compliance and effectiveness of environment protection measures (benefit augmentation and adverse impacts mitigation measures), within the EIA report.
5. The proponent is also required to inform the MOEST within three months of completion of project construction in order to plan for conducting environmental auditing timely.
6. The MOEST is now approaching economic valuation of ecological goods and services of forest resources that will be directly affected by project activities. In the past, efforts were made to determine direct use values only. Once the new approach is in place, the proponent might also consider impacts of the project on indirect use of the natural resources that benefit local people and enhance the proponents' social responsibility.
7. Schedules 1 and 2 of the EPR have been amended and published in the *Nepal Gazette* of August 2007, taking into consideration inputs of the concerned institutions.
8. In order to assist the proponents in preparing quality EIA reports, the MOEST in November 2006, under its completed NORAD project, published framework guides to streamline the EIA approval process, environmental management plan, environmental monitoring, and environmental auditing. It has also published a handbook on licensing and EA process for hydropower projects.

Conclusion

Environmental assessment has multifold benefits in addressing impacts that will happen or are likely to happen with affected communities and natural resources. The EIA and associated reports are made public so that the stakeholders have the opportunity to raise their concerns, opinions and issues. If the EA reports are prepared based on correct principle and practice, they provide ample opportunities to make the development project environment-friendly and sustainable. For this, the proponents, consultants and reviewing and approving agencies should work closely together, to make projects more practical and implementable, and to benefit from the associated environmental impact assessment tools.

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Policy Level Improvement in Hydropower Development

Bikash Thapa

Abstract. Mother Nature has given Nepal a vast opportunity for hydro energy production, but still the country is reeling under painful load shedding due to an electric power production deficit of 70MW. The main challenge for the country now is to harness the hydropower potentiality, which contributes for its economic development. In Nepal, policy deficiencies and the slow decision making process in electricity sector has resulted in the increased project costs and has reduced the involvement of private sectors and the entrepreneurs. Thus, restructuring and improvements at all policy level is required to overcome various hurdles, and then only will hydropower develop in Nepal.

Nepal is reeling under painful load shedding due to an electric power production deficit of 70 MW. Due to the political unrest the state is unable to give due attention to its production.

Once the ongoing political instability is settled, economic development will be the national agenda. As hydropower is the backbone of economic development, policy level improvements need to be strengthened by reviewing the progress made so far and learning from past shortfalls.

Hydropower developed during the democratic period only after the year 1988. After the People's Movement, Jana Aandolan-I, that year, the installed capacity reached 614 MW, whereas it was only 300 MW in the previous 30-year Panchayat era. The private sector played an important role in its development. Failure to meet the normal demand for energy will continue; however, even after completion of any new 300MW capacity project. The Nepal Electricity Authority (NEA) has not supplemented a single kW during the last five years. The 70 MW Middle Marshyangdi Hydroelectric Project is not likely to be completed in five years although it was planned to be completed within three years. The main reason for the delay is the political insecurity that is compounded with wrong policies of NEA and the government.

Without electricity, new factories, industries and daily activities like business expansion is not possible. Revenue to the state is generated from industrial production which requires electric energy. Mother Nature has given Nepal a vast opportunity for energy production that is not available in most countries of the world. The generation of hydropower is environmentally friendly and the resources required are abundantly available in Nepal. The main challenge is how to harness this vast potentiality.

The 10th Five Year Plan had a target to generate 314 MW hydroelectric energy, out of which 214 MW was to be generated from the private sector and the rest by government agencies. At the end of the 10th Plan, however, the capacity generated was only 40 MW, to which the contribution of the government was almost nil. The main reason behind absence of the private sector in its development is due to policy deficiencies. The *Finance Act* nullified the facilities granted by the *Hydropower Development Policy* to attract the private sector. For example, there was no corporate income tax for 15 years and no tax up to 1000 kW. The facility of 1% custom duty and no VAT were cancelled by *Finance Act*. The policy envisioned that the hydropower generated would be cheap. Hydropower and vegetable industries were placed in one category which made investors reluctant to invest. Thus, the wrong message was delivered due to the change in policy. The one window policy to facilitate hydropower development is not working. A letter from the Department of Electricity Development (DOED) is not even considered by a clerk of the Custom Office.

Decision making processes in Nepal are very slow and lethargic in the electricity sector. This has resulted in increasing project costs and has halted the entry of additional entrepreneurs. Therefore, restructuring at all policy levels is required.

Policies need to benefit consumers and investments must be competitive. Institutional restructuring is essential to develop hydropower as a national industry. Policies concerning customs and tax, as well as on forest cover have to be reviewed, as the Ministry of Forest and Soil Conservation has propagated a policy to require forest cover area as 45% when most of the transmission lines and power houses are located in forest areas. The harassment and pain in obtaining forest land for lease has discouraged entrepreneurs.

It is not only the policies of the Government that have harassed the private developers, but also NEA's undeclared policies. The *Power Purchase Agreement* (PPA) is an instrument that determines the return on hydropower investment. But, as the NEA has not paid much attention to the PPA over the last three years, developers with licenses cannot move ahead.

The DOED has issued 174 licenses for about 3000 MW, and are 64 projects below one megawatt. Out of these, some may have problems; but the main constraint is the lack of attention to the PPA. Mr. Anup Kumar Upadhyay, the Joint Secretary for the Ministry of Water Resources, has stated that the desired level of hydropower development is only possible through the investments of both the public as well as the private sectors. It is imperative to create a conducive environment to the private sector for domestic consumption. He holds the view that prior information on power purchase and pricing policy, where PPA can be done, must be given appropriately in order to attract private sector investment.

The ex-Director General of the DOED, Mr. Jayakeshar Maike, is of the opinion that in the absence of the

PPA, projects have not developed. The NEA is avoiding the PPA with the excuse that there is a lack of transmission lines. After the Arun-III project, the NEA has concentrated only in generation projects. He says that today's results are due to negligence in the construction of new transmission lines. In Mr. Maike's opinion, it is of utmost necessity to make policy level improvements. In the public sector, delays in decision making are hampering progress, thereby increasing the cost. Further, he adds that production, transmission and distribution of the NEA must be unbundled. Only then will competition be properly induced in all sectors.

