

Poverty Alleviation Fund

Gyaneshwor, Kathmandu

PROGRESS REPORT III

On

Converting Pani Ghatta for Electricity Generation

"Ghatte Bijuli-Gaun Jhilimili"

Project 1014

A Joint Award-Grant of Poverty Alleviation Fund and World Bank

On the brand slogan

"Launa Aba Kehi ta Garaun"



Concept drawing for AFPMA on IWM

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The project team would like to thank fabricators, technicians, Ghatta Owners, executives of Ghatta Owners' Associations and Area Service Centers for their collaboration to bring the project at this stage.

Special thanks go to the students and researchers of Department of Electrical and Electronics Engineering, Department of Mechanical Engineering of School of Engineering and Department of Environmental Science and Engineering of School of Science of Kathmandu University for their motivation to conduct and supervise the project works related to AFPMA and its control for continuous research and development that is helping a lot improving the technology further. Similarly, the project team is grateful to the Japanese firm "E&T Pvt. Ltd. Nepal" for the input from their side in this regard. The project team also extends its gratitude to all those dignitaries from SINTEF, NTNU, Nepal Engineering Council and Japanese Team of Experts to the laboratory of Kathmandu University and in the field to observe the R&D works on AFPMA.

On behalf of the project team

Dr. Ramesh Kumar Maskey
Project team leader
15 November 2009



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1. Background

The technically and socially innovative project "Converting Pani Ghatta for Electricity Generation (Ghatte Bijuli-Gaun Jhillimili)" received the grant award from Poverty Alleviation Project (PAF) and World Bank during the Nepal Development Marketplace 2008 competition "Launa Aba Kehi Ta Garaun" in Nepal.

This project aims to accomplish 3 kW low-speed gear-coupled axial-flux permanent magnet alternators to generate electricity for village electrification as an added end-use to existing short-shaft IWM. Furthermore the technology is to be disseminated in nine villages of Kavre, Nuwakot and Dhading with support from existing Ghatta Owner's Association through Area Service Centres. One unit will be installed in Lalitpur district for demonstration and testing purpose. Based on the philosophy of appropriate technology, the whole concept of the project has been designed to respect the traditional knowledge and values that are sustainable and gender friendly. The project management team has also proposed and innovative management approach, the Restore-Lease-Operate-Adopt-Disseminate (ReLOAD) approach for financial sustainability of and replicability of the project.

2. Introduction

This project has completed its second phase (Fabrication) and now it has entered into its third phase (Implementation). Though the project has not achieved its target objectives to install ten units in four districts as envisaged in project proposal within the stipulated time frame, there has been some success stories. The present report is to document the activities achieved so far and future course of actions.

This progress report also includes the photo documentation of the project implemented sites (Annex 1-5).

3. Objective:

The objective of this progress report is to describe the activities that have been performed by RETSC and its partner organizations, within the third phase, i.e., implementation phase, of the project. The specific objective is to document the two pilot projects implemented in Nuwakot and Kavre districts, one surveyed in Kavre district and one project repaired also in Kavre district.

4. Overview of the third progress report:

Following activities have been accomplished since the submission of second progress report on June 2009:

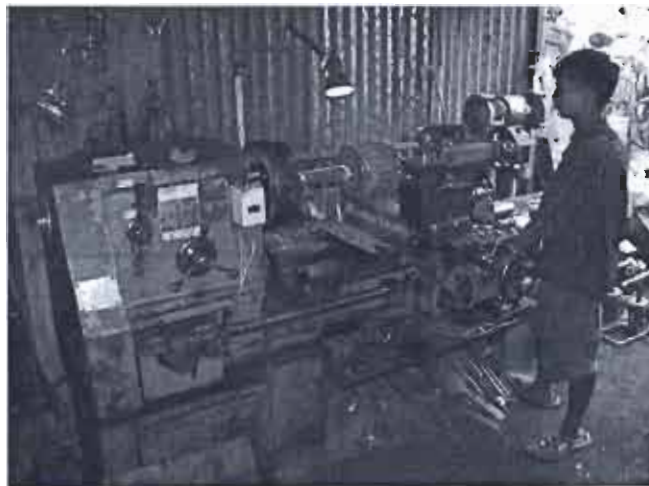
- **Fabrication of the components of ten Axial-Flux Permanent Magnet Alternator (July-September, 2009):** RETSC in cooperation with Center for Excellence in Production and Transportation of Electrical Energy (CEPTE/KU) has supervised the fabrication of the components of ten AFPMA at local

fabricator. The capacity of the components is designed for 3 kW, 220 V, 50 Hz AC power at 600 rpm (Fig. 1).



