Water resources use in the Annapurna Conservation Area: Case study of micro-hydropower management in Sikles and Chhomrong

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Images:

Sikles village

Chhomrong village

Income generation and reducing women drudgery from MHP electricity

ABSTRACT

This case study assesses the management aspects of Micro-Hydropower Plant (MHP) in Sikles and Chhomrong, two Gurung villages in the southern Annapurna Conservation Area (ACA) region. Both the plants were built by the Annapurna Conservation Area Project (ACAP) under the Alternative Energy Programme (AEP). The study analyses the strengths and weaknesses of

managing MHP from1) technical, 2) financial, 3) management and 4) social perspectives.

The Sikles plant, being larger and older, has been plagued with problems such as lack of effective policing measures, expensive landslide damage, high staff turnover, and no savings. Demand now exceeds supply, causing the Village Electrification Committee (VEC) to ban the use of low-wattage electric cookers and negate much of the firewood-saving effect of electrification. However, market penetration has reached 100%, and many positive social benefits, such as extended evening hours and reduced drudgery, have been noted.

The newer Chhomrong plant has had fewer technical problems, but also suffers from demand exceeding electricity supply. As a result, though much firewood has been saved by its ban in tourist lodges, most households still cook with firewood due to the insufficient power supply, and income generation using electricity is limited mainly to tourist lodges. In addition, there is a communication gap between the Chhomrong VEC and the ACAP office.

Two levels of recommendations stem from these results:

1. *For the near-term: a number of suggestions are made to improve the management of both Sikles and Chhomrong, applying these to other similar MHPs in the ACAP region where appropriate.*
2. *For the long-term: ACAP should view MHPs in the context of a larger system to support its goals. Investment in MHP construction alone does not necessarily lead to firewood conservation or to sustainable development. A more holistic approach that provides for education and technology for end uses, income generation, and long-term self-sufficiency is suggested.*

The recommendations suggested are aimed at electricity users, VEC and ACAP staff, both AEP related and conservation related. Overall, the Sikles and Chhomrong MHPs show progress towards ACAP's long-term goal of community self-management. However, much needs to be done before this goal is reached.

INTRODUCTION

ACAP's primary goal involves balancing natural resource conservation and sustainable community development. The Alternative Energy Programme (AEP) was thus established to provide energy alternatives to firewood, as well as technologies to minimize firewood usage. In an endeavor to extend renewable energy outreach to the communities in the Annapurna region by harnessing the

potentials of water resources in the region, ACAP has installed 11 communities owned and operated MHPs totaling to 464 Kilowatts (kW) of energy output.

BACKGROUND ON SIKLES AND CHHOMRONG

Since the high rainfall and steep topography of the mid-hills region of Nepal is especially suited to hydroelectric power generation, most of the MHPs found in Nepal are located in the mid-hills. ACA also has MHPs running in the Trans-Himalayan region.

The management issues faced by MHP in the mid-hills and the Trans-Himalayan region are different due to differences in water resource use and availability, topography, climate, and precipitation patterns. For instance, the mid-hills receive around 3,000 mm of rainfall annually, while in the rain shadow of the Trans-Himalayan region, annual precipitation is 250 to 500 mm (KMTNC, 1997). There are significant socio-economic and cultural differences as well.

Recognizing these differences, this study focuses solely on the southern belt of ACA where the majority of the ACAP MHPs are also located. The sampling frame was determined by selecting one MHP from each of the two regions in the southern belt where the MHP are concentrated. The two villages selected for this study, Sikles and Chhomrong, are representative of mid-hill villages, and further study is necessary to understand the management issues of other regions of ACA.

Among southern belt villages, Sikles and Chhomrong were chosen because of important similarities and differences between the two villages. They are both predominantly Gurung villages with similar water resource availability and precipitation patterns. Both are located at about the same elevation, and both have community-owned MHPs installed by ACAP.

