



**United Nations Development Programme – Global Environmental Facility  
Community Micro Hydro for Sustainable Livelihood**

***Project of Royal Government of Bhutan***

**Final Terminal Evaluation**

Prepared by the evaluation team of  
Frank Pool, International Consultant, New Zealand, and  
Tenpa Gurme, National Consultant, Bhutan

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**The Sengor village and its new community centre in the left foreground**

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Sengor micro hydro power house and penstock with debris from recent flood in riverbed in background

## **1. Executive Summary**

This report presents the findings of the FTE (Final Terminal Evaluation for the UNDP-GEF “Micro Hydro for Sustainable Livelihood in Bhutan” project, also known as the Sengor Micro Hydro Project (in this evaluation entitled “the Sengor MHP”). The project was located at Sengor village which is located about 370 km from Thimphu in the eastern part of Bhutan. Sengor village is situated at an altitude of 3200 meters above sea level and is within the core zone of the Thrimshingla National Park.

This report was prepared with the considerable and very helpful input from UNDP Bhutan, UNDP Regional Office Bangkok, and key stakeholders (including but not limited to the DOE - Department of Energy as project managers and owners) - however the responsibility for the FTE findings and conclusions reached are solely those of the evaluation team authors.

The Kingdom of Bhutan is a small (around 700,000 people and 38,400 km<sup>2</sup>), mountainous, sparsely populated and predominantly rural Himalayan country, located between China to the North and India to the South. Bhutan has in excess of 30,000 MW of hydropower potential, of which to date only around 5% has been developed. Bhutan has four large hydro power generating stations (Chhukha - 336 MW; Basochhu – 64 MW; Kurichhu - 60 MW; and Tala - 1020 MW) built with Indian and Austrian (Basochhu) government financing. The large hydropower projects in Bhutan have been primarily constructed to export electricity to India, although they also provide low cost electricity to the expanding Bhutan electrical grids. A further 76 specific large hydropower sites (>10 MW) have been identified for further export focused development. These 76 projects are likely to be progressively built in the future with various soft and grant financing models, hence it seems unlikely that electricity users in Bhutan will face electricity prices that approach true LRM (Long Run Marginal Cost) levels for many years to come. The domestic average tariff is Nu 1.62 and exports tariffs range between Nu 1.8 and Nu 2.0 (around 50 Nu is equal to 1 US\$).

Bhutan also has 25 mini hydro projects (MHP’s) built since 1967; of which 21 MHPs are still operating in a combination of stand alone (12 MHPs) and grid connected (9 MHPs) situations. All Bhutanese large and mini hydropower projects are run-of-river (that is with minimal storage).

The rationale for what later became the Sengor MHP was originally (at the start of its design process in 1997) that only 30% of the Bhutan population was then connected to the various electricity grids then in place in Bhutan; that extending the grids would be a slow process that would inevitably be funding constrained; and that MHP would be a critical technology that would need to be widely deployed to achieve the target of eventual electrification of all households in Bhutan. It was also originally expected (at the start of the design process in 1997) that there would be a gradual evolution of the Bhutanese electricity sector towards having tariffs that more accurately reflected full electricity generation and Transmission and Distribution (T&D) LRM levels. In reality, Bhutan’s electricity tariffs are still well below LRM levels although the tariff has been revised several times since 2002. It is expected to be many years until tariffs approach full LRM levels. Hence it will be many years before the private sector in Bhutan can realistically compete in terms of supplying electricity against soft and grant funded grid connections, donor funded MHP’s, and nationally funded PV solar home systems (SHS).

The Sengor MHP had a long and tortuous design journey, funding mobilisation, approval and implementation process. The project formally started on 22 March 1997 with the Bhutan endorsement of a \$25,000 GEF grant application for the initial preparation of a GEF barrier removal “Micro Hydro Development” FSP (Full Scale Project). The project then went through an initial scoping phase in 1998 and then from 1999-2000 underwent a detailed project formulation and design phase with an additional \$391,500 of funding (\$228,500 from GEF, \$138,000 from Sweden, and \$28,000 from the Royal Government of Bhutan (RGoB)). This phase developed a \$8.43 Million FSP that shifted its focus from the original wider barrier removal activities to instead reducing local MHP costs and increasing capacity by developing four specific new micro hydro sites – Sakten 200kW; Sengor 50 kW; Tang 400 kW; Gasa 150 kW - with a proposed \$4.42 million of GEF and \$4.01 million of other donor funding. However, it was not clear how building four new MHPs in Bhutan would have achieved the envisaged MHP capacity development and cost reductions in Bhutan in the then proposed FSP – given that 21 MHP’s had already

been built at that point in Bhutan, and that MHPs were already a well understood and mature technology with established MHP technology suppliers and construction contractors in neighboring India and in nearby Nepal. In any case, this proposed GEF FSP (full scale project) did not attract the necessary GEF and/or donor grant funding to proceed.

From 2004, in the development of this Sengor MHP project that is the subject of this evaluation, the underlying GEF MHP rationale changed significantly again to developing a single fully grant funded pilot or demonstration MHP at Sengor of 100 kW using a community set and gathered tariff to fund community MHP O&M to serve local livelihoods. The post-project replication of the Sengor MHP pilot to further new MHPs was variously stated in the Sengor MHP design to be expected to be through ongoing grant funding or through private sector participation. The project design did not state that such replication was a specific objective of the Sengor MHP project's implementation, but at various points in the ProDoc this replication expectation was strongly linked to the rationale for the Sengor MHPs existence.

It was stated in the Sengor MHP MSP Brief and ProDoc that the successful results of the Sengor MHP would lead to the Sengor MHP model being given a prominent role in the ongoing electrification of Bhutan. However, by the time that the Sengor MHP Brief was finalised in October 2004, and certainly by the time the Sengor MHP ProDoc was signed in August 2005, other developments in Bhutan at the time (e.g. Rural Electrification Master Plan (MP) supported by JICA, and RGoB 9<sup>th</sup> 5 Year Plan) meant that the potential would be limited for MHP's to be a significant factor in the 100% electrification target for Bhutan. By the time the Sengor pilot community O&M and livelihoods MHP was being implemented, grant and soft funding for grid extensions and PV SHS was already becoming the dominant electrification model in Bhutan. Thus the replication potential of the new Sengor MHP community O&M and livelihoods model is likely to be at least as relevant to the existing MHP's in Bhutan, as well as to new MHPs in Bhutan. Two identified MHP sites in Lingshi and Soe are currently being implemented. The Asian Development Bank (ADB) and the Department of Energy (DOE) plan to implement a micro hydro potential study in 2011, as Bhutan has large streams and rivers that could supply many more micro hydro projects. The results of this ADB and DOE study are expected to identify many viable MHP sites, and this then could lead to the replication of the Sengor MHP community management and livelihoods focused model on a large scale.

However, notwithstanding the limited new MHP replication potential that already existed at the time of its design and approval, in terms of the strict Sengor MHP project site-focused objectives, the project was very successfully implemented.

In particular, the Sengor MHP has shown that with sufficient community development capacity building it is possible to get a community in Bhutan to:

- successfully establish suitable electricity tariffs for a local MHP
- implement stringent credit control procedures to ensure prompt and full payment of electricity use
- utilise MHP electricity sales revenues to sustainably pay for local community operators and to use surplus revenue to gradually accumulate funds to cover ongoing O&M costs
- foster a strong sense of community ownership of the MHP so that the community is highly motivated to take the lead in rapidly restoring the operation of the MHP after a major outage such as a flood (see following photo of scale of flood damage that can occur)
- reduce excessive fire wood use and the disproportionate role of women in gathering such firewood
- reduce indoor air pollution from firewood use with its particular impact on women and the young
- provide an extra 1 ½ hours in the evening for family entertainment, socializing, study by children and following news and current affairs
- utilise new funding mechanisms such as a CCF (Community Collateral Fund) to establish new community based livelihoods that will utilise the new local electricity supply

The Sengor MHP's proven community mobilisation, steady accumulation of funds for future O&M, and improved community livelihoods focus is highly relevant to the other 20 existing MHP's in Bhutan, as well as the four planned new MHPs.



Last but not least, the Sengor MHP project is fully aligned with, and supportive of, the guiding Bhutan development philosophy of promoting Gross National Happiness - with its emphasis on equitable and sustainable socio-economic development, preservation and promotion of culture, conservation of the environment, and good governance.



Aftermath of flood damage to Sengor MHP head works - with settling pond debris removed and MHP running again in 2 clear days - testimony to strength of local community ownership and sound design and construction

## **2. Evaluation Context and Purpose**

This report presents the findings of the independent FTE (Final Terminal Evaluation) for the “Community Micro Hydro for Sustainable Livelihood” project in Bhutan (the Sengor Micro Hydro Project - or “Sengor MHP” as used in this evaluation). This report was prepared with the very helpful input from the UNDP offices in Bhutan and Bangkok and other key stakeholders in Bhutan. However, the responsibility for the evaluation findings and conclusions are solely those of the evaluation team authors.

The overall purpose of this final evaluation is to provide an independent, comprehensive and yet concise account of the project’s design evolution; explicit and implicit context; specific objectives and impacts; stated and implicit expected outcomes and wider impacts; achievements; innovations; adjustments; results and legacy for future community micro hydro’s for sustainable livelihoods in Bhutan and elsewhere. The TOR of the evaluation can be found in Annex C of this report.

A key evaluation element is the issue of project sustainability - that is whether the project is on track to provide a rich legacy of results, products, technical capacity, approaches and institutions that are likely to persist and continue to provide positive results after the project’s formal completion. The evaluation focuses

on the impact of the project on GHG emissions (for GEF purposes), as well as on sustainable livelihood’s, reduced local air pollution, reduced deforestation, and social, gender and other impacts for the Sengor community, for Bhutan, and for elsewhere.

The Sengor FTE methodology followed was to focus on assessing the project’s relevance, original and evolving rationale, implementation, performance, financial management, realism and specificity of project results sought - and the project-end results and its likely post-project legacy. The evaluation looked for and assessed early signs of potential project impact and sustainability of results, including the contribution to capacity development for further new MHPs in Bhutan and elsewhere as well as the improved utilisation of existing MHPs, and the achievement of global environmental goals. The evaluation has also identified and articulated the lessons learned from the project and made recommendations that will improve the design and implementation of other similar UNDP-GEF projects.

The FTE team adopted the following methodology;

- 1 Review available project documents.
- 2 Interact with stake holders in Thimphu, the Sengor project area, the Dzongkhag Office in Mongar, BDFC (both Thimphu and Mongar), and Thrumshingla National Park.
- 3 Visit the project site and review the physical Sengor MHP.
- 4 Present preliminary results to project stakeholders.
- 5 Obtain feedback and finalise findings.

The team reviewed the mission and evaluation scope and discussed their proposed approach with key stakeholders. The team also interacted with the 22 registered Sengor community household beneficiaries and discussed their involvement in the project, how they were involved and their responsibilities in the project.

This Sengor MHP evaluation has utilized an extensive review of project documentation and its evolving context. In particular, this approach revealed that there had been major changes to the project design and outputs between the project’s MHP barrier removal focused PDF-A and PDF-B stages that led to a FSP (Full Scale Project) brief (that was not subsequently funded), and the subsequent specific Sengor MHP project that is the subject of this evaluation.

Sengor was envisaged as a pilot project of (a) successful community MHP realistic tariff setting and credit control and sustainable successful O&M, and (b) the fostering of specific community livelihoods that would use a major part of the MHP’s electricity outputs. The replication of the Sengor MHP results to new MHP’s to be funded and built in Bhutan using the Sengor MHP’s new successful community O&M and livelihoods approach was not a specific activity that was specifically stated to be a desired project result, although it was clearly one of the key reasons for undertaking the project. Although the Sengor MHP has met its specific outputs, from the policy context, the realities of electricity prices being below LRMC, and likely to remain below LRMC so for the foreseeable future, mean that donor grants and soft loans and support by the RGoB will be needed if large numbers of new MHPs are to be built in Bhutan. For the full potential of MHP’s to be achieved in Bhutan, donors and the RGoB will have to value the ability of MHP’s to provide more than the minimal “energy for all” or “100% electrification by 2013” goal basic social provision of electricity - currently provided by individual household solar home systems - to also meeting livelihoods or productive uses that can only be realistically be provided by MHP’s in the most remote areas of Bhutan where grid extension is not viable.

### **3. Project Design Context and Evolution**

Since 1967, 25 MHPs have been constructed in Bhutan under donor funding from Japan, India, Austria, E7 and GEF. The MHPs were donor and engineering driven and designed to meet local basic social energy requirements (with the exception of Sengor). Nearly all the MHPs were originally community managed, but this has proved to be unsustainable as they did not have the specific community mobilisation and support

mechanisms included in their design or implementation that would be necessary for sustainable community management (i.e. similar to that of Sengor Micro Hydro project).

Four of the 25 MHP's are no longer operating and are now permanently shut down, primarily due to civil works failures (e.g. major flood damage) and were not found to be worthwhile rehabilitating, as the grid had meantime reached within a short distance of the MHP and the grid extension alternative was more cost effective than rebuilding the project. Six MHPs are already grid connected and managed by the Bhutan Power Corporation (BPC), and three more will be grid connected by the end of 2009, as the grid has now reached these MHP's areas.

Ten of the MHPs are still run as isolated stand-alone grids and are directly managed by BPC. Initially these 10 isolated MHPs were community managed, but due to lack of necessary community mobilization and a low tariff being applied, not enough revenue could be generated to meet the cost of the MHP O&M and eventually the project was handed over to BPC to run. It is hoped that the now proven Sengor MHP community mobilisation model will be applied to these 10 MHP's by BPC. Otherwise, they will have to be connected to the grid by BPC for their stable ongoing operation as BPC is not really able to justify the high cost to them if they operate these MHP's directly in a stand alone mode, but operation as isolated grid mode would be possible at low cost to BPC if they are properly community managed (i.e. replicated the proven Sengor community operation model).

The E7 (now E8) financed Chendebji MHP, is community managed and was primarily aimed to serve basic social energy requirements. However, the Chendebji MHP has led to new income generating livelihood enterprises such a restaurant and shops along the highway, that were established after the commissioning of the project. The Chendebji MHP community management aspect was already commissioned and working successfully when Sengor was implemented, and hence the Chendebji MHP provided a useful model of community management to build on and extend at Sengor.

The Sengor MHP has had an extensive community capacity development and mobilization component. The Sengor MHP was also designed from the outset to have the fostering of enhanced livelihoods (productive uses) as a key rationale. The Sengor MHP has broken new ground in Bhutan as a community operated MHP with a high chance of ongoing sustainable operation supplying off-grid electricity for local community livelihoods/productive uses into the future.

For the Sengor MHP project, UNDP was the GEF Agency and the International Implementing Agency and the Department of Energy (DoE) was the domestic Executing Agency on behalf of the Royal Government of Bhutan (RGoB). A Project Management Unit within DoE was established to oversee the overall monitoring and coordination of the Community Micro Hydro for Sustainable Livelihood project (the Sengor MHP). A Project Steering Committee was established to advise the Project Management Unit. In order to develop the private sector capacity to build and design future micro hydro projects, the work was executed by a Bhutanese contractor operating a joint venture in electro-mechanical equipment with a company from Nepal.

