Template/Proforma for Submission

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.:	RFRI/EP/2017-18/NMHS/CFLE-1

Date of Submission:								

PROJECT TITLE (IN CAPITAL)

CAPACITY BUILDING ON BAMBOO TREATMENT TECHNIQUES FOR PROMOTION OF EARTHQUAKE RESILIENT HOUSINGS AND STRUCTURES IN HILL REGIONS OF TRIPURA

Project Duration: *from* (**01/04/2017**) *to* (**31/03/2020**).

***Submitted to*:**
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GENERAL INSTRUCTIONS:

1. The Final Technical Report (FTR) has to commence from the date of start of the Project (as per the Sanction Order issued at the start of the project) till its completion. Each detail has to comply with the NMHS Sanction Order.
2. The FTR should be neatly typed (in Arial with font size 11 with 1.5 spacing between the lines) with all details as per the enclosed format for direct reproduction by photo-offset process. Colored Photographs (4-5 good action photographs), tables and graphs should be accommodated within the report or should be annexed with captions. Sketches and diagrammatic illustrations may also be given giving step-by-step details about the methodology followed in technology development/modulation, transfer and training. Any correction or rewriting should be avoided. Please give information under each head in serial order.
3. Training/ Capacity Building Manuals (with details contents of training programme technical details and techniques involved) or any such display material related to project activities along with slides, charts, photographs should be brought at the venue of the Annual Monitoring & Evaluation (M&E) Workshop and sent at the NMHS-PMU, GBPNIHESD HQs, Kosi-Katarmal, Almora 263643, Uttarakhand. In all Knowledge Products, the Grant/ Fund support of the NMHS should be duly acknowledged.
4. The FTR Format is in sync with many other essential requirements and norms desired by the Govt. of India time to time, so each section of the NMHS-FTR needs to duly filled by the proponent and verified by the Head of the Lead Implementing Organization/ Institution/ University.
5. Five (5) bound hard copies of the Project Final Technical Report (FTR) and a soft copy should be submitted to the **Nodal Officer, NMHS-PMU, GBPNIHESD HQs, Kosi-Katarmal, Almora, Uttarakhand**.

The FTR is to be submitted into following two parts:

Part A – Project Summary Report

Part B – Project Detailed Report

Following Financial and other necessary documents/certificates need to be submitted along with Final Technical Report (FTR):

Annexure I	**Consolidated and Audited Utilization Certificate (UC) & Statement of Expenditure (SE)**, including interest earned for the last Fiscal year including the duly filled GFR-19A (with year-wise break-up)
Annexure II	**Consolidated Interest Earned Certificate**
Annexure III	**Consolidated Assets Certificate** showing the cost of the equipment in Foreign and Indian currency, Date of Purchase, etc. (with break-up as per the NMHS Sanction Order and year wise).
Annexure IV	**List of all the equipment, assets and peripherals** purchased through the NMHS grant with current status of use including location of deployment.
Annexure V	**Consolidated Manpower Certificate** and **Direct Benefit Transfer (DBT) Details** showing the education background, i.e. NET/GATE etc. qualified or not, Date of joining and leaving, Salary paid per month and per annum (with break up as per the Sanction Order and year-wise).
Annexure VII	**Refund of any unspent balance as Demand Draft in favor of DDO, GBPNIHESD** payable at GBPNIHESD, Kosi-Katarmal, Almora, Uttarakhand.
Annexure VIII	**Details of Technology Transfer and Intellectual Property Rights developed.**

DSL: Date of Sanction Letter

3	1	0	3	**2**	**0**	**1**	**7**
d	d	m	m	y	y	y	y

DPC: Date of Project Completion

3	1	0	3	**2**	**0**	**2**	**0**
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	RFRI/EP/2017-18/NMHS/CFLE-1						
ii.	Type of Project	Small Grant	**SG**	Medium Grant		Large Grant		
iii.	Project Title	Capacity Building on Bamboo Treatment Techniques for Promotion of Earthquake Resilient Housings and Structures in Hill regions of Tripura						
iv	State under which Project was Sanctioned	Tripura						
v.	Project Sites (IHR States covered) (Maps to be attached)	The following sites have been selected for the implementation of the project work: **a) Barkathal Cluster (West Tripura)** 1) Bargachia para 2) Wabusa 3) Khampar para (Site-I) 4) Khampar para (Site-II)						