In the absence of an adequate investment environment in Nepal, young entrepreneurs like Mr. Sujit Acharya are constructing projects over four megawatts in north India's Himanchal Pradesh state. He is of the opinion that there should be a difference in policy for small and big projects. Fourteen proposals have been submitted for projects like the Upper Karnali, Arun-III and Budhi Gandaki. This will fulfill some of the energy needs of India. "We can earn billions by selling licenses to Indian Companies", says Mr. Acharya. "The policy for increasing tariff shall be made first while issuing licenses".

The NEA has different versions for making leaps in hydro-development. Mr. Bhoj Raj Regmi, General Manager for Engineering in the NEA is of the opinion that models should be different for small, medium and big projects, while keeping the already invested projects open. "Project size and investment models should be mixed", he says. Development will be fast, he maintains, if there is diversification in investment and project selection.

Mr. Ramakant Gauro, Engineer and Member of the Nepal Planning Commission, is of the opinion that policy should exist to make all the possible projects exploitable for national electrification and that the surplus to be sold to India. According to him while talking on exporting the electricity to India, many people asserted that the country's hydropower production is being sold out. He further says: "Let us hope that we will not be blamed for selling the country while exporting electricity to our neighbor."

To conclude, policy level improvements are required to overcome various constraints and hurdles. Only then will hydropower develop in Nepal.

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Dams, Environment and Local People

A.B. Thapa

Abstract. Dams, environment and local people are interrelated. Large dams have several large scale advantages in irrigation, flood control, power generation, inland navigation etc. It is equally true that it has also many large scale adverse impacts inducing controversy and disputes. For example, despite enormous benefits to Canada from large scale dams, the local people of the Basin are still feeling deep resentment at the way they were treated. Hence, it is utmost necessary to thoroughly examine all the important aspects of the project particularly the environment side regarding the implementation of large dams.

Large dams can be very beneficial. They can provide regulated flow to generate abundant hydroelectric energy. Similarly it would be possible to boost agriculture production by supplying regulated water for irrigation in the dry season when the demand for water is the highest. There can be several other advantages of building dams, including flood control and inland navigation.

When the nature of the benefits is analyzed, we find that dams benefit mostly the downstream regions while it impoverishes people living in upstream areas. In our case, India and perhaps Bangladesh would also benefit from dams constructed in Nepal, while our country would bear the brunt of adverse environmental impacts. Unfortunately, politicians, planners and entrepreneurs in Nepal tell the public that the livelihoods of local people will be greatly improved by implementing large hydropower projects such as the West Seti, Karnali-Chisapani, Tama-Kosi, Kali-Gandaki-2, Buri-Gandaki, and Andhi Khola projects, which are storage type projects. Is it really true that the people will be better off after the implementation of large storage dam projects? Or it is merely a deception? For comparison, let us see what the river basin residents of Canada are saying now 30 years after the implementation of the Columbia River storage dam projects.

Columbia River dam projects have provided enormously large benefits to Canada. Apart from the direct power benefits generated at hydropower stations in Canada, that country has received a large sum of money from the USA in return for flood control benefits to accrue to latter. In addition, Canada is receiving from the USA, in perpetuity, 50% of the additional power generated at 11 downstream hydropower stations, in return for providing the water storage. Despite the fact that Canada took full advantages of the Columbia River dam projects, the people living in the Columbia river basin still feel deep resentment at the way they were treated. The following are the excerpts from Canadian reports.

Basin people in Canada bitter about projects

In 1967 an American resource economist predicted that the Columbia River Treaty would provide an economic ‘shortfall’ for the Columbia Basin. Today that loss is considered incalculable. If negative environmental and social impacts are considered, the effects on the region are even more aggravated. The Basin bears the symptoms of the negative Treaty impacts with lower development and economic growth in many parts of the Basin, particularly those areas affected most directly by the reservoirs. The resentment and bitterness over how the region was treated 30 years ago is still in the minds and memories of many Columbia Basin residents.

The Treaty dams created four reservoirs flooding 60,000 hectares of land in the Columbia Basin. Included in the flooded land were dozens of small communities and thousands of acres of farmland and harvestable forest. The reservoirs damaged a regional fishery already crippled by the loss to other dams on the Columbia River. The flooding destroyed precious wildlife habitat and turned pristine natural lakes into huge fluctuating industrial reservoirs. The Arrow Lakes reservoir, for example, can rise and fall seven stories in height at the beach at Nakusp. During recent drought years, Valemount residents have had to drive more than 20 miles on lake bottom from their community dock on the Kinbasket reservoir to find water. As well as destroying potential wealth, the reservoirs have acted as barriers to resource development in parts of the region. Perhaps the worst impacts were the human costs. Thirty years ago more than 2,300 Basin residents were uprooted and moved from their homes and, in many cases, from their livelihoods to make way for the reservoirs.

The case of Nepal

Loss of agricultural production

*T*he valley bottoms of all major Nepalese rivers are extensively cultivated with paddy, maize, cereals, pulses and mustard being the most common crops. Reservoir formation would eliminate these cultivated lands resulting in an enormously large loss in agricultural production

Large numbers of people evicted

The areas to be submerged by the proposed storage reservoirs in Nepal are densely populated. According to a 1979 UNDP study, about 47,000 people would be displaced to implement the 360 MW Kali-Gandaki 2 storage project. Similarly, in the same study, it was estimated that about 22,000 and 14,000 people would be displaced with the implementation of the 180 MW Andhikhola and 460 MW Buri-Gandaki projects, respectively. These are the storage projects selected by the government to be implemented in near future.

Earthquakes danger

The geotectonic lines in Nepal that determine the geological structure of the Basin consist of two major thrusting faults—the Main Central Thrust (MCT) and the Main Boundary Fault (MBF). These faults extend in an east-west trend across Nepal, acting as the major division between formation groups.

The formation of a large reservoir overlying tectonically active and faulted areas would lead to an increase in seismic events. An existing dam at Koyna in India, for example, is believed to have triggered an earthquake of magnitude 6.3.

Dams at the center of controversy

The World Commission on Dams recently published the report *Dams and Development* (2000), providing in-depth information on issues related to dams. A few of the issues are discussed here.

Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable. In too many cases, however, an unacceptable and often unnecessary price has been paid to secure those benefits in both social and environmental terms by displaced people and by the natural environment.

Dams are at the center of controversy, dispute, and even violent confrontation. There are many reasons largely related to the scale and scope of the dams and the impacts.

