The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Jigme Wangchuk
Project title	Impact of Hydropower dam on macroinvertebrates and fish in Kurichhu Hydropower Plant
RSG reference	20738-2
Reporting period	January 2017-January 2018
Amount of grant	£5000
Your email address	jickmew@gmail.com
Date of this report	25/1/2018

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Document the fish and macroinvertebrates diversity				This project counted nine species of fish and 60 species of macroinvertebrates. Macroinvertebrates were mostly identified up to family level while about 18 species were identified to genus level. Seven species of fish were also recorded from the fish ladder with copper mahseer as a dominating species. Amongst the project sites most impacted area was downstream of the dam as we could not encounter any fish and very few families (17 families) of macroinvertebrates were documented.
Assess the efficacy of the fish ladder				The fish ladder seems to support fish passage mostly for juvenile fishes. We have enumerated close to 100 individuals within the length of fish ladder. It includes *Schizothorax rechardsonii, S. progastus, Crossocheilus latius, Neolissochilus haxagonolepsis, Glyptothorax* sp. *Pseudencheneis sulcata*, and *Garra* sp. We could find their presence in the fish ladder and could not confirm whether they migrate upstream of the dam. To confirm this, we are planning as a next step to tag the fishes using PIT tagging technology
To assess the role of tributaries at the upstream and downstream of the dam				Compared to the main river, tributaries both upstream and downstream support higher diversity of macroinveretbrates and fish. Downstream tributary supports about 40 species of macroinvertebrates and eight species of fishes. Similarly, upstream tributary supports seven species of fishes. Tributaries also serves

				as the spawning habitat for the fish which is very crucial for conservation
Train field staff from different institution on fish and macroinvertebrates assessment techniques				Through this training 15 employees from KHPA (Kurichhu Hydropower power Authority), territorial divisions, national parks and colleges interns obtained skills and knowledge on assessing the fish and macroinvertebrates at the project sites. Additionally, there were five local people who involved in the field assessment also benefited from this project.
Awareness and information dissemination				This objective is partially achieved. As of now the field findings were presented to the stakeholders. Posters was presented during the Bhutan Ecological Society annual symposium. Once the findings are put into the manuscript for publication in the peer review journal, this objective will be fully achieved.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

The accessibility to the site especially the fish ladder was very difficult and dangerous. We seek help from the hydropower management to transport our field equipment and staff safely at the site. Reservoir, upstream of the dam was not accessible as we were not equipped with the boat and moreover it is restricted by hydropower management for safety reasons. Thus, we could not do fish assessment at the reservoir. Upstream tributaries seem to be disturbed as the area is being developed for upcoming industrial estate. This may have also affected our result.

Some of the voucher specimens are yet to be confirmed regarding identification. Lack of national aquatic entomologist, specimen identification is difficult and we are tackling this through taking highly magnified images and get conformation on name of the species by referring to experts in Naturalis Biodiversity Centre in The Netherlands. This is taking lots of time than expected. Few voucher specimens not able to confirm through the image, we are planning to transport to the expert after the government approval.

3. Briefly describe the three most important outcomes of your project.

This project has documented the freshwater macroinvertebrates and fish diversity upstream and down stream of the dam including the tributaries. Upstream has the higher diversity of macroinvertebrates and fish diversity than downstream. This project accounts 60 species of macroinvertebrate and nine species of fish.

Downstream is one of the most impacted mainly attributed by the irregular discharge being regulated from the dam. It was also observed the substrate at the downstream has been cleaned by the high flow while cleaning the upstream dam.

Figure 1. Picture showing upstream dam and downstream tributary respectively

The weir and pool structure for fish ladder seem to support for fish movement. As per our assessment it was revealed about seven species of fish use the fish ladder. It is not certain that as these fishes make through the upstream exit as the distance increases from downstream entrance the number of individual fishes seem to decrease.

The tributaries both upstream and down stream supports higher diversity than the main river both in terms of macroinvertebrates and fish diversity.