Bargachia Para and Wabusa sites at Barkathal cluster

<table>
<tr><td></td><td></td><td colspan="6">  
At Barkathal cluster
b) Machmara Cluster (Unakoti Tripura)
1) Bhuvanpur
2) Deownbari
  
Bhuvanpur Deownbari</td></tr>
<tr><td>vi</td><td>Scale of Project Operation</td><td>Local</td><td></td><td>Regional</td><td></td><td>Pan-Himalayan</td><td></td></tr>
<tr><td>vii.</td><td>Total Budget/ Outlay of the Project</td><td colspan="6">29.61 lakhs</td></tr>
<tr><td>viii.</td><td>Lead Agency</td><td colspan="6">Forest Research Centre for Livelihood Extension (FRCLE), Agartala</td></tr>
<tr><td></td><td>Principal Investigator (PI)</td><td colspan="6">Pawan K Kaushik, Scientist-F, FRCLE</td></tr>
<tr><td></td><td>Co-Principal Investigator (Co-PI)</td><td colspan="6">Dr. Selim Reza, Coordinator, TRIBAC</td></tr>
</table>

ix.	Project Implementing Partners	Tripura Bamboo and Cane Centre (TRIBAC), Agartala
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Pawan K Kaushik, Scientist -F, FRCLE and Dr. Selim Reza, Coordinator, TRIBAC

2. Project Outcome

2.1. Abstract (not more than 500 words) [it should include background of the study, aim, objectives, methodology, approach, results, conclusion and recommendations).

Background:

Tripura is prone to various natural disasters, particularly Earthquake. The State is situated in the most vulnerable earthquake-prone Zone-V of India. Having regard to the fact of multi disaster-prone. It is difficult for marginalized peoples in hilly areas of Tripura to afford pucca houses to them. Tripura's high degree of earthquake susceptibility makes pucca houses in hilly regions unfeasible for low-income groups of people. The northeastern part of India is blessed with ample Bamboo resources. The tensile strength of 28000 pounds per square inch makes Bamboo one of the strongest building materials. The strong mechanical properties of bamboo enable it to withstand heavy loads of concrete during building construction. To serve the dual purpose of promoting earthquake-resilient Bamboo houses and community micro-enterprise development through treating the Bamboo using VPI to extend its durability, FRC-LE came up with a project proposal of 48 lakhs and was submitted to NMHS, but it was sanctioned with a reduced budget to 60% only. Considering the budget limitedness, FRCLE came up with a low-cost, earthquake-resilient and eco-friendly Bamboo house design that serves the interest of the marginalized people of Tripura. Construction of bamboo houses through a participatory approach at both the project sites (Machmara and Barkathal) was done by organizing trainings on different bamboo-based construction aspects as per the schedule of the project action plan. Lack of bamboo treatment facilities discourages the local communities from using bamboo in quake-resilient housing and structures. Without treatment, bamboo structures often get spoiled and all efforts in designing and making them go in vain. Bamboo resource is under degradation, and the use of bamboo without proper treatment need to be discouraged to minimize its consumption for conservation. Life in rural Tripura has an intimate relationship with Bamboo. A divine idea of developing Bamboo preservation-based community micro-enterprise in the tribal clusters of Tripura for economic self-sufficiency was the brainchild of FRC-LE. Design development and promotion of low-cost earthquake resilient Bamboo houses and establishing community micro-enterprise equipped with VPI (Vacuum Pressure Impregnation)

machines for increasing the durability of Bamboo for producing Bamboo handicrafts were the main gears of this visionary idea.

Objectives/ Aim:

- Skill upgradation and capacity building of hill communities on low-cost bamboo preservation technologies.
- Entrepreneurship development for hill communities through participatory management of livelihood-environment convergent models by establishing Bamboo Treatment Centers.
- Disaster risk reduction and Socio-economic upliftment of hill communities.
- Impact analysis and process documentation.

Methodology's:

- Hands-on training on bamboo treatment techniques and constructing earthquake-resilient bamboo houses (On-site –18 trainings).
- Start-up support with a viable business plan for risk mitigation.
- Earthquake-resilient bamboo houses constructed through a participatory approach.
- Studies were conducted to assess the impacts of training and awareness generation.