Impact of dams on local people devastating

Large dams are unique among major infrastructure projects in terms of the scope and manner in which they affect the pattern of access to resources, and in their distribution across space, time and social groups. They are generally justified by national or regional macro-economic benefits while their physical impact are locally concentrated, mostly affecting those within the confines of the river valleys and along the river reaches.

Large dams have significantly altered many of the world's river basins, with disruptive, long-lasting and usually involuntary impacts on the livelihoods and socio-cultural foundations of tens of millions of people living in the region. The impacts of dam-building on people and livelihoods—both above and below dams—have been particularly devastating in Asia, Africa and Latin America where, in the past, existing river systems supported local economies and lifestyles of large populations in diverse communities.

Local people ruined

Dams take a set of resources—a river and the lands along its banks, generating food and livelihood for local people, and transform them into another set of resources—a reservoir, hydropower and irrigation, providing benefit to people living elsewhere. There is a sense, therefore, in which large dams export river water and lands, removing them from the productive domain of one community to make them available to another.

The Grand Coulee in the USA's Washington state provides a vivid example. Native Americans were physically displaced by the project in order to provide power to industry and to households in a city some 250 km away. Furthermore the water and land that had previously supported their livelihoods was dammed and diverted to provide white settlers with irrigated farming

Resettlement problems

Resettlement for large dams tends to be on a larger scale than resettlement associated with other types of physical infrastructure. Roads and thermal power plants, for example, can be sited on marginal land, whereas dams generally flood rich and fertile agriculture land. Those resettled from dam or reservoir sites often lose not only their homes but also their livelihoods. Relocation in rural settings where good land is already occupied can be problematic.

Rio principle and the environment

In 1986 the UN General Assembly adopted the *Declaration on the Rights of Development* (DRD). It marked a significant step by the international community towards developing a normative framework that specifies responsibilities in applying a human rights approach to development. It moved beyond the sphere of individual human rights to address relationships between different interest groups in society and their

interaction with the state. In June 1992, the *United Nations Conference on Environment and Development* adopted a declaration usually known as the *Rio Principles*. Several of the principles are of immediate relevance to water and energy resources management. Principle Three, for example, recognizes the right to development, but insists that it be met in an equitable way that considers future generations as well as present participants in development. Principle Four insists that sustainable development requires that the environment to be integrated with the development process and form a central feature of the aim of that process.

In Conclusion

At present, Nepal is seen to be in a haste to make deals with private developers to implement large storage dam projects. If decisions are taken to implement such projects without thoroughly examining all important aspects, particularly the environmental side, the result will certainly be harm to our country.

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Environmental Impact from River Damming for Hydroelectric Power Generation and Means of Mitigation

Ash Kumar Rai

Abstract. Nepal is rich with inland water resources and has great potential for electricity power generation. Hydropower is one of the most sustainable national income sources to increase the nation's GNP. Relatively few water resources are under utilization, however, although some lakes in Pokhara valley and the Kulekhani storage type hydropower reservoir are successful in supporting multipurpose usage, combining electric power generation, irrigation and aquaculture. The Kaligandaki hydropower system is run of river, thus not feasible for cage fisheries; instead, it produces fingerlings of indigenous riverine fish for release into the river.

The impoundments after damming the rivers adversely impact both fish biodiversity and local fishing communities. Ecosystem change destroys feeding as well as breeding grounds, with a resultant loss of fish species. Where the movement of migratory fish up and down river is affected by hydropower development, fish hatcheries near the dam sites or fish ladders for fish movement should be considered as mitigation options. Local user groups and other stakeholders should be involved in decision-making, to keep good relations concerning peoples' livelihoods and the sustainability of aquatic resources. River systems should be thoroughly studied jointly with concerned agencies (e.g., electricity, irrigation and fisheries authorities; and local authorities) during formulation and application stages of hydroelectric power development projects.

Key words: River damming, power generation, biodiversity, fisheries, impact adversely, mitigation.

Inland water resources are the most important natural resources of the Nepal Himalaya. Nepal is the second richest country in inland water resources in the world, possessing about 2.27% of the world water resources (CBS 2005). About 5% of the total surface area of the country is covered by water (Bhandari 1992). The major sources of water are glaciers, snowmelt from the Himalayas, rainfall, and ground water. Out of 818,500 ha of total water surface area, there are about 6,000 rivers including rivulets and tributaries totaling about 45,000 km in length and covering 395,000 ha (DOFD 1961/62). The rivers, rivulets and tributaries play a very important role covering an estimated 48.3% of total water surface area. The riverine water resources are the nation's precious property, if properly utilized. Compared with other ecosystems, the aquatic life in this system is the most threatened biological diversity component. Most of the people use the world's river resources for food and recreation, and fishing is very important in the livelihoods and diets of the poor, providing an inexpensive source of animal protein and essential nutrients not available from other sources. Inland fisheries are generally less valued in terms of contribution to food security, income generation and ecosystem, but help greatly to highlight the complex contributions to rural livelihoods.

River systems and riverine fisheries management

Rivers provide substantial social as well as economic benefits to a large number of the people. The river fisheries provide a source of food and employment to sustain livelihoods, particularly of the rural poor. Most fisheries are of national economic importance and are crucial to local and regional food security, but they remain undervalued due to lack of proper management. Rivers are in an endangered position and suffer considerably due to human activities, including damming and catchment disturbances. Large rivers significantly support the earth's aquatic biodiversity. Migratory fish species are vulnerable during their life cycle due to river damming, and about 20% of the world's fresh water fishes are estimated near extinction or in urgent need of conservation. Therefore, to sustain biodiversity and fisheries in rivers requires sustainable management both of habitats and systems of exploitation. For the management of large river fisheries, the concerned authorities should be involved in the planning before the damming of rivers for electricity generation, in order to maintain and conserve river fish, fisheries and their environment accordingly. Most river fisheries are not managed effectively due to insufficient funding and lack of stakeholder collaboration, and are sometimes vulnerable to over exploitation. Appropriate legislation must be formulated to encourage more responsible management of living aquatic resources and the fisheries that depend on them. In some areas the water quality, quantity, fish poisoning, electro-fishing and mechanisms for fish passage are the subject of legislation that should apply rightly to protect ecosystem diversity. In addition, the user groups should also be involved in management decisions.

