SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY COOPERATION AND DEVELOPMENT

MICRO-HYDROPOWER IN AFGHANISTAN: AN AUDIT LESSONS & CONCLUSIONS

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DISCLAIMER
The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

Acronyms

Cap	Capacity
CM	Centimeter
FoC	Free of Cost
FP	Facilitating Partner
GoA	Government of Afghanistan
GoN	Government of Nepal
GPS	Global Positioning System
HH	House holds
IAM	International Assistance Mission
IOM	International Organizations for Migration
kW	Kilo Watt
M	Meter
MEW	Ministry of Energy & Water
MHP	Micro Hydro Power Project
MRRD	Ministry of Rehabilitation and Rural Development
NGO	Non Governmental Organization
NSP	National Solidarity Program
O/M	Operation and Maintenance
OJT	On the Job Training
REDP	Rural Energy Development Program
RPM	Revolution per Minute
SARI/E	South Asia Regional Energy Cooperation & Development
SRS	Simple Random Sampling
T &D	Transmission and Distribution
UN	United Nations
USAID	United States Agency for International Development
Exchange Rates with US$	
50 Afghanis	US$ 1.00
70 Nepalese Rupees	US$ 1.00

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Executive Summary

Extending the grid to all villages in Afghanistan is not a realistic option, given the terrain and the existing electricity infrastructure. There are several perennial rivers and rivulets capable of providing electricity in a majority of the provinces of Afghanistan. There are a number of stakeholders involved in developing this energy source but the information about the results, to a large extent, have been anecdotal and, almost all developments have been fully or partially funded by the donor community.

Recognizing the need to develop sustainable models for micro hydro installations for the rural areas of Afghanistan, USAID/Afghanistan, USAID/SARI/E, Afghanistan's Ministry of Energy and Water (MEW) and the NGO community are collaborating to begin to identify the lessons learned from two current and significant programs – National Solidarity Program (NSP) and Provincial Rehabilitation Team (PRT).

The focus of this report is an audit of existing sites developed by two large donor programs and identifies the issues, lessons, and the way forward.

The objectives of the MHP audit, building upon similar assessments, are:

- Assessment of the overall performance of selected MHP projects in Afghanistan
- Recommendations for strengthening and improving the two existing programs
- Input into the strategy for a national program for micro hydropower

The key findings of this effort are:

- Both programs have achieved significant accomplishments – approximately 62,000 households have been electrified
- Indigenous know-how for the construction of stone masonry structures and management of water resources exist, (irrigation, drinking water and grain grinding)making training in more modern approaches easy
- Good access to construction materials (cement, sand, steel, etc.) in the country
- Turbines installed have been very reliable
- Both programs can be strengthened – planning, accountability, use of natural and human resources, training, material selections and installation practices – particularly downstream of the turbine, and cost recovery at the village level
- Development is highly dependent upon donor assistance

Approximately 400,000 persons are now receiving electricity through these two programs. Turbines manufactured in Afghanistan have been reliable. The average household saves over $6 per month on fuel.

Planning at all levels needs to be improved taking a systematic approach. There was little evidence of site verifications by the two programs. Available capacity is too often less than the installed capacity. There is a significant need for training – technical, administrative and managerial. Majority of technical failures occurred with the electrical

system (synchronization, controls, transmission and distribution). Quality of service suffers from system losses. Majority of sites do not collect tariffs, delaying the inevitable.

The following matrix provides more details:

Findings	Amount	NSP	PRT
Households excluded after installation	20%	12%	41%
Households electrified	6,186	5,400	1,046
Average monthly general expenses/HH	US$105	US$110	US$93
Average reduction of monthly expenses for household fuel after MHP.	US$6.35	US$6.90	US$5.00
Plant calculated capacity higher than planned	20%	10%	46%
Plant calculated capacity lower than planned	48%	56%	28%
Plant measured capacity lower than planned	73%	77%	64%
Absence of settling basin	15%	18%	7%
Turbine capacity lower than planned capacity	8%	7%	11%
Turbine capacity higher than planned capacity	7%	10%	0%
Productive uses of electricity	13%	16%	6%
Tariff only covers the operator's salary not O&M	27%	27%	28%
No tariff	70%	73%	64%
Absence of O/M manuals	100%	100%	100%
Absence of basic tools such as clamp meter	100%	100%	100%
Oversized civil structures	100%	100%	100%
Lack of standard engineering practices in system development	100%	100%	100%
Lack of awareness of electrical safety, physical hazards, and technical know how.	100%	100%	100%
Lack of standard operating procedures	100%	100%	100%
Lack of lighting arrestor in P/H	100%	100%	100%
Lack of grounding equipment in P/H	100%	100%	100%
Non-operating control panel	20%	19%	29%
No control panel	76%	22%	94%
Poor system wiring (P/H, Transmission, Distribution, Household)	95%	97%	94%
Generator			
▪ China	87%	86%	100%
▪ Russia	7%	100%	0%
▪ Pakistan	3%	100%	0%
▪ Assembled locally	3%	100%	0%
Generator RPM < 1500	35%	24%	64%
Generator malfunction	27%	18%	49%
Voltage drop	100%	100%	100%
Turbine malfunction	0%	0%	0%
Turbine Type (cross flow)	98%	98%	100%
V belt breakage	17%	7%	42%

Further information on the results of this effort is contained in Section 3 and Appendix A and B.

The methodology for the audit of sites is based on the random sampling of developed sites in a number of provinces. Sixty sites in nine provinces were audited, **Table 4.1.** The sites sampled were developed by two large nationwide donor programs for rural electrification. Data, technical, economic and social, was obtained for each site using a field validated questionnaire (**Appendix C**). Three 2-person teams were retained to perform the audits. Initially 3 days of classroom instruction were provided to the Afghan teams, covering all aspects of the survey to be performed. This was followed by a field test run to strengthen classroom training and to test/validate the survey questionnaire. Four sites from two adjoining districts of Kabul, De-Sabz and Istalif were selected for the field tests.

Table 4.1 Sites surveyed by province

Provinces Team	Kabul	Kapisa	Bamyan	Parwan	Wardak	Ghazni	Panjshi	Takhar	Lagman	Total
A						6		6	6	18
B	10	6		8						24
C			8		4		6			18
Total										60

Success Stories

Not all sites were problematic, and even some that were, had their bright side. These examples show the potential for successful MHP development, the elements of sustainable models and the resourcefulness of some communities when resources are applied appropriately.

Financial stability In Baqi Dara village of Ghoorband District of Parwan Province, collections are sufficient ($2.00 per household per month) to pay for the operator's salary and repairs. The 300 houses are served and the system has been operating for 1 year.

Village planning In Bakhshi Khill village of Bakhshi Khill District of Panjshir Province, a 60kW project serves all 300 houses, charges $0.20 for each bulb per month and has designed irrigation and water supply into the project. The revenue generated is expected to cover salaries and O & M costs. The villagers are now seeking technical assistance for optimizing financial management and productive uses.

Good staff The 50kW project in Tondkhoo village (160 households), Abdullah Khill District of Panjshir Province, has determined the management and technical resources needed to effectively operate the MHP - 4 persons to keep the system running – 1 guard, 1 administrator, and 2 technicians.

Good collaboration The 15kW project in Alaa Qooli village, Paghman District of Kabul Province, is unique in that both NSP and IOM collaborated on the site. NSP provided funding for the distribution, IOM served as the Facilitating Partner – design and construction and the community provided the funds for the civil and electro-mechanical works.

Productive uses The 3kW project in Qlai Badal village, Paghman District of Kabul Province uses electricity during the day for pumping water for drinking and heating water for a Mosque. The 7.5kW project in Debhi Khamzargar village, Kohistan District of Kapisa Province, charges batteries during the day to generate income. The 70kW project in Qala-e-Now village, Alingar District of Laghman Province serves 90 households and has built in economically productive uses of electricity – carpentry shops, welding shops and stone crushing plants.

Self-sufficiency The 10kW project in Kookhi village, Alingar District of Laghman Province, serves 47 families. The turbine was manufactured in Kookhi village.

Best Success Example The 50kW project in Dehbala village, Waarsaj District of Takhar Province serves carpentry, stone cutting and welding shops during the day and a village mill that processes 420 kg wheat per day from 15 surrounding villages. Homes and businesses are fitted with meters and are charged $0.10 per kWh. Excess power is sold to a village across the river for $0.30 per kWh.

Based on knowledge gained from the field audit of MHP sites and on information available concerning site development programs of the donor community and other surveys, a number of principals can be concluded from this experience. The purpose in identifying these principals is to learn from the experience – both bad and good experiences – and apply them in a positive way in order to move the MHP development activities along in a sustainable system.

Principal One Large programs of rapid development in an unprepared environment of fragile capacity for sustainable implementation, can lead to questionable and even counterproductive results. Examples include local production of substandard equipment, unprepared communities, inadequately trained project implementers and strained finances.

General Recommendations In the short-term, make every effort to slow developments to match the capacity by downsizing planned government and donor programs, and in the longer-term, to raise, in a thoughtful and coordinated manner, the capacity through a national program of training, technical assistance, through access to resources and supported by a national program to a level to accommodate sustainable development.

Specific Recommendations Improve systematic processes. Increase data information using pre-prepared project development forms. Data should be evaluated,

spot checked in field, and approved prior to implementing work on the project. Key to this recommendation is streamlining the processes to avoid undue burden and/or delays for the sake of documentation.

Principal Two Communities as partners and stakeholders receive uneven education and guidance yielding projects with often unplanned results. Examples include lack of understanding of social and economic benefits and inabilities to maintain and troubleshoot systems

Specific Recommendations In the short-term, programs can be initiated to implement:

- Training – billing, collections, savings, salaries, maintenance, repairs, safety, system and operations
- Awareness – available financing through micro-finance institutions, opportunities for economically productive uses of electricity and access to attendant equipment, skills, and markets
- Monitoring and follow-up, record-keeping, service follow-up by developer, trouble-shooting

In the longer-term, a national program would include access to resources through regional resource centers, better service from developers, and public awareness programs.

Principal Three Lack of controls on best practices in fabrication, construction and engineering services at all stages of development leads to equipment and civil works failures. Examples include leaking penstocks, uncontrolled flow in power canals, ungrounded wiring and unsynchronized turbines and generators.

Specific Recommendations In the short-term, initiation through donors and/or NGO's a program of training to fabricators, installers and designers and constructors on engineering norms for MHP development. In the longer-term, a system could be established, either in the public or private sectors, or some combination of the two to develop:

- Certification of engineers, of construction firms and fabricators
- Develop associations of engineers or fabricators or suppliers for achieving benefits with information exchange, with bulk purchasing, with development opportunities
- Standards for fabricating that are checked and certified, standards for construction of civil works and structures and standards for raw materials and parts used in equipment fabrication.

Principal Four Absence of defined and agreed-upon roles for public and private sector provide a vacuum in the development of MHP in Afghanistan. Examples include the scattering of funded programs in government agencies, donor community and private sectors with little coordination, irregular information exchange and no national plan.

Specific Recommendations In the short-term, a joint public-private MHP development group could be formed to provide coordination and information exchange inputs in regularly-scheduled meetings.

In the longer-term, implementation of such means as:

- Defining institutional roles and responsibilities
- Developing guidelines, regulations and standards for private sector
- Developing a policy for MHP that outlines the path for the development of a national program
- Providing opportunities for the MHP industry to grow through economic incentives, training and research.

Principal Five Project funding, in the absence of controls, realistic budgeting, and availability, takes many forms and tracking the expenditures leads to uncertain results. Examples include cost over-runs, undersized power plants, and inefficiencies.

Specific Recommendation Increase transparency through budget reports and audits and improve accountability.

Principal Six Technology options need to be expanded and could use support. Examples include usage of turbines under improper conditions, little integration and/or inadequate mechanical and electrical power uses and absence of strong support for new designs

Specific Recommendation: In the short-term:

- Plan study tours; twining arrangements; and, workshops to facilitate applying lessons from the experience in other countries of the Region – Nepal, India, and Sri Lanka.
- ii)Hold technical workshops and, in the case of NSP, attendance by FP's would be mandatory

In the longer-term:

- Incorporate some of the successful pilots of community participation in electricity distribution services
- Develop minimum criteria for technical
- Refine simple turbines, fabricating techniques, evolution of turbine designs, construction techniques, funds management and accounting, micro-finance, communication techniques with communities, rural resource centers – fixed and mobile and other factors that might benefit MHP in Afghanistan.

Rural energy technology broadens the living standards of people in the remote and scattered settlements of Afghanistan that are not likely to be connected to a national grid in the foreseeable future. Sustainability of these technologies depends upon an integrated development approach that emphasizes financial responsibility, economic growth and community cooperation through sound leadership.

A forward looking, sustainable model and implementation strategy for MHP will be provided; incorporating these principals, in a document entitled *National Program Strategy for Micro Hydro Power.*

Section 1 Introduction

The South Asia Regional Initiative for Energy Cooperation and Development (SARI/Energy) program was launched in 2000 with an objective to build mutually beneficial energy linkages among the countries of South Asia. The program is currently active in eight countries of South Asia, i.e. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The program is supported by the United States Agency for International Development (USAID).

The SARI/Energy program contributions include: technical assistance and training; dissemination of good practice; exploring opportunities for the private sector; and, undertaking outreach and dissemination activities.

This report is based upon SARI/Energy assistance in Afghanistan for the development of micro-hydropower (MHP) within the larger context of the Afghanistan project involving energy trade, capacity building and training and renewable energy development.

Section 2 Background

In Afghanistan access to electricity is one of the lowest in the world (about 6%), with only 234,000 customers connected to the public power grid, of which 76,000 are in the Kabul area. The other provinces have even less access with rural areas being virtually un-served and most of the existing diesel units require overhaul or replacement. Besides this state of disrepair and non-availability of power, diesel generator operations result in high economic losses for Afghanistan due to fuel costs and availability.

Extending the grid to all villages in Afghanistan is not a realistic option. In addition, rural electrification by grid extension might not be viable for all parts of rural Afghanistan, because of their scattered characteristics. Literature reviews and discussion with various officials in the Ministry of Energy and Water (MEW) revealed that there are several perennial rivers and rivulets in a majority of the provinces of Afghanistan.

The availability of a comparatively low cost and readily available resource has given a new impetus for exploiting micro hydropower (MHP) as a major renewable energy source for rural Afghanistan.

Section 3 SARI/Energy Interventions

The recent addition of Afghanistan to the SARI/E program in 2005 has introduced the challenge of addressing the country's inadequate power production capacity as the power sector is one of the least developed sectors in Afghanistan, and its inadequate status is preventing the development of the country.

To best utilize the SARI/E program experience, acquired over a substantial period of time, USAID/Afghanistan has assigned Nexant Inc, the SARI/E program principal contractor, to provide assistance in three topic areas – power trade, capacity building and training and renewable energy, specifically MHP. The focus of this report is on the assistance in MHP. Specifically, an audit of existing sites developed through two large donor programs and to identify issues, lessons and the way forward. Ultimately, this information will contribute to a strategy document for a national program of MHP.

Section 4 The Audit

The purpose of the audit is to both identify problem areas and to build upon other similar assessments. USAID and NSP, for example, have conducted evaluations. The intent is to build upon this body of knowledge, extracting lessons and constructing one or more models for sustainable development.

4.1 The need for information

Energy is one of the basic inputs for accelerated sustainable economic development in rural communities. Supplying significant and reliable energy through MHP based on modern least cost design concepts provides a significant opportunity to the rural areas of Afghanistan. The current practice in Afghanistan for the development of rural electricity is for lighting, tv and radios without taking into account the sustainability aspects of the project based on financial management of the service and opportunities for economically productive uses of the electricity.

Other countries of the region have substantial experience in balancing financial, technical and social elements for a sustainable nationwide MHP program. In August 1996, for example, the Government of Nepal and the United Nations Development Program jointly launched the Rural Energy Development Program (REDP) with the goal of developing energy as an entry point for enhancing rural livelihoods. This program focused on a holistic approach of energy supply for sustainable development. Six program activities - Institutional Development, Demonstration Scheme Implementation, Human Resources Development, Community Mobilization, Natural Resources Management and Research and Development have been determined. These thematic activities are supported by the Government's Administration and Management and Communication Department to provide managerial support and promote information exchange, communication and networking.

The SARI/Energy program is providing support for renewable energy in rural electrification, generating new knowledge and information, in the following three topic areas to the Government of Afghanistan:

- MHP audit;
- A fabricator survey to assess turbine manufacturing capacity and capability as a business;
- The development of a program strategy for off-grid micro hydropower development

The objectives of the MHP audit, the focus of this report, are:

- Assess the overall performance of selected MHP projects in Afghanistan;.
- Provide input into the strategy for a national program for micro hydropower taking into account on-going activities in the sector and the lessons learned from the survey; and
- Provide recommendations for the two large MHP programs to improve and strengthen implementation

4.2 The methodology

The methodology for the audit of sites is based on the random sampling of developed sites in a number of provinces. The sites sampled were developed by two large nationwide donor programs for rural development including electrification. The approach taken for this audit was the development of a questionnaire to obtain technical, economic and social information and to obtain the assistance of three two-person Afghan engineering teams in conducting the field survey. This activity also provided Afghan engineers with the opportunity, through on-the-job training, to both get additional MHP experience and to also learn first hand of the experiences of the numerous rural sites in Afghanistan.

4.2.1 Questionnaire

A questionnaire (Appendix C) was developed for the audit. A field test run was carried out beforehand to ensure its validation. For this evaluation four sites from two adjoining districts of Kabul, De-Sabz and Istalif were selected. The objectives were to check the rationale of the pre-determined survey questionnaire and to make the survey team of six engineers acquainted with survey techniques and the substance of the questionnaire. The outline of the questionnaire topics follows:

- **Technical Aspects** - detailed technical information associated with civil, electro-mechanical and transmission and distribution;
- **Costs** - direct construction cost (civil+ electro-mechanical equipments + transmission and distribution work) and total construction cost (direct cost + administration and management + consultation cost);
- **Approach** - project development approach with the community;
- **Impacts** - environmental and socio-economic impacts before and after project installation;
- **Upgrading** - future plan for system expansion or possible future plan for developing mini grid to supply power to adjoining villages;
- **Service Charges** - information on tariffs, attendant collection and operation and maintenance of the installation;
- **Equipment Breakdown** - frequent recurring problems and their root causes. This section also tries to quantify the impact of equipment on livelihoods.

4.2.2 Preparation for Audit

- Six local engineers, three from Department of Renewable Energy and three from the private sector and NGO community were retained to form three teams to audit sixty sites in nine provinces. Each audit team was provided with survey equipment for the field work: digital camera, abney meter (clinometers), sprit level with string, measuring tape, pocket cientific calculator, stop watch, global positioning system (GPS), techo-meter (rpm meter), set of ranging rods, Vernier calipers, altimeter, clamp meter, and a satellite phone.

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- The audit team was provided with three days of comprehensive classroom training followed by the afore-mentioned two days of field demonstrations to four sites near the Kabul Area in order to make the team acquainted with survey techniques and to understand the objectives of this effort.

Figure 4.1 Audit team members receiving training prior to audit survey

Figure 4.2 Audit team taking measurement with clamp meter during tutorial session

4.2.3 Site Selection Assumptions

Simple Random Sampling (SRS) method was applied for site selection. In total sixty sites were selected at random from nine provinces. The assumptions made for site selection are as follows:

- The provinces which have less than ten sites were ignored;
- The nine provinces are: Bamyan, Ghazni, Kabul, Kapisa, Lagman, Panjshir, Parwan, Takhar and Sar-e-Pul Bad weather conditions and road blockage due to landslides on the way to Sare-e-Pul, rendered the team unable to travel to Sar-e-Pul, therefore they carried out a survey of sites in Wardak Province adjacent to Bamyan Province.
- Kunar and Paktya are ignored due to security reason.