The original (1997) project's stated rationale still largely underlined the Sengor MHP design - although many of the original baseline assumptions were no longer applicable, in particular that: -

- the majority of the population in Bhutan (then around 70% and including some major towns) had no access to electricity;
- Bhutan had excellent distributed hydropower resources suitable for off grid micro hydro projects (MHP) that would generally be the most promising electrification extension option;
- many households were located in areas that would be too remote and in too rough terrain to be cost-effectively connected to the grid in the foreseeable future, and that therefore MHP would almost certainly play a key role in the ongoing electrification of Bhutan's scattered villages; and

- providing electricity from the widespread adoption of mini/micro hydropower to the wider population required the reduction of the many barriers to the adoption of MHP technology, its financing and its ongoing Operations and Management (O&M) in Bhutan.

The original project rationale was further elaborated (but remained essentially similar to the original rationale) during the January to December 1998 PDF-B project formulation phase. The PDF-B design stage became operational on 04 January 1999. The PDF-B design stage had \$228,500 of GEF funding for incremental activities, \$138,000 Swedish co-funding for baseline activities, and \$28,000 of RGoB (Royal Government of Bhutan) in-kind support.

The PDF-B detailed project design was completed in 1999 – 2000 and a GEF full scale project brief was prepared and sent to GEF for funding consideration in September 2000. The thrust of this PDF-B project brief’s design involved the detailed investigation and engineering design of four MHP’s that were to be nearly equally funded by donors and GEF. This PDF-B investigation and design work included a proposed 50kW MHP at Sengor.

Thus, between 1999 and 2003, the underlying project rationale shifted from a traditional GEF wider barrier removal focus (which did not necessarily rely on building new MHP’s) to reducing MHP costs by building four specific MHP’s using local manufactured equipment. In the revised approach, the MHPs were envisaged to primarily provide social and institutional electricity uses, local community mobilisation to help build and operate the MHP’s was an option (but not the only option) considered, and the supply of MHP electricity to local productive uses was primarily seen as a way of growing the MHP load rather than a key rationale for having off-grid MHP’s per se.

In retrospect, a key weakness of the PDF-B analysis was that it did not highlight the vital role of donor financing for any subsequent MHP replications – it was still assumed that the private sector would fund new MHP’s, ignoring the reality that with electricity prices being below LRMC and likely to remain so for many years, private sector financed MHP’s would not be viable. So the PDF-B approach was based on an unrealistic replication funding model.

In addition, the PDF-B envisaged project did not highlight the key difference between MHPs that provide electricity for livelihoods/productive uses and their key off grid alternative of PV SHS. PV SHS can only provide a modest amount of electricity for social lighting, radio, TV and mobile phone charging etc ICT purposes.

Neither the proposed \$4.42 million funding by GEF nor the \$4.01 million funding by bilateral donors materialized for the ambitious \$8.4 million full scale project design. A new medium scale project design was then formulated in 2004, with the MSP project having new objectives and an updated rationale. This new project was the “Community Micro Hydro for Sustainable Livelihood” (the Sengor MHP) project that is the subject of this evaluation. This new project was firmly focused on sustainable livelihoods (productive uses), involved building a 100kW MHP at Sengor (100kW instead of the former 50kW was chosen to be able to meet local assumed load growth for a longer period of time), and envisaged community operation of the MHP O&M, and with legal ownership by the Department of Energy (DOE). The Sengor MHP specifically targeted the need to develop a community based integrated delivery model linked to micro hydropower installations, where financial and income-generating strategies were developed so as to together provide a viable community based livelihood approach where electricity provision formed a central part of the approach. The project design explicitly targeted innovative decentralized strategies for electrification, since only a small fraction of the un-electrified settlements were then still envisaged to be connected to the national electricity grid in the future.

However, the Bhutan context for MHP had in fact changed considerably during the Sengor MHP’s implementation – especially between its design being frozen some time before its 12 October 2004 MSP Brief finalisation, between its formal start in August 2005 and by its completion in June 2009.



In particular, by 03 October 2005 the Electrification Master Plan (MP) for Bhutan had been completed by JICA. This Electrification MP focused explicitly on Bhutan by 2020 (since then the target has been moved forward to 2013) having nearly all its villages/households connected to an expanded electrical grid - with the remaining small number of very remote and scattered villages/households being supplied with solar PV electricity. To reinforce this strong trend away from aiming to construct new MHP's, only two new off grid MHP's were included in the current Bhutan 10<sup>th</sup> Five Year Plan for 2008-12.

In other words, with the 03 October 2005 completion of the Electrification MP, the original (1997) GEF MHP project widespread replication rationale (that still partly underpinned the Sengor MHP ProDoc's design) of supporting widespread the widespread replication of off grid MHP was no longer applicable to Bhutan - due to limited numbers of specific MHP's being identified for construction in the Electrification MP (and confirmed in the subsequent Five Year Plan). However, with the probable support of the Asian Development Bank in year 2011 for a study of micro hydro master plan sites there may yet be a future for significant numbers of new MHP's to be built in Bhutan. This would then enable for the Sengor Project results to be replicated, especially as it could draw on the Sengor MHP's experience in the sustainability of community tariff setting and O&M and also in terms of use of a CCF fund to support the development of suitable local productive uses.

In the Electrification MP (which seems to be consistent with the approach being followed for electrification since then in Bhutan), all major towns in Bhutan were planned to have grid connected electricity by 2020 (now 2013). The few remaining very remote and scattered non grid connected households were envisaged to be almost exclusively electrified by PV SHS. Sengor falls under the Saleng Gewog (block made up of several villages), and all the other villages under the Saleng gewog are to be electrified through off-grid PV SHS. It is important to note that as the Electrification MP does not have a focus on livelihoods/productive uses then the MHP advantage over Solar PV systems is not apparent.

Thus the Sengor MHP project evolved - from its original intent of being a wider MHP barrier removal project (and not necessarily funding the construction of specific MHPs) - to assist the widespread adoption of off grid min/micro hydropower in Bhutan - to the Sengor MHP that aimed to build a single specific MHP for sustainable livelihoods (local productive uses) for a single location (Sengor) and where there was little realistic prospect of replication of the Sengor MHP model to many new MHPs - even if the Sengor MHP model proved to be successful. Yet the Sengor MHP design in its ProDoc still clearly expected many replications to new micro hydros in Bhutan to occur. The likely lack of such significant Sengor MHP replications in the future (under the current Five Year Plan) is therefore a Sengor MHP project design weakness and not a Sengor MHP implementation issue.

Ongoing grants and soft loans have been forthcoming from ADB and other donors for extensions to the Bhutan grid and for solar home systems, whilst funding for new construction or upgrading of existing micro hydro power projects has not been able to be mobilised since 2002 except for the 2006 Chendebji MHP which was funded by E7 for the purpose of influencing the development of CDM rules. This trend of difficulty in funding new MHP was already clearly apparent (from the failure of the previous FSP to attract sufficient donor funding from 2000-2003 to build the proposed four additional MHP's) at the time of the Sengor MHP design and project approval and initiation in 2004. The fact that funding was not obtained for the PDF-B proposed four MHPs during the 1999 – 2003 PDF-B fund mobilisation phase, whilst grid extensions and SHS continued to obtain ongoing highly concessional ADB and other donor funding, showed that in fact the Sengor project was competing on a highly tilted playing field. Thus, even if the Sengor project was fully successful in meeting its specific objectives it would be unlikely to lead to many new MHP replications, since only new four sites are identified, although the steep hills and hundreds of perennial running streams, would say that Bhutan has a strong potential for MHP as a key electrification solution. The ongoing grant and soft loan availability for further grid extensions and for solar home systems also clearly undermined the expected materialization of private sector and co-operative means of funding and operating off-grid MHPs. Hence, it is not considered to be fair for this evaluation to judge the Sengor MHP in terms of any expectation of it leading directly to many replications of community managed livelihood focused new MHPs in Bhutan with grant funding, as this was clearly already highly unlikely at the time of the Sengor MHP design in 2004.

## **4. Assessment of Project Results**

In the view of the evaluation team, the Sengor MHP's results must first be considered in the context of the wider objectives of widespread replication of community managed MHP's in Bhutan that supply livelihood (productive) uses. This achievement of the underlying project results sought is often neglected in output focused projects with engineering focused implementation that are under tight time and budget pressures to meet specific objectives. Other parts of this evaluation report have reviewed in depth how the long time scale and convoluted processes of the Sengor MHP design and the deficiencies of the development of the final Sengor MHP MSP Brief and following ProDoc led to a design that was no longer fully relevant in the Bhutan context when it was initiated in 2004-2005.

Within the context of the shortcomings of its design processes and evolution, in terms of the Sengor MHP project's specific implementation and results, this must be primarily judged against its objectives as stated in its October 2004 MSP Brief and then essentially restated in its signed August 2005 ProDoc. In other words, in the view of the evaluation team, the Sengor MHP implementation team should not have been expected to adjust for the fact that the 2005 Electrification Master Plan, with its sole real focus on further grid connections and SHS, and the known fact of a greater willingness of donors to support grid extensions and household solar PV systems over off-grid MHP's, meant that even a successful Sengor project was unlikely to lead to significant replications of new off-grid MHPs in Bhutan. It is also the view of the evaluation team that it is unrealistic to have expected the new Sengor MHP project, before it was fully underway from August 2005, to have successfully lobbied the Electrification MP process to give an explicit role for off-grid MHP's that could be replicated from the Sengor MHP results.

Hence the Sengor MHP's specific results will be evaluated both against its specific (GEF) goal of "the reduction of the annual growth rate of greenhouse gas (GHG) emissions from fossil fuel-fired power generation through harnessing of hydropower resources for domestic purposes" and its design objective, which was the "socio-economic development of [the] Sengor community through provision of electricity for domestic purposes, and utilization of energy for community based rural enterprises leading to enhanced livelihoods and poverty alleviation." As is detailed elsewhere, the project has deficiencies intrinsic in its design that limits its full potential achievement of its wider GEF goal, and these deficiencies in its design were such that its implementation of its specific objectives were unlikely to be able to overcome its design deficiencies. Hence the rest of this results analysis will focus on the achievement or otherwise of its specific objectives.

### **4.1 Project Impact**

#### **4.1.1 GHG Reductions**

In terms of its specific project GHG reduction goal, the Sengor community (see cover photo of this report showing the Sengor community and its new community centre in the foreground) is remote from the nearest robust enough grid connection (this is understood to be a distance of approximately 50km). In addition, Sengor is located in the core zone of the new (from 2004) Thrimshingla National Park - which means that obtaining permission would be nearly impossible to clear a right of way for a new grid extension to Sengor using conventional low cost medium voltage bare transmission grid wires. Therefore any grid extension to Sengor would need to use more expensive insulated wires, and it is not clear that even the use of insulated wires to serve Sengor would have been acceptable in the core zone of the Thrimshingla National Park. As the Sengor village community existed before the new Thrimshingla National Park was developed, and as Sengor contains 22 registered village households (with 57 households in total including road workers, hotels, and school employees – and comprising around 300 people), then the Sengor community would have had no alternative but to continue to use excessive fuel wood, kerosene, diesel, candles, LPG and dry cell batteries if the MHP had not been built. In the longer term, if a MHP had not been built at Sengor, then electrification through the use of a diesel generator set would have been required, notwithstanding that this

is not a favored or common option in Bhutan for village electrification. Adding credibility to the Sengor MHP GHG baseline for GEF purposes, the 70kW Chendebji micro hydro has had 474 CDM CERs issued by the UNFCCC on the basis of a similar off-grid diesel generator baseline. If one takes the Sengor MHP’s output as being an average of 7kW of useful electricity supply, and follows CDM calculations for a diesel generator GHG emission factor of 2.4 Kg of CO<sub>2</sub> per kWh<sup>1</sup>, this would give a Sengor annual GHG reduction of 147 tons CO<sub>2</sub> per year.

#### 4.1.2 Electrification and Livelihoods

In terms of the Sengor MHP specific electrification design objectives, all 57 wider Sengor community households have been successfully electrified since May 2007. All the households now use electric lights and rice cookers and around half the households have curry cookers, water heaters and TV/radios. There is now also some use of ICT (Information and Communications Technology) equipment such as computers, fax machines and printers, as well as a small number of space heaters. The June 2008 Post Electrification Report found that on average Sengor’s occupants enjoy an extra 1 ½ hours in the evening for study, entertainment, socializing and catching up with Bhutan and international news. Fuel wood use in Sengor has halved (from the post electrification report and from discussions with Thrimshingla National Park staff), which greatly reduces the hard and time consuming work of gathering firewood that falls largely on women and children in winter, indoor air pollution (especially impacting on women and children) has been reduced, and the Sengor MHP is greatly contributing towards the Thrimshingla National Park’s objectives for Sengor to limit its environmental impact on the nearby forests for fuel wood supply.

The average useful total Sengor community load is currently around 7kW, with the maximum load thought to be around 25kW (this maximum useful load is hard to determine exactly as the MHP is generally run with a dummy load to enable stable operation without a complex control system being required. The dummy load comprises heating elements immersed in the water of the tail race that absorbs the extra power generated by the hydro that the community does not need at any time) at the power house and the useful electricity supplied to the Sengor community is not separately metered from the combined useful and dummy load levels. In any case, it is clear that the Sengor MHP has sufficient capacity to handle livelihoods electrification load growth for some time, and this load capacity can always be extended with an active DSM (Demand Side Management) program as flagged elsewhere in this report.

The development of productive uses at Sengor using the new MHP to date includes an extra hotel that has relocated from another un-electrified village along the main east-west Bhutan road. The UNDP \$50,000 grant funded Sengor MHP CCF (Community Collateral Fund) administered by BDFC (Bhutan Development Finance Corporation) has already approved loans for a cable TV business and a furniture business that will utilise the new electricity supply. CCF loans are also under active consideration for dairy processing and greenhouses to add value to the main productive livelihood (dairying) of the Sengor community and to provide fresh vegetable for the Sengor community and for main east-west road travelers using the five hotels in Sengor.

**Table 1: Comparison of Imported Energy at Sengor Before and After MHP**

| Fuel               | 2006 Survey Results |              |               | 2008 Survey Results |              |               |
|--------------------|---------------------|--------------|---------------|---------------------|--------------|---------------|
|                    | Quantity            | (back loads) | (Truck loads) | Quantity            | (back loads) | (Truck loads) |
| Fuel Wood (Winter) |                     | 11,835       | 25.5          |                     |              | 13            |
| Fuel Wood          |                     | 6,235        | 15.5          |                     |              | 7             |

<sup>1</sup> CDM AMS I.D version 15 for renewable energy projects, Table I.D.1 for diesel generators of less than 15 kW running at 25% load factor such as mini-grid with 24 hours/day service, see <http://cdm.unfccc.int/UserManagement/FileStorage/7QXAZ5036WN8BEYKUDFRPJGL21V4I9>

|                                  |        |  |  |      |  |  |
|----------------------------------|--------|--|--|------|--|--|
| (Summer)                         |        |  |  |      |  |  |
| LPG- Gas<br>(cylinders)          | 133    |  |  | 89   |  |  |
| Kerosene<br>(liters)             | 4,503  |  |  | 1105 |  |  |
| Diesel<br>(liters)               | 1,250  |  |  | 0    |  |  |
| Candles<br>(Nos.)                | 10,044 |  |  | 339  |  |  |
| Dry Cell<br>Batteries<br>(Pairs) | 2,739  |  |  | 741  |  |  |

Fuel wood is mostly collected in the forests and carried out as back loads by women and children during the winter holidays and when the males and cattle have migrated for the winter to Lingmithang which is located in a lowland warmer climatic zone. LPG, Kerosene, Diesel, Candles and Dry Cell Batteries are mostly brought from Mongar, which is 87 km from Sengor and is Sengor's local District (Dzongkhag) centre.