Use of water resources

There are about 6,500 ha of pond area (0.8% of total water surface area) in Nepal used for aquacultures that, if properly managed, have the capacity to produce about 20,000 MT of fish per year (DOFD 2061/62). The rest of the water bodies of the nation are used for irrigation and electricity power generation. The water resource of lakes is estimated to be 5,000 ha (0.6%) of the water resources in the country. Of that amount, about 1,000 ha, primarily in the lakes of Pokhara valley of Nepal's midhill region, are under multipurpose usage. Pokhara's Phewa lake is used for electricity power generation, irrigation and aquaculture, as well as recreation for tourists. The nearby lakes Begnas and Rupa are also used for irrigation, aquaculture and recreation. In these lakes, aquaculture mainly involves cage fish culture and open water fish stocking. More than 300 family members are engaged in about 23,700 m^3 of fish cage aquaculture in these three lakes, producing 100 MT of fish per year. The people are basically fishers by profession, and are landless or have very low land holdings. The major role in cage fish culture is played by women in these communities, which therefore benefit from the employment. The three lakes of Pokhara valley are good examples of the multipurpose use of large bodies of water, including cage fish and open water fish stocking.

The 220 ha Kulekhani reservoir, at an elevation 1430 msl, was constructed in 1982 by damming the Kulekhani river and its tributaries at Markhu, Makwanpur District, in the hills south of Kathmandu valley. This is the first large-sized reservoir constructed in Nepal for electricity power generation. It is a storage type of reservoir with a catchment area of 126 km^2. It depends mainly on rainfall and water accumulated primarily during the monsoon season (June-September). (Despite its size, however, the annual run-off from the river and its tributaries is insufficient to meet electrical power demand.)

The Kulekhani reservoir is the first manmade reservoir in Nepal applying the cage fish aquaculture technology. The aquaculture component was implemented in 1984 by the Nepal government with assistance from IDRC, the Canadian International Development Research Centre (Rai 1989). The project assessed the feasibility of a fisheries development program by gathering in-depth information on the limnological/biological parameters, then helped establish the foundation for fisheries development programs in this and future storage type reservoirs. Storage type reservoir can get rich nutrients flows from surrounding villages and farms during rainfall, which in turn helps produce plankton, the natural food of such planktivorous fish species as silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*). The cage type aquaculture at Kulekhani provides job opportunities for the local people as part of the mitigation efforts following reservoir construction and loss of farmland. More than 210 farmers are engaged in the cage fish culture at Kulekhani using more than 32,000 m^3 cages for table fish production, and more than 7,100 m^3 of nursery and rearing cages for fingerling production. Altogether, more than 34,000 m^3 production cages produce fish in excess of 136 MT/year at a rate of more than 4 kg/m^3 (Rai 1989).

The Kali Gandaki hydroelectric power system is one of the nation's largest high capacity run-of-the-river projects, at a capacity of 144 MW. It was constructed by impounding the Kali Gandaki river at Mirmi, Syangja District, in the central midhills region (EIA 1996). The Kali Gandaki project has adversely affected fish biodiversity and the fishing community, who depend on fishing for their livelihood. This reservoir is a run-of-the-river type, and aquaculture is not feasible to mitigate such negative impacts. Therefore, a fish hatchery was built near the project site for mass seed production of economically high value indigenous riverine fish species, to allow stocking both up and down river from the dam site, to mitigate the negative effects of the dam on the pre-existing fisheries and to provide new income generation opportunities to the local fisher community.

The fish hatchery is run jointly by NARC, the Nepal Agricultural Research Council and NEA, the Nepal Electricity Authority. To the degree this program is successful, then this technology can be applied to future run-of-the-river type reservoirs. Out of the 184 fish species documented in Nepal (Shrestha 1995; Shrestha & Chaudhary 2003), 57 species have been recorded in the Kali Gandaki river (EIA 1996); of them, Sahar, Asla, Katle and Gardi are successfully being bred and stocked in the river each year, as project mitigation activities.

Fish propagation and stocking to mitigate or compensate for adverse effects of some activity within the water basins are some of the means to maintain or improve fish populations in the environment. Besides that, regular research work has been carried out to study the behavior, growth, reproduction and adaptability of local commercially important indigenous riverine fish species, and to develop techniques for environmentally friendly conservation and development in the dammed river systems. Such basic information should provide significant knowledge on the biodiversity of the river system and help develop appropriate fisheries management technologies.

Hydroelectric power generation

Hydroelectric power generation is one of the basic needs to increase the GNP of the country (EIA 1996). Because Nepal has abundant water resources, there is great potential to use water resources for the electricity development as a sustainable national income source. Nepal has built several dams for hydroelectricity and irrigation purposes. Some that were built for hydroelectricity power generation are at Pharping (500 kW), Sundarijal (900 kW), Panauti (2400 kW), Phewa (1088 kW), Dhankuta (240 kW), Gorkha (64 kW), Seti (1500 kW), Salleri (400 kW), Dhading (32 kW), Surnaiyagad (200 kW), Kali Gandaki-A (144 MW),

Marsyangdi (69 MW), Kulekhani-1 (60 MW), Kulekhani-2 (30 MW), Khimti Khola (60 MW), Bhotekoshi (36 MW), and Modi Khola (14.8 MW) (Jha & Chaudhary 2003). Water represents one of the main resource opportunity for developing electric power generation for Nepal's future economic development. Water availability in Nepal, however, is highly seasonal and unevenly distributed geographically, and while hydropower projects with storage reservoirs are economically viable they require huge capital investment.

Impacts of dam construction

The impoundments after damming the rivers adversely impact fish biodiversity and the economics of fishing communities that depend on fishing for their livelihood. Dams have contributed to better water storage, irrigation and energy production, but have led to changes in upstream and downstream species composition and, in some instances, to species loss. Between 1950 and 1990 in India and China, dams displaced over 26 million people (Karki 2000). In these countries, and in Nepal, dam construction has resulted in adverse impacts on river fauna such as dolphins and migratory fish species, and on local people such as Nepal's Majhi, fishing folk, who tend to receive inadequate compensation for land lost or also lack direct access to benefits from such dams.