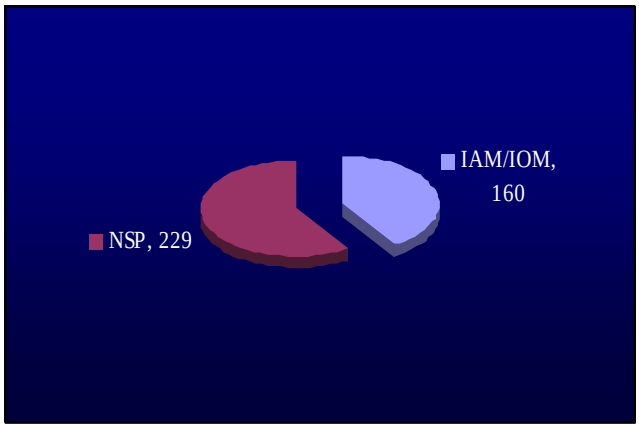
Table 4.1 Sites surveyed by province

Provinces Team	Kabul	Kapisa	Bamyan	Parwan	Wardak	Ghazni	Panjshi	Takhar	Lagman	Total
A						6		6	6	18
B	10	6		8						24
C			8		4		6			18
Total										60

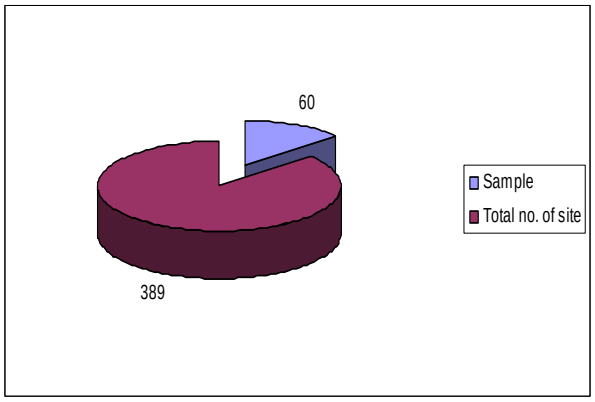
4.2.4 Sampling Techniques

A random sampling of sites developed by the two above-mentioned programs was carried out. Every effort was made to make the sample representative within the constraints of distribution, time and security. The following factors highlight the technique used.

Families of sites- 2
IAM Sites- 160 and its share is 41 percent;
NSP Sites- 229 and its share is 59 percent;



Total Sites- 389
Sample size 60 (15%).
Share from IAM: 30 percent.
Share from NSP: 70 percent



Basis of sample size

The sample size is calculated based on the formula that is mentioned hereunder:
n = [SQ (Z)* SQ (cv)]/SQ (p)
for an 80/20 confidence/precision Z = 1.282,p =0.2 and coefficient of variation cv = 0.5
Hence n =10.272
However this is an unadjusted sample size that must be adjusted for the total population N i.e. 389 projects in nine provinces. Therefore the adjusted sample size is
n (adjusted) = (n*N)/(n+N)= 9.98

This means that the size of the sample of population of 389 elements must be 10 elements in order to be representative of the total population with an 80/20 confidence/precision. Hence the audit is intended to audit sixty sites and satisfy the above criteria with extra level of precision.

However to minimize the logistic burden and time constraints the following points are also considered that are mentioned hereunder:

- Based on the previous experience it is assumed that on an average one site requires 1.5 days to carryout the task including travel time and logistic arrangements.
- Total available time for survey is one month. (1st April to 30th April)
- Total no. of sites can be surveyed in one month = 30/1.5 =20
- Therefore no. of sites can be survey by three teams in a month =3*20 =60
- The percent of sample size (%) = 15

Site selected for Seven Provinces= 7*6 =42
Site selected from two Provinces = (9*2) = 18 (due to proximity of site location)

4.3 Audit Results

4.3.1 Table

Table - 2 summarizes the sites sampled. Detailed tabular information for the sites may be found in Appendix A, MHP Audit Matrix and Appendix B, Site Summaries. This information also provides calculated vs. planned output for each site. Actual output, measured during nighttime load, is also provided for select sites.

4.3.2 General Findings

- Afghanistan has important hydraulic potential suitable for micro hydropower development;
- The country has a large market potential for micro hydropower development, since few rural communities have rural electrification provided by the national utility;
- There are a number of organizations already involved with and active in MHP development but not in a nationally coordinated way. There are two basic programs:

1) Provincial Rehabilitation Team (PRT), funded by USAID through International Organizations for Migration (IOM); and
2) National Solidarity Program (NSP), funded by the donor community through the Ministry for Rehabilitation and Rural Development with various Facilitating Partners (NGOs and the UN);

Table 4.2

Province	District	Village	Capacities			Funding Agency
			Planned (kW)	Calculated (kW)	Measured (kW)	
Parwan	Said khel	Shinwari	5	7	3	NSP
Parwan	Salang	Olang	40	32	19	NSP
Parwan	Said khel	Hamza Khel	5	12	3	PRT
Parwan	Salang	Sarnida Ahangaran	40	42	40	NSP
Parwan	Salang	Qalatak	40	48	X	PRT
Parwan	Ghorband	Baqi Dara	20	13	9	NSP
Parwan	Said khel	Rahmat Khan Khel	5	10	4	PRT
Parwan	Said khel	Ashtarkar	7.5	6	4	PRT
Panjshir	Hisa-i- duwumi	Godara Omars	16	16	12	NSP
Panjsher	Hisa-i- duwumi	Baba Ali	16	X		NSP
Panjsher	Bazarak	Talakan	12	X	9	NSP
Panjsher	Bakhsil	Bakhshi khel	132	57	60	NSP
Panjsher	Ghoriab	Peshghor	42	42	40	NSP
Panjsher	Dare Abdullah khel	Tondkho	50	12	13	NSP
Kabul	Shakar dara	Maidanak	5	12	5	PRT
Kabul	Deh Sabz	Ali khel	3	3	2	PRT
Kabul	Deh Sabz	Qalaye Qab Chi	3	4	3	PRT
Kabul	Istalif	Badal Shah khel	20	28	12	PRT
Kabul	Deh Sabz	Qalaye Jabar Khan	3	3	3	PRT
Kabul	Chap dara	Odro Khel	20	17	15	NSP
Kabul	Shakar dara	Yonus Khel	5	8	4	PRT
Kabul	Mir bacha Kot	Guzar	5	3	5	PRT

Kabul	Paghman	Parachi	15	10	11	PRT
Kabul	Paghman	Qalaye Badal	3	9	3	PRT
Kapisa	Nijrab	Deh Qazi	5	4	3	PRT
Kapisa	Nijrab	Delyar	7.5	7	4	PRT
Kapisa	Kohistan	Atef khel	5	X	X	NSP
Kapisa	Nijrab	Deh Naw	5	4	4	PRT
Kapisa	Kohistan	Qazi khel	30	52	14	NSP
Kapisa	Kohistan	Dabdi	7.5	3	3	PRT
Ghazni	Malistan	Mazar	10	10	10	NSP
Ghazni	Malistan	Dahane Bagh	7	X	1	NSP
Ghazni	Malistan	Naw dah	15	14	11	NSP
Ghazni	Malistan	Sare Sang	15	8	6	NSP
Ghazni	Malistan	Maidan	10	6	6	NSP
Ghazni	Malistan	Naw joy	7	4	4	NSP
Laghman	Alingar	Deh Shah Agha khail	7.5	7	X	NSP
Laghman	Alingar	Alokhail	X	X	X	NSP
Laghman	Alingar	Barekoot	10	4	4	NSP
Laghman	Alishing	Ghazi Abade kohna	6	6	6	NSP
Laghman	Alishing	Qala -e- naw	9	9	8	NSP
Laghman	Alingar	Kookhi	10	8	9	NSP
Wardak	Maidan Shar	Qule bala Pahin	10	7	7	NSP
Wardak	Maidan Shar	Jani khel	12	8	4	NSP
Wardak	Kohna khumar	Qalaye naw	15	6	5	NSP
Wardak	Maidan Shar	Seya peshab	7.5	5	5	NSP
Bamyan	Center of Bamyan	Ali bik	15	8	8	NSP
Bamyan	Center of Bamyan	Lesholqat	20	14	12	NSP
Bamyan	Center of Bamyan	Qalaye peera	15	X	7	NSP
Bamyan	Center of Bamyan	Sad barg	60	56	15	NSP
Bamyan	Center of Bamyan	Munara	50	7	X	NSP
Bamyan	Center of Bamyan	Ab bal Qazan	20	10	9	NSP
Bamyan	Center of Bamyan	Baba doost	50	8	8	NSP
Bamyan	Center of Bamyan	Kata sang	20	X		NSP
Takhar	Warsaj	Deh bala	50	20	15	NSP
Takhar	Warsaj	Payani	60	25	16	NSP
Takhar	Warsaj	Yawar -e- Safli	15	6	6	NSP
Takhar	Warsaj	Malwar -e- Bala	30	14	10	NSP
Takhar	Khuwja Ghar	Abdul Latif	9	9	9	NSP
Takhar	Warsaj	Yawar -e- Olya	8	18	6	NSP

- There is indigenous know-how for the construction of stone masonry structures and management of water resources (irrigation, drinking water and grain grinding), making training in more modern approaches easy;
- There is good access to construction materials (cement, sand, steel, etc.) in the country; Rural energy is a high priority for communities and plants installed primarily to improve the quality of life by providing electric lights and recreational usage, such as watching TV and listening to radios and cassette players, have been enthusiastically received. Absent in most cases is a financial management program based on tariffs to cover repairs, operation and savings for expansion and any

opportunities for economically productive uses of electricity to generate income for the community and jobs.

4.3.3 Technical Findings

4.3.3.1 Civil Structures

These structures – stream diversion, power canal, forebay, penstock, tailrace, power house - are entirely dependent upon site condition and no two sites are identical. Complete standardization of civil works is impossible, but standard approaches to design and execution could and should be used.

Some of the difficulties in civil works construction and operation are reflected in the following example. Baba Ali village is in Panjshir District of Panjshir Province.. The 16kW project has daytime productive uses that could be served by MHP, but are being served by diesel. Villagers are looking forward to changes: improvements in health, initiating changes to enterprise use of MHP, fuel savings, job opportunities, time saving and others. The project is 70 percent complete, but the team noticed some issues with the civil works: flood exposure, no settling for silt and gravel, improper lining of the canal and forebay and power canal is larger than necessary. Following are illustrations from other sites.

- Wrong site selection and positioning of intake;

- The structures are oversized and wrong dimensions;

- The canals are often oversized and have an incorrect slope, resulting in erosion and head loss;

- Due to the high gradient of some rivers, sediment load that includes gravel, debris etc. are common, but there are no gravel traps installed;

- Wrong sizing of the fore bay and trash racks.

- Wrong alignment, sizing and diameter of penstock and joints;

- Flood hazard affect an exposed powerhouse; safety measures (grounding, etc.) inside the power house are often lacking. Proper ventilation and sufficient lighting are also absent;

4.3.3.2 Electro-Mechanical Equipment

This equipment has a significant effect on the power generation and durability of the systems. Hence, extra precaution needs to be taken for the appropriate type, size, materials and fabrication of the components.

Examples are found in Baba Doost and Dar Hwely Papany villages. Baba Doost is a 50kW project situated in Center of Bamyan, Bamyan Province. The system is shut down due to the lack of synchronization between the turbine and generator, resulting in burned out wires, bulbs and appliances. The villagers are awaiting someone with funds to solve the problem. Dar Hwely Papany, in Warsaj District of Takhar Province is a project of 25kW. The system provided power to carpentry, welding and stone crushing shops and a grain mill (11kW), however due to generator failure, lack of turbine and generator synchronization the system is now also shut down. The villagers lack funds to repair and solve the design shortcoming.

Some of the difficulties in other sites follow:

- Limited range of standardized cross flow turbines; Cross flow design without control mechanism makes power optimization difficult and weakens the system performance.

- Evidence supports the apparent use of lower quality generators (requiring extra care and maintenance or funds for frequent repair and/or replacement) and no synchronization between turbine generator;
- Absence of load controlling and voltage controlling devices.
- Non-operational lighting arrester.
- Non functional/absence of ballast load (water heater, for example) in the power house.

4.3.3.3 Transmission and Distribution (T& D) system.

T&D components are very sensitive parts of a power plant. The system should be designed carefully to obtain optimum power outputs as well as reliable operation of the system.

Troubles are exemplified by Rhamat Khan Khil village and Ali Bik village. Rhamat Khan Khil is in Shaid Khil District of Parwan Province and has only 100V out of 220V in the system. Safety issues exist also from exposed transmission and loose wiring in numerous locations. Ali Bik is in the center of Bamyan in Bamyan Province, has 15kW capacity and serves 90 out of 105 families due to weak voltage and improperly designed distribution system.

Some graphic examples from other sites and difficulties follow:

- Inappropriate selection of cable size and material;
- Lack of appropriate layout design;
- Inadequate design of the transmission lines;
- Wooden poles without treatment result in fatal accidents and shortened pole life;

- Wrong sizing of insulators;
- Lack of awareness of safety issues;
- Inappropriate selection of technology and design omissions, such as the absence of a step-up transformer, when required for the system;
- Improper power house wiring, as well as house wiring;
- Non-operational fuses; lacking installation of miniature circuit breakers.

4.3.4 Management/Institutional Findings

This is one of the weakest points in the system – the preparation for system operation, management of people and finances, the repair and replacement of parts and equipment, the development of productive uses and other human, social, financial factors. Pre-project planning and organization are also problematic.

4.3.4.1 Project Planning and Management

Engineering skills and hardware play an important role in the success of micro- hydro development. The MHPs that were surveyed were facing problems in one or another that resulted in partial operation of system.

The findings, associated with faulty engineering and associated errors and proper standards and trainings, are exemplified by the projects in Olang village and Deh Peshghoor village. Olang village is in Salang District of Parwan Province, has a

capacity of 40 kW, but is only supplying 20kW to meet lighting demand at night, but there is no design to use excess power in the night or total power during the day. Deh Peshghoor village is in Ghoriab District of Panjshir Province and has 42kW capacity. There is sufficient flow for irrigation and water supply but it was not designed into the system. There are plans for electric enterprises, however with 1200 households, each would receive a maximum of 35W per household.

Findings from other sites include:

- Poor site selection, inadequate and inaccurate surveys, wrong sizing, poor installation and faulty equipment.
- Flood and landslide hazards to the plant.
- Poor estimation of hydrology, in part due to surveys being conducted from March onwards. During this season discharge is high due to melting of snow.
- Uneconomical ideal length of canal and improper canal design.
- Negligence in civil works practice
- Over sizing of generator and incapability of beneficiaries to replace or maintain the generator after breakdown
- No standard norms for estimation of raw materials.
- pattern and annual percentage increment in demand growth.
- No provision for tariff collection and no ownership feeling. Furthermore there are still a number of unresolved issues, for example, there should be an understanding of the connection between the quality of works and the resulting costs of attendant operation and maintenance.
- Many, but not all sites were unsuccessful in bringing major changes in beneficiaries' livelihood to ensure social sustainability and ownership feeling. Exceptions were the basis of the models proposed in Section VI, Sustainable Models.

4.3.4.2 Community Participation

Community participation is an essential vehicle for the active involvement of local people in planning, implementing, managing and operating rural energy systems and other community development initiatives for promoting sustainable rural energy development. To maximize beneficial impact, energy projects, particularly those that promote renewable, decentralized supplies, it is important to take community participation into account. This is also significant for the efficacy of operation and maintenance and for the sustainability of the energy supply - which are both determined by who is involved and trained. However despite the need for this important ingredient, even though participation was a criterion of one of the major donor programs, the team found some discrepancies during audit of some sites.

Examples include Shenwari village and Oalatak village. Shenwari village has a 5kW project in Said Khill District of Parwan Province. The villagers had asked that the whole village be electrified, but the developer insisted on 5 kW capacity, although more power would have been available from the Salang River – only 70 families out of 120 were electrified. Oalatak village, a 40kW project in Salang District, Parwan Province, has small-scale businesses – ice cream, metal workshop, grill shop that, because of the

unreliability of the MHP system, all use diesel power (so do entrepreneurs in Shenwari, spending $100 to $140 per month on diesel fuel). The resilient villagers, however, are enthusiastic about access to microfinance and are willing to also enforce a tariff, if they get training. The numerous technical failures – absence of control panel, V-belts breaking, generator output less than the turbine, the villagers feel is due to the developer who, they feel, doesn't want to impart his knowledge to the villagers so that the villagers would become competitors. 76 out of 163 households are electrified.

Issues from other sites include:

- No discussion or approach for developing an integrated type of project, for project sustainability or overall rural development.
- Little awareness for using energy efficient fixtures; most consumers are using cheap and substandard quality 20 W fluorescent and incandescent bulbs. The electricity is wasted by consuming extra power equivalent to the wattage of the inefficient bulb. In total one inefficient bulb actually consumes 40 W of energy instead of the rated 20 W, ultimately affecting the system's efficiency.

4.3.4.3 Capacity Building

Capacity building, in this case, refers to the efforts to improve the effectiveness for local management, as well as for fabricators and designers and constructors. This is the process through which inefficiencies and knowledge barriers are identified and skills that are needed to improve performances are carried out. The findings during audit in reference to capacity building initiatives are:

- So far, relatively few technology, know-how and transfer measures, i.e., best practices, have been introduced and the MHP sector is still very much in its infancy. Facilitating partners, fabricators and communities all have limited knowledge of the critical issues and components of MHP project implementation.

4.3.4.4 System Management

In Afghanistan, it is found that most MHP sites have been installed by donor assistance programs. They involved a contribution of the required capital that is beyond the reach of marginalized communities in terms of a one-time expenditure. In addition, engineering and construction services, followed by training were provided under contract and monitored in the case of NSP sites. Skilled operation and planned maintenance (O&M) programs enable the system to run smoothly, efficiently and continuously throughout its design life. (Normally more than 15 years).

Some examples of encountered difficulties include Olang village and Samida Aahangaran village. In Olang village the developer provided training to two operators, however villagers claim the failures in the system are due to their lack of understanding of the turbine and generator, the distribution system and O&M. In Sarnid Aahangaran, a 40kW project in Salang District, Parwan Province, the villagers are enthusiastic about children able to do homework and lessons at night. There are numerous opportunities of economic enterprises, however, they maintain the developer, claiming no budget, refused to train two villagers after they had requested training.

- Almost none of the installations have a planned O/M mechanism and schedule.
- The operators are virtually unaware of O/M terminology.
- IAM and Un-Habitat have provided O/M training to about 30 percent of the sampled installation, but there is no follow-up carried out by these organizations regarding its efficacy.
- Operators do not have any O/M manuals (illustrated), catalog for machinery and parts (illustrated).

4.3.4.5 Micro-financing

It is an important, but currently unused mechanism to support micro enterprises after developing skills and ability to start the enterprise or to expand their existing business which is already in place or to fund the development of MHP. The. main purpose is to make the villagers independent who are financially unsecured. Utilization of micro-financing requires financial discipline and organization in rural communities, which, in turn, will require capacity building for the capability and also require awareness on the community's part of the markets, equipment and opportunities for enterprise. These needed resources can be made available through regional resource centers and through other program activities, once a national program is established. The observations during site audits are:

- Numerous installations lacked a micro financing approach that could otherwise motivate and encourage villagers to establish small-scale enterprises according to their capacity and demand.
- No local or state level skill enhancement centers to improve the skills; direly needed to establish the vocational training centers or schools.
- Too few models for income generation that are feasible and suitable for MHPs.