Approach:

- Selection of target users/beneficiaries.
- Training and awareness for sensitization.
- Skill development on technical aspects of bamboo treatment and construction of bamboo-made earthquake-resilient houses.
- Setting up micro-enterprises in the bamboo treatment business.
- Construction of bamboo-made earthquake-resilient houses.
- Process documentation and impact analysis.

Results:

- Community awareness regarding preservation, conservation and judicious use of bamboo resources.
- Capacity building on bamboo treatment techniques and sensitization in adopting quake-resilient housing and structures.
- Setting up of two community micro-enterprises.
- Livelihood promotion for tribal and rural communities in the two project sites.
- Process documentation and Impact analysis of the project activities.

Conclusion:

Bamboo houses are eco-friendly and earthquake resilient. Moreover, the FRC-LE developed design of the Bamboo house is a low-cost house design which can be afforded by the low-income groups and the rich on hills in North-East India. When treated bamboo is used, the structure is more durable, and the Bamboo house may be maintained for even 50 years.

Recommendations:

Site selection and demarcation:

Field surveys and meetings were conducted for selection of the two project sites in Hill areas of West Tripura district and Unakoti district (undivided North Tripura). Two Village clusters i.e. Barkathal and Machmara were selected for execution of project work in participation with the local communities and promote the bamboo treatment techniques among them.

Participatory planning with community approach:

The local communities were involved in planning for smooth implementation of activities related to trainings, capacity building and micro-enterprise development in both the sites. For construction of model bamboo houses the plots identified and allotted by the communities were demarcated in both the clusters. The local artisans and experts engineers under PMAY were consulted in designing the models of the proposed bamboo structures.

Procurement of equipment and machineries:

Boucherie apparatus (6 units), Boiling Tank/Rolling Tank (2 units) and Vacuum Pressure Impregnated (VPI) Machine (2 sets) were purchased for conducting training and also for treatment of bamboos in commercial scale.

Trainings:

Course Modules for different trainings were developed in view of making it more people friendly. An exposure to experimental outputs was also organized and a participatory SWOT analysis of the experimental results was also conducted for exploring the feasibility and effectiveness of different treatments and methods. The scheduled activities as “Awareness cum Skill Training on Bamboo Harvesting and Preservation for Earthquake Resilient Green Buildings” were also organized for the participating communities in both the sites. A total of 130 trainees were trained in harvesting and preservation techniques. An exposure visit was also organized for the participating communities by demonstrating preservation techniques at the Centre. The participants were also taken to *Sri-Sri Ravishankar School* Building completely made of treated bamboos.

Construction of Bamboo Houses:

Construction of bamboo houses through a participatory approach at both project sites was completed by organizing training on different bamboo-based construction aspects and schedules as proposed in the action plan. In this connection, training on the “Importance of Bamboo Preservation, Joints and Joinery Techniques and Truss Making” was also organized in a phased manner.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1.	Skill up gradation and capacity building of hill communities on low-cost bamboo preservation technologies.	• Meeting conducted with local people to identify the target groups at Barkathal cluster, West Tripura and Machmara cluster, Unokoti Tripura. • Training imparted to 541 target users on bamboo preservation techniques. • Training organised on bamboo preservation and earthquake resilient buildings. • Selection of target users/beneficiaries. • Training and awareness for sensitization. • Skill development on technical aspects of bamboo treatment and construction of bamboo made earthquake resilient houses. • Setting up micro-enterprises on bamboo treatment business. • Construction of bamboo made earthquake resilient houses. • Process documentation and impact analysis.
2.	Entrepreneurship development for hill communities through participatory management of livelihood environment convergent models by establishing Bamboo Treatment Centres.	• The communities in the project sites were consulted and explained about the project deliverables and their role in management of the resources developed under the project. • Location and area for the establishment of Bamboo Treatment Centres were selected through participatory approach. • Machines, tools and other facilities for treatment of bamboos were provided to the both of Community Micro Enterprise.