However, the similarities end there. Sikles is a much larger village, but sees very few tourists compared to Chhomrong, which is on the heavily trafficked Annapurna Base Camp route. In terms of land use, Sikles lies in the Intensive Use Zone category indicating that higher population density has impacted natural resources due to agriculture, livestock rearing, fodder and fuelwood collection. Chhomrong is categorized under the Special Management Zone, where special management strategies, such as banning of firewood in lodges, are implemented to overcome the impact on natural resources due to tourism.

Built in February 2000, the plant in Chhomrong is relatively new, whereas the MHP in Sikles, built in 1994, is the second oldest in the ACA. Comparing the management of the two will show whether improvements have been made in the six years between the two projects.

RESEARCH METHODOLOGY

The sampling frame for this study was based on the distribution of the MHPs in the ACA. From this sampling frame, the villages of Sikles and Chhomrong were selected. Literature review and interview with professionals in the micro-hydro and alternative energy community in Kathmandu were done to understand what issues have arisen in other MHPs in Nepal. Using this background, questions were formulated for the village interviews during two field visits, which took place in Sikles and in Chhomrong.

During each field visit, the following activities took place:

- Conducted a group meeting of the VEC to interview the members and discuss concerns.
- Visited the MH plant itself, including civil structures, and observed plant operation.
- Interviewed households to understand domestic usage patterns. Effort was made to get the widest possible socioeconomic sampling of households, given the short time frame of the project.
- Interviewed plant manager and operators.
- Interviewed commercial users of electricity, including mill and lodge owners.
- Interviewed other village decision-makers, such as the VDC chair, CAMC chair, and LMC chair.
- Interviewed local ACAP staff (OIC, AE staff, CD staff).

SUMMARY OF FINDINGS

Data collected from the field visits show both positive aspects of MHP management and areas of improvement for both villages. The findings for Sikles and Chhomrong are presented in four categories: technical, financial, management and social issues.

SIKLES: Strengths and Weaknesses

1. TECHNICAL

Strengths: Considering the low success rate of MHPs in Nepal, the plant is still running after seven years of operation.

Weaknesses: Two landslides have occurred in the past few years, causing major damage to the inlet tank and headrace pipe. Repairing the damage added significant costs in terms of money, time and labor to the community, in addition to increasing dependence on ACAP for technical and financial support. The plastic used for the replacement pipe turned out to be of poor quality, necessitating repurchase. The replacement inlet tank was defective as well, as

there was no provision for removing silt and the original designs were not consulted.

Since households in Sikles purchase electricity on a per-watt basis, devices called "police switches" (miniature circuit breakers) are installed in each household to make sure that usage does not exceed quota. However, the original police switches supplied to the community after construction of the MHP were faulty. Fifty new switches were purchased and installed on a trial basis, but that still left 500 households without working switches, and no other effective monitoring mechanism.

The original feasibility study was for 100 kW of power generated for both Sikles and Parche, a neighboring village. During the first few years of operation, total demand in Sikles and Parche was much less than the 100 kW plant capacity, to the point that the VEC decided to offer electricity to Khelang, another neighboring village. Eventually, more households signed up for electricity and more appliances were used. Combined with the lack of police switches, demand now regularly exceeds supply. As a temporary solution, the VEC has decided to ban low wattage cookers until police switches are installed in all households. As a result, many households have reverted to using firewood for cooking, and want ACAP to buy back the low-wattage electric cookers since they are not being used.

As previously mentioned, Development and Consulting Services (DCS), the original contractor and technical advisor for the Sikles MHP, no longer works in the micro-hydro field, at this time, there is no planned replacement for DCS in Sikles to provide technical repairs or training.

2. FINANCIAL

Strengths: They have fully paid off their ADB/N loan. The electricity generated through the MHP has been used during the day for income generation through three agro-processing mills and one wood smoothing machine.