4.3.4.6 Success Stories

Not all sites were problematic, and even some that were, had their bright side. These examples show the potential for successful MHP development, the elements of sustainable models and the resourcefulness of some communities when resources are applied appropriately.

Financial stability In Baqi Dara village of Ghoorband District of Parwan Province, collections are sufficient ($2.00 per household per month) to pay for the operator's salary and repairs. The 300 houses are served and the system has been operating for 1 year.

Perseverance In Godarah Omars village in Panjshir district of Panjshir Province, a 16kW plant with sufficient flow for irrigation, drinking water and milling in the day and electricity generation at night. In spite of technical problems – no lightening arrestor, no proper grounding, no controls or distribution panel – the village is able to provide electricity to meet the needs. Monthly charge per household is $2.00 ($0.40 per bulb and there are 5 bulbs). Villagers indicate that there are positive impacts of electricity – less indoor air pollution (no kerosene), save time (no activity with fuel), guards, technicians, mechanics for the system (jobs). The community seemed to realize that there could be a

better life waiting for them. The tariff adequately covers O&M costs and operations. Periodic maintenance is provided by villagers. The community wants assistance to develop commercial farming and assistance with financial management.

Good potential In Talakan village of Bazarak District in Panjshir Province, a 12 kW project, serving 47 households, is under construction. The excess capacity presents opportunity for productive uses of electricity and/or an allowance for increased demand.

Village planning In Bakhshi Khill village of Bakhshi Khill District of Panjshir Province, a 60kW project serves all 300 houses, charges $0.20 for each bulb per month and has designed irrigation and water supply into the project. The revenue generated is expected to cover salaries and O & M costs. The villagers are now seeking technical assistance for optimizing financial management and productive uses.

Good staff The 50kW project in Tondkhoo village (160 households), Abdullah Khill District of Panjshir Province, has determined the management and technical resources needed to effectively operate the MHP - 4 persons to keep the system running – 1 guard, 1 administrator, and 2 technicians.

Good collaboration The 15kW project in Alaa Qooli village, Paghman District of Kabul Province, is unique in that both NSP and IOM collaborated on the site. NSP provided funding for the distribution, IOM served as the Facilitating Partner – design and construction and the community provided the funds for the civil and electro-mechanical works.

Productive uses The 3kW project in Qlai Badal village, Paghman District of Kabul Province uses electricity during the day for pumping water for drinking and heating water for a Mosque. The 7.5kW project in Debhi Khamzargar village, Kohistan District of Kapisa Province, charges batteries during the day to generate income. The 70kW project in Qala-e-Now village, Alingar District of Laghman Province serves 90 households and has built in economically productive uses of electricity – carpentry shops, welding shops and stone crushing plants.

Self-sufficiency The 10kW project in Kookhi village, Alingar District of Laghman Province, serves 47 families. The turbine was manufactured in Kookhi village.

Best Success Example The 50kW project in Dehbala village, Waarsaj District of Takhar Province serves carpentry, stone cutting and welding shops during the day and a village mill that processes 420 kg wheat per day from 15 surrounding villages. Homes and businesses are fitted with meters and are charged $0.10 per kWh. Excess power is sold to a village across the river for $0.30 per kWh.

Table 4.3 provides a summary of key findings from the MHP audits. The differences between the two existing MHP programs are also provided. The data reinforces the issues previously discussed in this section – system failures are primarily due to:

- poor planning - all levels

- systematic approaches are lacking
- improperly trained personnel – technical, administrative and managerial
- immediate capital costs outweigh life-cycle costs in decision making, e.g., design, material/equipment selection, and installation for power house, transmission and distribution
- cost recovery for O & M is generally not applied

On the positive side, it is interesting to note:
- few problems exist with the turbine
- average household saved over $6 per month on home fuels

Table 4.3 provides a summary of key findings from the MHP audits

Findings	Amount	NSP	PRT
Households excluded after installation	20%	12%	41%
Households electrified	6,186	5,400	1,046
Average monthly general expenses/HH	US$105	US$110	US$93
Average reduction of monthly expenses for household fuel after MHP.	US$6.35	US$6.90	US$5.00
Plant calculated capacity higher than planned	20%	10%	46%
Plant calculated capacity lower than planned	48%	56%	28%
Plant measured capacity lower than planned	73%	77%	64%
Absence of settling basin	15%	18%	7%
Turbine capacity lower than planned capacity	8%	7%	11%
Turbine capacity higher than planned capacity	7%	10%	0%
Productive uses of electricity	13%	16%	6%
Tariff only covers the operator's salary not O&M	27%	27%	28%
No tariff	70%	73%	64%
Absence of O/M manuals	100%	100%	100%
Absence of basic tools such as clamp meter	100%	100%	100%
Oversized civil structures	100%	100%	100%
Lack of standard engineering practices in system development	100%	100%	100%
Lack of awareness of electrical safety, physical hazards, and technical know how.	100%	100%	100%
Lack of standard operating procedures	100%	100%	100%
Lack of lighting arrestor in P/H	100%	100%	100%
Lack of grounding equipment in P/H	100%	100%	100%
Non-operating control panel	20%	19%	29%
No control panel	76%	22%	94%
Poor system wiring (P/H, Transmission, Distribution, Household)	95%	97%	94%
Generator			
▪ China	87%	86%	100%
▪ Russia	7%	100%	0%
▪ Pakistan	3%	100%	0%
▪ Assembled locally	3%	100%	0%
Generator RPM < 1500	35%	24%	64%
Generator malfunction	27%	18%	49%

Findings	Amount	NSP	PRT
Voltage drop	100%	100%	100%
Turbine malfunction	0%	0%	0%
Turbine Type (cross flow)	98%	98%	100%
V belt breakage	17%	7%	42%

Section 5 Lessons

5.1 Critical factors

- Micro hydro programs need **clear objectives**. Is the installation:
  - an investment in social infrastructure (that shall be considered in the same way as a training scheme, drinking water supply project, school or a health program)?
  - a program to sell as many micro hydro schemes as possible regardless of the user's need?
  - to create small profit making enterprises that are financially self-sustaining?
  - Hence, it is essential to **categorize and envisage** at the beginning the type of project to be constructed during the planning phase of the MHP. It is easier to make a **profitable** micro hydro plant **socially beneficial** than to make a **socially beneficial** plant **profitable** as sometime it is difficult to develop profitable end-uses, because of a **limited size** of the local community market and a **small installation**.
- **Financially self –sustaining** projects have cash generating end-uses (day time electricity using enterprises) to produce cash flow and increase the use of the plant (load factor) – at the very least a tariff schedule to cover salary and savings.
- **Lighting only** systems shall have great difficulty in achieving financial sustainability unless there is a planned billing and collection scheme in place.
- Lack of **community participation**, discussion during project inception, planning phase of the installation cause risk to technological sustainability.
- Practice of supplying **electricity free of cost** and absence of any type of commercial activities invites threat to the financial sustainability of the system.
- **Subsidies** in the form of low interest loans to communities, tax breaks to fabricators, etc. are likely to be necessary if micro hydro schemes are to be substantially improving the access of poor people to electricity. Providing subsidized assistance for the training of turbine manufacturers, or independent on site feasibility studies appears to be effective in reducing the costs to the users and in reducing the risk to the investor.
- The **cost of a micro-hydro plant** is dependent upon location, standards and effective management.
- The **ownership** feeling and creating an effective business-like style of management are equally important aspects for the success of MHPs.
- Selecting and acquiring **micro-hydro technology** that is appropriate to the location are prerequisites for success

5.2 Financially Sustainable End-uses

- MHPs can be promoted for **securing livelihoods** through developing small enterprises to maintain a **high load factor** of the plant or in other words to fully consume (about 98% of the total generation) the electricity the plant is producing.
- **Awareness generation** and **introduction** of appropriate **micro enterprise development models** suitable for MHPs could be an option for sustaining the system.

5.3 Governments

- The Government of Afghanistan (GoA) could develop a **straight forward policy** and clearly assign the **responsibilities** for MHP development with the necessary **enabling environment**. This would ideally be a part of assigning responsibilities for the provision of **decentralized energy services** to rural or marginalized communities.
- The GoA could create a **focal organization** such as **Alternative Energy Promotion Center** at central level perhaps building upon the existing Renewable Energy Center of the Ministry of Energy and Water (MEW) and it could be equipped with necessary expertise required for the integrated MHP development. The attendant roles of the Center might be: be
  - To formulate policy and strategy for implementation;.
  - To monitor and evaluate of program efficacy.
  - To ensure fair competition between supply option with stringent standards and provide equal access to assistance and other concessional funds, subsides, tax break and support.
  - To treat all energy supply options equally (for example- offer full menu of options) and to favor what best meets the needs of the consumer in different locations after assessing the technical, economic, social and environmental considerations.
  - To enforce quality and safety standards to prevent the users being exploited by shoddy equipment and installations.

5.4 Donors

- The program shall be developed on a **thorough understanding** of what has already been tried before in the country and elsewhere in the region.
- The **funding strategy** shall enhance (rather than duplicate or alter) local capabilities including organizations, and technical capacities.
- The donor agencies shall realize that MHP development can not have **short cut approaches,** for example, trying to install MHP within one or two months.. As a rule of thumb, and as practiced in the region elsewhere, the **100kW project** at least requires **18 months** time period for its installation.
- Ensure funds are available for **both micro hydro and associated end-uses**. Give particular attention to the **encouragement of pro-poor end uses** especially the **views of women** as major players in traditional energy systems.
- **Employ transparency** in making others aware of activities and **harmonize activities** with other donors, partners, equipment suppliers, contractors and government programs.

5.5 Project Developers (public and private)

- Efforts need to be made to **estimate the realistic size** of the market for micro hydro, taking into account **costs, alternatives and the likely availability of finance**, so as to determine whether the process of project development can be put on a more sustainable financial basis (including grants and subsidies). Additionally the scale of project development capabilities shall be increased sufficiently so as to reduce unit costs by capturing the economies of scale. If **minimum lighting** is the only energy

end-use required in remote locations, **photovoltaic** may be the **main alternative** being cheaper and capable of producing a better light than kerosene.

- Consideration shall be given to **productive end-uses** from the outset and it shall be treated as a small enterprises.
- The effort shall be to create a business like management structure even if cooperatives or community own ownerships are used.
- Attempts shall be made to **institute rules for tariff setting** and for inflation adjustments that are **technical and routine** rather than **arbitrary and politicized**. (For example- the price of electricity shall be linked up to some other freely traded commodity such as Diesel, kerosene and candles).
- MHP development is a **team effort** rather than one man show. The team shall comprise of Civil/Mechanical/Electrical Engineers/Surveyor/Hydrologist and socio-economists.

5.6 Capacity Building

- There would appear to be no **short cuts in developing local capacities**. The process takes a **long time and is costly**, but without such capacities micro hydro programs can not succeed. NSP, for example, has indicated a significant number of their MHP sites have experienced failures.
- A **local capacity** to build micro hydro plants locally **reduces the costs** substantially.
- Local capacities to manage **operate and maintain** micro hydro plants are **prerequisites** for the success. **Resources** need to be devoted to building this capacity.
- **Comprehensive vocational training** in all aspects of MHP installation should be introduced with in MRRD and NSP should take the lead.
- **Technical know** is severely lacking among the stakeholders and there should be a strong effort to develop **the guidelines for the implementation** of MHP projects.
  - MHP implementation guideline
  - Technical guideline for installation and procurement of E/M equipment with detail specification.
  - Community mobilization guidelines
  - MHP guidelines for Developers/Community for qualifying as a developer and uses.

5.7 Micro Hydro Plant Management

- Regardless of its ownership structure (cooperative or community based), successful management of an installation requires a "**Corporate Culture and Structure"** that shall minimize political interferences (Such as from power full community members such as "Shura") by providing clearly delegated authority to the management to achieve clearly stated objectives related to profitability, service coverage and the quality of the service to be provided.

Section 6 Sustainable Model(s)

6.1 A Sustainable Model

Sustainability may be defined as a dynamic effort, undertaking or enterprise that can be maintained, usually from a natural, economic, social and political perspective so that these resources are exchanged in a balanced and therefore continuous manner. This sustainability can change in magnitude over time – smaller or larger but still maintain its integrity, without altering the social and/or environmental fabric in a negative way.

A sustainable model of micro-hydropower development would be one in which the scale of the facility and its associated parts, while providing sufficient domestic and commercial service without causing disruption to the physical, social or economic environments can be managed and maintained technically and financially so as not to require technical or financial assistance outside the service community in order to continue its operation. Self-sufficiency is key to the success of the system – local understanding of the technical requirements and economic potential as well as access to technical and financial assistance when needed is integral to a sustainable system.

The question now is whether a sustainable model, based on both existing examples as well as improvements to selected successful projects utilizing current capacity and resources can be proposed or whether a sustainable model for Afghanistan must be built from changes in the present public and private sectors.

No cookie-cutter model in which one size fits all is possible in Afghanistan or anywhere else where hydropower is developed. Each site is different physically, so that much of the equipment and civil works must be tailored to the particular conditions. There are, however, approaches that can be recommended, based on the elements of successful projects, to strengthen and improve the implementation of the two current models in use.. It is also worth noting that, at this time, aspects of these models are working.

6.2 NSP Program

The NSP program is a thoughtful, participatory approach to MHP development in rural communities. Community representatives, all families and project committees participate in project design and implementation. To assist in this process, a Facilitating Partner (FP) is assisting in technical and managerial aspects. Funding for projects emanates from a Trust created by donors and administered and implemented by the Ministry of Rehabilitation and Rural Development. This program had the widest use of various turbine fabricators.

As shown in Table 3, both NSP and PRT share short-comings and accomplishments. Some of the results that reflect on the NSP approach are:

- most calculated plant capacities are lower than planned, leading to unrealized expectations
- only a little over one-tenth of the households were excluded after installation
- more instances of economically productive uses of electricity

The principal need for specific changes is mostly financial for O & M and productive uses. This would allow this program to become sustainable after installation through financial independence.

6.3 PRT Program

The Provincial Rehabilitation Team, a multi-lateral aid program develops infrastructure projects throughout Afghanistan. For MHP development, supported by a US-led PRT, a single NGO was responsible for developing a large number of sites through a single turbine fabricator and affiliates. The fabricator(s) built the turbines and installed the projects while coordinating with village leadership or a particular entrepreneur. Communities are responsible for developing their distribution system. The communities also contributed “sweat equity” to the project.

As shown in Table 3, although many of the issues are common with the NSP program, some issues in the PRT program are more pronounced:

- about 50% of calculated plant capacities were higher than planned
- more than 50% of measured plant capacities were lower than planned; suggesting more power could have been developed at almost half of the PRT
- 40% of households were excluded after installation
- quick impact program

Both programs suffered from equipment failure, but it was more noticeable in the PRT program. For example, two-thirds of the generators were running at less than 1500 rpm.

The program change for PRT being recommended is widening the scope to include providing the generator and transmission/distribution system as part of the overall system.... This program is a basic, primary level approach simple in execution and service, simple to operate and understand and a reliable system..

Section 7 Conclusions

The advent of micro hydro installation in Afghanistan can be traced to 1916 in Jabul Saraj of Parwan Province. However, till to-date Afghanistan's rural energy supply is overwhelmingly dependent on biomass resources such as fuel wood, agricultural residue and animal wastes. It is revealed from literature review and discussions with stakeholders that about 85% of Afghanistan's energy needs are met by such traditional fuels, having has led to significant lost of tress in the country.

The country's power grid has been severely damaged by years of war, and less than 10 percent of its population currently has access to electricity, with Kabul, for example, suffering severe power shortages.

Afghanistan's rugged and difficult topographical terrain coupled with scattered settlements form constraints to connect the rural communities to cost-effective energy services. The best alternative is to develop stand alone power systems to meet rural demand.

In the country most of the MHP installation efforts have focused on supply of energy for lighting, a typical first step. However, the prevailing approaches to energy use are unsustainable and have imbalanced the indigenous settings of rural livelihood. Energy development is not treated as a multifaceted activity but in fragments, and its integration with irrigation, water supply, agriculture, forestry or small scale cottage industries is not exploited for development.

Based on knowledge gained from the field audit of MHP sites and on information available concerning site development programs of the donor community and other surveys, a number of principals can be concluded from this experience. The purpose in identifying these principals is to learn from the experience – both bad and good experiences – and apply them in a positive way in order to move the MHP development activities along in a sustainable system.

Principal One Large programs of rapid development in an unprepared environment of fragile capacity for sustainable implementation, can lead to questionable and even counterproductive results. Examples include local production of substandard equipment, unprepared communities, inadequately trained project implementers and strained finances.

General Recommendations In the short-term, make every effort to slow developments to match the capacity by downsizing planned government and donor programs, and in the longer-term, to raise, in a thoughtful and coordinated manner, the capacity through a national program of training, technical assistance, through access to resources and supported by a national program to a level to accommodate sustainable development.

Specific Recommendations Improve systematic processes. Increase data information using pre-prepared project development forms. Data should be evaluated, spot checked in field, and approved prior to implementing work on the project. Key to this recommendation is streamlining the processes to avoid undue burden and/or delays for the sake of documentation.

Principal Two Communities as partners and stakeholders receive uneven education and guidance yielding projects with often unplanned results. Examples include lack of understanding of social and economic benefits and inabilities to maintain and troubleshoot systems

Specific Recommendations In the short-term, programs can be initiated to implement:

- Training – billing, collections, savings, salaries, maintenance, repairs, safety, system and operations
- Awareness – available financing through micro-finance institutions, opportunities for economically productive uses of electricity and access to attendant equipment, skills, and markets
- Monitoring and follow-up, record-keeping, service follow-up by developer, trouble-shooting

In the longer-term, a national program would include access to resources through regional resource centers, better service from developers, and public awareness programs.

Principal Three Lack of controls on best practices in fabrication, construction and engineering services at all stages of development leads to equipment and civil works failures. Examples include leaking penstocks, uncontrolled flow in power canals, ungrounded wiring and unsynchronized turbines and generators.

Specific Recommendations In the short-term, initiation through donors and/or NGO's a program of training to fabricators, installers and designers and constructors on engineering norms for MHP development. In the longer-term, a system could be established, either in the public or private sectors, or some combination of the two to develop:

- Certification of engineers, of construction firms and fabricators
- Develop associations of engineers or fabricators or suppliers for achieving benefits with information exchange, with bulk purchasing, with development opportunities
- Standards for fabricating that are checked and certified, standards for construction of civil works and structures and standards for raw materials and parts used in equipment fabrication.

Principal Four Absence of defined and agreed-upon roles for public and private sector provide a vacuum in the development of MHP in Afghanistan. Examples include the scattering of funded programs in government agencies, donor community and private sectors with little coordination, irregular information exchange and no national plan.

Specific Recommendations In the short-term, a joint public-private MHP development group could be formed to provide coordination and information exchange inputs in regularly-scheduled meetings.

In the longer-term, implementation of such means as:

- Define institutional roles and responsibilities
- Develop guidelines, regulations and standards for private sector
- Develop a policy for MHP that outlines the path for the development of a national program
- Provide opportunities for the MHP industry to grow through economic incentives, training and research.

Principal Five Project funding, in the absence of controls, realistic budgeting, and availability, takes many forms and tracking the expenditures leads to uncertain results. Examples include cost over-runs, undersized power plants, and inefficiencies.

Recommendation Increase transparency through budget reports and, audits and improve accountability.

Principal Six Technology options need to be expanded and could use support. Examples include usage of turbines under improper conditions, little integration and/or inadequate mechanical and electrical power uses and absence of strong support for new designs

Recommendation: In the short-term:

- Plan study tours; twining arrangements; and, workshops to facilitate applying lessons from the experience in other countries of the Region – Nepal, India, and Sri Lanka.
- ii)Hold technical workshops and, in the case of NSP, attendance by FP's would be mandatory

In the longer-term:

- Incorporate some of the successful pilots of community participation in electricity distribution services
- Develop minimum criteria for technical
- Refine simple turbines, fabricating techniques, evolution of turbine designs, construction techniques, funds management and accounting, micro-finance, communication techniques with communities, rural resource centers – fixed and mobile and other factors that might benefit MHP in Afghanistan.