#### 4.1.3 Gender

In gender terms, the Sengor MHP has had a very positive role on the lives of women, in particular:

- the reduced burden of gathering firewood, particularly in winter in Sengor at 3200m above sea level, when many of the men are away with the dairy cattle in lowland grazing pastures and the women and children remain in their homes in Sengor;
- increased ease and reduced time spent cooking - with 100% of the Sengor homes now having rice cookers, and 50% of households (as of survey in June 2008) also having curry cookers and water heaters;
- reduced need for time spent heating water for bathing and clothes washing as half the Sengor households had electric water heaters within a year of the Sengor MHP's commissioning;
- reduced indoor smoke and hence reduced respiratory problems that largely fall on women and children with the high use of traditional stoves;
- all households have now replaced their inefficient traditional mud stoves to steel smokeless stoves (locally called bukhari), which are more efficient and generate more heat and warms rooms more effectively, thus reducing fuel wood use (which the June 2008 survey showed had been halved);
- with the advent of electric lighting, women are now able to spend time in the evenings on non-formal education activities that contribute to the future development of the community and of Bhutan;
- a number of women were actively involved in the MHP training and study tours;
- women comprise the core element of the micro hydro management committee;
- women were strongly involved in the briefings and subsequent decision of various project activities in particular CCF development, tariff policy establishment, and O&M management of the micro hydro system. It can be noted (see following photograph) that the community meeting held with the evaluation team was predominantly attended by women members of the 22 registered Sengor households.

#### 4.1.4 Construction, Community Ownership and O&M

The Sengor MHP has shown the capacity to generate 125 kW (tested during the commissioning of MHP) maximum sustainable output (a significant increase over its 100 kW design output target level) and from the evaluation site visit the whole MHP installation appears to be a well designed and robust MHP in physical plant and local distribution system terms.

The Sengor community has implemented a stepped tariff that is slightly above the level of grid electricity supply elsewhere in Bhutan, and sound billing and credit control mechanisms appear to be in place to



maximise the revenue needed to keep the Sengor MHP sustainably operating into the future. With the current load being lower than the design anticipated electricity loads at Sengor, electricity revenue is also less than anticipated. It was impressive to see that to keep the MHP’s operators’ costs within its revenue the two Sengor MHP operators had agreed to share the hydro operating role on an alternate month-about job share basis with a marginal increase in their monthly compensation. This will enable the Sengor MHP to accumulate funds to cover future mechanical and electrical maintenance costs, as well as the unpredictable civil costs of recovering from the inevitable floods and landslides. This strong involvement of the Sengor community as a cohesive group in planning and making decisions for a financially sustainable future for their MHP illustrates the depth of commitment from the Sengor community and the establishment of robust and widely accepted community governance arrangements. It was also very promising that the two Sengor MHP operators had been adequately trained to undertake the MHP’s regular O&M and that they were sufficiently imbedded in the community that they had not left the community to earn more money in a nearby town with their new skills.

The new Sengor Community Centre appeared to be a well constructed and well maintained community facility that the community was proud of that had no doubt helped foster a necessary sense of community cohesion. The community turned out in force (one member from each of the 21 registered households) during the evaluation team site visit and they were clearly happy with their MHP and its operation and the significant positive impact it had already made on their lives.



Community meeting attended by a member of all households during June 2009 evaluation site visit (Note preponderance of women participants as the two operators are on the right and two evaluation team members are on chairs on the left)

The strong community ownership of the Sengor MHP was clearly demonstrated in the rapid community mobilisation after the major floods to get the MHP operating again within three days, and without waiting for external assistance.

## **4.2 Achievement of Project's Objectives and Outcomes**

In accordance with GEF criteria, to determine the level of achievement of project objectives and outcomes, the following three criteria are used in this evaluation: -

- i. Relevance
- ii. Effectiveness
- iii. Efficiency

The project's outcomes for each criterion are rated as follows: -

Highly Satisfactory (HS): The project had no shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

Satisfactory (S): The project had minor shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

Moderately Satisfactory (MS): The project had moderate shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

Moderately Unsatisfactory (MU): The project had significant shortcomings in the achievement of its objective in terms of relevance, effectiveness or efficiency.

Unsatisfactory (U): The project had major shortcomings in the achievement of its objective in terms of relevance, effectiveness or efficiency.

Highly Unsatisfactory (HU): The project had severe shortcomings in the achievement of its objective in terms of relevance, effectiveness or efficiency.

### **4.2.1 Relevance**

The establishment of the 100 kW micro hydro at Sengor has already contributed towards the development of enhanced local economic activities with the new hotel that has moved to Sengor from another location which did not have a reliable electricity supply. The Sengor community, which is by and large dependent on cattle farming, is now energized and is receptive towards enterprising ideas as they now are looking towards new livelihoods opportunities. It seems likely that many Sengor families will now diversify their present livelihoods activities toward new business areas. A furniture and cable TV business have already been approved under the CCF (Community Collateral Fund). Other businesses are being considered for CCF support, including milk processing, poultry raising for the supply of fresh eggs, improved cattle quality and milking technology. The Sengor micro hydro project is relevant to the achievement of Bhutan's 9<sup>th</sup> Five Year Plan, as it is a specified 9<sup>th</sup> Five Year Plan activity.

Sengor is located in the main Bhutan east - west highway and would have been vulnerable to migration loss due to difficult living conditions had it remained un-electrified. The coming of a reliable and affordable electricity supply to this remote community will help slow down out-migration as more viable businesses are now possible at Sengor.

The Thrimshingla National Park has focused on reducing the demand for timber in the park, and especially in its core zone where Sengor is located. Before the arrival of electricity, the Thrimshingla National Park had already discouraged the use of timber shingles for roofing by providing subsidised galvanized corrugated iron roofing. Now with the arrival of an adequate and reliable electricity supply, the park has further reduced the demand for timber for fuel wood as all families are using electricity for cooking. The park has now reduced the annual quota of timber from two truck loads to one truck load per household. The Sengor MHP's contribution to the halving of the remaining Sengor timber demand is highly relevant to the National Park, in which Sengor is located in its core zone.

The Sengor community's management of the community collateral fund (CCF) and the Sengor community's successful operation of its micro hydro power (MHP) plant and distribution system are compatible with the Bhutan government's policy of decentralization and good governance. The Sengor

community is well knit and every household seems to be active in their participation in various MHP and CCF developmental activities. The strength of the governance of the Sengor community was tested during a heavy flood on May 26, 2008. Although the MHP's civil infrastructure was still workable, the intake was covered with large boulders, and the de-silting pond was totally filled with sand. The Sengor community immediately assessed the damage to "their hydro plant", and immediately initiated clearing up activities with manual inputs from all households with no input sought from any outside agency. It only took the community two days after the flood was over to bring the micro hydro back into operation. A second pointer of the community ownership of the MHP is that the collateral fund management committee, in spite of receiving several proposals for new businesses, only approved the two projects that were closely related to the productive use of electricity, keeping the use of the CCF closely aligned with the ProDoc livelihoods promotion objective.

The project is in line with that of the RGoB guiding development philosophy of promoting Gross National Happiness - with its emphasis on equitable and sustainable socio-economic development, preservation and promotion of culture, conservation of the environment, and good governance. In particular the Sengor MHP: utilises sustainable and environmentally low impact run-of-the-river hydro power instead of unsustainable and imported diesel generation; by providing affordable and reliable electricity supply to Sengor it provides the basis for the inclusive, community wide and harmonious socio-economic development of Sengor; by providing night time lighting, it facilitates to preservation and enhancement of cultural elements; it reduces the previously excessive fuel wood use; and by facilitating a strong sense of community ownership of their MHP it promotes good governance.

The project is therefore rated highly satisfactory (HS) in terms of its relevance.

#### **4.2.2 Effectiveness**

The project objective was to "improve on the socio-economic development of Sengor community through generation of renewable energy and its utilization for community based rural enterprises leading to enhanced livelihoods and poverty alleviation". It was expected that the objective would be achieved through the following inputs;

1. Enabling policy framework for community based energy services
2. Community micro hydro delivery model
3. Rural enterprises and income generation from community energy

The provision of a reliable, adequate and affordable electricity supply in Sengor and associated changes have significantly contributed towards the wider improvement of the community's lifestyle. For example, the villagers have replaced their cooking from traditional inefficient wood stoves to electric stoves and efficient wood burning steel stoves. The productive time of the villagers (esp. women) has also increased as they now spend less time collecting fuel wood and are instead able to milk their cattle after sunset and churn the milk into higher value cheese products with the help of the new reliable and affordable electricity supply. Also their cooking lifestyle has changed and they are now spending less time in cooking as they cook rice (the Bhutanese main staple diet that is eaten three or four times a day) in electric cookers and they are able to heat water through electric boilers. With a reliable electricity supply the produce from their cattle is refrigerated and is able to be stored until it can be sold. In fact, the review team was only able to buy 15 balls of cottage cheese (a Bhutanese main ingredient used in their ubiquitous curry dishes) from the Sengor shop as all stocks had run out by mid-day. The growing use of electric cookers, electric boilers, and curry cookers are helping the micro hydro plant's viability as the load is increased considerably - otherwise the electrical demand would be too low to generate sufficient revenue to meet the hydro's O&M cost.

The Community Management committee has also approved three electricity based business proposals and two were already successfully operating.

The project is therefore assessed to be highly satisfactory (HS) in effectiveness terms

### 4.2.3 Efficiency

In terms of implementation timescale efficiency, under the final Sengor MHP MSP Brief signed by the RGoB on 12 October 2004 and by UNDP-GEF on 13 January 2005, the project was expected to start its implementation in June 2005 and run to June 2008. However, it then took until 12 August 2005 to turn the MSP Brief into a ProDoc and obtain all the necessary endorsement signatures. This meant that the start of the project was delayed around six months; hence a new realistic project end date would have been December 2008. The Project Management Unit completed the hardware component ahead of schedule and within the planned budget. The CCF (Community Collateral Fund) was slow in being developed and the first CCF funds were only released in December 2008, although financial mechanisms (including for, but not limited to, GEF projects) frequently take much longer to establish than anticipated, so this delay is quite understandable and not a serious negative for the project. The CCF inception and mobilisation delayed the project by a further six months. Overall, the project was therefore a total of 12 months delayed in its completion. However, given that the project completed a MHP with a proven sustainable 125 kW output compared to the target of 100kW within the same budget, and that the project had clearly done an excellent job in community mobilisation (as shown by the community mobilizing itself and restoring power generation within two clear days of a massive flood), a twelve months delay in the completion of the project is not seen as significant in the terms of project implementation efficiency.

In terms of overall cost efficiency in providing a reliable power supply to Sengor with the capacity to meet current and future loads to compare with the Nu 50 million (US\$1 million) Sengor MHP, the cost of new 11 kV bare conductor distribution lines is estimated in the JICA RE MP (of 2005) to be approximately Nu. 1.9 million per km (US\$38,000 per km). With the distance to Sengor being around 50 km from the nearest robust enough grid point, the total cost of providing grid electricity to Sengor would have been around Nu. 93.85 million (approx. US\$ 2 million). This cost however does not take into consideration the felling of large numbers of trees along the route for the right of way for the power line, the power line would have to pass through thickly forested and difficult terrain, also it would pass through the new Thrimshingla National Park and bird watching areas, and that a 50km 11 kV spur line might struggle to supply an equivalent load to the 125kW capacity of the Sengor MHP option.

The Sengor MHP not only costs less in straight capital cost terms than its grid extension option, but at the current peak load it clearly still has considerable underutilized capacity to meet future Sengor load growth. The Sengor Micro hydro project also including the widening of 207 meter road at a cost of Nu 19.18 million which is a further benefit to the Sengor community and the RGoB, hence the Sengor MHP is a highly cost-effective means to electrify Sengor compared to its grid extension alternative.

For large scale PV deployment of 550 Watt (peak) units, the JICA RE MP estimates the cost as Nu.0.19 million per household. Hence electrification through individual household solar PV systems would have cost around Nu. 10.83 million for all 57 Sengor households. However, the solar PV system alternative to the MHP would have only provided for social uses and not provided electricity supply for enhanced livelihoods, would have higher O&M costs (esp. replacement batteries), and would not have enabled the connection of future additional consumers. Hence the Sengor electrification option alternative via individual solar PV systems would not have met the growing productive energy use needs of the MHP option.

The Sengor MHP project was therefore found to be highly satisfactory (HS) in timescale and cost-effectiveness terms.

The overall level of achievement of project objectives and outcomes was therefore assessed to be “Highly Satisfactory” (HS).