Fig. 1: Fabricated components of AFPMA ready for assembling and finishing

- **Assembling of six AFPMA:** As discussed in the second progress report, the assembling of six AFPMA has been completed for a reduced version in order to address the actual site conditions. This is also to reduce the present cost.



However, the system is so designed that its capacity could be readily upgraded easily if the civil components of the IWM are improved to generate more power.

The assembled units are ready for preliminary testing. It will be dispatched to the site as soon as the later

will be identified by the local area partners.

- **Installation of pilot project of reduced version of AFPMA at Bhadrutar-1, Nuwakot for demonstration and field test:** Installation of pilot project for demonstration and testing of the reduced version of AFPMA (1 kVA) has been successfully completed in Bhadatar-1 of Nuwakot district (Fig. 2 and Annex 1). This site can be reached from Narayanthan, Shivapuri Danda to Bhadratar by bus and then 3 hrs walk to the village. In dry season jeeps also ply to this village. It took 3 days for installation of AFPMA including the house wiring training in three houses as demonstration. Rest of the wiring was done by villagers themselves. The system is community owned and managed by community who has agreed to the project format of pay back for 50% of the total project cost. Operator is Ghatta owner himself.

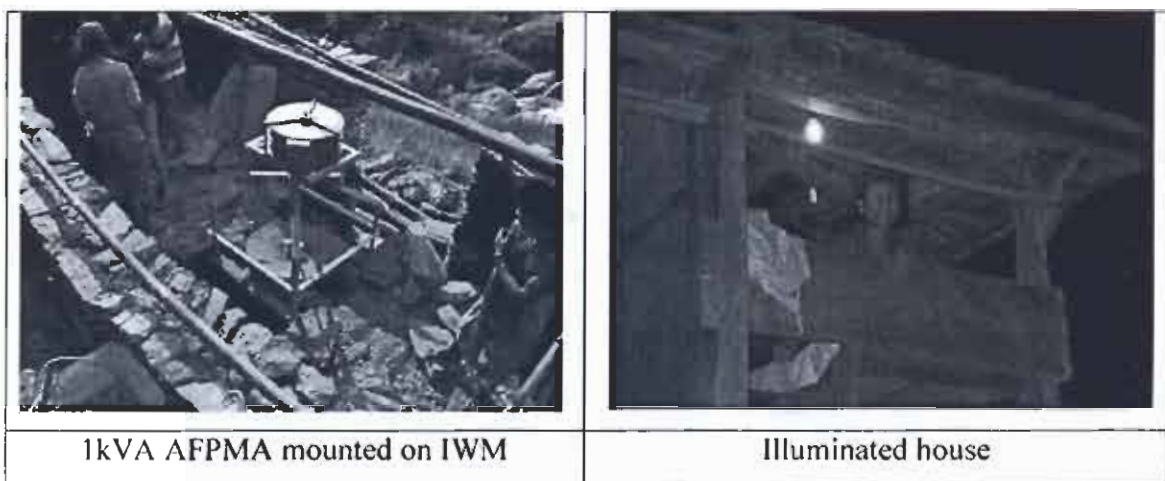


Fig. 2: Installation and demonstration of 1 kVA AFPMA at Bhadratar-1, Nuwakot

The field team did not make any agreement with the community during the field installation. However, the villagers formed a community user group and prepared a minute of meeting, which will be made available to the project team very soon. The Ghatta owner is from Tamang community has a family of 5. Children go to school but parents are uneducated. Table 1 presents the salient feature of the site.

Table 1: Salient Feature of Bhadratar Site

Discharge:	17.5 l/sec
Head :	12.8m
Power Generation:	769 watt (at 35% overall efficiency)
Power Generated:	400 watt (single phase distribution)
No of HH benefited:	20, each consuming 20watt
Load centre is scattered and about 250 m shortest to 1250m in longest distance.	