Weaknesses: The financial records have not been audited on a regular basis until last year. The electricity tariff charged to households has remained the same (NRs 0.5 per watt per month) since the plant was constructed in 1994. However, they have not paid back the soft loan provided by ACAP for the initial construction phase. In addition, ACAP has provided much financial support for subsequent maintenance and repairs, especially after the landslides occurred. As the VEC has enjoyed such continuous financial support from ACAP, they have had little incentive to raise the tariff to save money for plant maintenance or to keep electricity demand from exceeding the supply.

3. MANAGEMENT

Strengths: Village-level self-governance institutions, such as the CAMC, the VEC, and plant management are in place and functioning. The VEC conducts regular meetings, including the plant manager, with a high participation rate. In addition, there is continuity of management through the plant manager and many of the VEC members, who have been in place since the beginning.

Weaknesses: There is no observed technical record keeping or regular reporting to ACAP or anyone else. Considering that their financial dependence on ACAP is high, there is no reciprocal sense of responsibility to ACAP for reporting. Lack of records also makes future maintenance difficult.

There has been a high turnover of plant operators, and the VEC has found it difficult to find replacements. In fact, none of the current operators are from Sikles; it appears that there are better opportunities through migrant labor than in Sikles itself as a plant operator. Consequently, the current operators have little if any training and their duties are limited to simple preventative maintenance checks.

4. SOCIAL

Strengths: Almost 100% of households in the Sikles area now have electricity because of the MHP. All of these households contributed cash and/or labor to the plant construction and maintenance. From the household interviews, improvements in the standard of living have been noted:

- Lighting provides more time at night for housework, children's studies, and income-generating activities in some cases (such as weaving). Electric light is also better in quality than kerosene light.
- Decreasing the use of firewood for cooking/heating water or kerosene for lighting has decreased respiratory illnesses.
- Electric hot water heaters can supply hot water more conveniently than with firewood. Hygiene is improved as a result, through more frequent washing and bathing.
- Time and money are saved by not collecting/purchasing firewood or kerosene, and by using one of the three electric mills in the village for agro-processing.
- Radio and in some cases TV provides a connection to the outside world, as well as providing leisure and recreation.

A strong sense of community in Sikles has helped keep the plant in operation, and the governing institutions to work. For instance, when landslides damaged the plant's civil structures, many members of the community helped to repair the damage one reason for this strong community bond is the fact that Sikles is ethnically homogenous (Gurung); there are fewer potential conflicts and

inequities than there would be if the villages were ethnically diverse. At the same time, ethnic homogeneity also makes it difficult to find and punish those who may be exceeding their electricity quota, since the offender may very well be a friend or relative.

Weaknesses: There is no female representation in the VEC for decision-making. One of the three operators is female, but as she is the wife of one of the other operators, she does not have any visible influence in decision-making. When asked why women were not involved in the VEC meetings or village decisions involving electricity, the reply was that women "aren't educated, so they don't understand, plus they are too busy at home."

CHHOMRONG: Strengths and Weaknesses

Many of the same positive aspects seen in Sikles were also noted in Chhomrong.

1. TECHNICAL

Strengths: The Chhomrong MHP has had no major technical problems so far. They have a small inventory of spare parts, facilitating timely repairs should they occur. Police switches (miniature circuit breakers) are installed in every household and lodge, and unlike Sikles, work well.

Weaknesses: The VEC would like to expand the MHP because demand exceeded the 30 kW supply right from the beginning. However, this will be quite expensive, as the civil works need to be expanded much further in order to increase the water supply.

2. FINANCIAL

Strengths: They have paid off their ADB/N loan earlier than scheduled, in order to be eligible for another loan for a possible second phase expansion. The VEC borrowed money from the local community to pay back their loan; this enabled the community's savings to be mobilized in a productive sector other than farming or tourism.

Though Chhomrong MHP is less than 1/3rd the size Sikles MHP, Chhomrong MHP earns 80% of the total revenue generated in Sikles. This is mainly due to Chhomrong's productive end use (lodges consume more than half of the total electricity generated) and the incremental tariff rates. Chhomrong has been paying for, and in some cases performing, their own minor maintenance work.