Rural energy technology broadens the living standards of people in the remote and scattered settlements of Afghanistan that are not likely to be connected to a national grid in the foreseeable future. Sustainability of these technologies depends upon an integrated development approach that emphasizes financial responsibility, economic growth and community cooperation through sound leadership.

A forward looking, sustainable model and implementation strategy for MHP will be provided, incorporating these principals, in a document entitled *National Program Strategy for Micro Hydro Power, in August 2006.*

Section 8 Regional Experiences and past initiatives

The chapter intends to highlights the best practices and Research and Development (R&D) initiatives in the field of renewable energy. This chapter will provide useful information to the stakeholders of MHP in Afghanistan in the development and dissemination of rural energy system in abroad and in South Asia Region. These initiatives are the outcome of several years of involvement of various donor organizations, a number of academic institutions, consulting firms and private sector R&D initiatives organizations with proven track records and expertise.

These programs are conducted and organized with the active involvement of beneficiaries at community level and villagers have taken the ownership of these systems for their continued operation and management upon the successful completion of these initiatives for the benefits at the local level.

Sri Lanka

Electricity Consumer Societies in Sri Lanka

The village hydro schemes of Sri Lanka are usually managed by an Electricity Consumer Society (ECS) or its legal and more recent equivalent, Electricity Consumer Company (ECC), established for each project. These innovative mechanisms facilitate the participatory ownership and management of micro hydro schemes within village communities. Assistance in setting up the ECS is generally provided by an outside agency (A non-government Organization, such as in case of Sri Lanka Practical Action former ITDG). A society (ECS) is created in each village before requesting technical assistance to undertake a scheme. The ECS involve all potential beneficiaries of the scheme and becomes the operational and implementation conduit for the project. As the scheme moves into the operational phase it takes on a more managerial and regulatory role, although the structure and composition of the organization remained the same.

The ECS works a pivotal institution within the village community. The office bearers are selected at an annual general meeting. There is provision that 50% women should take the share of office bearer's position. The office bearers are responsible for managing the issues that are mentioned hereunder:

- Financial Control
- Tariff Setting
- Load Regulation
- Agreeing Electricity End-uses
- Taking actions following breakdowns
- Resolving disputes arising from electricity usage within the community.

Currently, with the advent of bank financing for the micro hydro the ECS had to be formalized into Electricity Consumer Companies (ECC) in order to become a legal body, with a status of a small company. Any loan repayment thereby the sole responsibility of the ECC.

Village Catalysts

In Sri Lanka another major element of the participative elements of village hydro programs is the training of "Village Catalysts" (some time known as barefoot technologist). These are usually village level electricians or repair technicians whose skills are upgraded by Practical Action an INGO one of the pioneer in MHP development and their services re-orientated towards operational and maintenance support to village hydro schemes. They meet the need to have "trouble shooting" capacity located near to the sites. Some catalysts are also capable of designing and manufacturing Pelton turbines up to 5 kW or so in capacity. In some areas there is sufficient demand to enable these catalysts to grow into entrepreneurs working independently. But despite their business like approach they still perform services free of charge or at low cost to certain communities due to a sense of personal loyalty. Catalysts also promote hydro in other villages and are often the first point of contact for potential beneficiaries and respond to inquiries and demands of Provincial Councils.

Nepal

The Rural Energy Development Programme (REDP) was initiated in Nepal in 1996 with support of the United Nations Development Programme (UNDP) with the aim of expanding rural energy access by communities, strengthening institutional capacity, and putting in place appropriate rural energy policy framework.

The **objective** of Programme is to develop rural energy systems for sustainable development through community participatory approach called community mobilization.

Approach

The program **operates** at three levels: Community (VDC) level, focusing on planning, implementation, operation and maintenance of the community energy systems;

- District level (DDC), concentrating on the institutionalization of rural energy system by building capacities to plan and monitor rural energy development process; and
- Central level, providing policy supports and coordination based on the lessons learned from decentralized level operations.

The **Achievements** as of March 2006 are: **150 Micro Hydro Demonstration Schemes and Peltric-sets commissioned** generating **1862.2 kW** and beneficiaries approximately **18,622** households. **1945** Solar Home Systems installed. **3900** toilet attached biogas plants and **9561** improved cooking stoves established that results in saving per day two to three hours of women's time for collecting fuel wood. **105** nurseries each with the annual production capacity of **2807767** saplings have been established. **187** community forests have been handed over to the communities. There have been **18** Rural Energy Service Centers (RESCs) established to provide timely technical services within the districts. **13** micro hydro schemes have been registered to the Cooperative.

The program has received number of international awards such as: Best Practice Program, Best Institutional Model and Pearl of Knowledge Award 2005, Bangkok, Thailand.

Rome was not build in a day

The great deal of current success of micro hydro results from the early attempts to build technological capability with existing metal workshops in Nepal. The first oil crises in 1973 stimulated the Nepalese government to look for alternative energy sources. The companies that had experience in building the traditional water wheels were graduated to adding electricity generation into improved water turbines.[1] By 1979, Agriculture Development Bank of Nepal (ADB/N) had established their Appropriate Technology Units (APU) to promote micro hydro and other technologies. ITDG now Practical Action became involved at this stage and worked with a number of the existing engineering companies to develop the technology. The capabilities of manufacturers was further enhances through a series of training programs starting in 1987 financed by ADB/N and ITDG. This experience was then transferred and adapted to other parts of the developing world. The outcome of these initiatives was compiled and developed in the form of manual by the name of "***Micro Hydro Design Manual***" by Adam Harvey, Andy Brown, Priyantha Hettiarachi and Allen Inversin IT Publications, London 1993 228 pp, ISBN 1 85339 103 4.

Rural Community Networks: Growing Social Capital Via Interactive Technologies through Rural Electrification in different parts of India, Nepal, Sri Lanka and Malaysia.

As the reach of the Internet and wireless communication technologies continues to expand at unprecedented rates around the world, concerns are growing about ways and means of bringing rural communities into the fold as well. A number of approaches have emerged, such as building bridges via globally-dispersed online communities, or via locally-based community networks.

Malaysia has come up with a number of "demonstration applications" such as Project Cybercare (www.lion-cybercare.org) for providing Internet access and educational resources among 26 networked orphanages; a tele-centre called e-Bario has also been set up for the Kelabit ethnic community in rural Sarawak.

Examples in **India** include TaraHaat (for e-marketing in rural areas), AkashGanga (for dairy cooperatives in Gujarat), Warna Wired Village Project (for sugarcane farmers in

[1] Prominent among these were Balaju Yantra Shala (BYS) established in 1960 with the assistance of Swiss Development Corporation (SDC); Butwal Technical Institute (BTI) establish with the assistance of United Mission to Nepal (UMN) National Structure (1963) Thapa Engineering Works at Butwal (1972) and The Engineering Company at Kathmandu (1973). In 1975 Butwal Engineering Works (BEW), a sister concern of BTI designed and tested the first Pelton turbine and fabricated the first cross flow turbine in 1976. BYS fabricated the first turbine for generating 6 kW in 1978. In the same year Thapa Engineering Works built their first cross flow turbine. Kathmandu Metal Industries (KMI) and National Structures and Engineering developed and installed the first Multi Purpose Power Unit (MPPU) to improve the traditional ghatta (Water- wheel).

Maharashtra), HoneyBee Network (documenting grassroots innovations for knowledge on sustainable natural resource management) and Gyandoot (community centre network in rural Madhya Pradesh). The National Informatics Centre is proposing a "Rural Studio" initiative for developing reusable software components and services for the rural development sector, and IndianVolunteers.org networks volunteers interested in such initiatives.

The Gyandoot initiative in **rural Madhya Pradesh, central India**, is perhaps one of the best such exemplars of sustainable community networking. IT champions along with grassroots supporters have played a major role here in demystification and awareness-raising about the use of interactive platforms for online knowledge sharing.

Numerous benefits of the community centre services have emerged, such as women vegetable buyers finding the markets with the best prices, garlic sellers locating the best auction centers, citizens voting on satisfactory or unsatisfactory performance of their elected officials, filing of complaints about malfunctioning water pumps, identifying treatment for cattle ailments, and even enabling the sale of a cow via an online ad.

A notable example in this regard is the Kothmale Community Radio and Internet project in **Sri Lanka**, where talk show hosts introduced the concept of "radio Web browsing" for listeners to call in with queries about the Net and online resources, which were answered by surfing on the radio station's Internet connection.

Documented usage of this cross-media service included online recipes for local bakers, jaggery export information, and research into new craft techniques for local bamboo artisans and blacksmiths, and environmental networking. Unfortunately, the station has been without Internet access for almost a year due to lack of funds and fees after the initial trial period.

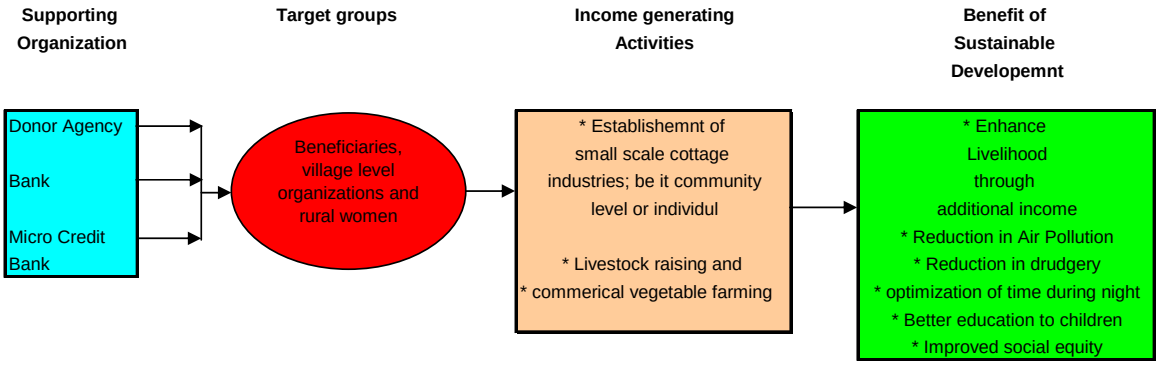
"The Gyandoot example has lessons for many other developing countries, including **Nepal**. For the first time, we actually have tools which can bring the fruits and promises of advanced technology to the rural communities," says Ramesh Vaidya, member of the National Planning Commission of Nepal.

Studies from the UN organizations indicate that though the costs of using ICTs for development may be high, the cost of not using them will be even higher, says Indrajeet Banerjee, professor at Nanyang Technology University in Singapore.

In sum, then, well-planned community network centers can play a key role in meeting the socio-economic aspirations of rural communities by successfully addressing the "8Cs" of success in the digital age: connectivity, content, community, commerce, capacity, culture, cooperation, and capital.

Bangladesh

The agricultural labor market is saturated, even during the peak season, and most landless and marginal farmers have no employment during the rest of the season thereby marginal farmers find themselves loosing control over capital resources through forced sell of their land. Their abundant human resources may however be shifted from agricultural labor to a renewable energy technology business, where there is potential to improve the energy system of the village. At the same time poor rural women could receive the services provided by such RETs to save time in household activities and accommodate more time for income generating activities. They could use their indigenous skill and resources to generate income by selling goods and services required by wealthier village people. Also the advent of labor saving technologies along with RET can reduce drudgery of rural women and therefore increase their labor productivity.



Lack of capital is the major constraint to such income-generating activities. Such activities (raising livestock, handicrafts, tailoring etc) that can be facilitated by a micro-credit loan distribution system have already been found more applicable to rural women than to men in rural Bangladesh. Men have tended to be involved in large-capacity development (Irrigation, domestic supplies) works.

Grameen Bank (GB) takes cares of the micro credit facilities and loan in village. It is very much successful model of generating income in villages by providing micro- credit. The main objective of the GB is to provide loans to rural people (landless and marginal farmers) to generate income and create employment. The bank forms small groups of about five villagers, who are usually women. Once formed, a group is closely monitored for a month to ensure that the members are conforming to the discipline of the GB rules. Two members of the groups receive loan and if they make their weekly payments for a period of several months, two more members of the group become eligible for the loan and so on. Each member of a small group receiving micro-credit loans from GB carries out a separate income generating activity, based on purchasing a cow, poultry, hand tools etc.

Public Participation Model

The Participatory Rural Energy Services in Karnataka (PRESK) is a project funded during 2003 and 2004 by the United States Agency for International Development

(USAID) to provide technical and capacity-building assistance to the Government of Karnataka (GOK). The project was designed to support the twin GOK initiatives of distribution reform and the devolution of government to local levels. Two years of project assistance was provided by Nexant, Inc. the USAID contractor, in cooperation with GOK and local expertise. A focal center for the continuation of PRESK was established within a GOK institution, recently designated as an independent society. This center is to be referred to as the PRESK Cell and will be managed by the Mahatma Gandhi Institute for Rural and Energy Development (MGIRED).

The scope of activities for the PRESK Cell incorporates a strategy of implementing the projects, plans and overall thrust of PRESK as carried out by Nexant during 2003 and 2004 and replicating the attendant successful approaches throughout Karnataka, and eventually to other states of the MGIRED domain. The overall policy direction and guidance for these activities will come under the supervision of the Chairman, MGIRED. Work mode for the implementation of activities will include a combination of coordination with government, private and semi-private sector partners, villagers and local governments and financial institutions – private, public and international, monitoring of project activities and plans, actual project implementation and development and presentation of training materials and other capacity building activities, such as peer exchanges.

The thrust of program activities will be:

- to advise, assist and promote implementation of recommended policy changes in the Government of Karnataka – economic, budgetary and programmatic;
- to continue and expand the training and capacity building services for the target talukas and other talukas within the State;
- and to promote, develop, integrate and replicate proven and identified pilots, approaches, methodologies, techniques and practices that have been discovered, tested, analyzed and found to be important to advancing PRESK goals for improving electricity distribution, promoting groundwater conservation and advancing best farming practices.

Work Activities.

A. Rural Development and Panchayat Raj Department model development and replication.
   - Training. Development of content for the training of trainers in *hoblis* (geographical setting of several small villages such as wards) of about 6 to 7 GPs each. Material will be taken from the capacity building program on water, energy and farming practices from the PRESK program, as well as information on the commitment process – model Resolution and model Memorandum of Understanding. Material will be in written and CD form and other visual aids, such as films.
   - Training Implementation. Identifying, coordinating with, meeting and going through sessions with around 100 hoblis. Suitable arrangements will be made for transportation, food and lodging, facilities, audio-visual

equipment, writing materials and other necessary items, as well as resource people and interactive methodologies for training;

- Communication. Arrangements to be made for reaching the audiences via satellite and also providing awareness and motivating communities through radio and TV programs, the content of which has already been identified in PRESK;
- Coordination. Implementation program is coordinated through taluka (Village Development Committee) executive officers, other local officials (BESCOM, DOA, etc.) and assistance is provided to trainers in meetings with GPs.

B. Pilot Replication

- Resource Center. Continuation of services of the resource center in Gubbi and expand service to other talukas, starting with remaining three talukas of PRESK experimental period. Included are development of facilities for Center, as well as equipment, materials and management;
- Mobile Resource Center. Continuation of services of the mobile resource center in Gubbi and expansion of services to other talukas. Cooperation with GOK agencies with common services will be evaluated and implemented where feasible – BESCOM, DOA, Mines & Geology, etc.;
- Agricultural Best Practice. Continue demonstrations of best practices in farming through Resource Centers, CDs, and study tours and in coordination with local farmers and agricultural experts. Continuing to identify additional new and effective approaches for demonstrating suitable cropping, timing, conservation of resources and other factors;
- Conservation. Demonstration of techniques, equipment and approaches to conserving resources in agricultural practices (water application, recycling of nutrients, non-chemical strategies, etc.) and in energy (optimizing bore well pumping time, low friction equipment in pumps, other demand side techniques).

C. Technical Services

- GIS Mapping. Follow-up with recommendations and next phase activities in PRESK consultant's report establishing local capability, coordinating with Karnataka State Council for Science and Technology and development of maps for managing energy, water and agricultural resources – laying out distribution lines, transformers, etc., borewells, groundwater, etc. and merging with other existing data bases (taxes, land titles, and other information);
- Continuation of development of approach to financing rural energy projects for poor communities, to discover means for GPs to access financial resources;

- Revolving Fund. Replicate successful experience of existing Fund with farmer group in Pavagada;
- Information Kiosks. Set up information kiosks at Resource Centers and perhaps elsewhere, providing information broadly useful to rural communities utilizing touch screens – precedents in many places in India;
- Regional Assistance. Implementation of outreach services with similar energy and rural development institutions elsewhere in India and in the South Asia region and coordination of mutually beneficial projects, services and activities – capacity building, newsletters, operational guidelines and standardization for equipment and utility operations, exchanging case study experiences, etc;
- Loss Reduction. Implementation of the proposed taluk-level loss reduction approach to improved electricity distribution;
- Connected Generation. Assistance in implementing the biomass gasification project for which a feasibility study has been done – seeking funding, developing plan for site implementation and project design, construction and local management after construction and ownership and seek other opportunities for connected and unconnected renewable generation for improved rural electricity services

8.1 Epitomes

Rural Energy Development Program, program supported (REDP) by Government of Nepal (GoN) UNDP/Nepal has supported a number of institutes to conduct R&D in different aspects of rural energy systems. Priority is given to those technologies that could be field tested so as to have their use as well as impact at the local levels. The REDP supported R&D initiatives are given in following pages:

Appendix A Matrix

S.no.	Province	District	Village	GPS Reading		Altitude	Installed Cap. (kW)	Source
				Northing (Latitude)	Easting (Longitude)	(m)		
1	**Parwan**	Said khel	Shinwari	35° 04' 931"	69 °15' 311"	2374	5	Salang River
2	Parwan	Salang	Olang	35° 16' 20.48"	69 °7' 8.54"	2458	40	Olang
3	Parwan	Said khel	Hamza Khel	35° 20' 47"	69° 15' 50"	1482	5	Salang River
4	Parwan	Salang	Sarnida Ahangaran	37°92' 33"	57° 97' 17"	2194	40	Salang River
5	Parwan	Salang	Qalatak	35°13' 59.4"	69° 12' 28"	X	40	Salang River
6	Parwan	Ghorband	Baqi Dara	35° 5' 50"	69° 9' 39.8"	1544	20	Ghoorband
7	Parwan	Said khel	Rahmat Khan Khel	35° 04' 57"	69 °15' 26"	2369	5	Salang River
8	Parwan	Said khel	Ashtarkar	35° 04' 47"	69 °10' 50"	1528	7.5	Salang River
9	**Panjshir**	Hisa-i- duwumi panjshir	Godara Omars	35° 19' 06"	69° 38' 40"	X	16	Shablah
10	Panjsher	Hisa-i- duwumi panjshir	Baba Ali	35°13' 23"	69° 41' 19"	X	16	Darah Hazarah
11	Panjsher	Bazarak	Talakan	69° 33' 18"	35° 18' 14"	X	12	Parandy
12	Panjsher	Bakhsil	Bakhshi khel	35°15.6'38"	69°28.4'23"	X	132	Panjshir
13	Panjsher	Ghoriab	Peshghor	Villagers did not allow		X	42	Ghoriab
14	Panjsher	Dare Abdullah khel	Tondkho	35°15' 27"	69°39' 15"	X	50	Kookzlar
15	**Kabul**	Shakar dara	Maidanak	35° 41' 27"	69°00' 41"	X	5	Shakardarah
16	Kabul	Deh Sabz	Ali khel	35° 38' 38"	69° 23' 06"	1943	3	Deh Sabz spring
17	Kabul	Deh Sabz	Qalaye Qab Chi	35° 14' 45"	69° 02' 11"	X	3	Alat Spring
18	Kabul	Istalif	Badal Shah khel	35° 42' 39"	69° 02' 10"	X	20	Istalif river
19	Kabul	Deh Sabz	Qalaye Jabar Khan	35° 35' 32"	69° 24' 45"	X	3	Khas spring
20	Kabul	Chap dara	Odro Khel	35° 41' 29"	69° 04' 06"	X	20	Shakardarah
21	Kabul	Shakar dara	Yonus Khel	34° 41' 27"	69° 00' 41"	2192	5	Shakardarah
22	Kabul	Mir bacha Kot	Guzar	34° 42' 37"	69° 06' 47"	1710	5	Shakardarah
23	Kabul	Paghman	Parachi	34° 35' 47"	68° 56' 58"	2461	15	Pagman river
24	Kabul	Paghman	Qalaye Badal	34° 36' 53"	68° 55' 16"	2461	3	Pagman river
25	**Kapisa**	Nijrab	Deh Qazi	35°02'32.75"	69°37'40.08"	1894	5	Ghouse Canal
26	Kapisa	Nijrab	Delyar	35°1'2.03"	69°36'34.42"	1745	7.5	Nejrab river
27	Kapisa	Kohistan	Atef khel	35°17.30.71"	69°18'23.73"	1685	5	Panjshir river
28	Kapisa	Nijrab	Deh Naw	35°01.50.57"	69°37'13.81"	1820	5	Nejrab river
29	Kapisa	Kohistan	Qazi khel	35°07.48.43"	69°17'34.20"	1563	30	Panjshir river