#### Matrix Logical Framework Analysis

| Project Outcome      | Indicator            | Achievement | Rating |
|----------------------|----------------------|-------------|--------|
| The reduction of the | Potential annual GHG | Achieved    | HS     |



|  |   |   |    |
|--|---|---|----|
| annual growth rate of GHG emissions from fossil power generation through harnessing of hydro power resources   | emissions from fossil fuel-fired power generation from Sengor area where micro hydro resources are present are avoided  | However peak load is only around 25kW for the 125kW MHP.  |    |
| The provision of electricity to fulfill the energy demand and introduce socio-economic development that utilizes surplus energy leading to enhanced livelihoods and poverty alleviation, thereby leading to the financial sustainability of community based micro hydro. | All the 26 rural households, 15 households belonging to school, BHU, RNR centre, National Work Force, and National Park Office are electrified through hydropower. A number of micro enterprises are established in the community of micro hydro generation by year 3 | Achieved<br>57 Household electrified. Micro enterprises established in year 4 and gradually becoming fully operational. | HS |
| Formulation of community micro hydro energy policy framework for replication   | Government policy and accompanying implementing rules and regulations on the utilization of community micro hydro resources for power generation is established by DOE supported by Consultants   | Achieved.<br>Policy established, but not clear how applicable it is to MHPs other than Sengor.                          | S  |
| Community based micro hydro energy policy analysis   | A clear government policy on the promotion, development and utilization of mini/micro hydro energy for power generation by DOE supported the Consultants  | Achieved.<br>Policy established, but not clear how applicable it is to MHPs other than Sengor.                          | S  |
| Formation of community organization  | Community group formed  | Achieved.<br>Community group clearly active and has strong community support.   | HS |
| Community mobilization workshops   | Regular community mobilization workshops for effective promotion of micro hydro implementation: A community organization established  | Achieved.<br>Workshop have fostered considerable interest and achieved strong community support                         | HS |
| Organize training/study tour for community organization and facilitators   | Number of training/study tour participants  | Achieved  | HS |
| Installation and implementation of designs/Plans for the Micro Hydro   | Comprehensive techno-economic feasibility completed by DOE and a detailed project prepared by DOE.  | Achieved  | HS |
|  | Detailed Engineering Designs completed and  | Achieved  |    |

|  |   |   |    |
|--|---|---|----|
|  | approved by DOE   |   |    |
| Hardware installations and Operation of Micro hydro plant  | Civil Structures, electromechanical equipment and support facilities construction completed by DOE  | Achieved  | HS |
|  | Installation and commissioning of micro hydro by DOE and suppliers  | Achieved  |    |
| Electricity pricing study for such community micro hydro   | A favorable power tariff policy for community micro hydro electricity approved and enforced by the community functional groups and DOE                      | Achieved  | HS |
| Micro hydro policy implementation Monitoring and Evaluation  | An evaluation report on annual production and sales of power from the micro hydro and the percentage share of this used for the livelihood support projects | Evaluation report not yet undertaken. However data exists for report energy sales recorded in the form of household energy bills. | MS |
| Monitoring and Evaluation of performance of micro hydro project  | Evaluation reports for micro hydro operation and economic performance by UNDP/DOE   | Evaluation report not yet undertaken. However data exists for report.   | MS |
| Planning of micro hydro power generation projects  | Proposal for new micro hydro generation projects completed by end of the project possible replication   | 2 new MHP projects underway in 9 <sup>th</sup> Five Year Plan and 2 more in 10 <sup>th</sup> 5 Year Plan.                         | S  |
|  | Feasible micro hydro proposals are submitted to RGOB, donors and private investors by the end of the project  | Not achieved  |    |
| Establishment of Community Collateral fund (CCF)   | Community Collateral Fund established and operation by year 1   | Achieved in year 4  | HS |
| Establishment of Rules and regulation for usage of CCF   | A set of conditions for use of CCF  | Achieved  | HS |
| Training of community entrepreneurs in the establishment, management and operation of small scale business | Training on securing finance and establishing micro enterprises   | Achieved  | HS |
| Study of RE-based livelihood and productive projects support policy  | Study of potential livelihood support and productivity projects that will utilize electricity from micro hydro completed by Dzongkhag and the consultants   | Achieved  | HS |
| Implementation of productive end-use   | End-use projects are put in place by the community  | Achieved. End-use projects in   | HS |

|  |  |  |    |
|--|--|--|----|
| activities   |  | process of implementation at project end.      |    |
| Monitoring and Evaluation of use of productive end use activities/projects | An evaluation report on the performance of SMEs; and business models of energy based rural enterprises documented and shared | Not yet achieved. Data exists for this report. | MS |

### 4.3 Capacity Development

The Sengor PMU (Project Management Unit) of DOE (Department of Energy) was involved in the Sengor MHP survey, design, procurement, contracting, implementation, and commissioning of the micro hydro and its distribution system hardware project components. DOE also has the in-house capacity to implement future micro hydro projects. The Sengor PMU was also involved in the various soft project activities as well as in preparing the pre and post electrification surveys of Sengor for preparation of the pre-electrification baseline and the evaluation of post-electrification results. The DOE now has a much better appreciation of how to successfully achieve sustainable community tariff collection and ongoing O&M of MHP's, which was fully demonstrated for the first time in Bhutan via the Sengor and Chendebji projects. DOE is now in a position to replicate this successful proven community tariff collection and sustainable O&M model (as well as the Sengor sustainable livelihoods element) to all the other 19 MHP's in Bhutan (other than Sengor and Chendebji) that are all run by DOE/BPC - and at lower cost through their local communities.

The Sengor community was briefed on frequent intervals with regard to the project objectives and the underlying model of full community participation and management of the project during the PMU's field visits and also while the CCF (Community Collateral Fund) was being developing, during the development of micro hydro energy policy and also introduced to community leaders through their first hand experience from other country's experience in their study tour of Nepal and the Philippines. The community has also successfully taken ownership of Sengor MHP tariff setting, the need for stringent credit controls, and the establishment and operation of a hydropower management committee.

The project has therefore achieved significant capacity development results in building the organization of the Sengor community.

### 4.4 Project Budget and Specific Results vs Objectives

#### Budget: Planned vs Actual Expenditure (US\$)

| SL# | Description  | UNDP/GEF |         |
|-----|--|----------|---------|
|     |  | Planned  | Actual  |
| 0   | Construction of Community Centre/Electricity Office      | 0        | 45,000  |
| 1   | Civil Engineering Works                                  | 240,000  | 255,000 |
| 2   | Electro-mechanical Equipment & Spares                    | 108,000  | 140,000 |
| 3   | Transmission and Distribution                            | 70,000   | 60,000  |
| 4   | Land acquisition   | 2,000    | 0       |
| 5   | Project Planning, Engineering Design, Site Supervision & | 15,000   | 30,000  |

|    |  |         |         |
|----|--|---------|---------|
|    | Administration   |         |         |
| 6  | Inspection & Testing of E&M Equipment at Manufacturing/Factory site, DSA & Travel  | 10,000  | 10,000  |
| 7  | Internal wiring, local labor & materials   | RGoB    | RGoB    |
| 8  | International Consultants (fees/Travel/DSA)  | 50,000  | 20,000  |
| 9  | Local Consultants/Experts (fees/Travel/DSA)  | 30,000  | 20,000  |
| 10 | Local travel of BPC/DOE staff  | RGoB    | RGoB    |
| 11 | Government/DOE staff emoluments  | RGoB    | RGoB    |
| 12 | Workshops, end use training courses  | 40,000  | 45,000  |
| 13 | Training/Study Tour (Nepal and Philippines)  | 60,000  | 50,000  |
| 14 | Training materials, equipment, facilities  | 20,000  | 20,000  |
| 15 | Workshop/training (for relevant agencies)  | 20,000  | 0       |
| 16 | BDFC loan  | BDFC    | BDFC    |
| 17 | Community collateral fund (CCF)  | 50,000  | 50,000  |
| 18 | TA and consultation for CCF management guidelines                                  | 20,000  | 40,000  |
| 19 | Production of Operation and Maintenance Manuals and other documentation            | 20,000  | 5,000   |
| 20 | Policy Framework for Rural Cooperatives  | 20,000  | 0       |
| 21 | Financial Mechanisms for Private and Community sector RET schemes                  | 15,000  | 15,000  |
| 22 | Training and cooperation program with local technical and engineering institutions | 15,000  | 0       |
| 23 | Monitoring & Evaluation  | 30,000  | 30,000  |
| 24 | Project Administration Unit in DoE   | RGoB    | RGoB    |
| 25 | Project Management at Sengor   | 20,000  | 20,000  |
|    |  | 855,000 | 855,000 |

The RGoB contribution of US\$ 140,000 was contributed in kind in the form of remuneration, benefits, communication, travel, rental, etc. The BDFC loan contribution of US\$ 50,000 was contributed in-kind - the BDFC takes the risk of 30% of a non performing loan (NPL) as per its memorandum of understanding. All the internal wiring cost including the material costs were borne by the beneficiaries.

It is worth noting that the project made economies in some areas to compensate for slightly higher than anticipated engineering costs (\$425,000 actual versus a budgeted \$363,000 or a 17% increase) as well as accommodating an extra item of a \$45,000 Community Centre/Electricity Office, while still coming in on



budget. This is an excellent result and is evidence of highly effective and appropriate budget planning and project management in the Sengor MHP project by DOE (the national executing agency).

The Steering Committee, in its various meetings held, approved the re-appropriation of funds allocated between project activities depending on their evolving funding requirements.

#### Fund Statement According to UNDP CDR Report

| TAs per CDR report      |                 |                 |           |  |
|-------------------------|-----------------|-----------------|-----------|--|
|                         | Govt Disb. US\$ | UNDP Disb. US\$ |           |  |
| Jan-Dec 2005            | 8241.07         | 6312.77         |           |  |
| Jan-Dec 2006            | 247636.21       | 3146.26         |           |  |
| Jan-Dec 2007            | 381407.16       | 8460.88         |           |  |
| Jan-Dec 2008            | 81904.67        | 35357.08        |           |  |
| Jan –Jun 2009           | 6242.69         | 9437.81         |           |  |
| TOTAL                   | 725431.8        | 62714.8         | 788146.60 |  |
| Seed money for O& M (A) |                 |                 | 25000.00  |  |
| TOTAL Expenses          |                 |                 | 813146.60 |  |
| BUDGET ALLOCATED        |                 |                 |           |  |
| UNDP                    |                 |                 | 335000.00 |  |
| GEF                     |                 |                 | 520000.00 |  |
| Total (B)               |                 |                 | 855000.00 |  |
|                         |                 |                 |           |  |
| FUND BALANCE (B-A)      |                 |                 | 41853.40  |  |

Although the fund balance is indicated as US\$ 41,853.40 however, the disbursement for the FTE consultancy services to review the Sengor MHP's results and draft this report had not yet been included. When this is included the project is expected to come in on budget.

#### Planned Activities and Their Achievement

| Activity   | Planned | Actual*  |
|--|---------|----------|
| <b>1. <u>Enabling policy framework for community based energy services provision</u></b> |         |          |
| 1.1 Community Micro hydro energy policy analysis   | Yes     | Achieved |
| 1.2 Community Energy Workshops/Study Tours outside Bhutan                                | Yes     | Achieved |
| 1.3 Community Micro Hydro Energy Policy Framework  | Yes     | Achieved |
| 1.4 Formation of a Community Organization  | Yes     | Achieved |
| 1.5 Community Capacity building through training/workshops                               | Yes     | Achieved |
| 1.6 Capacity building of DOE and Dzongkhag   | Yes     | Achieved |
| 1.7 Develop Operation and Maintenance Manual   | Yes     | Achieved |
| 1.8 Community Micro hydro energy policy Monitoring and Evaluation                        | Yes     | Achieved |
| <b>2. <u>Community Micro Hydro Delivery Model</u></b>                                    |         |          |
| 2.1 Review of feasibility studies and preparation of detailed project report             | Yes     | Achieved |
| 2.2 Preparation of detailed designs for implementation (civil & electrical)              | Yes     | Achieved |
| 2.3 Preparation of Tender Documents for micro hydro construction                         | Yes     | Achieved |
| 2.4 Awarding of Contract   | Yes     | Achieved |
| 2.5 Building of civil structures and Installation of Hardware                            | Yes     | Achieved |
| 2.6 Undertake electricity pricing study  | Yes     | Achieved |
| 2.7 Handing over of micro hydro to the community   | Yes     | Achieved |
| 2.8 Monitoring & Evaluation of performance of micro hydro project                        | Yes     | Achieved |
| 2.9 Construction of Community Centre/Electricity Office                                  | No      | Achieved |

|  |     |          |
|--|-----|----------|
| 2.10 Road widening of 207 meter length                                 | No  | Achieved |
| <b>3. Rural Enterprise and income generation from community energy</b> |     |          |
| 3.1 Economic feasibility study on renewable energy based enterprises   | Yes | Achieved |
| 3.2 Consultation and formation of CCF management guidelines            | Yes | Achieved |
| 3.3 Establishment of CCF   | Yes | Achieved |
| 3.4 Energy-based local business enterprises established                | Yes | Achieved |
| 3.5 Monitoring & Evaluation of energy based business enterprises       | -   | -        |
| 3.6 Document business models and lessons learnt                        | -   | -        |
| 3.7 Organize workshops to disseminate lessons learnt for replication   | -   | -        |

## 5. Sustainability of Project Outcomes and Catalytic Role

Bhutan’s 9<sup>th</sup> Five Year Plan (FYP) of 2002 – 2007 (covering the key design and implementation period of the Sengor MHP) identified two micro hydro sites (Chendebji and Sengor) for development. The grant funding sources for the two projects had been already identified before the 9<sup>th</sup> FYP was finalised. The current 10<sup>th</sup> FYP identified another two MHP’s for development and is currently in its implementation stage.

The 70kW Chendebji micro hydro was a one-off project that was fully grant funded by the e7 Fund for Sustainable Energy Development<sup>2</sup>. The Chendebji project is community managed and its operator has been directly employed by the community. There are two Committees established that have provided for the sustainable O&M of the Chendebji Project since its commissioning in August 2005. The project is legally owned by DoE. DoE also provides ongoing project technical support. The project was registered as a CDM project in May 2005 and 474 CERs (Certified Emission Reductions) were issued for the period from 19 August 2005 to 30 November 2006. The Chendebji MHP project is in operation and is still being successfully operated by the community.

In contrast to the Chendebji MHP, the Sengor MHP was designed from the outset to be a new type of pilot MHP for Bhutan that would be sustainable post-project in terms of its community operation and with a clear purpose to foster community livelihoods. Accordingly, the Sengor MHP had a significant explicit design focus on community capacity building, and the development of sustainable community livelihoods using the new financing mechanism being trialed – the CCF (Community Collateral Fund). Early indications of the Sengor MHP’s sustainability are highly promising, in particular from the Sengor community having a sufficient degree of ownership of their community MHP that they organised the necessary repairs and had the MHP operating again within three days of the devastating floods that blocked the MHP’s civil head works with rocks and gravel. So this evaluation has accordingly concluded that the Sengor MHP has excellent prospects for ongoing post project sustainability.

By the time the Sengor MHP was underway in August 2005, the Electrification MP (Master Plan - that was prepared by JICA) was being finalised (it was finalised in October 2005). The Electrification MP only seriously considered grid extension and PV SHS (off-grid) as viable further electrification options for Bhutan. Further, with the coming of democracy and a new government in 2008, the 100% electrification target for all Bhutanese households was brought forward from 2020 to 2013, which has meant that there was now really not sufficient time to undertake the complex and costly investigation, design and construction of new MHP’s from scratch to contribute to this target, let alone complicating the process further by introducing community management and livelihoods elements. In the midst of the ambitious 100% electrification target by 2013, only two new MHP sites are being targeted (Lingshi and Soe in Thimphu) by year 2013, The RE Master Plan in fact shows four micro hydro sites, in addition to the above two, the other two sites are Laya in Gasa Dzongkhag and Khelphu in Trashigang Dzongkhag. The provision of solar PV electrification is simpler in design and implementation terms than MHPs with their individual

<sup>2</sup> See [http://www.e8.org/Projects/RuralElectrification/Presentations/7.1%20\(EDF\)%20-%20Takao%20Shiraishi.pdf](http://www.e8.org/Projects/RuralElectrification/Presentations/7.1%20(EDF)%20-%20Takao%20Shiraishi.pdf)

engineering design and construction. However solar PV systems do not provide sufficient electricity capacity to supply productive uses in the same way as a Sengor-style MHP does, but the focus on SHS is understandable if electrification is defined as just providing lighting and not providing an electricity supply for cooking, water heating and livelihoods/productive uses. So comparing solar PV with MHPs for rural electrification in Bhutan is to compare apples and oranges – they give totally different energy services. The potential for large scale replication of the Sengor MHP results will only be feasible following the upcoming micro hydro Master Plan study's completion.

The Sengor MHP objectives of fostering private sector participation in operating MHP plants, the manufacturing of MHP components and the construction of MHP by local contractors were clearly unrealistic at the design stage - given that the 9<sup>th</sup> and 10<sup>th</sup> FYP's each included only two MHP's sites. It is hoped that the very positive Sengor MHP results will influence the next 11<sup>th</sup> FYP and more MHP's will be planned and that these MHP's back out some of the currently planned solar PV electrification of remaining un-electrified households.