Weaknesses: As in Sikles, the VEC management at Chhomrong has kept the electricity tariffs low. In fact, they even decreased the tariffs after the ADB/N loan was paid off. This has led demand to exceed supply, creating a situation for black market rates for electricity quotas. For example, one new lodge is

under construction, but since there is no more electricity supply for this lodge, the owner has to use his own household quota or perhaps negotiate electricity purchase from others. The VEC has not been able to maintain a balance between the supply and demand as the electricity tariffs are suppressed.

Financially the VEC is not prepared for the expansion of the MHP, but they are still pursuing it rather than increasing their savings first or clearing the local community debt.

3. MANAGEMENT

Strengths: The plant manager and both operators are well trained, and are capable of conducting minor repairs at the plant. They have also done much of the internal and external wiring and repairs in the village. Good records are kept, both technical and financial. The plant operators maintain a twice-daily record of technical data, and the VEC sends quarterly reports to the ACAP office in Ghandruk.

Unlike in Sikles, there is a very limited water supply being shared by many users: the MHP, traditional water mill, drinking supply, and irrigation. The VEC has managed the water resource competition in an efficient manner, allocating the water supply first to drinking water, irrigation, then the MHP, with the remainder going to the traditional mill, in line with the Water Resources Act of 1996.

Weaknesses: High staff turnover in both the ACAP head and field offices has caused a communication gap between Chhomrong and ACAP. Since there is no ACAP office in Chhomrong, the quarterly reports prepared by the VEC are sent to the ACAP office in Ghandruk, five hours away. However, none of the reports have been reviewed in Ghandruk, as there are currently no staffs responsible for MHPs. Neither has the current Alternative Energy Officer in Pokhara received any of the reports.

4. SOCIAL

Strengths: Unlike Sikles, Chhomrong has female representation in their VEC. The Ama Toli (mother's group) chairwoman was appointed to the VEC by the VEC/VDC chairman, who stressed the importance of female representation on the committee. In both Sikles and Chhomrong, many of the men have left for migrant labor, leaving the women as the decision makers of the household.

Like Sikles, Chhomrong is a tight-knit Gurung community, making management and regulation easy. Gurungs are naturally social, friendly people who live close together, encouraging a constant exchange of ideas (Bell, 1994). The households in Chhomrong are relatively wealthy compared to Sikles due to the presence of tourism.

Firewood use has been much reduced through ACAP's firewood ban in lodges. Lodges now use electricity, kerosene and gas for cooking, and electricity and solar panels for water heating. The VEC estimates that six households' equivalent of firewood is saved by not using firewood in one lodge.

Chhomrong has already had some experience with electricity. Many of the lodges used diesel generators for evening lighting prior to ACAP's MHP installation. A small Peltric set, installed by a private Japanese owner, also operated for several years and produced enough electricity to provide lighting for many of the households. Because of this experience, when the demand survey for ACAP's MHP was taken, most of the users knew of the uses and benefits of electricity and registered accordingly. In Sikles, where there was no prior electricity experience, it took some time for the villagers to learn about electricity and become convinced of its value.

Weaknesses: Most of the households still use firewood for cooking, because there is not enough electricity for them to use rice cookers and other firewood-saving appliances. It is not a question of affordability - most of them can afford rice cookers - but of power capacity and allocation. ACAP also promised to provide subsidized low wattage cookers, but those never materialized since Intermediate Technology Development Group (ITDG), the only manufacturer of these cookers, no longer make them.

RECOMMENDATIONS

Two levels of recommendations stem from the summary of findings:

1. Short-term: recommendations that can be implemented in the near future based on current resources.
2. Long-term: recommendations that require institutional rethinking over a wider scope and period of time.