30	Kapisa	Kohistan	Dabdi	35°7.30.71"	69°18'23.73"	1685	7.5	Panjshir river
31	**Ghazni**	Malistan	Mazar	33° 21' 15"	67°29'05"	2636	10	Gumruk river
32	Ghazni	Malistan	Dahane Bagh	33° 20'.30"	67°29'42"	2729	7	Gumruk river
33	Ghazni	Malistan	Naw dah	33° 23'.39"	67°21'04"	2771	15	Mak Nak river
34	Ghazni	Malistan	Sare Sang	33° 21'24"	67°19'34"	2732	15	Gumruk river
35	Ghazni	Malistan	Maidan	33° 19' 54"	67°29'25"	2683	10	Gumruk river
36	Ghazni	Malistan	Naw joy	33° 24' 55"	67° 20' 23"	X	7	Meyan shar river
37	**Laghman**	Alingar	Deh Shah Agha khail	34° 48'15"	70° 21' 16"	X	7.5	Engar river
38	Laghman	Alingar	Alokhail	34° 53' 30"	70° 27' 27"	X	X	Engar river
39	Laghman	Alingar	Barekoot	34° 50' 50"	70° 23' 34"	X	10	Engar river
40	Laghman	Alishing	Ghazi Abade kohna	34° 50' 45"	70° 04' 22"	X	6.5	Alishang river
41	Laghman	Alishing	Qala -e- naw	34° 45' 52"	70° 06' 32"	X	70	Alishang river
42	Laghman	Alingar	Kookhi	34° 49' 12"	70° 21' 16"	X	10	Alingar river
43	**Wardak**	Maidan Shar	Qule bala Pahin	34° 30' 38,38"	68° 46' 50.04"	2632	10	Qule bala pahin river
44	Wardak	Maidan Shar	Jani khel	34° 25' 54,05"	68° 49' 11,38"	2234	12	X
45	Wardak	Kohna khumar	Qalaye naw	34° 28' 38.7"	68° 47' 19,71"	2483	15	Qalaye naw river
46	Wardak	Maidan Shar	Seya peshab	34° 25' 29,29"	68° 49' 19,14"	2184	7.5	Seya peshab river
47	**Bamyan**	Center of Bamyan	Ali bik	34° 43' 37,59"	67° 41' 13,61"	3043	15	Dara river
48	Bamyan	Center of Bamyan	Lesholqat	34° 46' 09.40"	67° 43' 54.09"	2702	20	Dara river
49	Bamyan	Center of Bamyan	Qalaye peera	34° 45' 38.12"	67° 44' 24,05"	2703	15	Gandaha river
50	Bamyan	Center of Bamyan	Sad barg	34° 41' 30.26"	68° 00' 37,45"	2826	60	Dare kalo river
51	Bamyan	Center of Bamyan	Munara	34° 47' 31.65"	67° 46' 16.06"	2492	50	Dare fooladi river
52	Bamyan	Center of Bamyan	Ab bal Qazan	34° 43' 32.04"	67° 44' 02,41"	2965	20	Dare river
53	Bamyan	Center of Bamyan	Baba doost	34° 44' 53.38"	67° 39' 18,40"	2957	50	Dare river
54	Bamyan	Center of Bamyan	Kata sang	34° 45' 19.19"	67° 43' 10,34"	2782	20	kata sang
55	**Takhar**	Warsaj	Deh bala	36° 08' 47"	69° 58' 18"	X	50	Meyan shar river
56	Takhar	Warsaj	Payani	36° 11' 43"	70° 03' 48"	X	60	Meyan shar river
57	Takhar	Warsaj	Yawar -e- Safli	36° 10' 57"	70° 06' 49"	X	15	Dara -e- Qunduz River
58	Takhar	Warsaj	Malwar -e- Bala	36° 08' 35"	69° 56' 49"	X	30	Meyan shar river
59	Takhar	Khuwja Ghar	Abdul Latif	37° 03' 26"	69° 19' 15"	X	9	Takhar River
60	Takhar	Warsaj	Yawar -e- Olya	36° 10' 57"	70° 07' 50"	X	8	Takhar River

*For easy calculation it is assumed 1 US$- 50 Afghani

PRT Program

NSP Program

Status of the Project	Relatives dates			Av. mon. exp. saving on fuel after project (US$)	Tot. pop. of village	Total no of HH	Total no of HH using Electricity	Avr. mon. general exp./HH (US$)
	Start	Completion	commision					
Operation	01-03-02	01-05-03	X	4	720	120	70	100.00
Operation	03-05-05	30/8/2005	X	6	800	165	165	150.00
Operation	03-01-03	07-03-03	X	5	800	200	120	40.00
Operation	05-05-05	30/10/2005	X	6	2544	318	318	100.00
Operation	03-01-03	30/9/2003	X	5	493	163	76	100.00
Operation	03-01-05	20/7/2005	X	5	1200	150	150	140.00
Operation	04-03-03	27/6/03	X	4	300	70	70	100.00
Operation	03-01-02	03-01-03	09-01-03	5	1040	130	130	100.00
Operation	30/1/05	28/08/05	X	6	2190	80	80	200.00
Un. Const.	06-07-05	On going	X	4	2100	410		200.00
Un. Const.	14/8/2005	On going	X	5	650	47	47	200.00
Operation	04-02-03	10-01-05	X	5	3755	300	300	200.00
Operation	06-01-04	08-03-05	X	6	7200	1200	1200	200.00
Operation	19/06/2004	08-10-05	X	6	1180	160	160	300.00
Operation	03-01-03	13/09/2003	X	5	280	44	44	110.00
Operation	04-04-03	30/8/2003	X	5	300	50	30	100.00
Operation	05-03-04	10-05-04	X	5	600	110	30	80.00
Operation	18/4/2003	25/10/2003	09-01-03	4	600	100	100	100.00
Operation	13/4/2002	27/7/2002	X	4	300	25	25	100.00
Operation	01-01-04	02-10-05	03-05-05	4	1620	270	270	100.00
Operation	03-01-03	20/7/03	08-05-03	4	800	100	100	100.00
Operation	01-02-03	25-05-04	01-06-04	5	320	40	40	100.00
Operation	Sep-04	Oct. 2005	Oct.2005	6	200	30	25	100.00
Operation	Apr-96	Oct-96	Oct.96	4	350	45	45	120.00
operation	May-03	Sept.2003	Sept.2003	4	400	58	44	100.00
Operation	Mar-04	Aug-04	Aug-04	7	350	55	55	100.00
Und. Const.	Apr-06	X	X	6	380	64	64	100.00
Operation	May,03	Sept, 03	2003	7	576	96	96	80.00
Operation	May-05	Feb.2006	Feb-06	6	1864	233	220	70.00
Operation	Apr-04	Oct.2004	Oct.2004	5	128	16	16	60.00
Un. Const.	5/09/2005	X	X	5.5	200	52	52	80.00
Und. const.	Apr-05	X	X	6	100	22	22	60.00
Operation	Apr-04	Jun-05	Jun-05	7	200	43	38	62.00
Operation	Apr-03	Aug.04	Aug.04	8	100	60	22	60.00

Operation	Aug.04	Feb.2005	05-Feb	8	250	57	57	100.00
Operation				7	200	52	52	100.00
Operation	Apr-05	Jun-06	Jun-06	6	200	50	30	85.00
Un. Const.	Jul-05	X	X	8	450	143	83	90.00
Operation	May-04	Aug.2005	Aug.2005	6	270	91	91	90.00
Operation	25/09/2004	10/12/2005	10/03/2006	6	350	60	60	80.50
Operation	01/10/2004	02/05/2005	02/08/2005	7	360	90	90	80.00
Operation	Apr-04	Feb.2005	Feb.2005	8	400	47	47	90.00
Operation	Jun-04	Sept.2005	Sept.2005	8	600	80	80	90.00
Operation	May-04	Mar-05	Mar-05	8	600	170	170	100.00
Operation	13/07/04	01/03/06	01/04/06	7	900	150	150	110.00
Operation	Aug 2004	Feb-05	Feb-05	9	300	80	80	90.00
Operation	May 2004	April 05	April 05	8	500	105	90	100.00
Operation	March 2005	Nov 2005	Nov 05	9	1296	216	216	80.00
Operation	Sept 2005	Oct 2006	Oct 2006	8	600	120	120	90.00
Operation	Apr-02	Feb-05	Feb-05	7	1000	430	430	100.00
Operation	Jun-03	Sep-05	Sep-05	8	1100	60	60	90.00
Operation	Mar-05	Oct-05	Oct-05	8	1000	350	350	90.00
Operation	Mar-04	Oct-05	Oct-05	9	1200	300	300	80.00
Un. Const.	Jun-05	X	X	8	860	249	X	90.00
Operation	Mar-03	Oct-05	Oct-05	7	805	161	161	100.00
Operation	May-03	Aug-04	Aug-04	8	1147	167	167	110.00
Operation	Aug-04	Sep-05	Sep-05	8	500	101	101	110.00
Operation	Jun-04	Aug-05	Aug-05	8	265	53	53	90.00
Operation	June 2004	Feb-05	Feb-05	8	300	55	55	100.00
Operation	10/05/2003	20/06/2004	20/08/2004	9	450	95	95	70.00

Water right issues	Avr. Mon. bill of Electricity (US$)/HH	No of bulb(s)	Type of Bulb(s)	Power of Bulb (Watt)	Electricity Usage hrs.	Primary use of elctricity	Day time Electricity using Industry	Gross Head (m)
None	Free of cost	2	Fluorescent (Fl.)	20;10	6 PM - 11 PM	Lighting/TV & radio	None	4.54
None	Free of cost	2	Fluorescent	18;20	6 PM - 11 PM	Lighting/TV & radio	None	11
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	5.25
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	7
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	9.72
None	Free of cost	3	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	5.4
None	Free of cost	1	Fluorescent	10.00	6 PM - 11 PM	Lighting/TV & radio	None	4.31
None	Free of cost	3	Incandacent/Fl	100/2*40	6 PM - 11 PM	Lighting/TV & radio	None	5.27
None	2.00	1	Fluorescent	12.00	6 PM - 11 PM	Lighthing/TV & radio	None	5
None	0.80	1	Fluorescent	10.00	6 PM - 11 PM	Lighthing/TV & radio	Yes	X
None	0.40	1	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	2.00	2	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	5.5
None	2.00	1	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	18
None	1.00	1	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	5.5
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	5
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	5
None	Free of cost	1	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	7.85
None	Free of cost	4	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	24.7
None	1.00	2	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	6.7
None	Free of cost	4	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	7
None	Free of cost	1	Fluorescent	20.00	6 PM - 11 PM	Lighting/TV & radio	None	5
None	Free of cost	2	Fluorescent	20.00	6 PM - 11 PM	Lighthing/TV & radio	None	3.87
None	Free of cost	6;2	Incandasant/Fl	100;40	6 PM - 11 PM	Lighthing/TV & radio	None	8
None	Free of cost	3	Incandasant	40;25;15	6 PM - 11 PM	Lighthing/TV & radio	None	11
Yes	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	Yes	3.5
None	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	4.75
None	Free of cost	3	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	1	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	3.2
None	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	30.5
None	Free of cost	3	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	3.3
None	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	5.6
None	Free of cost	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	Free of cost	4	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	None	13.5

None	Free of cost	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	3.8
None	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	12
None	Free of cost	5	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	5.8
None	0.40	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	2
None	Free of cost	3	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	0.60	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	2.24
None	0.60	3	Fluorescent	10	6 PM - 11 PM	Lighthing/TV & radio	None	3.5
None	0.60	4	Fluorescent	10	6 PM - 11 PM	Lighthing/TV & radio	Yes	4
None	2	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	Yes	4
None	0.70	6	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	11
None	0.80	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	4.5
None	Free of cost	3	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	4
None	Free of cost	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	3.3
None	Free of cost	3	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	6.5
None	Free of cost	3	Fluorescent	30	6 PM - 11 PM	Lighthing/TV & radio	None	8.5
None	0.30	3	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	0.40	7	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	Yes	20
None	0.50	3	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	None	5.5
None	Free of cost	3	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	None	6
None	Free of cost	2	Fluorescent	40	6 PM - 11 PM	Lighthing/TV & radio	None	6.9
None	X	X	X	X	6 PM - 11 PM	Lighthing/TV & radio	None	X
None	1	3	Incandasant	60	6 PM - 11 PM	Lighthing/TV & radio	Yes	5.9
None	Free of cost	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	Yes	9
None	4	4	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	5.7
None	0.4	2	Fluorescent	20	6 PM - 11 PM	Lighthing/TV & radio	None	7.25
None	1	4	Incandasant	60	6 PM - 11 PM	Lighthing/TV & radio	None	4
None	1	4	Fluorescent	24	6 PM - 11 PM	Lighthing/TV & radio	None	4.5

Min. available dischare (m^3/sec)	Calculated Power Potential (kW)	Land Acquisition issues	Type of Intake	Type of Diversion work	Settling Basin Dimensions in meters			Canal dimensions in meters				
					Length (m)	width (m)	Height (m)	Length (m)	Width (m)	Depth (m)	Depth of water (m)	Thickness of canal wall
0.336	7	No	Right	Temp.	1.3	1.25	1.7	250	1.4	0.85	0.55	0.6
0.473	32	No	Left	Temp.	9	2.8	2	400	1.34	1	0.6	0.65
0.392	12	No	Left	Temp.	1.25	1.2	1.9	300	2.73	0.6	0.34	0.6
1	42	No	Right	Temp.	4.5	1.95	3.1	204	1.2	2.2	0.8	0.67
0.39	48	No	Left	Temp.	5	5	2.4	250	1.3	0.75	0.5	0.68
0.4	13	No	Left	Temp.	2.2	1.17	1.3	500	1.25	0.9	0.4	0.66
0.42	10	No	Right	Temp.	1.4	1.3	1.6	100	1.4	1.3	0.9	0.5
0.2	6	No	Right	Temp.	1.3	1.3	1.6	60	1.8	1.6	0.9	0.5
0.5	16	No	Left	Temp.	No Settling Basin			100	1.75	1.2	0.91	0.5
X	X	No	Right	Temp.	No Settling Basin			110	190	1.3		0.6
X	X	No	Left	Temp.	No Settling Basin			100	160	65	0.26	0.6
1.5	57	No	Right	Temp.	No Settling Basin			350	2.3	1	0.7	0.5
0.36	42	No	Left	Temp.	No Settling Basin			180	1.5	1	0.11	0.5
0.35	12	No	Right	Temp.	No Settling Basin			67	1.1	85	0.57	0.6
0.47	12	No	Right	Temp.	1.45	1.3	2.4	130	1.2	2.5	0.5	0.5
0.1	3	No	Right	Temp.	No Settling Basin			110	0.9	1.1	0.2	mud
0.1	4	No	Left	Temp.	1	0.86	1	50	0.5	0.5	0.2	0.5
0.23	28	No	Left	Temp.	4	1	1.2	1000	0.6	0.5	0.3	0.6
0.1	3	No	Left	Temp.	1	0.8	1.3	40	0.6	0.5	0.25	0.5
0.5	17	No	Right	Temp.	1.3	1.3	2.4	150	0.9	1	0.5	0.7
0.31	8	No	Left	Temp.	1.3	1.3	2.7	100	1.3	0.45	0.2	0.5
0.15	3	No	Left	Temp.	1.25	1.2	1.5	110	0.9	0.45	0.2	0.5
0.2	10	No	Right	Temp.	2.3	2.3	2	500	0.53	0.55	0.25	0.6
0.15	9	No	Right	Temp.	1.1	1.1	1.5	400	0.7	0.3	0.3	0.6
0.22	4	No	Right	Temp.	1.6	1.4	2.8	200	0.8	0.7	0.22	0.6
0.24	7	No	Right	Temp.	1.25	1.2	2.5	200	0.88	0.45	0.25	0.6
X	X	No	Right	Temp.	1.94	1.9	1.7	50	0.5	1.28	0.45	0.67
2.7	4	No	Right	Temp.	3.4	1.2	200	1500	1.3	1.4	0.6	0.6
0.25	52	No	Right	Temp.	9	3	2.7	Earthen canal				
2.8	3	No	Right	Temp.	1.58	1.3	1.2	60	1.3	0.56	0.8	0.6
0.4	10	No	Right	Temp.	3	3	1.6	300	1.2	0.7	0.4	0.5
X	X	No	Right	Temp.	2.6	1.9	1.1	2000	0.5	0.5	0.35	0.6
0.4	14	No	Right	Temp.	4	3	2	2000	0.6	0.58	0.3	0.5