Electrical power generation supports the development of the nation, but the river ecosystems suffer adversely, especially the maintenance of fish species, which were not considered in some of Nepal's earliest hydropower projects. The West Seti river system has been studied for hydroelectric power generation of 750 MW capacity, with a proposed 1,989 ha reservoir area (SMEC 2000). Asla (*Schizothorax* spp. and *Schizothoraichthys* spp.) is the dominant fish species in Seti River, and the migratory Sahar (*Tor* spp.) is also common in that area. Asla needs running water with high oxygenated water, but after damming the reservoir will have stagnant water where this species cannot survive. Sahar and Eels are long migratory fish that cannot move up and down after damming. Also note that Sahar spawns during rainy season and migrates upwards, but with the dam that migration will be blocked. The ecosystem will change and both feeding grounds and breeding grounds will be destroyed, leading to fish species loss. 7,876 people in 1003 households live around the reservoir, and will also be affected (SMEC 2000). Therefore, to minimise negative impacts and to address or redress any adverse impacts to the people and the ecosystem, holistic planning and management of dam construction should be adopted.

Potential for aquaculture in the reservoir

Manmade reservoirs in Nepal cover about 1,500 ha, comprising about 0.2% of the nation's water resources (DOFD 2061/62). As the number of reservoirs increases, it is projected that an estimated 78,000 ha more water surface area will be needed for hydropower generation and irrigation purposes (Pradhan 1987). The proposed hydroelectric power in West Seti River will create a 1,989 ha area in a storage-type reservoir. That reservoir will collect rich nutrients from the villages and farms during rainfall that, in turn, will promote plankton growth and the potential for development of planktivorous fish culture. As this occurs, new job opportunities will be created for local people living around the reservoir. At the same time, national fish production and per capita fish protein consumption will also increase. Poverty can be reduced and food security improved when smallholder farmers and subsistence fishers achieve higher levels of sustainable productivity.

However, a fish hatchery is necessary near the dam site to breed and produce enough fingerlings for aquaculture activities as well as for economically important high value local fish species to stock the river for conservation. Fishing pressure is an increasing trend with globally increasing human populations. Meanwhile, fish populations are decreasing due to over fishing all over the world, and sea water is becoming polluted due to mixing with polluted drain out water. Fish demand is high but fish production low; to fill the gap the importance of aquaculture in inland water bodies cannot be overstated. More than 6,000 large and small rivers flow in Nepal, some of which have high potential for hydroelectricity power generation; and, those with storage type reservoirs can accommodate commercial aquaculture. At the same time, community-based management should be applied to develop both responsibility and ownership within the fisher community.

Implementation approach for mitigation

During project formulation and implementation phase, the joint involvement of the electricity authority, irrigation, fisheries, and other district authorities and local concerned persons can, together, develop a strong approach to minimizing the adverse effect from damming. Either a fish hatchery or fish ladder for seasonal fish migration, depending on the reservoir type, can be developed as a mitigation measure that is both cost effective and sustainable. Fish hatcheries are needed to study and breed the local fish of economically high value and to develop breeding technologies for producing fingerlings and stock . The local fishing community should have fishing rights and also the authority and responsibility for conservation of fish diversity and the aquatic environment. A marketing strategy is also required for selling fish products both inside and outside the country. The local district should also be benefited by the project, with 10% of the profit from electricity

production dedicated for community development. Likewise, another 1% of the profit from electricity generation should be allocated each to local village development committees for fish and other biodiversity conservation and for environmental mitigation in the affected areas. A collective approach by resource users and the society at large will be effective for river maintenance and restoration of degraded rivers and their fisheries. In short, the fisheries sector should not run in isolation from the hydroelectricity sector, but should communicate with the public and other users of water resources for sustaining the program.

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Harnessing of Mini Scale Hydropower for Rural Electrification in Nepal

Hari Krishna Ghimire

Abstract. This paper provides insight on hydropower development in general and mini-scale hydropower in particular, for rural electrification in Nepal. It also analyses the opportunities and challenges in the development of mini-scale hydropower to supply reliable electricity in remote rural areas of the country as an aid to poverty reduction and economic progress.

Key words: Mini-scale hydropower, rural electrification, poverty alleviation.

Nepal, a small developing country, located on the lap of mighty Himalayas is endowed with huge potential of hydropower. Out of the theoretical potential of 83,000 MW, 42,000 MW is said to be economically viable in the present context. Apart from hydropower, no other natural resources in economically exploitable quantities are available in the country that can boost economic prosperity and raise the living standards of the people. Out of the population of 28 million, around 30% still live below the poverty line and only about 7% of the rural population has access to electricity so far. Poverty is a main cause of environmental degradation and of social conflicts in rural and mountain areas of the country. Indiscriminate uses of traditional energy sources, which are mostly available free of cost in rural areas, are causing negative consequences on the natural environment. Therefore, an alternative source of energy is required to preserve precious natural forests in rural and mountainous areas.

In the past, successive governments have not properly developed hydropower overall. Politicians and planners have been engaged in futile debates whether to give priority for the development of big, small or mini-scale hydropower schemes. Poor demand-side management, the project-oriented approach and political instability have hindered the speedy electrification process. Realizing past mistakes, the Government of Nepal (GON) had promulgated the Hydropower Development Policy 1992, the Water Resources Act and Electricity Regulation 1992, and the improved Hydropower Development Policy 2001. In recent years the policy and acts have shown some positive results in this sector. The Hydropower Development Policy of 2001, especially, places emphasis on rural electrification and the involvement of the private sector in the hydropower sector by offering a one-window policy and incentive packages.

Many power-purchase agreements (PPAs) have been signed in recent years, but rural electrification is the sector where private investors do not want to spend due to the low return on investment. Hence, a subsidy policy and community participation in rural electrification is being promoted. Rural people are encouraged to participate in grid extension and construction of integrated as well as isolated type mini-scale hydropower schemes for rural electrification. In this manner, hydropower as a natural endowment that is environmentally friendly and a perennial source of electricity, has been seen to enhance the sustainable development process in Nepal, as rural electrification is an important part of the development strategy. The GON, in its 10th five-year plan, had set the ambitious target of electrifying up to 2,600 Village Development Committees (VDCs) through the extension of the integrated national grid system. The energy needs of 1,000 more VDCs were proposed to meet by decentralized energy production systems during the 10th five-year plan. Due to the rugged mountainous terrain and scattered nature of human settlements, the national grid extension to these areas is difficult and uneconomical.

