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	Phurpa
Project title	Detection and Documentation of Forest Disease in Jigme Dorji National Park in Bhutan for Forest Conservation
RSG reference	18852-1
Reporting period	14 months (2015-2016)
Amount of grant	4970
Your email address	phurpapsix@gmail.com
Date of this report	31/12/2016

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
To undertake a comprehensive inventory of forest diseases in the JDNP.				Study is divided into four seasons • Sixteen field weeks and additional one week education programme was carried out. • 100 sampling unit (50m *50m) were completed • 5052 trees were investigated
To detect and document the diversity of forest diseases and provide disease incidence and severity index				Total of 20 virulent forest pathogens were identified to species level. • 15 virulent fungi belonging to 11 families. • 3 mistletoes belonging to 2 families. • 2 insect pests belonging to 2 families. • Mean disease incidence index =28.8% (SD=13,21) • Disease severity index=0.414 (SD=0.165)
To create base line information and to fill the research gap in forest pathology discipline in Bhutan				• First such project in Jigme Dorji National Park. • The project results were submitted to JDNP and Department of Forest and Park services Bhutan for references. • Project is also submitted to Bhutan Ecological Society for publication to reach wider scale

Forest protection and conservation in line with forest pathology science				• Bhutan still lack forest diseases inventory • Forest protection activities are concentrated only to wildfire and anthropological activities. • Forest diseases research is in infancy. • There is a huge lacuna of knowledge base in forest pathology in Bhutan. • Yet, this project diversifies the forest protections to forest pathology and are now included into the Forest Management Code of Bhutan 2016. • It is also included in Forestry Field Manual of Bhutan: Silviculture and other Forestry Field Operations, 2016.
Education and awareness on forest pathology				• Education to team members and the forest officials • Local community were also involved in collecting the field data and were highlighted on forest pathology principal with images, poster and presentation. • Presentation to Colleges of Naturel Science and FRI about forest pathology. • Students were enthusiastic with this new science in Bhutan and were motivated to carry out such project in near future.

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

Jigme Dorji National Park being second largest park with 4,319 km^2 in Bhutan covers almost all the western Bhutan. The heavy monsoon rains in summers and snow in winter with varied topographical gradient (rugged and broken with many steep and steep slopes) from 1,000 meters to more than 7,000 meters above mean sea level was one of the main limiting factors for the sampling. Project team had to wait for favourable weather and due to inaccessibility of motor road team members had to walk days to reach different range of JDNP which translated into high finical cost.

Due to unfavourable terrain, sometime selection of desired number of the sampling randomly and evenly throughout the study area was difficult and had to opted possible means in some study sites. Apart from these challenges, project went very well as planned with schedule and methodology with continued support and advice from the referees during its tenure.

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

1. Knowledge base

This project documented the diversity of forest diseases and the virulent pathogens in JDNP which will act as information reservoir related to forest pathology to researchers, academicians and policy planers. It also provided a scientific way of protecting plants against the diseases incorporating the traditional knowledge. It also served as the base line information for the forest management and conservation in line with forest pathology science. It was first project related to forest diseases and it played significant role in creating base line knowledge about forest pathology to local people, students and foresters.

2. Diversification of forest protection and management for conservation biology

Until this project, Bhutan rich forest was in unique position as forest conservation were primary based on Traditional Social Restriction System, Buddhist principles, Gross National Happiness (GNH) vision and less than 9% was under scientific management with huge gaps in Forest Pathology. But, now forest pathology and its importance are included in the Forest Management Code of Bhutan, 2016 and Forestry Field Manual of Bhutan: Silviculture and other Forestry Field Operations, 2016. It is also planned to include in the next forest inventory or any other forest assessments which ever come first.

3. Education and Awareness

Forest diseases outbreaks since 1980's, had shown that diseases and insect pests can pose a great threat to forest management, conservation and biodiversity, yet in conservation efforts discussions of forest diseases is either absent or restricted to animals' diseases. Forest diseases seldom received more than a brief mention entirely due to lack of forest pathologists.

With this project, both local people and forest officials were made aware about the consequences and threats from forest pathology in conservation science.

Presentations to students, local communities and officials inculcated urgent need to enhance the forest pathology science in Bhutan. This project also educated on prevention and control of forest diseases and local people role in biodiversity conservation.

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

Many stakeholders were involved during the tenure of this project, especially park's team (Forest officials, rangers and foresters). The park manager generously provided the 5 foresters in each different range of the Park during the field survey. The foresters were very much relevant and helpful thought out the survey with their depth knowledge of the field situation and area infested with diseases. Inhabitants of the park were also comprised of trans-human and they were interview and educated during the reconnaissance survey. Project team were mostly stationed in trans-human camps to protect from harsh weathers where they received out-looked to forest diseases.