0.47	8	No	Right	Temp.	4	3	1.7	250	1.4	1	0.7	0.8
0.27	6	No	Right	Temp.	2.6	1.65	1.5	0.35	0.6	0.5	0.25	0.6
0.15	4	No	Left	Temp.	2.5	2.5	1.6	1500	0.6	0.7	0.5	0.5
1.2	6	No	Right	Temp.	3	2	1	150	1.35	0.8	0.6	0.35
X	X	No	Right	Temp.	2.9	0.9	1.6	20	0.9	0.74	0.5	0.5
2.13	4	No	Left	Temp.	2.9	1.9	0.9	650	1	0.57	0.45	0.5
0.27	6	No	Left	Temp.	No Settling Basin			700	1.2	0.8	0.6	0.5
3.8	70	No	Right	Temp.	No Settling Basin			800	0.11	0.8	0.5	0.6
0.3	8	No	Right	Temp.	0.22	0.9	0.16	1500	0.9	0.74	0.5	0.6
0.15	7	No	Right	Temp.	3	2.45	1.2	420	1	0.7	0.5	0.5
0.28	8	No	Left	Temp.	6	1.1	1	3000	1.1	0.83	0.6	0.5
3.6	6	No	Right	Temp.	2.45	3	1.2	200	0.7	0.7	0.45	0.6
0.3	5	No	Left	Temp.	1.95	1.47	1.7	1000	1.1	0.8	0.5	0.5
0.19	8	No	Right	Temp.	2	0.9	0.75	200	0.95	0.6	0.25	0.6
0.35	14	No	Left	Temp.	1.75	1.33	2.5	150	0.75	0.9	0.3	0.7
X	X	No	Right	Temp.	3.35	1.03	1.06	200	1.1	0.85	0.25	0.6
0.6	56	No	Right	Temp.	3.7	3.73	2.5	800	0.35	1	0.45	0.6
0.3	7	No	Right	Temp.	X	X	X	1500	2	0.5	0.4	0.6
0.37	10	No	Right	Temp.	1.8	1.4	0.9	450	1.3	0.66	0.6	0.6
0.25	8	No	Left	Temp.	2.9	2.7	0.8	150	1.5	0.55	0.5	0.5
X	X	No	Right	Temp.	X	X	X	500	1	0.7	0.4	0.7
0.26	20	No	Right	Temp.	2.9	2.6	1.9	700	2.5	1.2	0.6	0.7
0.6	25	No	Right	Temp.	3	2	1.2	700	1.8	1	0.6	0.5
0.25	6	No	Right	Temp.	3.4	2.4	1.25	500	2.2	1.2	0.28	0.5
0.4	14	No	Right	Temp.	2.6	2.1	1.85	700	1	1	0.8	0.5
0.25	9	No	Right	Temp.	X	X	X	1500	1.6	0.8	0.5	0.5
0.48	18	No	Right	Temp.	19	4	0.9	300	1.76	1.1	0.8	0.5

Penstock's features				Power House dimensions				
Length	Dia	Slope	materials	Length	Breadth	Height	Thickness of wall	Type of roof
					(m)			
(m)	(m)	(degree)		(m)	(m)	(m)		
6	0.33	37	Mild steel	4.05	2.25	2	0.5	Thatched
17	0.52	31	cast iron	4.7	3.6	2.85	0.6	Thatched
7.5	0.33	34	cast iron	3.1	2.7	2.2	0.53	Thatched
2*8	0.52	37	cast iron	4.1	3.2	2.7	0.55	Thatched
15	27.5	37	cast iron	4	3	2.4	0.6	Thatched
10	52.9	37	cast iron	3.1	3.1	2.7	0.75	Thatched
6	0.33	34	cast iron	3.6	2.5	2	0.5	Thatched
7.5	0.32	37	cast iron	3.5	2.4	2	0.5	Thatched
8.5	0.5	26	Mild Steel	4	3	3	0.5	CGI sheet
6	50	39	Mild Steel	5.5	3.5	2.5	0.6	Thatched
8	0.5	20	Mild Steel	3	3	2.4	0.5	CGI sheet
3.5	0.6	26	Mild Steel	7	3.5	3	0.5	CGI sheet
52	0.5	20	Mild Steel	4	3	3	0.7	CGI sheet
9	0.6	38	Mild Steel	5	3	2.4	0.5	Thatched
7	0.33	23	Cast Iron	2.7	2.5	2.3	0.5	Thatched
9	0.27	47	Cast Iron	2.9	2.5	2.2	0.5	Thatched
13	0.27	40	Cast Iron	2.4	2.3	3.1	0.5	Thatched
52	23	45	Cast Iron	4.5	3.5	2.7	0.6	Thatched
9.5	0.27	39	Cast Iron	2.6	2.2	4	0.5	Thatched
8	0.52	20	cast iron	4.6	3	2.4	0.7	Thatched
6	0.33	30	cast iron	3	2.6	1.8	0.6	Thatched
6	0.27	31	cast iron	2.7	2.2	1.9	0.5	Thatched
24	0.32	18	cast iron	2.5	2.5	1.8	1	Thatched
20.7	0.22	35	cast iron	2.4	2	2	0.6	Thatched
6	0.33	30	cast iron	3.7	2.9	2.3	0.7	Thatched
6	0.33	38	cast iron	3.5	2.8	2	0.7	Thatched
Under Consuturction				4.2	4.2	3.6	0.6	Thatched
6	0.33	30	cast iron	4.2	2.9	2.3	0.6	Thatched
180	0.27	37	cast iron	3.5	3	2.5	0.55	Concrete
4	0.21	30	cast iron	3	3	2.5	0.6	Thatched
40	4.6	30	cast iron	2.8	2.8	2	0.75	Concrete

7	0.5	38	cast iron	4	3	2.5	0.5	Thatched
18.5	0.31	41	cast iron	3	2	2.15	0.5	Concrete
5.4	0.41	39	cast iron	3.8	3	2.5	0.6	Thatched
14	0.25	38	cast iron	2.5	2.5	2	0.5	Thatched
0.8	4.5	35	cast iron	3	3	2.5	0.5	Thatched
1.8	0.28	37	cast iron	4.5	3	2.6	0.5	Thatched
2.9	0.5	41	cast iron	3.5	3	3	0.5	Thatched
1.8	0.41	51	cast iron	5	3.1	3.1	0.7	Thatched
3	0.4	35	cast iron	4	2.8	2.5	0.4	Thatched
3.7	0.6	43	cast iron	5.1	3	3.2	0.5	Thatched
3	0.5	41	cast iron	3.5	3	3	0.5	Thatched
12	0.33	42	cast iron	2	2	2.6	0.5	Thatched
5	0.5	40	cast iron	3	2.5	2.2	0.5	Thatched
7	0.34	34	cast iron	5.5	4.5	2.6	0.6	Thatched
3.5	0.67	22	cast iron	3.5	3	2.7	0.5	Thatched
9	0.32	32	cast iron	5	3	2.5	0.5	Thatched
12	0.52	38	cast iron	5	3	2.5	0.5	Concrete
7	0.48	40	cast iron	4.8	2.9	2.38	0.6	Concrete
28	0.48	40	cast iron	7.6	5.5	3.3	0.6	Thatched
7	0.45	39	cast iron	8.5	4	2.5	0.7	Thatched
8	0.52	40	cast iron	5	3	2.5	0.5	Thatched
12	0.47	30	cast iron	5	3	2.5	0.6	Thatched
7	0.49	50	cast iron	5	3	2.5	0.6	Concrete
9	0.52	37	cast iron	5	4.5	2.5	0.5	Thatched
12	0.55	37	cast iron	5	3	2.5	0.6	Concrete
12.2	0.36	30	cast iron	2.9	2.5	2.5	0.5	Thatched
10	0.5	48	cast iron	5	3	2.1	0.6	Thatched
6	0.5	46	cast iron	4	3	2.5	0.5	Thatched
6	0.52	40	cast iron	4.1	3.2	2.7	0.5	Thatched

of PH from village (m)	Type	Capacity (kW)	Make	No of V belts	Dia of Turbine Pulley (m)	Dia of Roter (m)	Width of Turbine BO (m)	Measured Output (kW)	RPM (rot./min)	Dia of Generator Pully	Efficiency (%)	Make
200-1000	Cross flow	5	Local	2	0.54	0.36	0.33	3	950	0.13	60	China
350-3000	Cross flow	35	Local	4	0.61	0.44	0.64	19	1050	0.18	70	China
100	Cross flow	5	IAM	1	0.56	0.33	0.33	3	1050	0.13	60	China
700	Cross flow	2*20	IAM	3	0.6	0.45	0.59	40	1500	0.15	60	China
1200	Cross flow	40	Jabul Saraj	Turbine was taken for maintenance				Temporarily shut down				China
1000	Cross flow	20	Local	3	0.61	0.4	0.65	9	1450	0.15	60	China
300	Cross flow	5	IAM	4	0.65	0.37	0.33	4	1350	0.13	50	China
500	Cross flow	5	IAM	2	55	36.94	33	4	1350	0.13	50	China
1500	Cross flow	30	Habib cop.	2	0.65	0.3	0.75	12	1500	0.18	95	China
300	Cross flow	45	Salami cop	4	0.55	0.3	0.6	Under Construction				
800	Cross flow	12	Nasemi Cop	4	0.6	0.3	0.66	9	1500	0.1	75	China
2000	Cross flow	(4*15)	Salami cop	(4*2)	0.4	0.4	0.6	60	1250	0.2	45	Russia
800	Cross flow	45	Habib cop.	4	65	20	70	40	1500	0.2	95	China
800	Cross flow	40	Abdull Nabi	2	42	30	40	13	1500	0.13	30	China
400	Cross flow	5	IA M	1	0.54	0.32	0.33	5	1500	0.13	50	China
240	Cross flow	3	IAM	1	0.46	0.28	0.12	2	900	0.13	67	China
400	Cross flow	3	IAM	1	0.56	0.28	0.16	3	1500	0.13	40	China
400	Cross flow	20	Mehro	1	0..44	0.28	0.23	12	1350	0.14	70	China
700	Cross flow	3		1	0.46	0.28	0.12	3	1100	0.13	40	China
2500	Cross flow	20	IAM	1	0.54	0.39	0.49	15	1450	0.13	70	China
500	Cross flow	5	IAM	4	0.56	0.34	0.33	4	1250	0.13	60	China
inside the village	Cross flow	5	IAM	2	0.56	0.34	0.33	5	1500	0.13	60	China
2000	Cross flow	15	IAM	3	0.56	0.42	0.34	11	1350	0.14	60	China
500	Cross flow	3	IAM	2	0.46	0.34	0.17	3	1500	0.13	50	China
150	Cross flow	5	IAM	1	0.56	0.35	0.32	3	1350	0.13	60	China
100	Cross flow	5	IAM	1	0.56	0.36	0.32	4	1450	0.13	60	China
300	Cross flow	5	IAM	2	Under Construction							
1000	Cross flow	5	IAM	2	0.56	0.35	0.33	4	1200	0.13	60	China
1500	Cross flow	30	Local	3	0.46	0.42	0.3	14	1500	0.13	60	China
1500	Cross flow	7.5	Kabul workshop	1	0.55	0.32	0.32	3	1200	0.12	60	China
300	Cross flow	10	Local	1	0.65	0.1	0.5	10	1500	0.14	98	China
150	Cross flow	7	Said Wahid	1	0.5	0.36	0.58	1	1500	0.2	50	China
400	Cross flow	15	Said Wahid	1	0.5	0.36	0.58	11	1450	0.13	78	China

1500	Cross flow	15	Said Wahid	1	0.6	0.44	1.3	6	1339	0.16	80	China
100	Cross flow	10	Said Wahid	1	0.65	0.61	0.9	6	1475	0.1	87	China
500	Cross flow	7	Said Wahid	1	0.65	0.5	0.9	4	1500	0.1	97	China
400	Cross flow	7.5	Local	2	0.74	0.34	0.45	X	1500	0.12	60	China
180	Under Construction											
350	Cross flow	10	Sultan	2	0.76	0.4	0.52	4	1500	0.14	70	China
400	Cross flow	6.5	Afghanistan	1	0.75	0.4	0.48	6	1500	0.13	60	China
200	Cross flow	70	Laghman province	1	0.76	0.44	0.66	8	1500	0.13	85	Pakistan
350	Cross flow	10	Laghman province	1	7.4	0.44	0.58	9	1500	0.1	82	China
1200	Cross flow	10	Noorullah.Neng	1	0.64	0.41	0.57	7	1500	0.13	65	China
700	Cross flow	12	Noorullah.Neng	2	0.6	0.1.1	0.7	4	1500	0.14	60	China
800	Cross flow	15	Kabul workshop	2	0.75	0.35	0.6	5	1500	0.13	70	China
100	Cross flow	7.5	Noorullah.Neng	1	0.83	0.6	0.69	5	1500	0.12	65	China
100	Cross flow	15	IAM	2	0.54	0.23	0.32	8	1350	0.13	60	China
600	Cross flow	20	Khalil, Kabul	4	0.64	0.44	0.64	12	1500	14	80	Afghanistan
2000	Cross flow	15	Noorullah.Neng	2	0.81	0.42	0.81	7	1500	0.13	70	Afghanistan
6000	Cross flow	60	Pakistani	3	0.85	0.48	0.54	15	1500	0.15	70	Pakistan
5000	Water wheel	50	Eng.Pule khumri	1	0.2	0.51	0.53	X	X	X	X	X
5000	Cross flow	20	Yasin Nasimi Co	3	0.6	0.52	0.6	9	1500	0.21	90	China
2000	Water wheel	50	Eng. Kabul	1	0.2	0.51	0.51	8	1500	0.15	X	China
3500	Cross flow	20	Malem.kabul	1	0.8	0.43	0.84	X	X	X	X	X
300	Cross flow	50	Eng.Aman	3	0.66	0.33	1.4	15	1500	0.13	76	China
1000	Cross flow	60	Rawoof(takhar)	3	0.85	0.4	0.76	16	1500	0.11	65	Russia
200	Cross flow	15	Russian	3	0.3	0.48	0.39	6	1500	0.8	89	Russia
500	Cross flow	30	Eng.Aman	2	0.64	0.41	0.6	10	1500	0.1	71	China
1000	Water wheel		Abdul Hakim	2	0.51	2		9	1500	0.4	90	China
600	Cross flow	18	Eng.Shakoor	4	0.6	0.26	0.62	6	1500	0.1	77	Russia

Transmission line				Direct	Total	Funding	Fascilating	Revenue
Length (m)	Cable	Daimeter (mm)	Hight above GL (m)	Construction Cost (US$)	Project cost (US$)	Agency	Partner	collection from each HH/month (US$)
1000	Aluminium*	10	4	2800.00	4500.00	NSP	IAM	0.4
3000	Aluminium	10	4	44257.06	48682.77	NSP	None	0.7
600	Ordinary	7	4	3500	4500.00	PRT	IAM	0.4
700	Aluminium	10	4	15723.78	17296.16	NSP	UN-Habitat	1
1200	Aluminium	10	4	21887.00	24075.70	PRT	IAM	1
1000	Aluminium	10	4	40659.48	44724.95	NSP	UN-Habitat	2
300	Aluminium	10	3	3600.00	4000.00	PRT	IAM	1
500	Ordinary*	10	3	3000.00	4242.00	PRT	IAM	Free of Cost (FOC)
1500	Aluminium	10	4	29820.00	32802.00	NSP	UN-Habitat	2
Yet to be Constructed				58660.00	64526.00	NSP	UN-Habitat	0.8
Yet to be Constructed				12600.00	138600.00	NSP	UN-Habitat	0.4/bulb
2000	Aluminium	10	5	120000.00	132000.00	NSP	UN-Habitat	12
800	Aluminium	10	4	60000.00	80000.00	NSP	UN-Habitat	2
800	Aluminium	10	5	31000.00	35220.00	NSP	UN-Habitat	0.2/bulb
400	ordinary	7.5	3	2000.00	3000.00	PRT	IAM	0.4
240	Aluminium	10	3	600.00	800.00	PRT	IAM	No revenue/FOC
400	Aluminium	10	3	Donated by IAM		PRT	IAM	FOC
400	Aluminium	10	3	Donated by IAM		PRT	IAM	FOC
700	Aluminium	10	3	Donated by IAM		PRT	IAM	FOC
2500	Aluminium	10	5	37736.42	41510.06	NSP	SDF	FOC
500	Aluminium	10	4	2194.00	3911.00	PRT	IAM	FOC
None	Aluminium	10	3	2300.00	4118.00	PRT	IAM	FOC
2000	Aluminium	10	3	5000.00	6500.00	PRT	IAM	2
500	Ordinary	4	4	1551.00	3251.00	PRT	IAM	FOC
150	Ordinary	10	3	1800.00	4400.00	PRT	IAM	1
100	Ordinary	10	5	1270.00	4270.00	PRT	IAM	FOC
300	Ordinary	10	5	9355.00	10290.50	NSP	UN-Habitat	FOC
1000	Aluminium	10	5	1800.00	4400.00	PRT	IAM	FOC
1500	Ordinary	7	4	44000.00	45440.00	NSP	UN-Habitat	FOC
1500	Ordinary	10	5	8922.20	9422.20	PRT	IAM	FOC
300	Ordinary	10	4	10400.00	13520.00	NSP	Care	FOC
150	Ordinary	7	4	4400.00	5720.00	NSP	Care	FOC
400	Ordinary	7	5	7600.00	9880.00	NSP	Care	FOC

1500	Ordinary	8	4	12400.00	16120.00	NSP	Care	FOC
100	Ordinary	7	5	11400.00	14820.00	NSP	Care	FOC
500	Ordinary	7	4	10465.00	13605.00	NSP	Care	FOC
400	Ordinary	8	4	10000.00	13000.00	NSP	Dakaar	FOC
180	Ordinary	7	4.5	Under construction	Under construction	NSP	Dakaar	FOC
350	Ordinary	7	5	16540.00	21502.00	NSP	Dakaar	FOC
400	Ordinary	8	4.5	12000.00	15600.00	NSP	Dakaar	FOC
200	Ordinary	8	5	18000.00	23400.00	NSP	Dakaar	FOC
350	Ordinary	7	4	9000.00	11700.00	NSP	Dakaar	FOC
1200	Ordinary	7	4.5	12000.00	14000.00	NSP	S.C.A	FOC
700	Ordinary	7	5	9963.00	11463.00	NSP	S.C.A	FOC
800	Ordinary	8	5	19972.00	21912.00	NSP	S.C.A	FOC
100	Ordinary	8	4	11000.00	12500.00	NSP	S.C.A	FOC
100	Ordinary	8	5	21000.00	23100.00	NSP	UN-Habitat	FOC
600	Ordinary	8	4	21860.00	30860.00	NSP	UN-Habitat	FOC
2000	Ordinary	7	5	19800.00	21800.00	NSP	UN-Habitat	FOC
6000	Ordinary	8	5	190000.00	201000.00	NSP	AKDN	FOC
5000	Aluminium	10	6	2400.00	3000.00	NSP	UN-Habitat	FOC
5000	Aluminium	10	4	35700.00	39270.00	NSP	UN-Habitat	FOC
2000	Ordinary	4	3	10000.00	11000.00	NSP	UN-Habitat	FOC
3500	X	5	5	X	X	NSP	UN-Habitat	FOC
300	Ordinary	8	5	33000.00	42900.00	NSP	Concern	FOC
1000	Ordinary	9	5	32800.00	42640.00	NSP	Concern	FOC
200	Ordinary	8	4	20200.00	26260.00	NSP	Concern	FOC
500	Ordinary	9	5	10600.00	13780.00	NSP	Concern	FOC
1000	Ordinary	7	4	7000.00	9100.00	NSP	ACTED	FOC
600	Ordinary	8	5	19000.00	25650.00	NSP	Concern	FOC

*Aluminium- Cable used for transmission line
*Ordinary - Wire used for internal house wiring and other domesstic general purpose but not as a transmission line cable.
Direct cost- This cost includes Civil, Electro-Mechanical equipemnt and Transmission and Distribution cost.
Total cost- Direct cost + Administration + Management + Consultant cost (if any).
FoC- Free of Cost.

Brief Summary Table (The detailed technical information is provided in the in Annex –A. The serial no. of summary table and matrix are identical)

S.No.	Project Summary

1	The 5kW PRT/IAM project is located in Shinwari village, Said Khill District of Parwan Province. It is about 200 m walking distance from Dawood shop in Jabar Khill area. The beneficiaries were using kerosene for lighting before the Micro hydro Project.
	The villagers intended to electrify the entire village with the generating power of MHP and a request was made to the concerned developing authorities. However, the developer was determined to install only 5 kW despite the potential to produce more power from the Salang River. Only 70 families out of 120 families are receiving electricity service.
	The electricity is free of cost and a nominal amount equivalent to US$0.40 is collected from each household served to pay the operator's salary. The village has lots of opportunities for entrepreneurial activities. It is ironic to know that the entrepreneurs are spending around US$100-140 on diesel fuel each month to operate their small-scale industries by diesel generators due to weak and unreliable power supply from the MHP.
	