3.	Disaster risk reduction and Socio-economic upliftment of hill communities.	• Meetings conducted with the Jan Unnayan Samiti Tripura (JUST) for selection of site at Borkathal (West Tripura) and the Anandmarg for selection of site at Bhuvanpur (Unokoti Tripura in North). • The committees have adopted the model of entrepreneurship through bamboo preservation techniques. • The committees from the both site were involved in treating the bamboos for construction of the Bamboo houses proposed under the project. • Design of earthquake resilient buildings was finalized, locations were selected and the bamboos were treated in phases.
4.	Impact analysis and process documentation	• Feedbacks from the members of community enterprise were collected for finalizing the recommendations under the project.

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Deviations made, if any, and Reason thereof:
	Trainings on skill up gradation and capacity building of hill communities	541 target users trained and they are now able to treat the bamboos by themselves.	

	Setting up of micro enterprise in two project sites and establishment of bamboo treatment	2 micro enterprises set up for participating communities for product development and other activities.	
	Entrepreneurship development through livelihood- environment models and DRR in participatory manner	Socio economic status of hill communities is expected to improved as per the feedback so far.	
	Bamboo houses were constructed and demonstrated and development of manual	8 bamboo houses constructed and demonstrated	

(*) As stated in the Sanction Letter issued by the NMHS-PMU.

2.4. Strategic Steps with respect to Outcomes (in bullets)

S. No.	Particulars	Number/ Brief Details	Remarks/ Enclosures
1	New Methodology developed	• The continuous increase in population generated huge pressure on natural resources. There is massive demand on wood timber for construction purpose as well as other wooden based works resulting severe deforestation in existing natural forest. • To find out the suitable alternative, bamboo has enough potential to replace the needs of timber. But bamboo is very susceptible to fungi and termite attack which reduces its durability. • To keep bamboo infestation free for a long duration there is need of treatment and preservation in bamboo. Now a day's various commercial chemical preservatives (CCA, CCB and PCP which is responsible for environmental and human health hazards) are used to treat the bamboo for extending its life span. Hence, to make environment safe, eco-friendly bio resources based media such as 'Castor', 'Neem + Kalamegh' are used to treat bamboo whose effectiveness is equivalent to commercial	

		chemical preservatives. • Besides, these bio media are easily available and cost effective so people can readily use these media to treat the bamboo for construction purpose and other works. However, much work still needs to be done to completely determine the efficacy of many of these newly developed preservatives and techniques. • To make bamboo treatment and preservation more people friendly, utilization of bio resources in a proper scientific way is obvious. These kinds of alternatives can work in both ways by saving the environment replacing hazardous chemical in addition to sustainable treatment of bamboo.	
2	New Models/ Process/ Strategy developed	• SWOT analysis to know the effect of different media on bamboo preservation • Bamboo treatment using VPI machine for extending durability	
3.	New Species identified	NA	
4.	New Database established	NA	
5.	New Patent, if any	NA	
	I. Filed (Indian/ International)		
	II. Granted (Indian/ International)		
	III. Technology Transfer(if any)		
6.	Others (if any)		

3. Technological Intervention:

S. No.	Type of Intervention	Brief Narration on the interventions	Unit Details (No. of villagers benefited / Area Developed)
1.	Development and deployment of indigenous technology	NA	
2.	Diffusion of High-end Technology in the region	Vacuum pressure impregnation technology was introduced for bamboo treatment.	02 Nos.
3.	Induction of New Technology in the region	Boucherie apparatus was promoted for small scale treatment process. Bamboo treatment tanks were also installed to introduced Boiling method.	06 Set
4.	Publication of Technological / Process Manuals	Developed construction manual for low cost bamboo made houses	01 No.
	Others (if any)		

4. New Data Generated over the Baseline Data

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data

5. Demonstrative Skill Development and Capacity Building/ Manpower Trained

S. No.	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	**ST**	**Woman**	**Total**
1.	Workshops	4		17	42	25	59
2.	On Field Trainings	6		85	172	125	257
3.	Skill Development	3		97	128	120	225
4.	Academic Supports						
	Others (if any)						