For now, AFPMA is installed on his IWM but it is actually management is performed by community and they have decided to install the AFPMA in a separate IWM, 100m far from where it is now. The construction work has been started and soon it will be finalized. After the invitation, the project team will go for one day to help them for installation and the contract will be signed. After that the project will be officially handed

over to the community. They will keep the former IWM owner as the operator on salary basis. The term for this change will be in the same modality that was submitted in the progress report II. Small variation will be made with few common understandings to cope with the local condition.

- **Installation of pilot project of reduced version of AFPMA at Gokule, Amalbesi, Kavre for demonstration and field test:** Installation of pilot project for demonstration and testing of the reduced version of AFPMA (1 kVA) has been successfully completed in Amalbesi of Gokule VDC in Kavre district (Fig. 3 and Annex 2). This site can be reached by bus from Banepa to Budhakhani (3 hrs) and then by walk around 8 hrs. There is no central grid supply in the peripheri. Local people have not seen light and TV before the project.

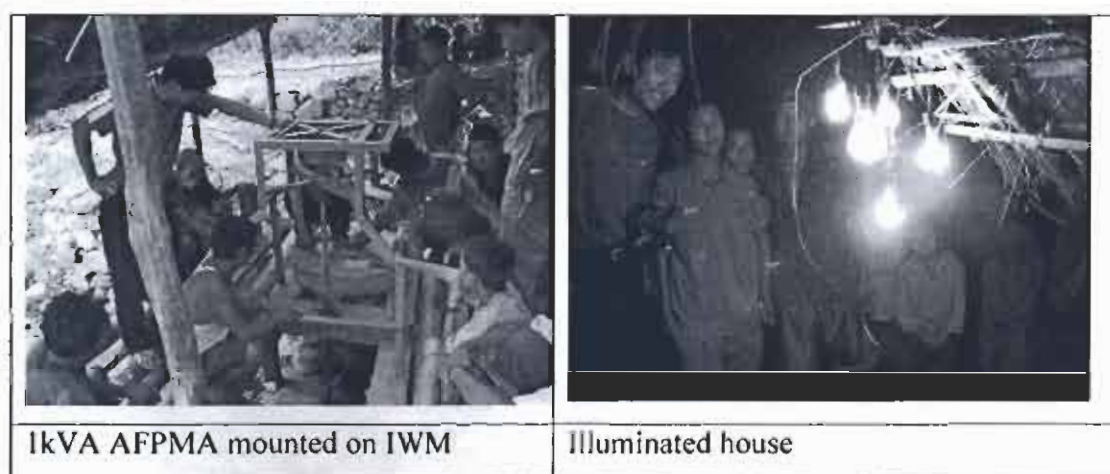


Fig. 3: Installation and demonstration of 1 kVA AFPMA at Amalbesi, Kavre

Table 2: Salient Feature of Gokule Site

Measured Discharge at the time of survey:	53.8 l/sec
Net Head :	4.5 m
IWM turbine model	NYC 24" diameter
Nozzle diameter	2.5"
Penstock diameter	8"
Power Generation:	769 watt (at 35% overall efficiency)
Power Generated:	431 watt.single phase distribution)
No of HH benefited:	16, each consuming 15 watt, one HH with 50 W TV plus 25 W Deck
Load centre is scattered.	

- **Formation of Kushadevi Electricity Users' Committee:**A seven member Kushadevi Electricity Users' Committee in Khushadevi VDC ward no. 4 has been formed to utilize the electricity produced by the IWM (see Minutes of Meeting of Users' Committee in Annex 3). At present 13 households receive 30 W/HH electricity. The protocol prepared by the committee provides the rules and regulations for sharing the benefit from this project (see attachment). Each

household is liable to pay NRs100.00 per month for using 30 W electricity. The Ghatta owner provides his service as the operator of AFPMA and collects the monthly fee and takes care of repair and maintenance of the project. As a salary he receives 10% of collected money per month and he receives the electricity free of charge. Out of collected money 10% is allocated for repair and maintenance of the project per month. The remaining 80% of collected money goes back to Ghatta Owner Association. 14 households are in pipeline to be connected if the power plant's capacity were increased through modification of the civil components. There is a potentiality to increase the capacity if the fund were available.

- **Repair works at Kushadevi site:** After 9 months of installation and around 7 months of continuous (12 hrs/day) operation the AFPMA was demolished for the inspection and subsequent repair and maintenance work. It was found that three coils were rubbed by the magnet plate due to erosion of the shaft and its consequent subsidence (Fig. 4, Annex 4).