	The IAM provided training to the operators but they do not have any operator's manual in the power house and villagers are not aware of safety issues and fatal accidents of electricity.
	The villagers have recommended the following points, restated into technical language, for the sustainability of the projects:
	▪ MHP sites shall be selected using engineering norms and standards keeping into considerations the availability of water, gross head available, no of household to be electrified, annual growth in population as displaced people are returning their homes, installation of control panels, fuses and distribution of electricity according to project capacity.
	▪ Selection of transmission line according to load and distance traversed by the line.
	▪ The concerned government line agency shall be responsible for monitoring and evaluation of the projects and follow ups.
	▪ There should be a project administration unit with the user group that shall take care of :
	  ▪ Effective financial management and accounting of the project.
	  ▪ Distribution of electricity and
	  ▪ Revenue collection.

2	The 40 kW NSP project is located in Olang village, Salang District of Parwan Province. It is along the Kabul Mazar-e- Sharif highway and 100 m walking distance from the highway. The villagers were using kerosene and diesel generators for electricity. The project was developed after consulting the villagers and taking their consensus. The electricity is now sufficient to cater to their demand for electrifying their houses during the night. During day the system remains idle. The beneficiaries realize that they have not recognized the importance of electricity due to a lack of awareness and knowledge. Electricity service is being provided free of cost and a

	nominal amount is being collected from every household to pay the salary of the operator. Currently, the maximum demand of electricity in the village is only 20kW out of installed capacity of 40 kW. It is observed and reported by villagers that there are some shortcoming in the systems, for example, there is only one overflow gate; the lightning arrestor was not installed properly; the control box is out of order; the water heater that is used for a load sink is not functional and V belts ruptured frequently due to over stressing. The NSP has trained two person from the community, however upon asking the reason of system breakdowns, they reported to have a lack of understanding for operating the machines, lack of understanding about the distribution system, lack of appropriate training for O/M and lack of knowledge of future consequences of the system as it grows in demand to the point of demand exceeding supply
3.	The 5 kW PRT/IAM project is located in Hamaza Khill village, Said Khail District of Parwan Province. It is about 2 km far from Kaji Ali Khail village. The beneficiaries reported that, before this MHP project, they are using small generators and kerosene for lighting. Now out of 200 families only 120 families are using electricity. The system is unreliable with irregularities such as weak voltage, supply interruptions, etc. The villagers reported that they have provided their inputs, their requirements and suggestion to the developer, but during installation the developer ignored the villagers' demands and suggestions. Currently, the water is used for irrigation, operating two mills and producing electricity, however villagers expressed their grievances that despite the potential to produce more electricity, developers overlooked their request of developing power plant of 20kW, and about 40% of the village remains un-electrified. The electricity is free of cost and collecting nominal amount to pay the salary of operator. The workman ship and overall impression of the system seems to be poor as the lightening arrestor and circuits are burned, the connections are loose and wiring is poor. It is observed that after electrifying the village some beneficiaries are using electrical sewing machines during their leisure time and seem to be motivated towards income generating activities after having electricity. Villagers also reported that after electrifying the village partially, the people who have not received connection due to inadequacy of power are against the project and their developed a feeling of unfriendliness among them and now it has become a serious threat to the system as well as for others who have electricity.
4.	The 40 kW NSP/Un-Habitat project is located in Sarnida Aahangaran village, Salang District of Parwan Province. It is about 1 km away from the main Kabul Mazar-e-Sharif highway. Now the local people are using electricity instead of kerosene and diesel for lighting their houses. The village has opportunities to use electricity for income generating activities, however they lack knowledge and financing for establishing the small scale day time electrical industries. It is observed that wire in power house was not done properly. It is also found that the transmission line technicians require comprehensive training for construction, maintenance and operation. The electricity is free of cost, but they are collecting US$0.50 for the payment of the monthly salary of the operator. The villagers informed the team enthusiastically that, due to availability of lighting, they are aware of world's current affairs and their children have enough time for doing home work and preparing lessons. The team learned that,even with several requests to the NSP Facilitating Partner, the villagers received several excuses for not having a sufficient budget to provide training to two community men.
5.	The 40 kW NSP project is located in Qalatak village, Salang District of Parwan Province. It is about 20 minutes walking distance from Sare pul Bazaar. The project was developed with the villagers, however, due to the inadequacy of the transmission line design and construction, villagers are experiencing: high voltage loss, and sparking due to touching of two wires etc. The electricity is free of cost and US$1.00 is collected monthly for the payment of the operator's salary. Due to unreliability of electrical power from MHP, some small scale industry such as ice cream, metal workshop, grill shop etc. are forced to use diesel generator. The community lacks trained man power, however they are operating the system by adopting the principle of learning by doing. The team found that, inspite of a large voltage drop in

	service from the first house to the last house, community people indicated that they are willing to establish small scale cottage industries to generate their income as well as to make the MHP sustainable, if they obtain access to micro-financing. The community also informed the team that they are willing to enforce the tariff system for the financial sustainability of the project as well as to collect funds for O/M and operator's salary. They are seeking assistance to implement a tariff scheme in their village. The V belts ruptured six times, but the operator is not able find out the cause of the problem. The system does not have a control panel, leading to blowing out bulbs and electrical appliances. There is no synchronization between the generator, which has a lower capacity than the turbine. The villagers also indicated that the the monopoly by developers is the reason villagers lack technical knowledge of the system, suggesting the need for monitoring and evaluation of developers' performance.
6.	The 20 kW NSP/UN-Habitat project is located in Baqi Dara village, Ghoorband district of Parwan Province. The project is about 300 m far from police station. The project is providing electricity free of cost. However the community is collecting equivalent to US$2.00 for paying the salary and carrying out minor maintenance work in the system. The UN-Habitat has provided basic training to operators; however the operator does not have any kind of operation manual. The beneficiaries reported that V-belts rupturing problems occurred frequently. They have replaced it six times from the date of commissioning and are unable to find out the root cause of this problem.
7	The 5 kW Aga Khan/ IOM project is situated in Rahmat Khan Khill village, Said Khill district of Parwan Province. It is walking distance from the Rahmat Khan Khill mill. The community people reported that during construction of MHP, only a few members of the community received unskilled labor work for about three months. The wiring around the power house is improper, the connections are loose and wire connecting from generator to control box is also loosely connected. The wires are inappropriately selected without following any standards. It is also observed that the aluminum wires are fastened around the trees as the transmission line poles were decayed due to poor maintenance. There is virtually no awareness among the villagers about safety issues and fatal accidents about mishandling of the transmission line. The villagers reported the system has very low voltage (100V) instead of 220. The generator cable was burned many times. Upon asking the reason they indicated that they are unable to detect the cause of the problem. The community is lacking skilled manpower and technical know how.
8	The 7.5 kW PRT/IAM project is located in Ashtarkar village, Shaid Khill District of Parwan Province. It is only 700 m far from Ashtarkar road. The villagers reported that the discharge of stream is enough to use the water for irrigation and mill during day and during night the water is being used for producing electricity. The system is running is low efficiency and voltage is low around 150V instead of 220V.The control switch is missing in the power house. The quality of conductors and V-belts are inappropriate for 7.5 kW capacity project. The intake is frequently washed out by even minor floods and the villagers are seeking some assistance to construct it of Gabions. The generator has been burnt already and repaired once. It also vibrates a lot as it is not anchored on a firm foundation.
9.	The 16 kW NSP/UN-Habitat, Godarah Omars MHP is located in Godarah Omars village, First portion of Panjshir District of Panjshir Province. It is only 50 m far from Panjshir highway. The water being used for irrigation, drinking water supply and milling operation in conventional way; however it could be designed technically by taking into account above mentioned parameters. The power house does not have any lightening arrester and the circuit breaker in the power house is missing. The system is using metal poles; however it is observed that the poles do not have enough strength and are not designed as per the engineering norms. The electricity is supplied free of cost and community is collecting 40 cent/bulb and each house is using five bulbs. The electricity has brought some positive changes as reported by beneficiaries are mentioned hereunder; ▪ Substantial reduction in indoor air pollution as before they are using kerosene. ▪ Optimization and saving of time.

	▪ Employment generation e.g. mechanics, electricians, guards for powerhouse etc. ▪ The last and foremost is: there is a change in their attitude toward life, society and development work. They seem to be supportive for any kind of development work. This project make the community realizes that development is prerequisite for better and sustained livelihood. The UN-Habitat has provided training for O/M but they do not have any O/M manual for machineries. The tariff has well taken care of the money for O/M and the administrative cost for operating system. The periodic maintenance of the system is carried out by the villagers. The villagers id the team that they have plans to develop scientifically proven commercial farming (as opposed to subsistence farming). The community seems to be active in this region and needs some technical assistance for financial management of the project and to efficiently operate the community saving funds. It seems that the community has addressed the social issues related with the project, however the survey team observed some of the discrepancies on the technical front: ▪ Not enough protection for flood hazards ▪ River carries gravels and gravel trap is missing ▪ River carries silt and settling basin is missing ▪ No proper canal lining ▪ On electro-mechanical front the fuses are inadequate, no lightening arrestor, there is no proper grounding, no load controller device is installed, lack of proper switching mechanism, no distribution panel and installation and erection of transmission line poles is not done properlye .
10.	The 16 kW NSP UN-Habitat project is situated in Baba Ali village, second part of Panjshir District of Parwan Province. The project is five minutes walking distance from road head and is under construction. Community reported that there is a potential to design and develop the multipurpose project but unfortunately the project is only designed to produce electric power. There are some day time electricity using industries and currently they are operating by diesel generator. The villagers seem to be optimistic and looking forward to get substantial changes in the village that are mentioned hereunder: ▪ Improvements in heath and education facilities and initiating day time electricity using industries. ▪ Growth on rural economic development activities there by improving the livelihood. ▪ Time saving ▪ Avoid unnecessary spending on fossil fuels ▪ Creation of more job opportunities. The project is not yet completed, however about 70% of civil works seem to be completed. The audit team observed some inadequacy in civil works that are mentioned hereunder: ▪ The flood hazard is prominent and needs extra protection ▪ Improper canal lining ▪ As river carries gravel and silt; both gravel and settling basin are included in design ▪ Forebay and canal size is larger than required
11.	The 12 kW NSP/UN-Habitat project is situated in Talakan village, Bazarak District of Panjshir Province. The project is 10 minutes walking distance from theic road head and the project is under construction. After electrifying the village the beneficiaries have decided to collect US$ 2/month from each household as a monthly bill of

	electricity. The villagers are enthusiastic about the project and optimistic toward the positives changes (that are already mentioned above) that the project is going to bring in future.
12.	The 60 kW NSP/UN-Habitat project is located in Bakhshi Khill village of Bakhshi Khill District of Panjshir Province. This project is about 1 km away from the road head. The team found that the project has sufficient water to design and develop multipurpose uses for irrigation as well as drinking water supply. The tariff is fixed on the basis of the number of bulbs each household has installed and is equivalent to US$0.20 per bulb. The villagers have reported that they are seeking technical assistance from the donor community for developing financial sustainability of the project. The following additional irregularities have been observed in the systems: ▪ Wet power house floor ▪ No Load controller installed ▪ No power house grounding ▪ No control Panel ▪ Flood hazard to power house.
13.	The 42 kW NSP/UN-Habitat project is situated in Deh Peshghoor village, Ghoriab District of Panjshir Province. The Project is about 1.3 km far from nearest road head. The project has sufficient water to design and develop integrated uses, such as irrigation, drinking water supply, milling etc.; however neither the villagers nor the FP discussed the possibilities for such initiatives. Currently, there isn't any day time electricity using enterprises established in the village; however there are plans to set up such businesses in the future. The community is collecting US$2.00 from each household to pay the salary of the staff as well as to meet the administrative and O&M cost of the project. The project has some irregularities that are already mentioned above.
14.	The 50 kW NSP/UN-Habitat project is situated in Tondkhoo village, Abdullah Khill District, 2nd part of Panjshir Province. The project is about 1 km far from nearest road head. The project has generated some employment during the construction of the project. Currently It has employed four personals viz. two technicians, one guard and one administrator. The tariff is fixed on the basis of no of bulb per household and is equivalent to 20 cent/ bulb/household. On an average the monthly electricity bill is around 80 cent per household and it is sufficient to manage the operating cost of system (staff, maintenance and administration). This project also has similar irregularities that are already mentioned above, were overlooked during the execution of the project.
15.	The 5 kW PRT/IAM project is situated in Maidanak village, Shakardarah District of Kabul Province. The project is about half an hour walking distance from nearest landmark i.e. high school. It is reported to the team that during implementation of the project the developers overlooked the villagers' suggestion to design the project for about 20 kW. The project was built according to developers own plan due to budget limitations. There is no tariff and whenever the system breaks down and requires repair and maintenance, the operator collected money equals to US$1.00 from each household. The community is experiencing a problem with the generator and nobody in the village is able to find out the root cause of the problem. The village does not have any skilled manpower to solve the problem. Upon asking the community their views about financial management, they informed the team that a detailed study with detailed cost estimate; cost of equipment and its transportation cost should have been carried out before executing the project.
16.	The 3 kW PRT/IAM project is situated in Ali Khail village, Deh Sabz District in Kabul Province. The project is about 10-15 minutes waking distance from Ali Khail secondary school. It is reported that there are opportunities for establishing day time electricity using small scale enterprises. There is need of a micro finance mechanism to support such an endeavor in the village. The system also needs to be upgraded to run these units. The system has some problems: ▪ Power house need to be repaired as it was constructed with mud and water leaks into the powerhouse.

	▪ Generator breaks down frequently. ▪ No technicians available in the village ▪ Wire around the powerhouse is improper. ▪ Wire connections are loosely connected. ▪ Power house floor is damp and wet. ▪ No voltage controller and almost every night the bulbs blow off due to high voltage.
17.	The 3 kW PRT/IAM project is situated in Qalaye Qab Chi village, Deh Sabz District of Kabul Province. The project is about 30 minutes walking distance from Fasela Islamic School. The project was designed to serve 110 families, however it is supplying only 30 families in the village due to its inadequate capacity. The peak demand for the community is about 20 kW. These people are facing problems that are already outlined above.
18	The 20 kW PRT/IAM project is located in Badal Shahkail village, Estalef District of Kabul Province. The project is near Istalef secondary school. The project is destroyed during war and rehabilitated with the assistance from IAM. The electricity is supplied free of cost and $0.40s is collected from each household to pay the salary of the operator. The following discrepancies were observed during the audit survey: ▪ Intake needs to be improved and rehabilitated. ▪ Headrace canal need to be improved. ▪ Poor transmission line network ▪ No transmission line poles in place. ▪ Control panels are not functioning.
19.	The 3 kW PRT/IAM project is located in Qalaye Jabar Khan village, Deh Sabz District of Kabul Province. The project is a few minutes' walking distance from nearest road head. The problem identified are: ▪ Lack of trained operator ▪ No circuit breaker ▪ No Control Panel ▪ No standard transmission line ▪ Loose connections in the distribution. ▪ The belts are uncovered with safety mesh. ▪ Lack of proper lighting and ventilation inside the powerhouse. ▪ Household bulbs blowing out frequently
20.	The 20 kW NSP/SDF project is located in Odro Khail village Chapdara District of Kabul Province. The project is about twenty minute walking distance from the nearest road head. The problems recognized during audit are: ▪ No load or flow controlling device installed. This results in tripping of the system due to heavy load and low voltage in the system during 6 to 10 PM. During off peak hours the system has insignificant load and due to high voltage, the appliances and bulbs blows out frequently.

	▪ The generator breaks down frequently. ▪ The wiring is not done properly ▪ The wires are loosely connected. ▪ The transmission line wires are selected in an adhoc manner without considering electrical norms and standards. ▪ Lack of trained manpower and understanding to operate the equipment.
21.	The 5 kW PRT/IAM project is located in Yonus Khill village, Shakardara District of Kabul Province. The project is about 100 m far from the Mosque. The major finding during audit are: ▪ Power is insufficient to cater the villager's demand. ▪ The demand of village is around 15 kW. ▪ No Tariff collection system and collecting US$ 1.0/househhold for paying the salary of the operator. ▪ No switch in Powerhouse and system is controlled by opening/ shutting down the valve at forebay. ▪ No Control Box and panel. ▪ Lack of Technical manpower and know how.
22.	The 5 kW PRT/IAM project is located in Guzar village, Mirbacha Kout of Kabul Province. The project is walking distance from the Guzar village mosque. The findings are as follows: ▪ Water seepage inside the power house ▪ Leakage from the penstock and turbine joints. ▪ Back flow of water from the tail race. ▪ Generator breaks down frequently.
23.	The 15 kW project is located in Alaa Qooli village, Pagman District of Kabul Province. The NSP has provided assistance for Electrical Networking. The community has arranged the funds for civil and electro-mechanical works. IOM served as the Facilitating Partner for this project. The project is one-half km from the nearest road head. The major setbacks with the system are: ▪ Power house is subject to flooding and needs protection ▪ Transmission line wires are selected on adhoc basis. ▪ Wiring around the powerhouse is improper. ▪ The powerhouse requires proper ventilation. ▪ Technical O/M manuals/guidelines are lacking
24.	The 3 kW PRT/IAM project is located in Qlai Badal village, Pagman District of Kabul Province. It is a few minutes' walking distance from the nearest road head. During the day electricity is used for lifting water for drinking and heating water for Mosque. The problems observed are: ▪ No control panel ▪ Heat sink that is used as voltage control is burned out.

	▪ Irregularities in the distribution system. ▪ No operator for operating the system. ▪ No funds for repairing the system ▪ Lack of initiatives and ownership ▪ Lack of technical person. ▪ No O/M manuals or guidelines for operating the system. ▪ Lack of awareness on safety issues. ▪ Bulbs and appliances frequently burn outo ▪ Frequent burning of transmission line cable. ▪ House wiring and cable capacity are insufficient for voltage handled
25.	The 5 kW PRT/IAM project is located in Deh Qazi village, Nijrab District of Kapisa Province. The project is near Hafeza High School. The project has been running smoothly, however the power generated from this project is inadequate to serve the village, supplying electricity to only 44 out of 58 families. Fortunately the project is in operation with out any problem; however it is lacking control panel, heat sink that is used for controlling the voltage, no trained manpower, no O/M manual and no skilled operator.
26.	The 5 kW PRT/IAM project is located in Delyar village, Nijrab District of Kapisa Province. The project is about 200 m from nearest road head. The project is running smoothly till to-date. The major observation during audit are as mentioned hereunder: ▪ No control panel ▪ Heat sink is out of order ▪ Loose connections ▪ No skilled operator.
27.	The 5 kW NSP/Un-Habitat Project is located in Atef Khail village, Khoistan District of Kapisa Province. It is 20 minute walking distance from nearest road head. The project is under construction. The major findings during audit are: ▪ The training is provided by UN-Habitat. ▪ The operator does not have any O/M manuals
28.	The 5 kW PRT/IAM Project is located in Deh now village, Nijarb District of Kapisa Province. It is walking distance from Dehnow Bazar. The major finding during audit are: ▪ Frequent breakage of V-velts ▪ No skill manpower and no O/M manual ▪ No voltage control mechanism ▪ No tariff ▪ No control box

	▪ No heat sink ▪ The transmission line poles are in decayed condition and frequently the poles fall down. ▪ Once the powerhouse is turned on, nobody sits there to monitor and control the machines and checking the voltage and current.
29.	The 30 kW NSP/UN-Habitat Project is located in Qazi Khail village, Kohistan District of Kapisa Province. It is half km far from Moen Khan Khail village. It is reported that villagers have requested to install the system that caters the demands of the entire village but the FP ignored their suggestion to install 50 kW project. Now due to inefficient system design it is only producing 10 kW of power.
30.	The 7.5 kW PRT/IAM Project is located in Debdi khamzargar village, Kohistan District of Kapisa Province. The project is walking distance from the middle of the village. It is an old project that was used for milling. Later after rehabilitation the mill was replaced by power. Currently, the electricity is used for battery charging as a source of income generating activity during the day. Findings during the audit are: ▪ Frequent breakage of V- velts ▪ No O/M manual and no trained manpower ▪ Lack of awareness on safety issues.
31.	The 10 kW NSP/ Care International Project is located in Mazar village, Milistan District of Ghazni Province. The project is walking distance from the nearest road head. The findings during the site audits are: ▪ The wiring of the powerhouse is improper. ▪ The wire connections are loose. ▪ No voltage control mechanism and the bulbs frequently get burned out. ▪ Meters such as voltmeter, amp meter are non-functional. ▪ The operator does not have any operational manuals and lacks technical know-how; and nobody in the village is aware of the technical problems.
32.	The 7 kW NSP/Care Project is located in Dahan Bagh village, Malistan District of Ghazni Province. The project is walking distance from the nearest road head. As of now the system does not have any technical problems and is operating smoothly. However, the team observed that the transmission poles do not have any insulatorz and wires are running around the pole. The villages also reported that the transmission poles have 0.6 m foundation depths. The foundation, depth as a rule of thumb, should be at least 1m for community level MHP transmission and distribution lines.
33.	The 15 kW NSP/Care Project is located in Now deh village, Malistan District of Ghazni Province. The project is walking distance from the nearest road head. The finding are: ▪ The village has access to satellite receiver and there is computer usage after electrification. ▪ No voltage regulator and control panel. ▪ Bulbs frequently burned out, ▪ No step up transformer installed to meet demand.
34.	The 15 kW NSP/Care Project is located in Saresang village, Malistan district of Ghazni Province. The project is adjacent to the road. The finding are: ▪ Poor wiring inside the powerhouse.