AWARENESS - CUM - SKILL TRAINING PROGRAM UNDER FRCLE - NMHS PROJECT

on

BAMBOO PRESERVATION, JOINERY AND TRUSS MAKING FOR CONSTRUCTION OF BAMBOO HOUSES

27 - 28th Aug., 2019

Venue: Barkathal, West Tripura

Organised by

FOREST RESEARCH CENTRE FOR LIVELIHOOD EXTENSION

SHAL BAGAN FOREST CAMPUS, PO – GANDHIGRAM, AGARTALA - 799012

In Collaboration with TRIBAC

AWARENESS - CUM - SKILL TRAINING PROGRAM UNDER FRCLE - NMHS PROJECT

on

BAMBOO PRESERVATION, JOINERY AND TRUSS MAKING FOR CONSTRUCTION OF BAMBOO HOUSES

Sept. 10 - 11, 2019

Venue: Bhubanpur, Machmara

Organised by

FOREST RESEARCH CENTRE FOR LIVELIHOOD EXTENSION

SHAL BAGAN FOREST CAMPUS, PO – GANDHIGRAM, AGARTALA - 799012

In Collaboration with TRIBAC

Bhuvanpur, Machmara Cluster, Unakoti Tripura




Bargachia, Barkathal Cluster, West Tripura

6. Linkages with Regional & National Priorities (SDGs, INDC, etc)/ Collaborations

S. No.	Linkages /collaborations	Details	No. of Publications/ Events Held	Beneficiaries

1.	Sustainable Development Goal (SDG)	• JUST (Jana Unnayan Samati Tripura), Agartala. Facilitating community mobilization activities. The NGO has a very good liaison with the communities for the last 3 years. • EDII (Entrepreneurship Development Institute of India), Agartala Branch. Marketing support for community entrepreneurship development. The institute has an expertise and mandate of entrepreneurship development in Tripura.		
2.	Climate Change/INDC targets			
3.	International Commitments			
4.	Bilateral engagements	TRIBAC (Tripura Bamboo and Cane Development Centre, Agartala)		
5.	National Policies	PMAY Scheme		
6.	Others collaborations	Ananda Marga Sanstha		

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats	Trainings on skill up gradation and capacity building of hill communities.	Entrepreneurship developed.
2.	Govt Departments (Agriculture/ Forest)	Setting up of micro enterprise in two project sites and establishment of bamboo treatments.	Youth have been benefitted through trainings.
3.	Villagers	Entrepreneurship development through livelihood- environment models and DRR in participatory manner.	Bamboo growers, artisans and PMAY beneficiaries have been benefited.
4.	SC Community	Bamboo houses have been constructed and demonstrated and manual developed.	Target groups/ Local communities were depend on microenterprise for generating livelihood.
5.	ST Community	Trainings on Skill Up gradation and Capacity Building of Hill Communities (541 target users on bamboo preservation techniques).	Training imparted to 541 target users on bamboo preservation techniques and its importance. The VPI plants, Boucherie machines and Treatment Tanks (Boiling and soaking) were installed and demonstrated in the field during hands on trainings.
6.	Women Group	Training and workshop for capacity building.	Additional income generation through community micro enterprise.
	Others (if any)		

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	3,00,000	2,59,084	86.36
II.	Travel	65,000	64,757	99.63
III.	Expendables &Consumables	60,000	58,323	97.20
IV.	Contingencies	50,000	49,951	99.90

V.	Activities & Other Project cost	1,00,000	98,182	98.18
VI.	Institutional Charges			
VII.	Equipments	8,50,000	8,46,926	99.64
	Total	14,25,000	13,77,223	96.65
	Interest earned	32,308		
	Grand Total	14,57,308		

* Please attach the consolidated and audited Utilization Certificate (UC) and Year wise Statement of Expenditure (SE) separately, *ref*. **Annexure I.**