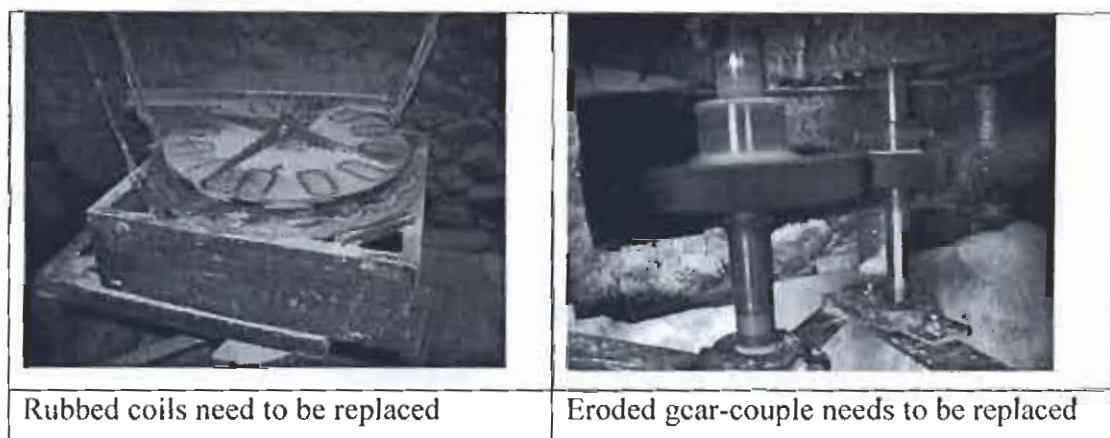


Fig. 4: Component of AFPMA dismantled for repair and maintenance at Kushadevi, Kavre

- **Pending installation in Lubhu:** Although Nepal-hilfe Bilingris also agreed to finance the cost of IWM installation as mentioned in the progress report II, the installation of one unit has not been materialized due to delayed in the decision from their board. The project team is waiting for an invitation to install the same.
- **Visit of representative of Japanese firm E&T Nepal:** A team of Japanese delegates visited the site with the aim to observe the use of IWM for rural electrification (see Fig.6). They were much interested in its technicality as well as financial sustainability. The visit was requested by a Nepal-based Japanese company 'E&T'.

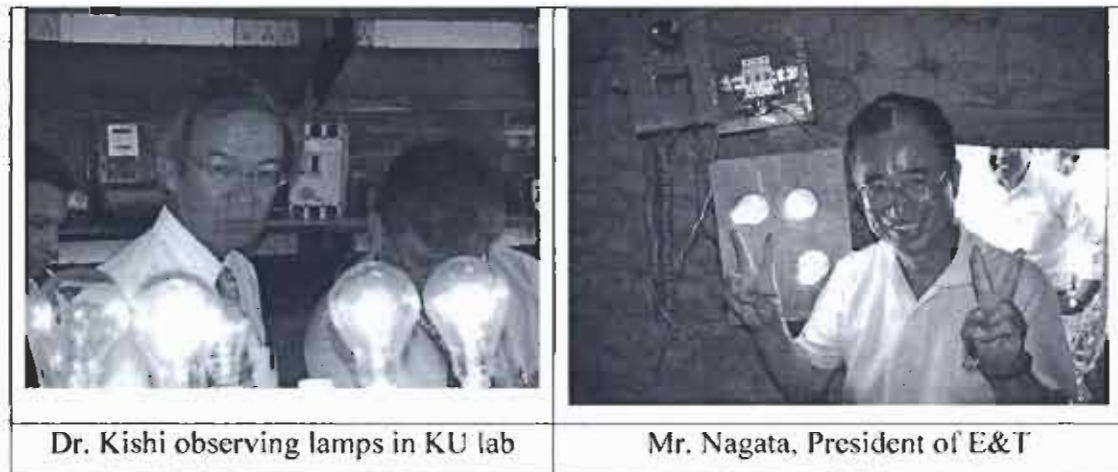


Fig. 5: Visit of Japanese delegates to KU laboratory and in field in Kushadevi, Kavre

- Visit to laboratory of Kathmandu University from different organization:** The research Director, Dr. Peter Stoa of SINTEF and Dr. Inge Johansen, former Vice-Chancellor of NTNU and Nepal Engineering Council's members observes AFPMA 3 kW at KU (see Fig.6).