Mini- and micro-hydropower development

Although the first hydropower plant of 500 kW was constructed in Nepal as early as 1911, to date only 550 MW of hydropower has been developed. Classification of hydropower plants took place in 1975 when the GON established the Small Hydel Development Board (SHDB) to electrify remote district headquarters through the construction of isolated type small hydropower schemes. At that time, hydropower plants from 100 kW to 5,000 kW were called small-hydros, and plants of less than 100 kW capacity were categorized as mini/micro-hydropower plants. In 1985, the Nepal Electricity Authority (NEA) was formed as per the Nepal Electricity Act of 1984, to look after all electricity-related jobs by merging the Electricity Department, the Nepal Electricity Corporation and the SHDB. Currently, there is a separate department called the Small Hydropower and Rural Electrification Department under the NEA charged with developing and operating small hydropower schemes and carrying out rural electrification ventures through the extension of the national grid system.

A new classification of hydropower schemes has emerged recently for practical reasons, as different institutions are involved in the development of hydropower projects. This is also due to the liberal hydropower development policy (1992 and 2001), which is mainly meant to attract private investors and encourage the rural electrification process. Now, hydropower plants of less than 100 kW fall under micro-hydros and plants between 100 kW to 1,000 kW are called mini-hydros. Other hydropower plants between

1,000 kW to 10 MW fall under small-hydros and those more than 10 MW capacity are classified as medium and big hydros.

Thousands of traditional water wheels (*ghattas*) are in use throughout Nepal since early days. These primitive water wheels are being developed as multi-purpose power units (MPPUs) for agro-processing and electricity generation purposes. They are popular for the electrification of scattered and isolated settlements in the hilly areas of Nepal. During the daytime they provide mechanical power for rice hulling, grinding, oil expelling and so on, and during the night they generate electricity for lighting and recreational purposes. A number of agencies and institutions are supporting the implementation process of micro-hydropower plants (MHPs). To date, around 2,200 MHPs, including 800 mechanical schemes, have been installed, and the total installed capacity of electricity generation from these plants has reached to around 7.5 MW.

After 1970, the GON provided subsidies of up to 75% for electro-mechanical equipment for micro-hydropower plants through the Agricultural Development Bank, Nepal (ADB/N)) to electrify remote rural areas of the country. But, from 1995/96 onward the process for implementation of micro-hydropower schemes took new momentum as a new institution called the Alternate Energy Promotion Centre (AEPC) was established under the Ministry of Science and Technology. The main objective of AEPC is to promote and disseminate renewable/alternative energy technologies and meet basic energy needs of rural people residing in remote areas of the country. AEPC administers provide subsidies to enthusiastic micro-hydropower developers through its interim rural energy fund supported by the Energy Sector Assistance Program (ESAP). Apart from AEPC, there are other institutions and organizations like the UNDP's Rural Energy Development Program (REDP), the government's Remote Area Development Committee (RADC) and the Annapurna Conservation Area Project (ACAP).

Challenges and opportunities

Around 30% of the total population of Nepal live below the poverty line, and most reside in remote rural areas. Many people who live in rural and mountain areas are mired in poverty and destitution. They do not have access to modern development and new technologies. Productivity in these areas is very low because of primitive and traditional farming methods. Sufficient arable lands with irrigation facilities are not available in most rural hilly communities. Agricultural products from limited land areas are inadequate to feed the local people. Natural forest areas are being destroyed for new farming lands. Fuelwood, agricultural residues and animal wastes are widely used to fulfill basic energy needs. Even now, in some far-flung rural areas of Nepal, pine sticks are used for lighting. Kerosene is a luxurious item, costing the equivalent of around US$ 1 to 2 per liter. Deforestation is rampant, causing multi-dimensional consequences to the environ-ment.

To alleviate the misery of the rural people and to raise their minimum living standards, a supply of adequate and reliable electricity is essential. Where extension of the national grid line is not possible in the near future, and where the establishment of diesel power plants is too expensive, a dependable supply of hydro energy is only the long-term solution. As there are 6,000 rivers and rivulets criss-crossing the country, plenty of potential mini-scale hydropower sites can be found in the rural mountain areas. The promotion of tourism, the establishment of small industries and the provision of lift irrigation are some features that will certainly stimulate the local economy. Hilly mountain regions are favorable for growing varieties of fruits and valuable herbal species; but due to the lack of appropriate markets and processing and transportation facilities, rural farmers are not greatly interested in growing such products.

Experience shows that a qualified and trained manpower is needed to run sophisticated electricity generating equipment. In the case of mini/micro-hydros, it is not economical to send an expert for maintenance to remote area for a low kW capacity generating plant. All responsibilities of consultants and contractors are completed once the commissioning of energy generating plant is over. But, future problems remain with the poor promoter with limited technical and financial ability. The life of a hydropower plant could be 70- 80 years or more, if it is properly maintained and operated. Some micro- and mini-hydropower plants built in the past could not be connected to the national grid due to technical as well as economic reasons. Usually, owing to better quality and reliability, people prefer to have grid electricity than electric energy supplied from a stand alone plant.

Given this background, it is obvious that there should be a multi-pronged strategy of rural electrification in Nepal. Both the implementation of mini-micro-hydropower plants and extension of the national grid system should go ahead together, based on principles of comparative advantage and economic efficiency. The NEA, as a public utility, has a responsibility of planning, implementation and management all major electricity supply installations in the country. The NEA has hinted positively and has agreed to work together with AEPC and SHPP (the Small Hydropower Promotion Project) for the grid connection of micro-hydropower plants wherever technologically and economically viable. Recently, the concerned parties have agreed in principle to implement two pilot schemes for grid connection—one in the range of 15 to 25 kW and another from 50 to 100 kW.

Although, theoretically, grid connection of a hydropower generating plant (even if it is of one kW) is possible, without technical and economic analysis there is no point promoting it (obviously with limited subsidy in the case of micro-hydros). One recent experimental study carried out by the Electrical Department of the Institute of Engineering of Tribhuvan University shows that hydropower plants of less than 10

kilowatts cannot be considered for grid connection in the current context.

Conclusion

Hydropower as a non-polluting, environmentally friendly, renewable, locally available and reliable source of energy that needs to be exploited to the fullest extent possible, to meet national energy objectives in the Nepal context. Due to the unique operating characteristics of hydropower plants, reliability and stability of power grid can be achieved. For economic and social development, a dependable supply of electricity is a necessity. In a country where (apart from hydropower) other energy resources of an economically exploitable scale are not available, hydropower development is an important means to provide reliable and affordable electricity.