9. Major Equipment/ Peripherals Procured under the Project** (if any)

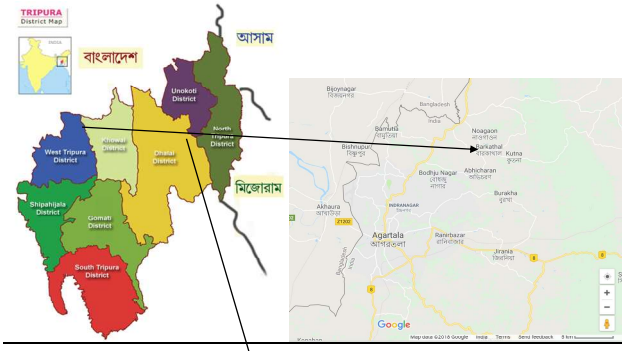
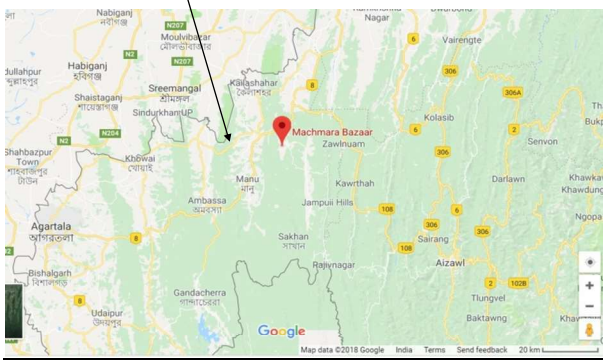
S. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	Boucherie Apparatus	Rs. 96,900/-	All the equipments are operational and being utilized for training demonstration and business development.
2.	Rolling Tank /Boiling Tank	Rs. 29,944/-	
3.	VPI (Vacuum Pressure Impregnated machine)	Rs. 1,47,500/-	
4.			
5.			

Details should be provided **(*ref* Annexure III &IV).

10. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States Covered	*1*	Two hilly areas of Tripura.
2.	Project Site/ Field Stations Developed	2 clusters (at two project sites, total 6 houses constructed)	6 model houses – One in each of six villages and 2 Structures for Microenterprises - One in each of two cluster equipped as a bamboo treatment centre.
3.	New Methods/ Modeling Developed	SWOT Analysis for feasibility study	The continuous increase in population generated huge pressure on natural resources. There is massive demand on wood timber for construction purpose as well as other wooden based works resulting severe deforestation in existing natural forest. To find out the suitable alternative, bamboo has enough potential to replace the needs of timber. But bamboo is very susceptible to fungi and termite attack which reduces its durability. To keep bamboo infestation free for a long duration there is need of treatment and preservation in bamboo. Now a day's various commercial chemical preservatives (CCA, CCB and PCP which is responsible for environmental and human health hazards) are used to treat the bamboo for extending its life span. Hence, to make environment safe, eco-friendly bio resources based media such as 'Castor', 'Neem + Kalamegh' and 'Cow urine' are used to treat bamboo whose effectiveness is equivalent to commercial chemical preservatives. Besides, these bio media are easily available and cost effective so people can readily use these media to treat the bamboo for construction purpose and other works. However, much work still needs to be done to completely determine the efficacy of many of these newly developed preservatives and techniques. To make bamboo treatment and preservation more people friendly, utilisation of bio resources in a proper scientific way is obvious. These kinds of alternatives can work in both ways by saving the environment replacing hazardous chemical in

			addition to sustainable treatment of bamboo.
4.	No. of Trainings arranged	20 Trainings	• Awareness generation cum training program on bamboo harvesting and preservation for housing.(Dated: 19-05-2017) • Awareness generation cum skill training on bamboo harvesting and preservation for earthquake resilient green building. (Dated: 15-11-2017 to 16-11-2017) • Awareness generation cum skill training program under CFLE-NMHS project on bamboo harvesting and preservation for earthquake resilient green building. (Dated: 05-01-2018) • Training programme on bamboo preservation, joints and joinery techniques and truss making. (Dated: 25-03-2018 to 26-03-2018) • Training on processing, preservation and artisan work for construction of bamboo house and related application. (Dated: 16-11-2018 to 17-11-2018) • Training on bamboo treatment house construction and awareness generation. (Dated: 07-12-2018, 08-12-2018 and 11-12-2018) • Training on bamboo preservation, joinery and truss making for construction of bamboo houses. (Dated: 27-08-2019 to 28-08-2019) • Training on bamboo preservation, joinery and truss making for construction of bamboo houses. (Dated: 10-09-2019 to 11-09-2019) • Entrepreneurship development through establishment community microenterprise on bamboo preservation. (Dated: 16-09-2019) • Bamboo architecture and structural components for house construction etc. (Dated: 25-11-2019)
5.	No of beneficiaries attended trainings	*541*	Training on bamboo preservation, truss making, sustainable harvesting, house construction, VPI operation was imparted.
6.	Scientific Manpower Developed	*2*	JRFs were engaged under the project at the centre.