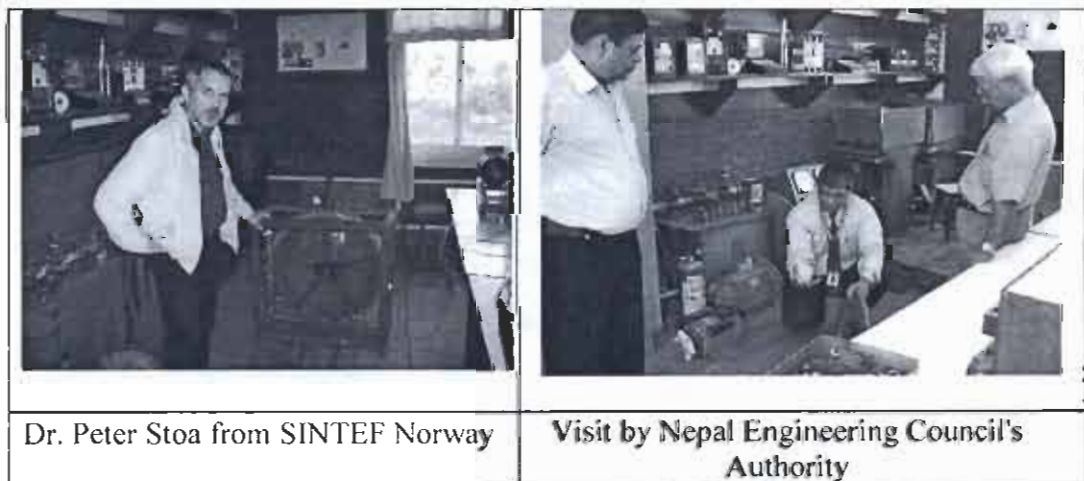


Fig. 6: Visit from SINTEF, NTNU of Norway and Nepal Engineering Council, Nepal

- Students' Study visit:** Students of Environmental Engineering of Kathmandu University visited the site (Fig. 7) on to gain some knowledge about the IWM and AFPMA as per the requirement of their course on hydropower and renewable energy. They also interacted with the Ghatta owner about the implementation of the project and its success story to electrify 13 households even in the place where grid supply is available.

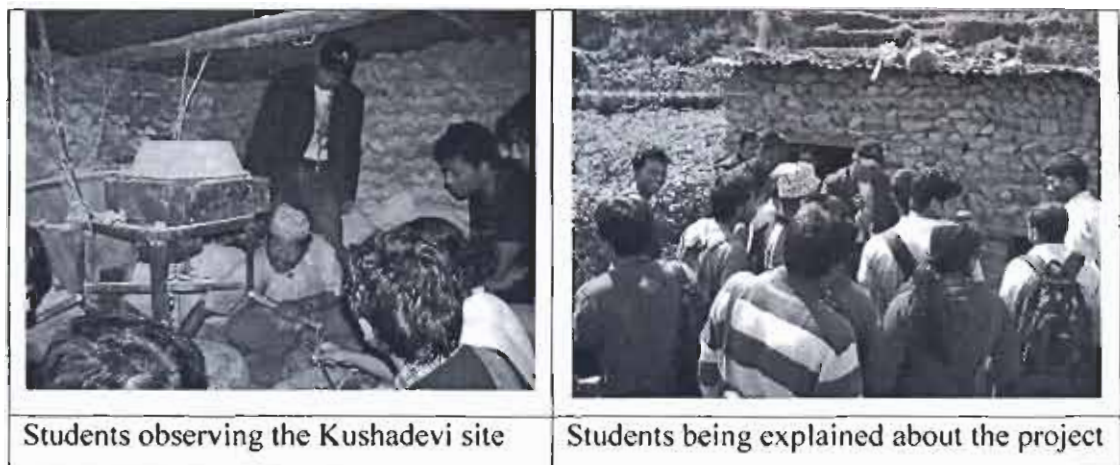


Fig. 7: Students' study visit to Kushadevi site

- Site survey in Panauti IWM:** In order to accelerate the implementation phase, the project team decided to conduct field survey of IWM near Panauti (see Fig. 8). Although there is a possibility to incorporate AFPMA of 3 kW size, it was revealed that the Ghatta owner is much interested in improving the civil structures (intake, canal etc) rather than generating electricity from his IWM. He was even not interested to make a community meeting. Therefore, the project team dropped the idea to install the unit at this site.