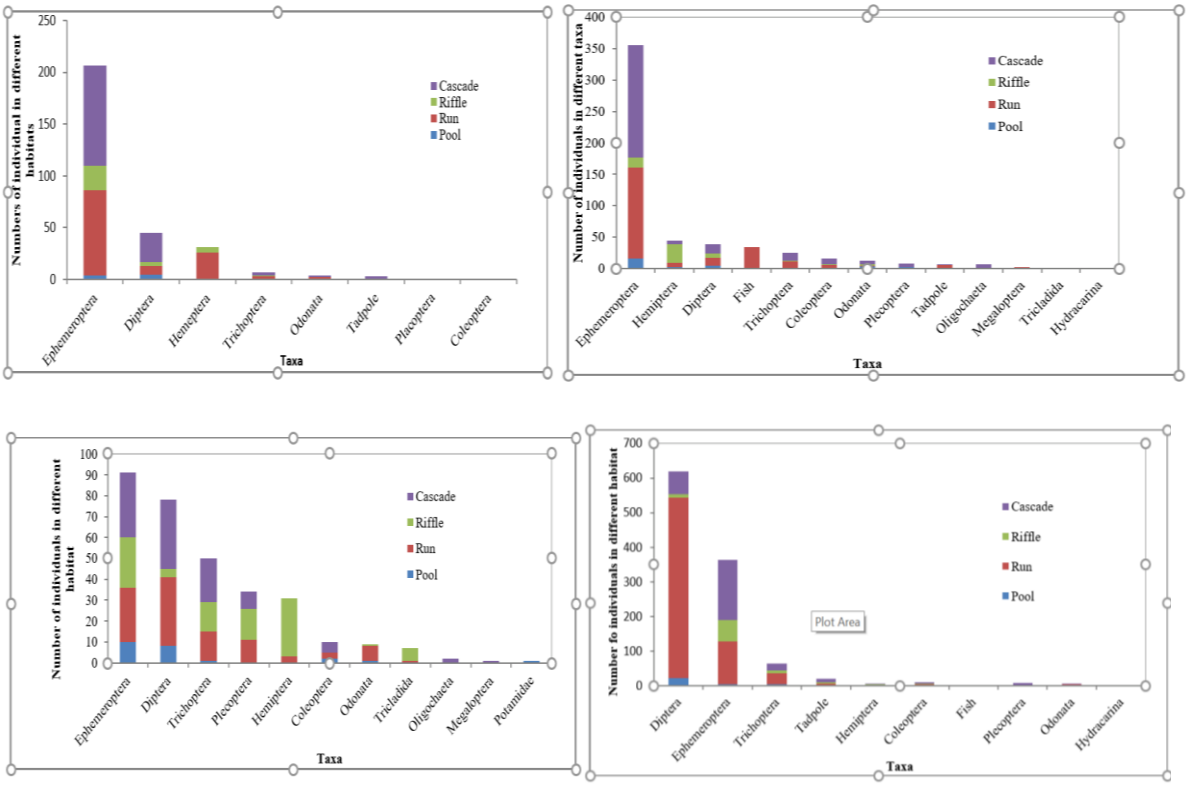

Figure 2. Showing number of individual under each taxa (from left to right from-first row-Downstream (main river) upstream Main River, second row- Downstream (tributary) and upstream (tributary).

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Communities along the upstream and downstream of the project involved through their participation in the field. Their involvement in the field as porters, field assistants, field guides and sharing the local knowledge in the locality particularly on fish species has helped both the researcher and the local residents. Employees of local institutions from the Forest territorial Division, National Park, Forest Management Units, Kurichhu Hydropower plants and college student also participated actively that has benefited in understanding the importance of freshwater biodiversity and assessment techniques.

5. Are there any plans to continue this work?

The method for assessing the fish ladder efficacy in our case seems not to work and we could not conclude the efficacy of the fish ladder by assessing the presence of fish. Thus, we have a plan to use the PIT (Passive Integrated Transponder) device technology in future to understand whether fishes pass through the existing fish ladder and how frequently they pass through. This technology will enable us to understand the number of fish that will make through the fish ladder. However, through this project we were able to confirm that the fish ladder supports movement of juvenile fish. There are only two hydropower facilities in the country with the provision of similar fish ladder. In future, extension of such studies will help understand and recommend fish ladder construction that best suits in the local environment.

Similarly, macroinvertebrates are indispensable food source of fishes and many other predators in the aquatic system. One-time measurement always overlooks the presence of species diversity; thus, I will continue to work on exploring the macroinvertebrates not only at the present project site but also in other country site in the hydropower plants and development sites to study the changes attributed by human interference. This will enhance our knowledge and skills besides disseminating the knowledge and skills to others.