	(Phd/M.Sc./JRF/SRF/ RA):		
7.	SC stakeholders benefited	*299*	In both the sites
8.	ST stakeholders benefited	*342*	In both the sites
9.	Women Empowered	*270*	
10.	No of Workshops Arranged along with level of participation	5	4 (inclu. 1 Exposure visit)
11.	On field Demonstration Models initiated	6 **Bamboo houses**.. (attach maps about location & photos)	 Location of **Barkathal Cluster,** West Tripura in Googlemap  Location of **Bhuvanpur Cluster**, Machmara, Unokoti Tripura in Google map 

			    
12.	Livelihood Options promoted		Livelihood option through community enterprise on bamboo treatment was developed and promoted under the project
13.	Technical/ Training Manuals prepared		Construction manual for bamboo houses was finalized (appen
14.	Processing Units established	2 - under progress....	Photos already given at Sl. No. 2.

		(attach photos)	
15.	No of Species Collected	*NA*	
16.	New Species identified	*NA*	
17.	New Database generated (Types):	*NA*	
	Others (if any)		

11. Knowledge Products and Publications:

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.		03			
2.	Book Chapter(s)/ Books:				
3.	Technical Reports	02			
4.	Training Manual (Skill Development/ Capacity Building)	01			a) Training programs on 'Awareness generation and skilling in bamboo treatment methods' covered a total of 541 participants. The bamboo users have started realizing the necessity of bamboo treatment techniques due to the awareness generation and publicity through media. b) Awareness cum Skill Training on Bamboo Harvesting and Preservation for Earthquake Resilient Green Buildings.

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
					c) Training program on "Processing, Preservation and artisan work for construction of Bamboo house and related application" was conducted at Khampar Para, Barkathal project site for three days during 16th, 17th and 19th November, 2018. d) One more training program on Bamboo preservation, Joints and joinery techniques and truss making was organised for familiarization of 30 participating users with the machines and tools procured for making bamboo houses.
5.	Papers presented in Conferences/Seminars	4			a) One research paper "Utilisation of Bio Resources based media for Eco-friendly Preservation and Treatment of Bamboo species" published in Seminar proceedings. b) Kaushik, P.K. and Islam, N.J. Md. Scope of Bamboo Treatment

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
					Techniques for Promotion of Community Enterprise Development among Tribal Women in Tripura, International Conference on Climate Change, Biodiversity and sustainable Agriculture (ICCBSA- 2018), 13-16 December, 2018, Jorhat, Assam, p. 302. c) Fabrication of low-cost and user friendly VPI bamboo treatment plant by P.K Kaushik, Submitted for publication at North-East Colors, Tripura. d) Construction of Low Cost, Earthquake Resilient Bamboo Houses Using Treated Bamboos by Md. Nuruj Jaman Islam and P. K Kaushik, Submitted for publication at Tripura Times, Agartala, Tripura.
6.	Policy Drafts/Papers				
7.	Others:				

* Please append the list of KPs/ publications (with impact factor and further details) with due Acknowledgement to NMHS.

12. Recommendation on Utility of Project Findings, Replicability and Exit Strategy

Particulars	Recommendations
Utility of the Project Findings	• The treatment methods are not much complicated, so getting the attention of the local communities and organizations with an increasing trend day by day. • The treatment methods are equally useful for the bamboo handicraft sector also. Thus, the model developed under the project is much more feasible to extend and may be well adopted by local users in the future. • Based on the findings/observations the machine can be improved and upgraded for better performance and commercial output. • The outcomes and experiences from this project will be utilized in our new project in collaboration with IIT, Guwahati on "Evaluation of Bamboo Houses for Earthquake resistance". • In future projects, it will provide an opportunity to study the durability of bamboo made housing components like posts, truss, wall panels etc. made out of treated bamboo of different species.
Replicability of Project	• The model of Community Micro-enterprises developed under the project can be very well replicated in other parts of the State. • The model can be well adopted under the PMAY Scheme subject to a suitable policy for popularising bamboo houses over the RCC. • For wider acceptability and implementation of the project, outcomes can be replicated through the Vibrant Villages Programme in the border villages.
Exit Strategy	The Center will continue to mobilize the community for low-cost bamboo houses in the region. Further, the project outcome will be disseminated amongst other stakeholders through the line Departments and Agencies as they have already linked to them. The established units under the project will inspire the community, especially youth, to adopt the project's outcomes. So sharing the project's outcomes with the line department and agencies and the support of beneficiaries and stakeholders under the project will give a strategic exit.