1. Short-term

TECHNICAL

Sikles urgently requires police switches to monitor their electricity usage, so that low-wattage electric cookers can once again be used. In addition, since DCS will no longer provide them with technical support, the VEC should begin building working relationships with other existing micro-hydro service providers (a list of whom can be provided by ACAP). In this way, they will be prepared for any major technical problems that may occur in the future.

Also, ACAP has technical human resources in the form of the AEP staff - the Alternative Energy Officer, two Alternative Energy Assistants and several Alternative Energy Helpers. However, when even minor technical problems

occur, the VECs tend to ask ACAP to call a technician, often at great expense of time and money, and then ask ACAP to subsidize the costs. Frequent turnover of the AEP staff has also left gaps in ACAP's knowledge base of its own MHPs.

Rather than hiring more staff, the existing staff should be more efficiently utilized to handle technical issues, as well as to find and prevent problems before they occur. Local technical capacity should also be increased. This can be accomplished through:

- regular and thorough hands-on training of staff, who can then train plant operators/managers;
- regular preventative maintenance visits by ACAP staff (these are planned, but have not yet occurred);
- more mobility of ACAP staff for troubleshooting;
- incentives for long-term retention of both ACAP and plant staff;
- proper handover between outgoing and incoming staff;
- proper handover of the MHP to the community.

FINANCIAL

Electricity generation should not just be for consumption, but also for production. Income generation from electricity is important for continued financial sustainability of MHPs. Compared to Chhomrong, where over half of the electricity is used to generate income through tourist lodges; Sikles only has three mills and one wood finishing machine. Considering that Sikles has very little money saved after seven years of operation, they should expand their electricity end uses to include more productive, income-generating activities.

Though their financial situation is better, Chhomrong should still consider diversifying their income-generating activities to reduce their dependency on only one sector, especially given that tourism has decreased significantly this past year. Electricity is currently not allocated for agro-processing, even though agriculture is the other major economic activity in Chhomrong.

Both Sikles and Chhomrong should start setting aside separate funds for capital replacement and maintenance repair.

Budgeting for new plants should take into account the total life-cycle cost of a similar plant. The only way to do this is to know from experience what this life-cycle cost might be. ACAP should keep better financial records, especially of its own total yearly expenditures on each plant, to plan for future MHP budgeting and prepare current MHPs for financial independence. From the beginning, the budget should include spare parts, full operation and maintenance, capital replacement, police switches and other enforcement measures, as well as

provision for end uses (such as a subsidy for low-wattage cookers) and gradual reduction of ACAP assistance.

MANAGEMENT

Keeping good records, both technical and financial, are essential for long-term management and preventative maintenance of MHPs. In Sikles, the plant manager keeps financial records, but they should be audited more regularly. A technical log book should also be maintained by the Sikles plant operators as in Chhomrong.

Careful record keeping is of no value if the information is not shared or utilized. There were several noted communication gaps among the VEC, plant operators and ACAP in both villages. In particular, the regular reports prepared by the Chhomrong VEC have not yet reached the ACAP headquarters. More frequent communication among the plant operators, the plant manager, ACAP field offices, and the ACAP head office is necessary for all parties to learn from each other's experiences.

VECs from different villages can also learn much from each other. A workshop was held in Pokhara two years ago for VECs, managers and AE staff to discuss common MHP issues, but no inter-village discussion has occurred since then.

Communication can be facilitated through:

- regular visits by ACAP AEP staff (as suggested above for technical purposes);
- regular workshops, such as the one held in Pokhara two years ago;
- accountability of one staff member in each ACAP field office for collecting and maintaining information about the MHPs in its sector (this doesn't have to be done by an AEP staff member);
- regular accountability of field staff member to the AEO in Pokhara for reporting certain information about the MHPs in its sector.

SOCIAL

The advantage of both Sikles and Chhomrong from an MHP management perspective is that both villages are almost entirely Gurung, and share a strong sense of community. In this study, very few problems were noted in terms of equitable distribution of electricity, water resource conflicts or the like. However, both villages could use more representation from women and lower-income groups in decision-making regarding electricity.