Electrification may not be a big problem where the national grid can be extended economically. In very remote areas, however, where the national grid cannot be extended in the near future due to economic reasons, a group of interconnected mini-hydropower plants seems to be a viable proposition for the total electrification of the country. For this purpose, project sites, target areas and load centers should be carefully selected and implemented. Over the long run, local grids can be connected to the national grid system and the system can function economically and reliably. With its limited technical ability and financial resources, Nepal alone is not in a good position to construct mini-scale hydropower plants and establish local grids in all remote hilly areas of Nepal. Hence, the government of Nepal should create a conducive environment for foreign assistance and should request developed countries of the world to offset investment under carbon swaps and clean development mechanisms.

Nepal has more than 90 years of experience in the field of mini-scale hydropower development. Many success and failure stories have happened during this period. Many governmental, non-governmental and private agencies are involved in the field of mini/micro-hydropower development, including almost two-dozen manufacturers/installers and an equal number of specialized consulting agencies. Acquired experiences and technological as well as managerial achievements in this sector can be one of the agendas for mutual cooperation among the SAARC countries. Nepal also can benefit from friendly countries of the SAARC region that have experience in the field of larger hydropower schemes.

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Pioneering the Hydropower Development

Janak Lal Karmacharya

Abstract. The Clean Energy Development Bank (CEDB) has done a pioneering work to provide the loan for hydro projects without collateral under the "project financing" concept. However, a rigorous project processing regime is required to protect from any risk along with strong and continuous monitoring by the Bank. This paper highlights the requirement of technical due diligence of candidate hydro projects looking for financing. CEDB has developed and adopted a systematic hydropower project processing process *Operational Policy and Guidelines*. Cost-over run or time overrun due to any reason is the two major concerns for Financier as well as Developer. Rigorous screening is needed to ensure virtual risk proof lending.

With the twin objectives of, but particularly focused on financing and helping mobilize financial resources for developing hydropower projects, the Clean Energy Development Bank (CEDB) designed itself to fly by mustering banking experts from the very beginning. However it had to create an organization equipped with the proper manpower and technical documentations to make the Bank capable of conducting technical due diligence of candidate projects for financing.

The CEDB began with the development of guidelines and technique for conducting due diligence of hydropower projects intending to finance, which included identification of fatal flaws in a project design (if any), to deal with it in the early stage of the project appraisal, field visit by Bank's expert to ensure that the designed structures fit into the natural setting, and that the design parameters have been derived from a reliable natural data base and preliminary appraisal. The results must ensure the feasibility of components and the overall viability of the project and that the due diligence report be professionally acceptable.

Such rigorous screening procedures are needed to ensure virtual risk proof implementation of a hydropower project. The hydropower development is a capital intensive investment and the construction takes place in and against the nature. Careful analysis based on deep experience is necessary to ensure the least risky solution.

In view of this requirement, the CEDB has developed and adopted an *Operational Policy and Guidelines*, which is a sound documentation leading to an institutionalized approach to hydropower financing.

Project processing starts with preliminary appraisal which involves preliminary technical appraisal to rule out any "fatal flaw" that might occur (which may not allow proceeding with the project or suggesting early remedy out of the flaw), preliminary environmental appraisal, preliminary commercial appraisal, and preliminary financial appraisal. A field visit by the Bank's expert is launched to conduct physical assessment of site particularly the project lay- out, physical positioning of major structures, access and location of power evacuation facilities and general assessment of hydrology, sedimentology and topography. A preliminary appraisal report is produced advising the Bank management to go ahead with the financing of the project as designed by the developer or to take due consideration to suggestions by the CEDB team during field visit and preliminary appraisal. The next step is to carry out due- diligence. This involves the detailed review of hydrological geological parameters of the project adopted for design, adequacy of design, detailed cost estimate, logical construction schedule, environmental mitigation plan and mitigation measures and mechanism for mitigation of adverse impacts. In- depth financial analysis with sensitivity analysis is reviewed for its adequacy.

A critical part of the due-diligence is the risk analysis. Cost- over run or time overrun due to any reason is the two major concerns for Financier as well as Developer. The possibility and the financial implication of such over runs are to be assessed and the possible impact on the viability of the project is ascertained. The resulting financial parameters must be acceptable to the Bank.

One of the major bottleneck in the development of hydropower has been perceived to be the difficulty faced by developers in raising the collateral required to raise the loan. To address this problem, the Bank has decided to provide the loan without collateral under the "project financing concept". A rigorous project processing regime is required, however, to protect from any risk and this should be accompanied by strong and continuous monitoring by the Bank during construction, operation and maintenance of the hydropower plant till the repayment period. The Bank must have a say in the type of tendering and in the choice of the contractors and the consultants during supervision. The joint team of Financier and Developer alone can ensure the cost effective and timely delivery of the product.

The Clean Energy Development Bank has started its journey first with strengthening of this capacity and introducing the concept of project financing. The CEDB has already created a strong ripple in the hydro market within a period of just one and half years. The CEDB is processing five hydropower projects of various capacities with the intention of financial closure.

The project financing is not an easy and risk free path. But it is the CEDB's conviction that project financing is the answer to the sluggish development of hydropower specially the small hydropower development.

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Janak Lal Karmacharya, holds a PhD degree in hydrology and hydraulics, and has been working in the power sector, especially in hydropower development, for more than three and half decades. Dr. Karmacharya has participated and led studies, design and construction of hydropower schemes and development of hydropower policy in Nepal and abroad. He is a past Managing Director of the Nepal Electricity Authority, and is currently Head/Hydro Business, Clean Energy Development Bank, a member of the Steering Committee of the Dams and Development Project under UNEP, and Vice President of the International Hydropower Association. He has also served as a consultant to the World Bank and the USA-funded South Asia Regional Initiative/Energy Program.

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Review Article

The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Costs by Thayer Scudder (London and Sterling, VA: Earthscan, 2005)

Reviewed by Hari Mohan Mathur

Large dams are among the most contentious issues in development today. Long regarded as symbols of progress, they are now being increasingly seen as inherently flawed and destructive of ecosystems and societies. Using his extensive knowledge about dams in Asia, Africa, North America and Latin America, Thayer Scudder charts the 'middle way' forward by examining all aspects of the costs, benefits and risks of large dam development projects.

Scudder analyses large dams in this book as a flawed yet still a necessary development option. This was also the conclusion of the Final Report of the World Commission on Dams (WCD 2000) on which he was one of 12 commissioners. In many ways this study is a follow-on volume, providing an account of the impacts of the WCD Report on the dams debate. It may be noted that while UN agencies and some countries in Europe endorsed the report, it was rejected by China and India, the two major large dam building countries.