Workshop was conducted with help of local leader to the local communities and basic field disease symptoms and identification were taught for both local and forest benefits. Local people from all corner of country who were visiting to Gasa hot spring which is located inside the park were interacted and educated for forest pathology and their role in controlling the outbreak of the forest diseases were highlighted. The students of College of Natural Resource, Bhutan and Forest Research Institute, India enthusiastically participated during the education and awareness programmes of this project.

5. Are there any plans to continue this work?

I propose to develop a long term research and conservation program focusing on the Forest Pathology in forest conservation science. This study is a first step in establishing the program which primary aimed to create baseline data on forest pathogens in JDNP. With very limited knowledge about forest pathology in Bhutan, my next steps will be national workshop about Forest Pathology in conservation science involving the key conservation agencies, stakeholders and NGOs in Bhutan.

In coming years I also have planned to do project on the Conifers diseases and mistletoes assessments which is one of very promising forest diseases in Bhutan. I also have planned to do project on forest disease with respect the climate change. I have requested the Bhutan Trust Fund for Environment Conservation (BTFEC) and WWF-Bhutan for Fund to continue this pioneer research on forest pathology in Bhutan which has long term conservation benefit.

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

1. Presentation to College of Natural Science, Bhutan.
2. Presentation to Forest Research Institute, India.
3. Presentation to local communities and forest officials of JDNP.

4. Poster was made and circulated to important stakeholders.
5. Result will be also published in scientific national (Bhutan Ecological Society) and international journal.
6. Detail project will kept in JNDP for reference

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 grant was used for a period of 14 months (November 2015 – December 2016), as same time scale anticipated in the project.

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
Salaries/wages	1,721	1,750	-29	One more forester was included due to heavy luggage and steep terrains. Due to very harsh weather (snow and monsoon rain) wages demanded to be raised slightly
Travel cost	445	460	-15	There was increased in fuel price which shoot the transportation cost. The difference was also due to overheads.
Tent	39	39	00	
Rain coats	24	25	-01	The difference was due to overheads (addition of one forester)
Boots	18	20	-02	The difference was due to overheads (addition of one forester)
Education and awareness	1211	1250	-39	Refreshments were more expensive than expected. At same time there was large number of participation from College of Natural Science, Bhutan and Forest Research Institute, India
Communication	186	170	+16	Most of time communication were made from the fixed line of Institute (FRI), which result in fall of expenditure
Digital camera	501	501	00	
GPS	170	170	00	
Measuring tape	5	5	00	
Vernier calliper	20	18	+02	It was brought from the near border of Bhutan (Phuntsholing) which is cheaper without tax
Printer	200	200	00	
Printer paper	90	100	-10	More number of data sheet were printed and

				paper were more expensive in Bhutan than expected
Posters	100	90	+10	Poster were printed from the Kuensel Corporation which is little cheap then expected
Stationaries	40	30	+10	Most of stationaries were donated from the team member which resulted in fall in price
Contingencies	200	250	-50	Culture media (PDA) were brought to culture the pathogens for the identification
Total	£4,970	£5,078	£-108	Short in budget, 10,000 in Bhutanese Currency were requested from JDNP and BTFEC

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

Most important next step according the this project are,

1. Continuing with monitoring protocol which is essential to evaluate the diseases assessment, control and effect of predisposing factors and climate change to forest diseases.
2. Gathering more data and refine the diseases distribution model with help of remote sensing and GIS.
3. Replicate the similar project in other region to provide more data for conservation status assessments with respect to forest pathology for conservation science in Bhutan
4. Continuing with conservation education and awareness to forest officials, students and local communities to being closer to nature and make them understand the importance and consequence of forest pathology.

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?

Rufford Foundation logo was used in every presentation and awareness in Forest Research Institute, India and College of Natural Science in Bhutan. During course of education programmes RSGF was acknowledge and mention in length. Many students and conservationist workers were highlighted to RSGF. RSGF Logo was used in printed copy of my thesis which is distributed to Forest Research Institute and JDNP library.

11. Any other comments?

Bhutan have been identified as a global biodiversity hotspot and counted among the 234 globally outstanding eco-regions of the world by WWF with 72% of forest cover. However, in conservation efforts discussions of forest diseases is either absent or restricted to animals' diseases. Forest diseases seldom receive more than a brief mention. Therefore, there is urgent need to diversify the conservation measures to forest pathology as without forest both biodiversity and country economic will be in questions.

According to the UNFCCC the forest diseases will be increase with respect to climate change therefore, proper polices, laws and mitigation measures are needed urgently. It will be also very helpful if conservation donor, NGOs, agencies, etc. work and fund on project related to forest pathology because even in present there is very few project done on forest pathology as healthy forest is paramount importance and necessary for species survival and economic growth.