6. How do you plan to share the results of your work with others?

The preliminary finding of the project has been already shared among the stakeholders and communities living along the project sites. The outcome of the studies was presented to the students, Kurichhu Hydropower Plant and forestry personnel and college students. The final outcome of this project will have shared through publication in the journal and the copy of the published journal will be uploaded in our institute website (www.uwice.gov.bt) for wider information sharing.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The project was planned for one year (January, 2017 to January, 2018) and objectives were achieved within the planned period.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Small Wi-Fi microscope to take magnified picture of live specimens in the field	350	340	+10	A microscope with the provision of Wi-Fi was procured to take live pictures in the field
Android phone with high storage capacity and capability to connect with microscope Wi-Fi to take pictures	300	310	-10	An android phone with 32 GB with a memory GB was procured for taking pictures and storing the data in the field
Safety gears (Waders, boots, hand gloves)	250	280	-30	Safely gears such as wader, live jackets and hand gloves has been procured from outside country, thus cost has gone up from the budgeted amount
Extension gears (rain gears, rucksacks, boots and pack bags)	650	620	+30	These gears were procured from the local market for the field assistants who were involved in the filed throughout the project period. Thus, the cost were cheap compared to exported ones.
Stationery, and other sampling equipment such as kick net, caste net, fishing rod, fishing bad, vials,	350	350	0	All these sampling equipment, except stationaries has been bought outside country,
Vehicle rental and maintenance	670	720	-50	Cost for hiring the vehicle for transportation of field equipment and field crew members has gone up as the distance from the working site was long.
Food and lodging during the survey	350	290	+60	Cost for this was over estimated
Daily allowance for the surveyors	950	1050	-100	Initially the travel cost was estimated for less than ten field assistants thus the estimated cost was short by 100
Charges to porter, local guide and fisherman	380	200	+180	Since the project site is not very far from the road head cost of porter

				and pony was saved substantially which was helpful to meet other short expenses
Training/seminar, voucher and poster preparation, presentation and exit meeting	350	400	-150	A presentation was made to the local communities, and institutions employees at the project site. They were provided with the working lunch with two times tea.
Water proof camera with macro capability	400	420	-20	Two cameras was purchased for taking the pictures in the water, that is why the cost was short
	5000	4980	+20	The excess amount will be used for procuring the PIT tags for fish

9. Looking ahead, what do you feel are the important next steps?

This project is first of its kind and such measurements are not done in the past. As we explore more, the shortcomings of the project are identified. In this project fish assessments manually along the ladder is not an appropriate method as it is not accessible easily and a series of measurements cannot be performed once the discharge is regulated. The most appropriate method would be PIT tagging. This technology will easily trace how many fishes can make through the fish ladder and determine the efficacy of the fish ladder. Through this experience I am planning to tag fishes downstream and upstream.

Apart from the present project site as a continuing work, a similar study will be carried out in the other hydropower projects.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

I have used the logo in the presentation and posters. Many were interested and impressed to know that there are such research funding opportunities for nature conservation. I have also shared the website link of Rufford Foundation to those interested.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Ngawang Jamtsho, Forest Ranger, **Kinley Wangdi** Forester, representing from the Mongar Territorial Division, **Tashi Jamtso** representing from Phrumsingla National Park were main team members who helped organizing this project work at the field sites. The identification of sampling reach, intimating with the local institution on execution of this project, field data collection, and organizing the training programmes in the field.

Mr. Yeshey, **Rinchen Wangdi**, **Mr. Daza** from the locality also involved specifically to sample the fish as they have more experiences on fishes in the locality. They were

very instrumental in the field for sampling the fish using the local methods such as cast net, stream diversion, hand catching and basket trap.

Jamyang Tenzin and **Rinchen** from UWICER helped in data collection from the field, using the various field equipment for fish and macroinvertebrates. **Tshering Dorji**, and **Krisna Bastola** from Bhutan Ecological Society also participated during the field data collection at the project site.

Interns from Sherubtse College, (**Jigme Phuntsho, Yonten Phuntso, and Chador Wangmo**), Uttranchal College, Dharadun (**Tandin Dorji** and **Ugyen Kelzang**) also participated in assessment of fish and macroinvertebrates in the field and identification of voucher specimens using the dissecting scope at the UWIECR.

12. Any other comments?

RF has been very supportive in funding the research activities and dissemination of findings to the public at large through direct involvement of communities in the project areas. This has helped communities and many stakeholders participating in conservation activities that has strengthened the understanding of the nature and human coexistence. Such continuous support in the developing country is always a blessing when our government has not much funding for conservation work. Over the year I have observed many young researchers specializing their interest on conservation works and generating lots of useful information for communities and government; the information may be useful for decision makers and policy makers that would ensure in balancing the conservation and development activities. I look foreword for continuous support from your organisation.