Given the accelerated rural electrification tempo, the main potential future catalytic role of the Sengor MHP will lie with the 21 grid connected and stand-alone MHPs that are operated by BPC (Bhutan Power Corporation). The inherent cost structure and bureaucracy of a large and geographically dispersed organization such as BPC means that the day to day O&M of MHP's such as Sengor can intrinsically be done by local community managed operators at a lower cost and enhanced operational responsiveness. If this replicated community management and O&M model was applied to the 21 existing BPC managed MHP's, then using Demand Side Management (DSM) to more fully utilise the Sengor MHP's output, as well as the use of a CCF-style model to grow the electricity load through increased community livelihoods - would improve the viability of these MHPs. DSM issues should also be fully included in the design and implementation of the four most promising MHPs identified by the Electrification Master Plan, namely Lingshi, Soe, Laya and Khelphu. For Sengor, the current peak load of 25kW and average load of 7kW (at June 2008) would ideally be built up towards a peak load of 70 kW in winter and 100 kW in summer to fully utilise its 100 kW MHP installed capacity (noting that sustained and stable operation at 125kW was proven in commissioning tests). Building base loads to maximise MHP revenue and replace as much fuel wood use as possible would include using time clocks or 2 meters or ripple control for peak and off peak storage hot water, space heating, clothes drying, greenhouse heating, chicken shed heating, and so forth. To maximise the Sengor pilot community MHP model's catalytic role, some issues still need to be resolved as regards what will happen to Sengor funds over time and how will they ultimately be reused, and which donor or funding source will provide the necessary funds for CCF replication sites/projects?

According to GEF criteria, four dimensions of sustainability are used viz. Financial Resources, Sociopolitical, Institutional framework and governance and environmental. On each dimension of sustainability of the project, outcomes are rated as: -

Likely (L): There are no or negligible risks that effect this dimension of sustainability.

Moderately Likely (ML): There are moderate risks that affect this dimension of sustainability.

Moderately Unlikely (MU): There are significant risks that affect this dimension of sustainability, and

Unlikely (U): There are severe risks that affect this dimension of sustainability.

## **5.1 Financial Resources**

The project had an adequate budget to achieve the Sengor MHP outputs as specified in the ProDoc and to sustain the project financially for the foreseeable future after its formal completion. The Project has provided a significant seed funding of US\$ 50,000 for the community collateral fund and US\$ 25,000 to support future operation and maintenance of the Sengor micro hydro project. In addition, the project is also receiving a regular income stream from the sale of electricity and the funds obtained are being deposited on a regular basis in the community bank account. As the energy demand grows, the project viability will increase with the improved electricity sales revenues.

It is therefore Likely (L) that the project's outcomes are financially sustainable.

## **5.2 Socio-Political**

No significant social or political risks are envisaged to the ongoing project sustainability, as the community is clearly well knit and the project is fully compatible to the needs of the community. The only socio-political risk that can be envisaged would be large numbers of outsiders settling in the community due to the ready availability of reliable and affordable electricity for social uses and for enhanced livelihoods, however, this risk is not likely to impact or change the community harmony as the local power management committee has full authority to decide whether any new electricity supply should be provided or not. In addition, the community also has their village development association, where all the 22 registered households are members. The community is very happy with the project and the project is intrinsically woven into the well being of the community. The community takes great pride in their project. The acceptability of the project can be well judged from the rapid and spontaneous response to repair the flood damage in only three days and get "their hydro" working again as fast as possible.

It is therefore Likely (L) that there will not be any significant social or political risks to the sustainability of the project.

## **5.3 Institutional Framework and governance**

The Agreement drawn between the three main stakeholders for the project, namely the Department of Energy, the Mongar Dzongkha Administration and the Sengor Community for "the Sustainable Operational and Management of Sengor Micro Hydropower Demonstration Project" on 14 February 2009 clearly spells out the responsibility and obligation of each party. In addition, the agreement is valid for only five years, this gives the Department of Energy the ability to review the project performance after five years and make recommendation for changes if needed. The running and operation of the project is also monitored by the Sengor Community Development Committee, the effectiveness of this being proven after the May flood, when the project successfully mobilised the community to clear the relevant flood debris to get the MHP operating again in two days once the flood waters had subsided.

The two Sengor MHP operators appear to be well trained and involved in the project during construction and commissioning, as well as introduced to specific micro hydro management issues through their study tour in Nepal and the Philippines.

There are therefore Likely (L) that there are no institutional framework and governance risks to the sustainability of the project.

## **5.4 Environmental**

The Sengor MHP has a low environment impact as it is a run-of-river hydro scheme with minimal civil works impacts. No transformers are used in the project as the length of the distribution system is short; hence there is no risk of transformer oil leakage.

The head race pipe buried underneath the road could have been an environmental concern as any damage to the pipe would lead to water seepage and ultimately could cause a landslide to the steep sided section of road involved. However, this is a low risk as the project had to undertake road widening before burying the pipe well off to the side of the road. There is thus little risk of an external event that could break the head race pipe.

It is thus Likely (L) that no environmental events will risk the sustainability of project outcomes.

Overall, therefore it is Likely (L) that the project outcomes will be sustainable.



## **6. Project Monitoring and Evaluation System**

The Sengor MHP had the normal UNDP-GEF M&E (monitoring and evaluation) requirements specified in its ProDoc - comprising a project steering committee to oversee the project at a wider strategic level and a National Project Manager heading up a PMU (project management unit). For the Sengor MHP the PMU was located in the Department of Energy.

A mid-term evaluation (MTE) report was completed in July 2007 - by a team that included an international consultant who had been involved in the prior FSP project design. The MTE reviewed the operation of the PMU and concluded that the project management provided for the project's implementation was lean (this final evaluation would concur with this MTE assessment). The project's evolution and the applicability of its underlying MHP replication rationale to new MHP's in Bhutan were not questioned in the MTE. The MTE did not discuss the fact that the then recently completed Electrification Master Plan (MP) had effectively closed the door on any new MHP's being built beyond the four specified in the 9<sup>th</sup> and 10<sup>th</sup> Five Year Plans (FYP's), nor that the Sengor MHP was not manufactured in Bhutan and hence that this local MHP manufacturing part of the project design was no longer applicable.

A post-electrification report was completed for the Sengor MHP in June 2008, but like its predecessor baseline survey of September 2006, the post electrification report was very technical and engineering focused and was undertaken by the implementing agency - which also had a very strong engineering focus. The pre and post electrification reports do not shed much real light on the real level of community involvement pre and post project and how much of the observed community changes were really due to deliberate project interventions. The assessment of the level of community involvement and the influence of project interventions on community changes was therefore undertaken by the FTE review team.

The project steering committee met four times- the first Local Project Appraisal Committee (LPAC) meeting was on 08 August 2005. The major agenda item of that meeting was the approval of the project from GEF/HQ and the steering committee expressing their opinions on the project document. Then meeting also discussed that there were inconsistencies in the project budget and the necessary changes were discussed and agreed to.

The first steering project committee met a year later on 13 June 2006. The major decisions taken at that meeting were the re-appropriation of budget to the hardware component of micro hydro construction as the bid from the contractors was found to be above the planned budget.

The second steering committee was held on 11 January 2007. The major decisions taken at that meeting were the re-appropriation of funds for monitoring and evaluation; exchange loss during the refund to UNDP, additional road widening works that were approved since the Bhutan Road Act did not permit the construction of any infrastructure within fifty feet of the centre point of the road (The head race pipe was then buried after the road widening was completed).

The third steering committee was held on the 4<sup>th</sup> of February, 2009. The major decisions taken at that meeting were the extension of the project completion date from August 2008 to June 2009 mainly due to the non-completion of the training on poultry farming and for greenhouse vegetable production and also to provide sufficient time for completion of the final terminal evaluation report. The transfer of the fund balance of US\$ 25,000 towards the community seed money fund for operation and maintenance was also approved at this meeting.

This final evaluation concurs with the finding of the mid-term evaluation (MTE) that the project management and hence the monitoring and evaluation of the Sengor MHP seems to have been given less of

a priority than the engineering implementation of the specific project technical outputs. Evidence of a certain lack of focus on M&E would be the lack of linkage of the project to the Electrification Master Plan, the lack of awareness that the Electrification MP effectively negated the possibility of significant numbers of new MHP being built in Bhutan in the future, the lack of monitoring of the actual amount of useful electricity supplied to the Sengor community compared with the proportion of useful produced electricity just dumped into the tailrace water through a bank of immersion heater elements, and the fact that there were no apparent plans to export the Sengor community management and O&M model to other existing MHP's in Bhutan. The long convoluted design of the Sengor project probably accounted for some of these M&E deficiencies.

According to GEF criteria, the final evaluation report should include separate assessments of the achievements and shortcomings of the project M&E plan and of the implementation of the M&E plan. They are M&E design; M&E plan implementation; and Budgeting and Funding for M&E Activities. The M&E will be rated as follows;

Highly Satisfactory (HS); There were no shortcomings in the project M&E system;  
Satisfactory (S); There were minor shortcomings in the project M&E system;  
Moderately Satisfactory (MS); There were moderate shortcomings in the project M&E system;  
Moderately Unsatisfactory (MU); There were significant shortcomings in the project M&E system;  
Unsatisfactory (U); There were major shortcomings in the project M&E system; and  
Highly Unsatisfactory (HU); There project had no M&E system.

## **6.1 M & E Design**

The Sengor micro hydro project was well designed in a technical MHP engineering sense, for example, in order to meet the projected long term peak electricity demand, an additional stream was utilized and directed towards the main MHP intake. With the use of this additional stream, the MHP at the time of testing and commissioning was able to generate a stable 125 kW electrical output. Also, the head tank has two hours of peak load water capacity, whereby during winter when the flow is at the lowest, the tank can store enough water to generate two hours of output at 100 kW during peak hours. This design feature is compatible with the long term energy demand scenario. No direct GEF funds were available to undertake the M&E, hence this M&E activity was provided by the project's RGoB in-kind contribution. RGoB officials comprised the project technical team and they also provided bid evaluation of the MHP construction proposals. During the tender evaluation the team considered the engineering aspects of the different proposals to obtain the best technical offer. After the confirmation of the engineering details of the proposals, all associated activities were then monitored accordingly. The monitoring of the hard components was primarily due to the professionalism and hard work of the project implementation agency of the hard engineering aspects of the project, rather than its specific M&E design. In addition, the project's M&E design did not include tracking the replication of the Sengor MHP community management or productive uses results to new and existing MHPs in Bhutan and elsewhere, which is a less than ideal in a pilot or demonstration project where the soft components and replication were stated in the ProDoc to be a primary rationale for undertaking the project.

The M&E design was therefore found to be Moderately Satisfactory (MS).

## **6.2 M&E plan implementation**

As per the ProDoc, the Project Steering Committee was formed to assist the project management office (PMO) in monitoring and guidance to the PMO. Critical decisions were taken at the steering committee meetings to facilitate the project's progress. In total, four project steering committee meeting was held. Progress report training reports and field visit reports were also submitted.

In addition, the Chairman of the Project Steering Committee also visited the sites to monitor at first hand the progress of the project and interact with the community and stakeholders viz. Dzongkhag and BDFC.

Also, the Chief Engineer of the Department of Energy visited the site to monitor the work quality and progress. UNDP Bhutan officials also visited the site and consulted the community and stakeholders on the project. The financial reports were submitted on a quarterly basis to UNDP through the government.

Although the soft component schedules were not precisely followed as per the ProDoc, however, this shift in schedule did not bring any significant loss to the project. All commitments as per the ProDoc were implemented. The auditing of the project was also suitable for monitoring of fund disbursement levels. The project was sufficiently well monitored and evaluated during its implementation so that activities that were not in the ProDoc were considered and implemented as required such as road widening and community strengthening, as well as construction of a community building. These activities help support the sustainability of the project, for example the road widening helps in avoiding damage to the buried pipe, and the new community building helps as an assembly point for the villagers to discuss important issues of concern to the village. Also, in future various stakeholders such as agriculture, health, livestock and Dzongkhag officials can use the new community building for the dissemination of information and in educating the community on new and best practices.

M&E plan implementation was found to be satisfactory (S).

### **6.3 Budgeting and Funding of M& E Activities**

The project did not have M&E activities scheduled for after the project completion viz to monitor the impact of CCF, institutional relationships and ongoing project support. The project also did not have systematic M&E activities to study the productive use impacts of micro enterprise development in the community. In addition, the M&E activities did not include the monitoring of the replication of the project results, both for new and ongoing micro hydro projects in Bhutan or elsewhere.

The M&E activities for budgeting and funding were found to be unsatisfactory (U).

The project was found to be Moderately Satisfactory (MS) in overall M&E terms.

### **6.3 Monitoring of Long Term Changes**

The Sengor “Community Micro Hydro for Sustainable Livelihood” project is the first project of its kind in the Bhutan energy sector which had a design emphasis on replication. Although substantial inputs were made available during the project implementation, the actual tracking and progress of replication was not considered in the ProDoc and no funds were made available for this purpose.

The primary project objective was to foster demonstration and hence replication of the Sengor MHP pilot’s approach; however, the primary project implementation focus seems to have been geared towards project physical engineering completion and it was then assumed that the rest of the soft components and the replication would naturally follow without specific budgets and project activities. The project per se has a low risk of hardware failure as all MHP engineering inputs were well considered. However, the demonstration and hence replication aspects of the project remain questionable, as the importance of this underlying project replication rationale was not understood clearly by the stakeholders who need to initiate and monitor such demonstration and replication activities. The monitoring of long term changes fostered by the project should also include demand side management (DSM) activities as successful replication of the project to existing MHPs will depend on DSM being implemented to control peak and seasonal loads.

## **7. Assessment of Processes that Affected Attainment of Project Results**

The Sengor MHP had a long design journey, funding mobilisation, approval and implementation process. The project formally started on 22 March 1997 with the Bhutan country endorsement of a \$25,000 GEF

grant application for the initial preparation of a GEF barrier removal “Micro Hydro Development” FSP (Full Scale Project). The project then went through an initial scoping phase in 1998 and then from 1999-2000 underwent a detailed project formulation and design phase with an additional \$391,500 of funding (\$228,500 from GEF, \$138,000 from Sweden, and \$28,000 from the Royal Government of Bhutan (RGoB)). This phase developed a \$8.43 Million FSP project proposal for four specific micro hydro sites – Sakten 200kW; Sengor 50 kW; Tang 400 kW; Gasa 150 kW - with a proposed \$4.42 million of GEF and \$4.01 million of other donor funding.

With the failure of the \$8.43 Million FSP project proposal to attract the necessary funding either from GEF or from donors, the project budget was reduced to a medium scale project (MSP) concentrating on only the Sengor MHP site. The Sengor Micro Hydro project scope of work changed significantly from the FSP design in five ways: (1) the Sengor micro hydro’s design power output was doubled to 100 kW; (2) the project soft component now included significant up-front and ongoing involvement of stakeholders; (3) the objective of providing community electrification now focused on livelihoods and hence on productive end-use enterprises; (4) there would now be explicit community based management of the micro hydro; and (5) the rationale of the project now explicitly included the project being a demonstration that would lead to replication of the project results to additional (new) MHPs.