	▪ Connections are poor. ▪ Transmission line is not proper. ▪ Severe voltage loss at the end of the sytem. ▪ No skilled operator and no O/M manuals.
35.	The 10 kW NSP/Care International Project is located in Maidan village, Malestan District of Gazni Province. The project is walking distance from the road. The project is supplying electricity free of cost and there is no tariff yet. The findings during audit survey are mentioned hereunder: ▪ Improper wiring for switch board - the connections were loose and burned due to sparking. ▪ The voltmeter and ampmeter have frequent problems, but the operator is unaware of the root cause and is supplying electricity by passing these instruments.
36.	The 7 kW NSP/Care Project is located in Now joy village, Malistan district of Gazni province. The project is few minutes' walking distance from the nearest road. The findings are: ▪ No trained operator and no O/M manuals. ▪ No tariff collection system.
37	The 7.5 kW NSP/DACAR Project is located in Deh Shah Agha Khail village, Alingar District of Lagman Province. The project is only fifteen minutes' walking distance from the nearest road. Initially the system was sufficient to meet demand of the village; however now the voltage is low and only 70% of the beneficiaries are using electricity.
38.	The 9 kW NSP/DACAR Project is located in Alo Khail village, Alingar District of Lagman Province. The project is 10-15 minutes walking distance from the nearest road. The project is under construction. It is reported that the system is designed only to meet the demand of 83 out of 143 families. Upon asking the reason villagers informed the team that the Facilitating Partner had a budget to install only 9 kW project.
39.	The 10 kW NSP/DACAR Project is located in Bure Koot village, Alingar district of Lagman Province. The major problem with the installation are as mentioned here under: ▪ No proper wiring in the power house. ▪ The operator does not have any operational manual. ▪ The V bets have frequent problems and need to be replaced every month. The operator is unaware of the root cause.
40	The 7.5 kW NSP/DACAR Project is located in Ghazy Abad Kohna villiage, Alishing district of Lagman Province. The project is 30 minutes walking distance from road head. The system is relatively new. It is operating smoothly. The DACAR has provided training to the operator and the operator does not have any O/M manual
41.	The 70 kW NSP CARE International Project is located in Qala-e-Now village, Alingar District of Lagman Province. The project is walking distance from the road. The project is supplying electricity free of cost. The Facilitating Partner has supported the beneficiaries in establishing carpentry shops, welding shops and stone crushing plants. Since the system is relatively new and no major problems have occurred and system is running is smoothly. Recommendation from the villagers for project imporvement are: ▪ The operators should be trained properly. ▪ The operator should be equipped with O/M manuals, technical guidelines and basics tools required for O/M maintenance of system. ▪ There should be a stringent tariff collection mechanism.

42.	The 10 kW NSP/DAKAR Project is situated in Kookhi village, Alingar District of Lagman Province. The mill and battery charging shop are in operation in the village using electricity. The turbine is manufactured locally in a village workshop. Findings during audit are: ▪ Leakage from turbine joints. ▪ Wet powerhouse floor ▪ Lack of awareness of safety issues for electricity usages. ▪ No O/M manuals for operating the machines
43.	The 10 kW NSP/SCA project is situated in Qole Bala- Pahin village, Maidan shar district of Wardak Province. The project is 25 km from the District head quarters. The findings are: ▪ The power house is far from village i.e. load center. ▪ No transformers are installed. ▪ The transmission cable is ordinary service wire. ▪ No control panel, no voltage regulation mechanism
44.	The 12 kW NSP/SCA project is located in Jani Khel village, Maidan shar district of Wardak Province. The project is only 50m far from the road . The team findings are: ▪ The transmission and distribution is not per engineering norms and there are high voltage losses and there are no transformers installed. ▪ There is no skilled operator, no O/M manuals. ▪ No voltage regulation mechanism and no control panel.
45.	The 10 kW NSP/DACAR Project is located in Qaloy Now village, Kohna Khumar district of Wardak Province. It was reported that the Facilitating Partner did not provide any training to the operator. Community elders appointed an operator who has some technical knowledge on maintenance. The operator does not have any O/M manuals. The system is operating smoothly so far as it was commissioned only last year.
46.	The 7.5 kW NSP/ SCA Project is located in Seya-Peshab village, Maidan Shar district, Wardak Province. The project is 10 minutes walk distance from the main road. The system is supplying electricity to three villages. The beneficiaries are collecting US$20.00 from each village per month. The findings are: ▪ Lack of skilled manpower in Seya-Peshab village ▪ No training is provided to the operator and there are no O/M manuals. ▪ Due to a conflict among the villagers, the power distribution system is not in operation.
47	The 15 kW NSP/UN-Habitat Project is located in Ali Bik village, center of Bamyan, Bamyan Province. The project is 20 km far from the main road. The findings are: ▪ Out of 105 families only 90 families are using electricity due to weak voltage and improper distribution system. ▪ No training to operator and no O/M manuals. ▪ Transmission line is long and there is a severe voltage drop. ▪ No control box and voltage regulation mechanism in the powerhouse.
48	The 20 kW NSP/UN-Habitat Project is located in Shiwalqat village, Central Bamyan, Bamyan Province. The project is hardly 10m meters from nearest road. The findings during site audit are as follows:

	▪ No tariff collection mechanism ▪ No trained operator and no O/M manuals. ▪ Control box is not installed. ▪ Lacking voltage regulation mechanism ▪ Severe voltage drop and no step up transformers.
49	The 15 kW NSP/UN-Habitat Project is located in Qalaye- Pera village, Central Bamyan, Bamyan Province. The project is 2 km far off from nearest road. The findings during site audit are: ▪ Initially the community had diesel generation and payed US$ 1.60 per bulb now they have micro hydro and are paying US$0.40 per bulb. ▪ Community is using satellite receiver for TV. ▪ The community is lacking skilled operator. ▪ Lack of control panel and voltage regulation mechanism, such as a heat sink.
50	The 60 kW NSP/AKDN project is situated in Sadbarg village, center of Bamyan of Bamyan Province. The project is 200 m from nearest road. The findings are: ▪ During day electricity is supplied to shops in Market. ▪ The power is supplying free of cost and there is no tariff collection. ▪ Voltage drop is high, due mainly to the location of the powerhouse 6 km from the load center and no transformers are installed. ▪ No skilled and trained operators and no operation manuals. ▪ No control panel and no voltage regulating mechanism.
51	The 50 kW NSP/Un-Habitat Project is located in Munara village, Center of Bamyan of Bamyan Province. The project is walking distance from the nearest road. The findings are: ▪ The powerhouse is far from village and transmission and distribution losses are high and no transformers are installed. ▪ No skilled operators and no operation manuals. .
53.	The 50 kW NSP/Un-Habitat Project is situated in Baba Doost village, Center of Bamyan, Bamyan Province. The findings are: ▪ The project is not in operation due to equipment breakdown – the generator is not synchronized with the turbine and has burned out wires, bulbs and accessories..
54.	The 20 kW NSP/Un-Habitat Project is located in Kata Sang village, Center of Bamyan, Bamyan Province. The project is 20 km from the District head quarters. The project is under construction. So far only the intake has been constructed and head race canal work is under way.
55.	The 50 kW NSP/Concern Project is located in Dehbala village, Warsaj district of Takhar Province. The project is walking distance from the nearest road. The village has carpentry shops, welding shops and stone factories drawing electricity from the project. The local community has fixed the tariff at US$0.10/kWh. The project does not have a control panel in the powerhouse and no control regulation mechanism. Fortunately, the system is running smoothly to date and there is no complains from the beneficiaries.
56.	The 25 kW NSP/Concern Project is located in Dar Hwely Papany, Warsaj district of Takhar Province. The project is around 700 m from the nearest road. The village

	has one flour mill and its capacity is 11 kW. The village also has carpentry shops, welding and stone crushing plant. The major problems observed are: ▪ The Chinese generator burned out and was replaced by a Russian brand, which also burned out.. ▪ The system is now inactive because the beneficiaries do not have funds to replace it or to maintain it. ▪ There is no synchronization between Turbine and generator, and it seemed that the generator is of less capacity than the turbine. ▪ The beneficiaries reported that after 21 days of installation the generator was burned out and since then the problem occurred on a regular basis.
57.	The 15 kW NSP/Concern Project is located in Yawaar Suflaa village, Warsaj district of Takhar Province. The project was old and it was rehabilitated using same machines after repairing. The project has used both generator and cross flow turbine that were made in Russia. Transmission line poles are made of concrete. The finding are: ▪ No O/M manuals for operating the machineries. ▪ No control box ▪ Generator burns out frequently ▪ Bulbs burn out frequently ▪ Supply is interrupted due to system shutdown ▪ System is not designed to utilize the availabile discharge.
58.	The 30 kW NSP/Concern Project is located in Malwar Bala village, Warsaj district of Takhar Province. The villagers are happy that there is substantial savings on buying fuel. However, it is reported that the voltage is weak due to substandard generator that was made in China. The operator does not have any O/M manuals for operating the powerhouse
59.	The 10 kW NSP/ACTED Project is located in Abdullatif village, Khwaja Ghar district of Takhar Province. The project uses a water wheel instead of a turbine. Mr. Abdull Hakim Khan from the local community has made the turbine wheel in his workshop and installed it. The findings are: ▪ Voltage fluctuation ▪ No control box. ▪ V belts rupture frequently. ▪ Fuses blow out frequently.
60.	The 10 kW NSP/Concern Project is located in Darah Qundoz village, Warsaj district of Takhar Province. The project is 10 km from the District head quarters. Eng. Shukoor from local village installed the turbine. The generator was made in Russia. The problems observed are: ▪ No control box ▪ High Voltage fluctuation. ▪ V-belts ruptures frequently ▪ Poor system efficiency due to significantly week voltage. ▪ No O/M manuals.

Afghanistan Mini/Micro hydropower Assessment Program

Mini/Micro hydropower Audit Study

Questionnaire/Check list for Audit Study

Team –**A**…….. **B**…….. **C**……..
Names of the Audit team members:

1……

2……

Date of Survey…….

A. General Information

1. Province……
2. District…….
3. Village…….
4. Project capacity (kW)……..
5. Elevation of Project (m)……..
6. Project GPS Location:
   - Latitude…….
   - Longitude…….
7. Access relative to nearest road head……..
8. Name of the source stream……
9. Type of Project
   - New Project……..
   - Rehabilitation……
10. Status of Project: (Mark the bullets accordingly)
    - Under construction…….
    - Completed……
    - Yet to be commissioned……
    - Idle or damaged……
    - If any other type……..
11. Relative dates
    - Start date…….
    - Completion date…….
    - Commission date…….

B. Social/Environmental Information

1. What is the total population of village?.....
2. How many house hold in the village?.....
3. How many house hold are getting electricity?.....
4. What is the primary source of income of villagers?.....
5. What is their average monthly expenditure?.....
6. Did the project bring any employment opportunity in the village? Explain.
   ……
7. What are the fuels used before the project?
   ……
8. How much is the saving on fuel after electrification.
   - 100-200 Afghani
   - 200-400 Afghani
   - 400-600 Afghani
   - 600-800 Afghani

9. In beginning of the project what were your inputs or suggestion for the Project?
   …….

10 Did developer take your advice? If not why the he ignore your suggestions?
   …….

11 Is community using the water for Irrigation or drinking when they are not using electricity?
   ……
   ……

12 Is there any provision in the system to use excess water for Irrigation/drinking or any other purpose? Explain
   ……
   ……..

13 Is there potential to design multipurpose project (for example- with the help of project, is it possible to generate electricity and at the same time draw water for irrigation, drinking, heating water, pumping and water milling)
   ……
   ……

C. Electricity User Information.

1. What is the average monthly bill per house hold?
   ……

2. Are there any day time electrical industries?
   - Yes……..
   - No……..
3. If yes what are they? ……
4. What is the monthly Electricity bill of these industries? ……
5. How many bulbs each household has?
   - Incandescent light bulbs……Watt……

- Neon Bulbs……Watt
- If any other……

6. What are electricity usages hours in the village?
   ……
7. Are there any grid supplies or any other means of supply for example Diesel?
   ……
8. What are the primary uses of electricity in household?
   - Lighting
   - Cooking
   - Boiling water
   - TV/Radio etc.
   - Other purpose if any

D. Site Potentials

1. Gross head of the project in meter (m)…….
2. Minimum available discharge in canal (litre/sec)…….
3. Power potential based on above parameters (kW)……

E. Technical information

1. What type of intake structure? Right/Left side of the river or any other type
2. Does River carry large boulders? Yes/No
3. Type of diversion work? Permanent/Temporary
4. Is there any gravel/debris trap as close to the head works? Yes/No
5. Is there any settling basin as close to the intake? Yes/No
6. Location of settling basin?.....
   a. Length (m)……..
   b. Width (m)……..
   c. Height (m)……
7. Head race canal Dimension?
   a. Length (m)……
   b. Breadth (m)……..
   c. Depth (m)…….
   d. Depth of water in the head race canal (m)……
   e. Thickness of side wall (m)……..
8. Is there any seepage from Headrace canal? Yes/No.
9. Geology around Forebay area stable/unstable

   Penstock Information

10. Length of Penstocks (m)…….
11. Diameter of Penstocks (m)……..
12. What is the slope of penstocks?
13. Material of Penstocks? Mild steel/Cast Iron/Wooden/ if others any.

    Powerhouse Information

14. Dimension of Power house
    a. Length (m)
    b. Breadth (m)

c. Height (m)
d. Thickness of wall (m)
e. Type of roof (Thatched/mud/Corrugated iron sheet/Concrete/ specify if any other type……
f. Location of powerhouse? Level ground/high enough above the river to be safe from floods/stable ground/unstable ground

15. Distance of Powerhouse from Village (m)……

16. How many overflow gates are along the canal and assess the quality of those gates and their location. Explain.
……
……..

Turbine Information

17. What are the turbine type and its capacity?
……
18. Who is the manufacture of the Turbine? And who has installed it?
……
19. How is the quality of valves, belt and its drives? Explain.
……
20. How many V belts…….
21. What is diameter of Turbine Pulley…….
22. What is the diameter of generator pulley…….
23. Diameter of roter…….
24. What is the width of Turbine (BO)……

Generator Information

25. What is the output of generator, rpm and its efficiency? Measure as well as verify it using name plate attached with the machine.
    - Output (kW)……
    - Rpm (Revolution per minute) (no.)……
    - Efficiency (output/input*100) %.....
    - Manufacturer of the generator……
26. Is there any lightning arrestor? Examine it physical features.
……
27. How the earthing was done? Are the moving part are covered with safety net? Examine the overall safety of powerhouse.
……
28. Examine the control panels and its fuses, switches, gauges/meters and wiring quality inside the power house.
……
……
29. Circuit Breaker……
30. Wire ends Insulation quality…….
31. Workmanship……
32. Overall impression of control box……
33. What is the size and material of wire form powerhouse to poles and poles to house?

……
……

34. What is the quality of conductors and their adequacy in the transmission line?

……
……
……
……
……

35. How is the quality of distribution system and adequacy of pole design and its materials? List the material of the pole. How high up the wire from ground level? Whether wires run around the plastic insulator or around the pole?

……
……
……
……

F. Cost Break down Information

1. What is the Direct construction cost (civil, Electro-Mechanical equipment, transmission/distribution?)

   ……
   ……

2. What is the total project costs (Direct cost + administration +management + consultant)

   ……
   ……
   ……

3. Who is the Donor Agency of the project? (Such as National Solidarity Program, Asian Development Bank, Word Bank etc.)

   ……
   ……

4. Who is the Facilitating Partner (FP)……

5. What is the local contribution to the construction?

   ……
   ……

G. Direct Benefits

1. What is the revenue collected from house hold?

   ……
   ……

2. What is revenue collected from day time electrical industries?

   ……
   ……

3. What is the revenue collected from mills?

   ……
   ……

H. Indirect Benefits

1. What changes are observed after electrifying the village? (Such as effect on health, education etc...) Explain.
   ……
   ……
   ……
   ……
   ……
2. Do you feel that electricity helped villagers to avoid unnecessary spending on imported materials? (Such as Diesel and Kerosene).
   ……
   ……
   ……
   ……
3. Do you feel that electricity has saved time? And work during night? Explain
   ……
   ……
   ……
   ……
4. Do you think that electricity has created job opportunities? And did it also help to generate and raise the income level of the villagers?
   ……
   ……
   ……
   ……
5. Do you think that after the electrification, villagers are much more motivated towards development activities?
   ……
   ……
   ……
   ……
6. Do villagers believe that electricity is the one of the source of rural economic development?
   ……
   ……
   ……
   ……
7. What are positives and negative changes did you notice after electrifying the village? Explain.
   ……
   ……
   ……
   ……
   ……

K. Development Approach

1. How much time did the project require for completion and when it was commissioned?

   ……

2. Who has provided the training for Operation and Maintenance and how the fund shall be collected?

   ……

3. Do you have any type of machine operation manual/guideline?

   ……
   ……

4. Does tariff includes the money for O/M of the project?

   ……
   ……

5. Is tariff is sufficient to manage the operating cost (staff, maintenance, administration and interest) of the project?

   ……
   ……

L. Major breakdown of Equipment

1. What are the locations of problem and are they repairable or irreparable?

   ……
   ……
   ……
   ……
   ……
   ……

2. What are the types of problem? And how often they occurred?

   ……
   ……
   ……
   ……
   ……

4. What is the understanding of how the problem occurred?

   ……
   ……
   ……
   ……

5. What was reason of system breakdown? Lack of knowledge; training; funds or any other issues. Explain.

   ……
   ……
   ……

M. Recommendations

1. What are the recommendations for the betterment and sustainability of Project?

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3. What shall be the financial structure of the project and how it shall be managed more effectively?

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4. What are the effective project management considerations?

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Q. Personal Recommendation

1. What are the observations and judgments on Project performance of the survey team? *(Please limit yourself within two pages.)*

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