Before this can occur in a meaningful way, education is necessary. Without education on the uses and advantages of electricity for reducing drudgery, increasing income generation, and resource conservation, those who may be

affected most will not even realize, much less articulate, their electricity needs and wishes.

Education on energy use should be coupled with education on energy efficiency. Once energy efficiency is made a priority, then villages with MHP will be able to do much more with the electricity they are allotted, rather than limiting important uses like low-wattage electric cookers as in Sikles, or cooking with firewood as in Chhomrong.

In addition to education, ACAP should also continue to encourage end uses, such as low-wattage electric cookers and water-heating immersion rods that support the conservation goal. For the short term, ACAP can solicit or support other organizations or companies that develop these types of technologies, and then provide incentives to the communities for their use.

2. Long-term

ACAP's investment into micro-hydro should not be viewed in isolation, but as part of an integrated system. If MHP is to truly support ACAP's goals of natural resource conservation and sustainable development, then each new MHP project should be considered holistically: from now to later, from construction to production, from ACAP input to community use. Without a holistic view towards MHP management, the goal gets lost. Why, for instance, are the households in both Sikles and Chhomrong still using firewood to cook?

Figure 4 below illustrates the MHP system. ACAP provides technical and financial support for the construction of the MHP as well as its operation and management. The MHP in turn provides electricity to power devices for cooking, lighting, leisure and micro-enterprise. Revenue is generated from device use through tariffs, which also pay for operation and maintenance.

The outputs of this system are decreased firewood use, increased living standard, increased time, reduced drudgery, and increased income.

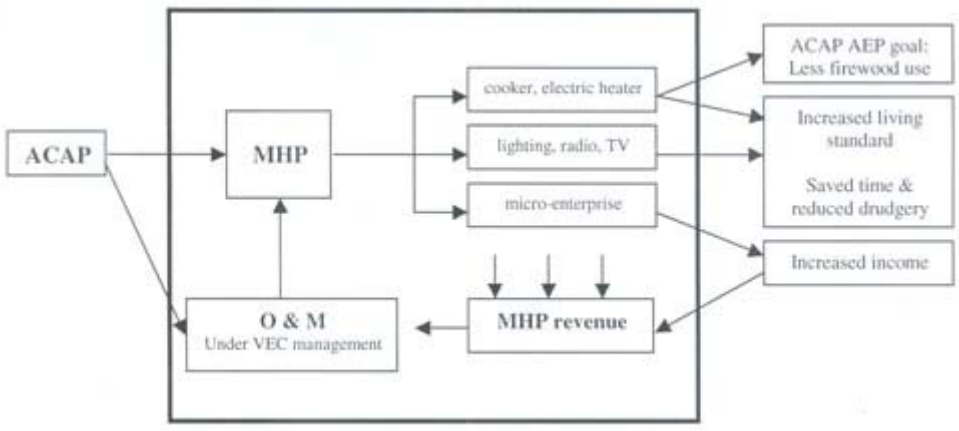

Figure 4. MHP system, with ACAP input and current AEP goals.

As it stands, only cooking appliances and electric heaters, neither of which are used very widely in Sikles or Chhomrong, directly contribute towards the AEP goal.

Figure 4 illustrates that investment in MHP construction alone does not necessarily lead to firewood conservation nor to sustainable development. To that end, each new project should include not only construction and basic maintenance, but also provide for:

- diverse end uses supporting conservation and improved living standards
- education regarding electricity use (for citizens) and maintenance (for staff)
- income-generating activities

AEP cannot do this alone. Right now, the goal of AEP is strictly conservation focused, but Figure 4 shows that MHP directly contributes to other positive benefits for communities. Changing AEP's goals to become broader means that ACAP will also need to become broader in its general approach. ACAP has a rich array of programs and institutions already in place, such as Ama Toli, Lodge Management Committees, Savings and Credit Groups, etc., that directly relate to MHP and its effects. However, the current tendency is for each group to work separately and autonomously. Working together across disciplines will enable the AEP to approach each MHP project in a holistic manner, thereby ensuring its long-term success and sustainability.