The implementing agency (DOE) had executed and managed 25 micro hydro project financed by donors and the implementation of the engineering aspects of the Sengor micro hydro project was therefore not a new activity for DOE. Although the soft components of the project were novel in Bhutan, the project had taken suitable consideration of the requirements and has implemented them fully. The project would benefit more if post project monitoring were planned and funded as this activity would be critical to the sustainability of the Sengor project community management and O&M concept.

For the Sengor MHP project, a Project Management Unit (PMU) within DoE was established to oversee the overall monitoring and coordination of the Community Micro Hydro for Sustainable Livelihood project (the Sengor MHP). A Project Steering Committee was established to advise the Project Management Unit. In order to develop the private sector capacity to build and design future micro hydro projects, the work was executed by a Bhutanese contractor operating a joint venture in electro-mechanical equipment with Nepal and Indian equipment suppliers. A PMU office was also established at the construction site. Therefore adequate human resources were provided for the project’s implementation. The project also had the support of other engineering arms of DOE/BPC for their technical inputs to the project. The project utilised the lessons learned from the Chendebji micro hydro project. The Project steering committee was established as an executive and advisory body to the project.

The Sengor MHP project was fully aligned with, and supportive of, the guiding Bhutan development philosophy of promoting Gross National Happiness - with its emphasis on equitable and sustainable socio-economic development, preservation and promotion of culture, conservation of the environment, and good governance. The electrification of the Sengor village through micro hydro development was in line with the Ninth Five Year Plan of the Royal Government of Bhutan and the vision to electrify the country by 2020. The community management of Sengor Micro hydro project was also in line with the vision of the government to promote people’s participation in the decision making process at the Gewog level.

The Sengor MHP project briefed relevant stakeholders through various public consultations and mobilized the community in decision making process to generate local ownership of the project. Other key stakeholders such as the Thrimshingla National Park were familiar with the project and were happy and supportive of the project as it also helped the park through the reduction in loss of trees, and dependency on the park would be reduced as the economy improves, noting that the Park provides CGI sheet for roofing on subsidy in place of shingles. The Mongar Dzongkhag administration was also involved and this ensured that duplication of activities did not take place. The BDFC was also involved and now provides mobile loan (sanctions, collects premium and advisory) facility on monthly basis to Sengor community, which was earlier not available.

The Project Management Unit was fully responsible for the physical and financial implementation of the

project. The PMU on a quarterly basis submitted the final report for fund release and any additional funds release due to change in scope after approval from the steering committee. The project was audited and reported accordingly. The Royal Government of Bhutan co-financing of US\$ 140,000 was contributed through the engagement of its officials in the project, the co-financing cost was absorbed in the annual budget of the DOE. The BDFC co-financing of US\$ 50,000 also contributed to the Sengor project through their underwriting of 30% of the losses from non-performing loans, this condition will help in the success of the CCF. The individual households self-financed their internal wiring installation, thus meeting the obligation of community contribution of US\$ 20,000.

The project had an initial loss of time from the ProDoc only being signed in August 2005. Once project implementation started it was found that the road need to be widened to accommodate the head pipe and the project then lost considerable time to obtain the necessary road widening approval from the Department of Road. In addition, the project also faced delays in the completion of training activities. The project completion date was extended from August 2008 to June 2009. The project faced a year's completion delay due to unforeseen reasons as well as scheduling problems, however the project completion delay of one year did not have any negative impact or cost implications.

## **8. Cross Cutting Issues**

### **i. Governance**

The Sengor MHP project is fully aligned with, and supportive of, the guiding Bhutan development philosophy of promoting Gross National Happiness - with its emphasis on equitable and sustainable socio-economic development, preservation and promotion of culture, conservation of the environment, and good governance. The Royal Government of Bhutan has a major thrust of political decentralization whereby the powers in decision-making are vested in the people or their elected representatives. The involvement of the people in decision making is expected to evolve greater participation in their own development process and lead to greater responsibility. The Sengor MHP project has considered the involvement of the community and the stakeholders in the cycle of the project. The electrification of Sengor village through the Micro Hydro development was in line of the Ninth Five Year Plan of the Royal Government of Bhutan and the vision to electrify the country by 2020. The community management of the Sengor Micro hydro project was also in line with the vision of the government to promote people's participation in the decision making process at the Gewog level. Prior to project implementation and during the implementation, the PMU engaged stakeholders through active participation in meetings and briefings. The communities were informed on the various activities through meetings and seeking the participation in training of their representative.

### **ii Promotion of gender equity**

In gender terms, the Sengor MHP has had a very positive role on the lives of women, in particular:

- the reduced burden of gathering firewood, particularly in winter in Sengor at 3200m above sea level, when many of the men are away with the dairy cattle in lowland grazing pastures and the women and children remain in their homes in Sengor;
- increased ease and reduced time spent cooking - with 100% of the Sengor homes now having rice cookers, and 50% of households (as of June 2008 survey) having curry cookers and water heaters;
- reduced need for time spent heating water for bathing and clothes washing as half the Sengor households had electric water heaters within a year of the Sengor MHP's commissioning;
- reduced indoor smoke and hence reduced respiratory problems that largely fall on women and children with the use of traditional stoves;
- all households have now replaced their inefficient traditional mud stoves to steel smokeless stoves (locally called bukhari), which are more efficient and generate more heat and warm rooms more effectively, thus reducing fuel wood use (which the June 2008 survey showed had been halved);
- with the advent of electric lighting, women are now able to spend time in the evenings on

- non-formal education activities that contribute to the development of the community and of Bhutan;
- a number of women were actively involved in the MHP training and study tours;
- women comprise the core element of the micro hydro management committee;
- women were strongly involved in the briefings and subsequent decision of various project activities in particular CCF development, tariff policy establishment, and O&M management of the micro hydro system. It can be noted (see earlier photograph in this report) that the community meeting held with the evaluation team was predominantly attended by women members of the 22 registered Sengor households.

## **9. Lessons and Recommendations**

The Sengor MHP (Micro Hydro Project) in its long evolution and design (1997 to 2004/5) made a number of simplistic assumptions, and did not continue to question “now why exactly are we doing this project again, and how are its results supposed to be replicated post project”. This leads to some key lessons and recommendations that can be drawn from the Sengor MHP’s design and implementation, as follows: -

### A. Need Properly Researched and Clear Logic Designs

The Sengor MHP design followed on from the abortive GEF FSP (Full Scale Project) that did not attract the expected donor and GEF funding in 2000-2003. By late 2004, when the Sengor MHP was finalised, nearly five years had then elapsed since the prior GEF FSP’s situation analyses – yet many outdated assumptions remained in the Sengor MHP’s design. Although the Sengor project had some new innovative elements that appear to have been successful and are likely to be sustainable post-project, its design implicitly assumed replication mechanisms for the construction of many new MHP’s that were clearly no longer relevant in 2004 when the Sengor MHP design was finalised. For example, the Sengor MHP design’s problem definition still aimed to foster private sector MHP manufacturing and financing in Bhutan, when it should have been clear by 2004 that the already then existing donor and soft loan model of grid expansion and solar PV would be highly likely to remain the dominant rural electrification mode into the foreseeable future in Bhutan.

### B. Need Strong Policy Linkages

The Sengor project design mentioned the need for a policy on MHP in Bhutan, but it is not apparent to what extent the advocacy of MHPs was included by the project participants in the formulation of the Electrification Master Plan (MP) prepared by JICA. The Mid Term Evaluation still talked about the need for a separate MHP policy, but by then the horse had already bolted, as the Electrification MP envisaged electrification being by grid extension and solar PV and the 9<sup>th</sup> and 10<sup>th</sup> Five Year Plans only mentioned 4 new MHPs (2 for each FYP). The fact that solar PV is an expensive means to provide minimal electrification and is generally unable to make much impact on livelihoods was not questioned in the Electrification MP – which served as an investment plan for the electrification of all households in Bhutan target. It is odd that it was not questioned why solar PV was being promoted as a key electrification technology in a country with abundant and well distributed hydro resources right down to individual household (pico hydro) levels that can use well proven hydro technologies and thus avoid the well known problems of solar PV battery replacement and recycling. Unfortunately, the Sengor project had weak policy linkages in its design to the debate that should have occurred regarding using MHP and Pico hydro instead of solar PV for off-grid electrification in Bhutan.

### C. Pilot Projects Must Be Replicable if Successful

For a project such as the Sengor MHP, which was aiming to be a pilot project (as stated in its MSP Brief and ProDoc project design and considered to be one of its purposes during its implementation), then it must be implemented in a context where a successful pilot project is likely to be widely replicated. Critically, the Sengor MHP design did not include a suitable policy component in its design or a focus in its implementation to ensure that the upcoming known Electrification MP (Master Plan) being prepared by JICA process included MHP as a serious option alongside the simpler “no think” options of grid extension and solar PV that donors were already then clearly prepared to fund in

preference to off-grid MHPs. The Sengor MHP design was also silent regarding how many replications were expected, who was supposed to initiate such replications, and how they were supposed to be funded. A quick review of replication potentials would have revealed that only two new MHPs were envisaged in the then 2002-2007 9<sup>th</sup> Five Year Plan, and hence that new Sengor-inspired MHP replications beyond single digits were highly unlikely. Hence the Sengor MHP hardware elements can only realistically be replicated in the four micro hydro sites as shown in the Electrification MP, although the soft community mobilisation and MHP O&M component of the project can be replicated at the 19 existing micro hydro sites presently operated by BPC.

D. Community Mobilisation Cannot Just Be Assumed

The Sengor MHP project was “lucky” that the Sengor community was sufficiently: cohesively organised; motivated; able to establish and enforce a realistic tariff; and provided MHP operators for training who stayed on even when the necessary revenues to fully pay both their salaries did not materialize. As far as can be ascertained, these prerequisites of successful community mobilisation had not been surveyed or documented during the technical evaluation of Sengor’s MHP potential.

E. Community Collateral Fund Is Promising But Needs Ongoing Support

The Sengor CCF concept is clearly a promising concept to support new community livelihood projects. However, it is a common GEF experience that a new financing mechanism takes a major effort over a generally longer than expected time period to become fully effective. In the case of Sengor, the CCF seems likely to need ongoing support to play the key role in fostering increased Sengor community livelihoods that has been planned. It also seems likely that the new Sengor electricity using SME’s will also need ongoing support to develop real, tangible and sustainable businesses. This was realized and the MSP team connected the project to an EU-funded livestock project that has provided business development and livestock based enterprise development support in Sengor. This will reduce the demand on BDFC (Bhutan Development Finance Corporation) and RGoB to provide required SME development support at Sengor, which is useful given BDFC’s many competing demands on its limited resources.

F. Strategic Load Growth and Peak Load Management Needed

The Sengor MHP, along with Bhutan’s other grid connected and off-grid electrification projects, are run-of –the-river hydropower projects that cannot store water for periods of peak demand or to meet peaks beyond their baseload generation capacity. However, there does not seem to be any DSM (Demand Side Management) mechanisms in place to manage MHP or grid electrical peak demand or build up additional loads in periods of low demand. All Bhutanese hydro projects and grids, including Sengor, could usefully utilise well-known DSM techniques to increase summer and night time minimum electrical loads and manage peak loads (e.g. using low off peak tariffs with inexpensive time clocks or ripple controls for off peak storage water and space heating) to utilise currently wasted generation and T&D capacity. Even if charged at very low tariffs, such new loads would still help maximise revenues for sustainable scheduled and unscheduled O&M and for investment in new capacity extensions, the development of community electrification and livelihoods capacity, and for new community projects such as footpaths, street lighting and so forth.

G. Micro Hydro Potential Study and Mobilisation of Donors Needed

In view of Bhutan’s steep mountains and perennial flowing streams, the potential of micro hydro is clearly very high. With solar PV now being widely deployed in remote areas to provide initial electrification to cover basic social needs, there is a strong potential for MHP to be deployed as a “second wave” more durable remote electricity supply that can also meet livelihoods or productive uses to hence lead to local economic development using the now proven Sengor MHP model. Therefore, it is very important that the proposed ADB donor funded Micro Hydro Master Plan proceeds and that this then be followed by funding mobilisation from donors to build the promising MHPs that are identified by the Micro Hydro Master Plan.





Sengor village area showing cattle grazing pastures amongst the strongly forested Thrumshingla National Park environment

## Annex A : List of Abbreviations

|           |  |
|-----------|--|
| ADB       | Asian Development Bank   |
| BDFC      | Bhutan Development and Finance Corporation                               |
| BPC       | Bhutan Power Corporation (of RGoB)                                       |
| CDM       | Clean Development Mechanism (of the Kyoto Protocol)                      |
| CER       | Certified Emission Reduction (of CDM)                                    |
| DOE       | Department of Energy (of RGoB)   |
| DSM       | Demand Side Management   |
| Dzongkhag | Regions of Bhutan (equivalent to provinces)                              |
| E7/E8     | The largest seven (now eight) electricity generation companies worldwide |
| FSP       | Full Scale Project (for GEF)   |
| GEF       | Global Environment Facility  |
| Gewog     | Administrative block made up of several villages                         |
| GHG       | Greenhouse Gases   |
| ICT       | Information and Communications Technologies                              |
| JICA      | Japan International Cooperation agency                                   |
| LPG       | Liquid Petroleum Gas   |
| LRMC      | Long Run Marginal Cost   |
| MHP       | Micro Hydro Project  |
| MP        | Master Plan  |
| MSP       | Medium Sized Project (for GEF)   |
| MTE       | Mid Term Evaluation  |
| NGO       | Non-Governmental Organization  |
| Nu        | Ngultrum – Bhutan currency unit = Indian Rupee (approx. 50 Nu = 1 US\$)  |
| PDF       | Project Development Facility   |
| PMU       | Project Management Unit  |
| ProDoc    | Project Document (for UNDP)  |
| PV        | Photo Voltaic  |
| RCB       | Regional Centre Bangkok (of UNDP)  |
| RGoB      | Royal Government of Bhutan   |
| SHS       | Solar Home Systems (PV panels with battery)                              |
| T&D       | Transmission and Distribution  |
| UNFCCC    | UN Framework Convention on Climate Change                                |

## Annex B: Review Mission - People Met

### June 15, 2009

1. Mr. Jigme Dorji, Park Manager, Thrumshingla National Park, Thimphu.
2. Mr. Karma Chhoegyal, Programme Officer, UNDP, Thimphu.
3. Mr. Yeshey Wangdi, Director General, Department of Energy, Thimphu.
4. Mr. Pema Tshering, Project Manager, Sengor Micro Hydro Community Project, Thimphu.
5. Mr. Chabilal, Dy. Project Manager, Sengor Micro Hydro Community Project, Thimphu.
6. Mr. Tashi Penjor, General Manager-HR, BDFC, Thimphu.
7. Ms. Karma Tsomo, Asst. General Manager, BDFC, Thimphu.

### June 17, 2009

1. Mr. Dorji Wangdi, Asst. Park Manager, Thrumshingla National Park Headquarters, Ura.
2. Mr. Yeshy Nedup, Operator, Sengor Micro Hydro Project.
3. Mr. Karma, Operator, Sengor Micro Hydro Project.
4. 22 (Registered) households of the Sengor community.

### June 18, 2009

1. Mr. Sherub Tenzin, Dzongda, Mongar Dzongkhag.
2. Planning Officer, Mongar Dzongkhag.
3. Mr. Sonam Dhendup, Asst. Branch Manager, BDFC, Mongar.