There are many reasons why large dams are under attack. Large dams are not as beneficial as they are made out to be. Their costs are usually understated. The majority of people whom large dams force to relocate fail to regain their losses, ending up impoverished, in a condition worse than before. Governments and project authorities lack both the commitment as well as the institutional capacity to address the complex resettlement issues. Questions are also being increasingly raised as to the continued appropriateness of the development paradigm of which large dams have become the most visible symbol.

Yet, in spite of the growing criticism against large dams, they remain a necessary development option and continue to be built in many countries. Benefits from large dams are not small either. Large dams provide irrigation to farmers, electricity to run industries, and drinking water to cities. For countries lacking other natural resources, such as Nepal and Laos, large dams with capacity to export hydroelectricity provide a source of foreign exchange for development purposes. There are other benefits associated with them as well

Scudder uses resettlement as an lens through which to examine the entire large-dam building process. A focus on resettlement provides an important mechanism for assessing (a) when dams are an acceptable option and when they are not, (b) how the decision-making process should be structured and (c) should a dam be found a preferred option, how to work out a planning, implementation and asset handing-over process that ensures that the majority of resettlers become project beneficiaries. Other requirements for the process to be sustainable include: attention to impacts on the environment, impacts on downstream communities and a detailed examination of institutional structures required for an acceptable development process to proceed.

The first four chapters of the book deal with the issues of large dam disputes and involuntary resettlement. The first chapter introduces the theme, noting that no accurate figures exist of the number of people displaced by large dams. When data are available, they often turn out to be underestimates and unreliable for planning and budgeting purposes. This is also true of projects financed by the World Bank, known for its meticulous methods of researching and documenting the minutest project details. The multi-dimensional stress of dam-induced resettlement, which often tends to be underemphasized, is discussed in considerable detail under its various dimensions: physiological, psychological and socio-cultural. In this chapter, the author also outlines his own career, to illustrate how and where he obtained the information used in this book and to state his current position on large dams as a development option. He is firmly of the view that the number of new large dams should be reduced by weeding out those for which better alternatives exist and by better management of existing dams.

A substantial body of theory has grown around the study of resettlement processes, discussed in Chapter Two. The first model, a four-stage framework, theorizes on how the majority of resettlers can be expected to behave during a successful resettlement process. Its application was limited to development-induced involuntary resettlement and land settlement schemes. Scudder developed this model in 1979, refining it in subsequent years with Elizabeth Colson. Michael Cernea followed with his Impoverishment Risks and Reconstruction Model in 1991, which also underwent further refinements later. This model is focused on impoverishment risks that accompany involuntary resettlement and on corrective reconstruction processes. Scudder attempts to combine and broaden the two approaches into a single theory, as the two analytical frameworks can provide policy-makers with a powerful tool for planning and implementing a more successful process of development-induced involuntary resettlement. Although the two models look at the resettlement process from very different angles, they clearly suggest that success is possible, but only if planners adequately involve affected people and provide significant development opportunities for settlers and hosts alike.

The first detailed statistical survey of resettlement outcomes from 50 large dams located around the world

is presented in Chapter Three, which concludes that there is no evidence of any improvement for resettlers in recent years (defined as at least restoring living standards). Further, it is contended that such outcomes are unnecessary because positive outcomes have occurred and successful resettlement can be achieved under certain conditions. A number of key factors that the survey found are necessary if a successful outcome is to be achieved include: project staff capacity, funding and political will, implementation of adequate opportunities and resettler participation. But are lessons learned from the small number of successful cases widely applicable? The answer, according to Scudder, is a provisional 'yes', provided issues such as institutional capacity, funds, political will, opportunities and participation are adequately addressed. Chapter Four is devoted to ways by which river basin communities can benefit from many opportunities that arise from the dams-related development process and become project beneficiaries.

Most of this book deals with issues, but a large section, comprising Chapters Five and Six, is devoted to case histories. The case histories are important, as they best illustrate the complexities and the unexpected events that so often prevent large dams from realizing their expected benefits. The initial draft of this volume was intended to provide detailed case histories of eight large dam projects, but while analysis of the Mahaweli Project has been retained as originally planned, the other seven cases appear in this publication in an abridged form. The book discusses environmental and social impacts below dams in a long Chapter Seven. While dams are built, management of their catchments and adverse environmental and socio-economic impacts seldom receive the attention that they deserve. The author warns that unless adequate attention is paid to these issues, the consequences of this neglect will be serious, more serious in the future than in the past.

The discussion of institutional arrangements in Chapter Eight is perhaps the most exhaustive treatment of the subject in the entire resettlement literature. The record to date suggests that regardless of type, project authorities are incapable of dealing adequately with resettling downstream communities as well as with environmental issues. A large number of institutions need to be involved if water resource development projects are to be sustainable. In addition to central governments and project authorities, these include other government agencies as well as private sector contractors, consultants, other firms and local institutions, including those of affected peoples, NGOs, donors, financial institutions, independent panels, universities and research institutions. Scudder critically considers the role of all players, including the World Bank, in great detail. Recognizing the World Bank contribution in bringing resettlement issues high on the global development agenda, he specially mentions Michael Cernea and Robert Goodland for their pioneering role in pushing new initiatives. But all is not well with the Bank approaches and outcomes. The author finds the Bank's resettlement policy guidelines rather weak, and concludes that it is these guidelines that have played an impoverishing role in the past and that the recently watered down guidelines will continue to play such a role in the future as well.

Should large dams be built? The answer to this question is 'yes'—but it is not an unqualified yes. Dams can be built, but only after a 'best practice' options assessment that takes environmental and social issues fully into account, and only where adequate policies exist and are implemented, and where project authorities, contractors and consultants are under legal obligation to follow contractual conditionalities necessary to implement the project as intended. Those requirements however do not exist anywhere at present, World Bank-assisted projects included. In the final Chapter Nine, supporting WCD's Seven Strategic Priorities, Scudder examines and suggests the procedures that need to be followed for decision-making, planning, implementation and operations and management if large dams are not to be flawed and unsustainable as is presently the case.

This classic work by a world authority reflects 50 years of research and thinking about large dams worldwide. No one concerned with the human costs of development can afford not to read this book.

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Table 2. Estimated total hydropower potential of Nepal (based on MOWR 2003)

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