The eventual goal is for the management of the Annapurna Conservation Area to be fully handed over to the local communities, including their MHPs. Long-term self-sufficiency means that communities have to decrease the ACAP input into the MHP system shown in Figure 4, through a combination of the following:

- Appropriate alternative energy sources, such as solar and bio gas, to reduce pressure on MHP.
- More efficient electricity use through energy-efficient appliances, insulated buildings, and demand management.
- More attention to income generation from electricity, so that MHP maintenance is funded entirely locally.

The end result, in Figure 5, is a self-sufficient, community-owned and managed MHP system with many positive benefits for years to come.

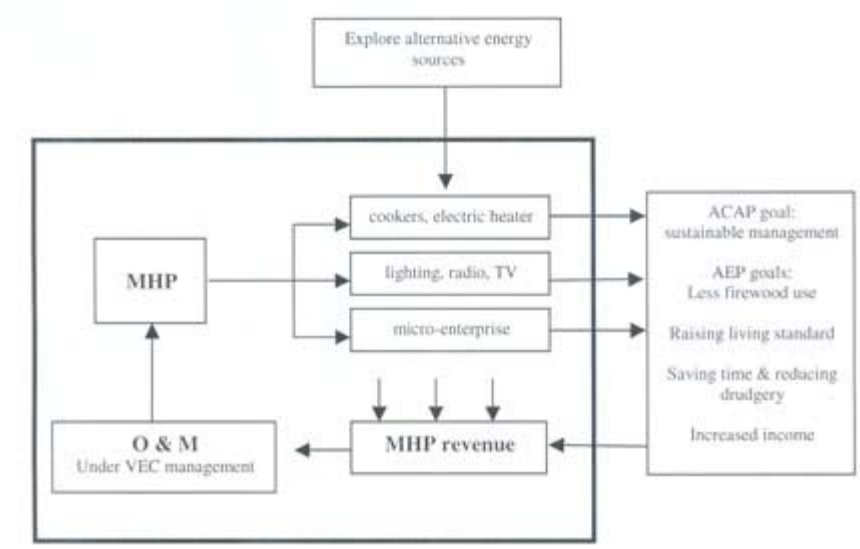

Figure 5. MHP system without ACAP dependence, focused on new ACAP goals.

CONCLUSION

The goal of ACAP's Alternative Energy Programme is to conserve forest resources in the ACA by reducing the consumption of firewood. Financially, the single largest activity in AEP, and in ACAP as a whole, is micro-hydroelectricity. The justification for this investment is that micro-hydro brings the AEP closer to its conservation goal by providing communities that use firewood with a clean, local alternative energy source.

This study focused on how ACAP can improve its approach to future micro-hydro projects by assessing the management of two current MHPs in the southern sector: Sikles and Chhomrong. Comparing the overall MHP management between Sikles and Chhomrong shows that some progress has been made in the six years separating the two plants. However, there is still some room for improvement.

For Sikles and Chhomrong, as well as for ACAP, some near-term suggestions for technical, financial, managerial and social improvement are made. These suggestions can be implemented with existing resources, and the resulting improvements can be seen in the near future. However, further improvement for MHP sustainability requires a more holistic view towards MHP management over the long term. The objective of the MHP projects should not only include the reduction of firewood usage, but more importantly also achieve sustainable management practices.

These recommendations can also be applied towards other ACAP micro-hydro projects, as well as other water resource use projects such as safe drinking water and irrigation. Continued self-assessment and management improvement

ensures that ACAP's programmes meet the ACAP goal of balanced conservation and sustainable development.

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Notes to readers

This paper is a case study on Mountain infrastructure: access, communications, and energy. A Mountain Forum E-consultation for the UNEP / Bishkek Global Mountain Summit. 23-28 April 2002.