### **FTE Preliminary Findings Workshop - 22 June 2009 (at UNDP Thimphu)**

| No | Name                | Office                    | Designation       | Email  |
|----|---------------------|---------------------------|-------------------|--|
| 1  | Mr. Sudarshana      | Poverty<br>UNDP           | Programme Officer | <a href="mailto:sudarshana.perera@undp.org">sudarshana.perera@undp.org</a> |
| 2  | Ms. Karma Tsomo     | BDFC                      | AGM               |  |
| 3  | Ms. Anjana Giri     | GEF SGP                   | NC                | <a href="mailto:anjana.giri@undp.org">anjana.giri@undp.org</a>             |
| 4  | Mr. Yeshey Wangdi   | DoE, MOEA                 | Director General  | <a href="mailto:ywangdi@druknet.bt">ywangdi@druknet.bt</a>                 |
| 5  | Mr. Pema Tshering   | DoE                       | PM                | <a href="mailto:doepema@gmail.com">doepema@gmail.com</a>                   |
| 6  | Mr. Chhimi Dorji    | DoE                       | Dy.EE             | <a href="mailto:Chhimi08@gmail.com">Chhimi08@gmail.com</a>                 |
| 7  | Nar Bdr Khatiwore   | DoE                       | Dy. E E           | <a href="mailto:narbdr@gmail.com">narbdr@gmail.com</a>                     |
| 8  | Mr Rajan Velumail   | UNDP, RCB                 | Tech Advisor      | <a href="mailto:rajan.velumail@undp.org">rajan.velumail@undp.org</a>       |
| 9  | Mr. Karma L Rapten  | UNDP                      | Head              |  |
| 10 | Mr. Tashi Tenzin    | Tourism Council<br>Bhutan |                   | <a href="mailto:tashi@tourism.gov.bt">tashi@tourism.gov.bt</a>             |
| 11 | Mr. Karma Chhogyal  | UNDP                      |                   |  |
| 12 | Ms. Sonam Y Rabgye  | UNDP                      | PA                |  |
| 13 | Mr. Tshering Penjor | GNHC                      |                   | <a href="mailto:tsheringp@gnhc.gov.bt">tsheringp@gnhc.gov.bt</a>           |
| 14 | Mr. Frank Pool      | Consultant                |                   | <a href="mailto:frank.pool@paradise.net.nz">frank.pool@paradise.net.nz</a> |
| 15 | Mr. Tenpa Gurme     | Consultant                |                   | <a href="mailto:trep_a_tenjur@yahoo.com">trep_a_tenjur@yahoo.com</a>       |

### June 29, 2009

1. Ms Shaanti Kapila, Energy for All Initiative Regional Coordinator, RSID, ADB, Manila

**Annex C: Consultants Terms of Reference**

**TERMS OF REFERENCE**

**Final Terminal Evaluation of  
“Community Micro Hydro for Sustainable Livelihood”**

**I. Purpose**

The evaluation of the UNDP/GEF “Community Micro Hydro for Sustainable Livelihood” Project aims to provide a comprehensive and systematic account of the performance of the project by assessing its project design, process of implementation, achievements vis-à-vis project objectives endorsed by the GEF including any agreed changes in the objectives during project implementation, and any other results. The terminal evaluation has four complementary purposes:

- To promote accountability and transparency, and to assess and disclose levels of project accomplishment.
- To synthesize lessons that may help improve the selection, design, and implementation of future GEF activities.
- To provide feedback on issues that need attention, and on improvements regarding previously identified issues.

To contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on the effectiveness of GEF Operations in achieving global environmental benefits and on the quality of M&E across the GEF system

**II. Background**

The “Community Micro Hydro for Sustainable Livelihood” Project is a Global Environment Facility (GEF) supported project and is in line with GEF Operational Programme No. 6, “Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs,” and GEF Strategic Priority-4 “Productive uses of Renewable Energy” implemented through the United Nations Development Programme (UNDP). All parties signed the 3 year duration project on 12 August 2005 that indicates official implementation of the project. The project area covers Sengor village which is located about 370 Km distance from Thimphu in the eastern part of Bhutan under Mongar Dzongkhag. The village is situated at an altitude of almost 3000 meters above sea level and is within the core zone of the Thrimshingla National Park.

The goal of the project is the reduction of the annual growth rate of greenhouse gas (GHG) emissions from fossil fuel-fired power generation through harnessing of hydropower resources for domestic purposes.

The project’s objective is the socio-economic development of Sengor community through provision of electricity for domestic purposes, and utilization of energy for community based rural enterprises leading to enhanced livelihoods and poverty alleviation

To achieve the above outcomes, the following resources were allocated:

| Agency    | Amount (in USD) |
|-----------|-----------------|
| GEF       | 520,000         |
| UNDP      | 335,000         |
| GEF PDF A | 25,000          |

|                             |                  |
|-----------------------------|------------------|
| Government (In kinds)       | 140,000          |
| Beneficiary/BDFC (In kinds) | 70,000           |
| <b>Total</b>                | <b>1,090,000</b> |

### III. Specific Objectives

The evaluation of the Community Micro Hydro for Sustainable Livelihood project should properly examine and assess the perspectives of the various stakeholders. The following areas should be covered in the final evaluation report:

#### 1. General Information about the Evaluation

The final evaluation report should include information on when the evaluation took place; places visited; who was involved; the key questions; and, the methodology. The final evaluation report will also include the evaluation team’s TOR and any response from the project management team and/or the country focal point regarding the evaluation findings or conclusions as an annex to the report.

#### 2. Assessment of Project Results

The final evaluation will assess achievement of the project’s objective, outcomes and outputs and will provide ratings for the targeted objective and outcomes. The assessment of project results seeks to determine the extent to which the project objective was achieved, or is expected to be achieved, and assess if the project has led to any other short term or long term and positive or negative consequences. While assessing a project’s results, the final evaluation will seek to determine the extent of achievement and shortcomings in reaching the project’s objective as stated in the project document and also indicate if there were any changes and whether those changes were approved. If the project did not establish a baseline (initial conditions), the evaluator should seek to estimate the baseline condition so that achievements and results can be properly established.

Assessment of project outcomes should be a priority. Outcomes are the likely or achieved short-term and medium-term effects of an intervention’s outputs. Examples of outcomes could include but are not restricted to stronger institutional capacities, higher public awareness (when leading to changes of behavior), and transformed policy frameworks or markets. An assessment of impact is encouraged when appropriate. The evaluator should assess project results using indicators and relevant tracking tools.

To determine the level of achievement of the project’s objective and outcomes, the following three criteria will be assessed in the final evaluation:

- **Relevance:** Were the project’s outcomes consistent with the focal areas/operational program strategies and country priorities?
- **Effectiveness:** Are the actual project outcomes commensurate with the original or modified project objective?
- **Efficiency:** Was the project cost effective? Was the project the least cost option? Was the project implementation delayed and if it was, then did that affect cost effectiveness?

Wherever possible, the evaluator should also compare the cost-time vs. outcomes relationship of the project with that of other similar projects.

The evaluation of relevancy, effectiveness and efficiency will be as objective as possible and will include sufficient and convincing empirical evidence. Ideally the project monitoring system should deliver quantifiable information that can lead to a robust assessment of the project’s effectiveness and efficiency. Outcomes will be rated as follows for relevance, effectiveness and efficiency:

**Highly Satisfactory (HS):** The project had no shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

**Satisfactory (S):** The project had minor shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

**Moderately Satisfactory (MS):** The project had moderate shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

**Moderately Unsatisfactory (MU):** The project had significant shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

**Unsatisfactory (U):** The project had major shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

**Highly Unsatisfactory (HU):** The project had severe shortcomings in the achievement of its objective, in terms of relevance, effectiveness or efficiency.

While rating the project’s outcomes, relevance and effectiveness will be considered as critical criteria. If separate ratings are provided on relevance, effectiveness and efficiency, the overall outcomes rating of the project may not be higher than the lowest rating on relevance and effectiveness. Thus, to have an overall satisfactory rating for outcomes, the project must have at least satisfactory ratings on both relevance and effectiveness.

The evaluators will also assess other results of the project, including positive and negative actual (or anticipated) impacts or emerging long-term effects of a project. Given the long term nature of impacts, it might not be possible for the evaluators to identify or fully assess impacts. Evaluators will nonetheless indicate the steps taken to assess long-term project impacts, especially impacts on local populations, global environment (e.g. reduced greenhouse gas emissions), replication effects and other local effects. Wherever possible evaluators should indicate how the findings on impacts will be reported to the GEF in future.

**Capacity Development**

The effects of the Micro Hydro for Sustainable Livelihood Project activities on strengthening the capacities of the DOE, and the Sengor Communities will be assessed.

The following table should be completed to provide a summary of the planned and actual activities of the project as well as the expenditures up to the present.

| Article I. Activities |        | Article II. Budget |                     |                     |
|-----------------------|--------|--------------------|---------------------|---------------------|
| Planned               | Actual | As per ProDoc      | Actual Expenditures | % of Project Budget |
|                       |        |                    |                     |                     |

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|  |  |  |  |  |

### 3. Assessment of Sustainability of Project Outcomes

The final evaluation will assess the likelihood of sustainability of outcomes at project termination, and provide a rating for this. Sustainability will be understood as the likelihood of continued benefits after the GEF project ends. The sustainability assessment will give special attention to analysis of the risks that are likely to affect the persistence of project outcomes. The sustainability assessment should also explain how other important contextual factors that are not outcomes of the project will affect sustainability. The following four dimensions or aspects of sustainability will be addressed:

- **Financial resources:** Are there any financial risks that may jeopardize sustenance of project outcomes? What is the likelihood of financial and economic resources not being available once the GEF assistance ends (resources can be from multiple sources, such as the public and private sectors, income generating activities, and trends that may indicate that it is likely that in future there will be adequate financial resources for sustaining the project’s outcomes)?
- **Sociopolitical:** Are there any social or political risks that may jeopardize sustenance of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public / stakeholder awareness in support of the long term objectives of the project?
- **Institutional framework and governance:** Do the legal frameworks, policies and governance structures and processes pose risks that may jeopardize sustenance of project benefits? While assessing this parameter, also consider if the required systems for accountability and transparency, and the required technical know-how are in place.
- **Environmental:** Are there any environmental risks that may jeopardize sustenance of project outcomes? The final evaluation should assess whether certain activities will pose a threat to the sustainability of the project outcomes.

On each of the dimensions of sustainability of the project, outcomes will be rated as follows.

**Likely (L):** There are no or negligible risks that affect this dimension of sustainability.

**Moderately Likely (ML):** There are moderate risks that affect this dimension of sustainability.

**Moderately Unlikely (MU):** There are significant risks that affect this dimension of sustainability.

**Unlikely (U):** There are severe risks that affect this dimension of sustainability.

All the risk dimensions of sustainability are critical. Therefore, the overall rating for sustainability will not be higher than the rating of the dimension with lowest ratings. For example, if a project has an ‘Unlikely’ rating in either of the dimensions then its overall rating cannot be higher than ‘Unlikely’.

### 4. Catalytic Role

The final evaluation will also describe any catalytic or replication effect of the project. If no effects are identified, the evaluation will describe the catalytic or replication actions that the project carried



out. No ratings are requested for the catalytic role.

## 5. Assessment of Monitoring and Evaluation System

The final evaluation will assess whether the project met the minimum requirements for project design of M&E and the implementation of the Project M&E plan. GEF projects must budget adequately for execution of the M&E plan, and provide adequate resources during implementation of the M&E plan. Project managers are also expected to use the information generated by the M&E system during project implementation to adapt and improve the project. Given the long duration of many GEF interventions, projects are also encouraged to include long-term monitoring provisions to measure mid-term and long-term results (such as global environmental effect, replication effects, and other local effects) after project completion. The final evaluation report will include separate assessments of the achievements and shortcomings of the project M&E plan and of implementation of the M&E plan.

### M&E during Project Implementation

**M&E design.** Projects should have a sound M&E plan to monitor results and track progress towards achieving project objectives. An M&E plan should include a baseline (including data, methodology, etc.), SMART (Specific, Measurable, Achievable, Realistic and Timely) indicators and data analysis systems, and evaluation studies at specific times to assess results and adequate funding for M&E activities. The time frame for various M&E activities and standards for outputs should have been specified.

**M&E plan implementation.** The final evaluation should verify that: an M&E system was in place and facilitated timely tracking of progress towards the project objective and outcomes by collecting information on chosen indicators continually through the project implementation period; annual project reports were complete, accurate and with well justified ratings; the information provided by the M&E system was used during the project to improve project performance and to adapt to changing needs; and, projects had an M&E system in place with proper training for parties responsible for M&E activities to ensure data will continue to be collected and used after project closure.

**Budgeting and Funding for M&E Activities.** In addition to incorporating information on funding for M&E while assessing M&E design, a separate mention will be made of: whether M&E was sufficiently budgeted at the project planning stage; and, whether M&E was adequately and timely funded during implementation.

Project monitoring and evaluation systems will be rated as follows on quality of M&E design and quality of M&E implementation:

**Highly Satisfactory (HS):** There were no shortcomings in the project M&E system.

**Satisfactory(S):** There were minor shortcomings in the project M&E system.

**Moderately Satisfactory (MS):** There were moderate shortcomings in the project M&E system.

**Moderately Unsatisfactory (MU):** There were significant shortcomings in the project M&E system.

**Unsatisfactory (U):** There were major shortcomings in the project M&E system.

**Highly Unsatisfactory (HU):** The Project had no M&E system.

The overall rating of M&E during project implementation will be solely based on the quality of M&E

plan implementation. The ratings on quality at entry of M&E design and sufficiency of funding both during planning and implementation stages will be used as explanatory variables.

### **Monitoring of Long Term Changes**

M&E of long term changes is often incorporated in GEF supported projects as a separate component and it may include determination of environmental baselines, specification of indicators, provisioning of equipment and capacity building for data gathering, analysis and use. This section of the final evaluation will describe the actions and accomplishments of the project in the establishment of a long term monitoring system. The review will address the following questions:

- Did this project contribute to the establishment of a long term monitoring system? If it did not, should the project have included such a component?
- What were the accomplishments and short comings in establishment of this system?
- Is the system sustainable, i.e. is it embedded in a proper institutional structure and has financing?
- Is the information generated by this M&E system being used as originally intended?

### **6. Assessment of Processes that Affected Attainment of Project Results**

Among other factors, when relevant, it is suggested that the evaluation team considers the following issues affecting project implementation and attainment of project results. However, evaluators are not expected to provide ratings or separate assessment on the following issues but they could be considered while assessing the performance and results sections of the report:

- **Preparation and readiness.** Were the project's objectives and components clear, practicable and feasible within its timeframe? Were the capacities of executing institution and counterparts properly considered when the project was designed? Were lessons from other relevant projects properly incorporated in the project design? Were the partnership arrangements properly identified and the roles and responsibilities negotiated prior to project approval? Were counterpart resources (funding, staff, and facilities), enabling legislation, and adequate project management arrangements in place at project entry?
- **Country ownership/drivenness.** Was the project concept in line with the sectoral and development priorities and plans of the country? Are project outcomes contributing to national development priorities and plans? Were the relevant country representatives, from government and civil society, involved in the project? Did the recipient government maintain its financial commitment to the project? Has the government approved policies or regulatory frameworks that are in line with the project's objectives?
- **Stakeholder involvement.** Did the project involve the relevant stakeholders through information-sharing, consultation and by seeking their participation in the project's design, implementation, and monitoring and evaluation? For example, did the project implement appropriate outreach and public awareness campaigns? Did the project consult and make use of the skills, experience and knowledge of the appropriate government entities, NGOs, community groups, private sector, local governments and academic institutions in the design, implementation and evaluation of project activities? Were perspectives of those that would be affected by decisions, those that could affect the outcomes and those that could contribute information or other resources to the process taken into account while taking decisions? Were the relevant vulnerable groups and the powerful, the supporters and the opponents, of the processes properly involved?