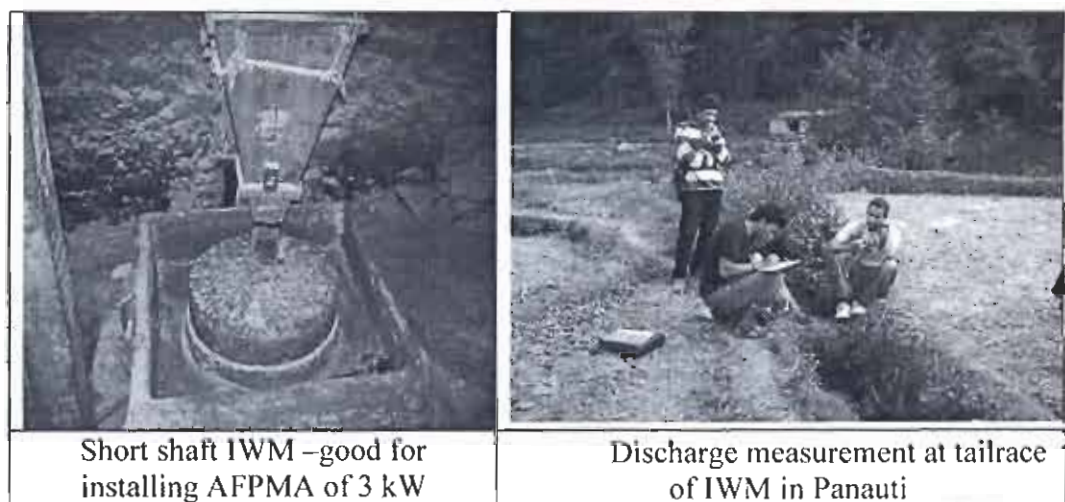


Fig. 8: IWM Site at Panauti

- Planning to install one unit in Palung, Makawanpur Districts (PAF's project area):** The project team is making a visit to the site in Palung, in Makawanpur District, which is the village within the PAF's project area. It is thought feasible to install one unit in the village where PAF is active. However, this has to be agreed from PAF. The details of project will be discussed after the team returns from the field survey.

- **Modification of AFPMA topology:** As per the second progress report, the size of the AFPMA was reduced to address the site condition and the budget. The present configuration is capable to generate up to 1 kVA if the site is less than 1.5 kW. The modification is done in such a way that the capacity could be expanded if the efficiency of the IWM system were improved.
- **Structural Analysis of AFPMA using CAD tool CATIA:** A group of dedicated engineers from E&T Pvt. Ltd. is conducting mechanical stress analysis of AFPMA. The outcome will show the structural strength of the AFPMA shaft and casing. That will increase the confidence level to predict the life span of the unit. It will also help in cost and size optimization.

5. Problem Encountered and Suggestions for Remedy

The present political instability and the monsoon have an impact on the project progress. However, the major problem encountered is the limitation information and delayed collaboration from the local area partners. It has been felt that the local area partners including Ghatta Owner Associations seem not very much interested to implement the project due largely the lack of direct financial incentive from the project. It is being difficult to convince them to have the revolving fund managed by themselves after the payback from the ghatta owners that might take more than two years or so. Those who have taken the AFPMA to the site found that the system was too heavy to carry.

Therefore, there is a need to build up consensus between PAF and the project team to reduce the size of AFPMA to fit with the site condition and to compensate with the increase in cost of the project. On top of that the team feels necessary to choose the working area of PAF to install the remaining AFPMA so that these project could be easily accessible and well take care off. On the other hand PAF's own objectives will be met in that way.

6. Remaining Works:

In the next couple of months RETSC together with CEPTE and CRT/N will be focusing on the field installation of the AFPMA in three districts. For this the team needs to collaborate with PAF to install the remaining units in its project areas.

Annex 1: Photo documentation of implementation of AFPMA in Bhadrutar-1, Nuwakot





Annex 2: Photo documentation of implementation of AFPMA in Amalbesi, Kavre