- **Financial planning.** Did the project have the appropriate financial controls, including reporting and planning, that allowed management to make informed decisions regarding the budget and allowed for timely flow of funds. Was there due diligence in the management of funds and financial audits? Did promised co-financing materialize? (**Please complete the form in Annex 1 on co-financing**).
- **Implementing/Executing Agency's supervision and backstopping.** Did Implementing/Executing Agency staff identify problems in a timely fashion and accurately estimate their seriousness? Did Implementing/Executing Agency staff provide quality support and advice to the project, approve modifications in time and restructure the project when needed? Did the Implementing/Executing Agencies provide the right staffing levels, continuity, skill mix, and frequency of field visits for the GEF projects?
- **Co-financing and Project Outcomes and Sustainability.** If there was a difference in the level of expected co-financing and actual co-financing, then what were the reasons for the variance? Did the extent of materialization of co-financing affect the project's outcomes and/or sustainability, and if it did affect outcomes and sustainability then in what ways and through what causal linkages?
- **Delays and Project Outcomes and Sustainability.** If there were delays in project implementation and completion, then what were the reasons? Did the delay affect the project's outcomes and/or sustainability, and if it did affect outcomes and sustainability then in what ways and through what causal linkages?

## 7. Cross cutting issues

Considering that UNDP is concerned about poverty reduction, local governance and promotion of gender equity, the review will be required to look at these cross cutting issues:

### i. Governance

How has the project facilitated the participation of the local communities and Dzongkhag administration in and during the pre feasibility phase of broad consultation and decision making processes?

### ii. Promotion of gender equity

Has the project considered gender sensitivity or equal participation of man and women and boys and girls in decision making processes?

To what extent have gender issues and the promotion of gender equality been considered in the project concept and design, and in the adopted implementation mechanism? Have women and men been consulted on their needs and have their different needs been considered? Does the project promote equal participation of men and women/boys and girls in decision making processes? Does the project promote equal access of men and women/boys and girls to project resources, services, and benefits? What project management mechanisms/strategies are in place to facilitate equal participation and equal access to project benefits?

To what extent have mechanisms been considered/developed to assess impact of the project on women and men in Sengor Community and on gender relations existing prior to implementation of the project? Have targets been set for women's and men's participation and for women's and men's benefits, and appropriate performance indicators been developed to measure progress in achieving these targets? To what extent has the disaggregated data been useful to key stakeholders (policy makers, community leaders, etc.)?

## 8. Lessons and Recommendations

The evaluators will present lessons and recommendations in the final evaluation report on all aspects of the project that they consider relevant. The evaluators will be expected to give special attention to analyzing lessons and proposing recommendations on aspects related to factors that contributed or hindered: attainment of project objectives, sustainability of project benefits, innovation, catalytic effect and replication, and project monitoring and evaluation.

Evaluators should refrain from providing recommendations to improve the project. Instead they should seek to provide a few well formulated lessons applicable to the type of project at hand or to GEF's overall portfolio. Final evaluations should not be undertaken with the motive of appraisal, preparation, or justification, for a follow-up phase. Wherever possible, the final evaluation report should include examples of good practices for other projects in a focal area, country or region.

#### **IV. Methodology**

The evaluation will consist of a desk review of relevant project documents and reports related to the planned evaluation and of the GEF. The expert will then conduct focused group discussions, meetings, and interviews with the Project Director and other partners on topics and issues that relate to the implementation and impact of the project. The Expert is expected to become well versed as to the objectives, historical developments, institutional and management mechanisms, project activities and already documented "lessons learned" of the project. Information will be gathered through document review, group and individual interviews and site visits. More specifically, the evaluation will be based on the following sources of information:

- Review of documents related to the project such as project document, quarterly and annual progress reports, other activity/component specific deliverables, reports and evaluation, if there are any, etc.
- Structured interview with knowledgeable parties, i.e., Project Director, Project Personnel, Sub-Contracting Parties/Entities, National Consultants, UNDP Country Office Counterparts, members of the Project Steering/Advisory Committee/s, Community-Based/Peoples Organization/s, Project Beneficiaries or grantees, etc.
- A number of visits to various pilot project sites, if feasible. The site visits should be discussed with the Project Coordinator and UNDP.

#### **V. Timing and Submission of the Report**

The Community Micro Hydro for Sustainable Livelihood Project evaluation will begin on the 2<sup>nd</sup> week of June 2009 and should be completed by the 1st week of July 2009. A first draft evaluation report will be prepared by the expert within the evaluation period and initially will be shared with the UNDP CO and Department of Energy (implementing Agency) to solicit comments or clarifications. The draft report will be presented to the Project Steering Committee and the other stakeholders for further deliberations and in order to obtain feedback necessary for finalization. A final report will be prepared and delivered within two weeks after the evaluation exercise highlighting important observations, analysis of information and key conclusions including its recommendations. The report (in 10 copies) will be prepared and submitted to the UNDP CO.

#### **VI. Roles and Responsibilities**

The UNDP-GEF Regional Technical Advisor will assist the UNDP CO and members of the evaluation team in preparing for the final evaluation of the project. The evaluation team will be composed of an independent highly qualified expert together with at least one independent national consultant. The executing agency shall provide in advance copies of the necessary documents needed by the experts during the evaluation period. Likewise, the Department of Energy shall provide the list of contact

persons representing the various stakeholders of the project, which will be the basis for the tentative itinerary/schedule of activities, which the expert will prepare. The Department of Energy will finalize the schedule of activities in consultation with the expert and UNDP CO staff. The Department of Energy and UNDP-Bhutan will coordinate the logistical arrangements for the evaluation.

## **VII. Budget**

All the costs incurred for the conduct of the evaluation shall be charged against project funds. The interested individuals or group of consultants should submit a proposal with a budget estimate for consideration by the Selection Committee. Payment of Expert/s' professional fees shall be made in accordance with the Service Contract to be issued in this regard.

## **VIII. Outputs**

The following are the required outputs of the final evaluation:

- A succinct written review of the status of the Community Micro Hydro for Sustainable Livelihood Project discussing the above points and that may include relevant maps or tables pertinent to the review where available. The report should be delivered to UNDP and the Chairman of the Steering Committee of the project, not later than 2<sup>nd</sup> week of July 2009 in hard copy form plus CD-Rom in electronic file format e.g. MSWord.
- Presentation of the evaluation findings and recommendations to the UNDP and PMO
- Complete Final Evaluation Report (hard copy and in electronic format)

## **IX. Team composition**

- One international consultant knowledgeable about Micro Hydro model, policies and Renewable Energy, with solid experience in project management (implementation, monitoring and evaluation process) and familiarity with promotional activities in the areas of energy and environment.
- One national consultant who has extensive knowledge in the Micro Hydro and Renewable energy situation of Bhutan, with experience in developing performance indicators, project appraisal and evaluation of development projects.

## **X. Qualification Requirements**

- Evaluators must be independent of both the policy-making process and the delivery and management of assistance to the Community Micro Hydro for Sustainable Livelihood project. They should not have been engaged in the activities to be evaluated, or responsible in decision-making roles for the design, implementation or supervision of the project. In cases where a member of an evaluation team has been involved with some aspects of the project, this member should refrain from evaluating those aspects. In cases where project evaluation team members are not independent, are biased and are not free of conflict of interest, UNDP will put in place a final evaluation quality control review by its independent evaluation office.
- Evaluators will be impartial and will present a comprehensive and balanced appraisal of the strengths and weaknesses of the project or activity being evaluated.

- The evaluation team should comprise of professionals with strong evaluation experience, with requisite expertise in the subject matter of the project, and with experience in economic and social development issues.
- Evaluators should be knowledgeable about the relevant policies of the GEF and will abide by the *GEF Evaluation Office Ethical Guidelines* (available at: [http://gefco.org/uploadedFiles/Policies\\_and\\_Guidelines\\_Ethical\\_Guideline-published\(1\).pdf](http://gefco.org/uploadedFiles/Policies_and_Guidelines_Ethical_Guideline-published(1).pdf))
- Evaluators should ensure that while conducting the final evaluation they take into account the views of all relevant stakeholders. The TORs for this GEF project’s final evaluation and its schedule should be made known to key stakeholders.
- Evaluators should become familiar with the project document and should use the information generated by the project including, but not restricted to, baseline and information generated by its M&E system. Evaluators should also seek the necessary contextual information to assess the significance and relevance of results.
- The evaluation team should provide information relevant for follow-up studies, including terminal evaluation verification on request to the GEF partnership up to 3 years after completion of the terminal evaluation

#### **Terms of Reference Annexes**

- Annex 1: Financial planning/Co-financing
- Annex 2: List of Documents to be reviewed
- Annex 3: Proposed field mission schedule

**Annex 1 (must be completed as part of final evaluation report)**

**FINANCIAL PLANNING/ CO-FINANCING**

| Co-financing<br>(Type/Source)                     | IA own financing<br>(USD \$) |        | Government (USD \$) |        | Others* (USD \$) |        | Total (USDS) |        | Planned | Actual |
|---|------------------------------|--------|---------------------|--------|------------------|--------|--------------|--------|---------|--------|
|   | Planned                      | Actual | Planned             | Actual | Planned          | Actual | Planned      | Actual | Planned | Actual |
| - Grants  |                              |        |                     |        |                  |        |              |        |         |        |
| - Loans/Concessional<br>(Compared to market rate) |                              |        |                     |        |                  |        |              |        |         |        |
| - Credits   |                              |        |                     |        |                  |        |              |        |         |        |
| - Equity investments                              |                              |        |                     |        |                  |        |              |        |         |        |
| - In-Kind support                                 |                              |        |                     |        |                  |        |              |        |         |        |
| - Others (*)                                      |                              |        |                     |        |                  |        |              |        |         |        |
| <b>Total</b>                                      |                              |        |                     |        |                  |        |              |        |         |        |

\*Other refers to contributions mobilized for the project from other multilateral agencies, bilateral development cooperation agencies, NGOs, the private sector and beneficiaries.



## **Annex 2: List of Key Background Documents for the Evaluation**

### **Sl. # Documents**

#### **A Project Document**

- 1 Community Micro-Hydro for Sustainable Project Document 2003

#### **B UNDP Documents**

- 1 Common Country Programme Action Plan (cCPAP) 2008 - 2012
- 2 United Nations Development Assistance Framework for the Kingdom of Bhutan 2008-2012

#### **C Government Documents**

- 1 Bhutan Millennium Development Goals: Needs Assessment and Costing Report (2006-2015) – Planning Commission, Royal Government of Bhutan
- 2 RGoB (2002), Ninth Five-year Plan 2002-2007. Planning Commission, Royal Government of Bhutan, Thimphu.
- 3 Rural Electrification Master Plan
- 4 RGoB (2000), Bhutan 2020: A vision for Peace, Prosperity and Happiness, Royal Government of Bhutan, Thimphu.
- 5 RGoB (2005), Millennium development Goals Progress Report 2005: Bhutan. Planning Commission, Royal Government of Bhutan, Thimphu

#### **D UNDP/GEF Guidance Documents**

- 1 The Evaluation Policy of UNDP 2006
- 2 GEF Focal Area Strategy paper 2007
- 3 GEF Tracking Tools
- 4 Guidelines for GEF Agencies in Conducting Terminal Evaluations (Evaluation Document No. 3, 2008)

#### **E Project Monitoring Reports**

- 1 Baseline survey.
- 2 Auditor’s report on the United Nations Development Programme (UNDP) Assisted Project: Community Micro-Hydro for Sustainable Livelihood
- 3 Mid-term Evaluation Report
- 4 Post electrification Report

#### **F Key Project Outputs**

- 1 Community Collateral Guidelines
- 2 Community based rural enterprise feasibility study document
- 3 Community Micro Hydro Policy guidelines
- 8 Project Fact Sheets for Community Micro Hydro for sustainable livelihoods project.
- 9 Project Implementation Reports for, 2005 2006 and 2007.
- 10 Quarterly Progress Reports.
- 11 Annual Work and Budget Plans.
- 12 Budget documents and expenditure reports.
- 13 Minutes of PSC and project partner meetings.

## **Annex 3: Proposed field mission schedule**

The terminal evaluation field mission is scheduled to begin from 2<sup>nd</sup> week of June with the departure of the international consultant from home base. The tentative program is given below.

| Dates        | Time      | Program   | Remarks  |
|--------------|-----------|---|--|
| XXXX         | 0930-1200 | Arrive Thimphu and sort out programs with the national consultant   | Pick-up will be arranged from Paro.                |
| 15 June 2009 | 0930-1000 | Meet with stakeholders in Thimphu:<br>Call on Dasho Sonam Tshering, Secretary, MoEA                           | Halt at Thimphu.<br>WWF to coordinate the meeting. |
|              | 1015-1045 | Director General, Dept. Of Energy.  |  |
|              | 1100-1130 | Project Management Team, DoE, MoEA  |  |
|              | 1145-1300 | Meet with UNDP officials  |  |
|              | 1500      | Meet with BDFC official   |  |
|              | 1600-1400 | Consultants prepare for field trip.   |  |
| 16 June 2009 | 0900-1730 | Travel to Bumthang  | Halt at Bumthang                                   |
| 17 June 2009 | 0900-1030 | Travel to Sengor. En route meet the park manager, Thrimshula Park. Field work and meetings with beneficiaries | Halt at Sengor                                     |
|              | 1100-1600 |   |  |
| 18 June 2009 | 0800      | Travel to Mongar. Meet with the District Administration and BDFC  | <b>Halt at Mongar</b>                              |
| 19 June 2009 |           | Travel back to Bumthang   | Halt at Bumthang                                   |
| 20 June 2009 |           | Travel back to Thimphu  |  |
| 21 June 2009 | 1430      | Prepare a draft preliminary findings  | Work in UNDP CO                                    |
| 22 June 2009 |           | Presentation of the draft preliminary findings to the stakeholders.   | DoE Conference hall.                               |
| 23 June 2009 |           | Compilation of comments from the presentation. Sort out further work programs with national consultant.       |  |
| 24 June 2009 |           | Consultant leaves Bhutan  |  |
| XXXX         |           | Work on the draft report from home.   |  |
| 30 June 2009 |           | Share the first draft with DoE, UNDP, and UNDP-GEF RTA electronically.  | National consultant input via email.               |
| 3 July 2009  |           | Receive of comments from the stakeholders   |  |
| 5 July 2009  |           | Revise the document based on the comments of the stakeholders and IA/EA..                                     | Comments via email                                 |
| 7 July 2009  |           | Submit the final document   |  |