(**PROJECT PROPONENT/ COORDINATOR**)

(Signed and Stamped)

(**HEAD OF THE INSTITUTION**)

(Signed and Stamped)

Place: ……..
Date: …../……/……

PART B: PROJECT DETAILED REPORT

The Detailed report should include an Executive Summary and it should have separate chapters on (i) Introduction (ii) Methodologies, Strategy and Approach (iii) Key Findings and Results (iv) Overall Achievements (v) Project's Impacts in IHR (vi) Exit Strategy and Sustainability (vii) References and (viii) Acknowledgement (It should have a mention of financial grant from the NMHS, MoEF&CC)

Further, description of Technical Activities, List of Trainings/ Workshops/ Seminars with details of trained resources, list of New Products developed under the project, Manual of Standard Operating Procedures (SOPs) developed, Technology developed/Transferred etc should be enclosed as Appendix.

1 EXECUTIVE SUMMARY

The Executive Summary of the project should not be more than 3–5 pages, covering all essential features in precise and concise manner as stated in Part A (Project Summary Report) and Part B (Comprehensive Report).

Field surveys conducted for the selection of the project sites in West Tripura district and Unakoti district (undivided North Tripura).Two Village clusters i.e. Barkathal and Machmara selected for executing the project work in West Tripura and Unakoti District respectively. Beside this, two community groups were formed for smooth implementation of project work in both the sites. Suitable locations were identified for construction of model houses at villages in both the cluster has been identified. The model of bamboo structure were developed in consultation with the local experts.

Boucherie apparatus (6 nos.), Boiling Tank /Rolling Tank (2 nos) and Vacuum Pressure Impregnated (VPI) Machine (2 nos.) were purchased for conducting training program and bamboo treatment. Course Modules for different trainings were developed for making it more people friendly. A participatory SWOT analysis was also conducted for exploring the feasibility and effectiveness of different treatments and methods.

FRCLE conducted trainings on "Awareness cum Skill Training on Bamboo Harvesting and Preservation for Earthquake Resilient Green Buildings" in Barkathal, West Tripura and Bhuvanpur, Unakoti Tripura.

Construction work for Bamboo building at both the project sites were executed with a participatory approach by conducting training programs. FRCLE imparted trainings on "Importance of Bamboo Preservation, Joints and Joinery Techniques and Truss Making" in both the sites.

2 INTRODUCTION

2.1 Background of the Project (max. 500 words)

Tripura is prone to various natural disasters, particular to Earthquake. The State is situated in the most vulnerable earthquake prone Zone-V of India. Having regard to the fact of multi disaster prone. It is difficult for marginalized peoples in hilly areas of Tripura to afford pucca house to themselves. High degree of earthquake susceptibility of Tripura makes pucca houses in hilly region unfeasible for the low income groups of people. North-eastern part of India is blessed with ample Bamboo resources. Tensile strength of 28000 pounds per square inch makes Bamboo one of the strongest building materials. The strong mechanical properties of bamboo enable it to withstand heavy loads of concrete during building construction. To serve the dual purpose of promoting earthquake resilient Bamboo house and community micro-enterprise development through treating the Bamboo using VPI to extend its durability FRC-LE came up with a project proposal of 48 lakhs and was submitted to NMHS but it was sanctioned with a reduced budget to 60% only. Keeping in view the budget limitedness in mind FRC-LE came up with a low cost, earthquake resilient and eco-friendly Bamboo house design which serves the interest of marginalized people of Tripura. Construction of bamboo buildings through a participatory approach at both the project sites (Machmara and Barkathal) are in progress by organizing trainings on different bamboo-based construction aspects as per the and schedule of the project action plan of the project. Construction of two houses is fully complete at Barkathal site. In this connection trainings on different aspects on bamboo treatment and house construction are being organized. Lack of bamboo treatment facilities discourages the local communities to use bamboos in quake resilient housing and structures. Without treatment, bamboo structures often get spoiled and all efforts in designing and making them go in vain. Bamboo resource is under degradation and use of bamboos without proper treatment is needed to be discouraged to minimize its consumption for conservation. Life in rural Tripura has an intimate relationship with Bamboo. A divine idea of developing Bamboo preservation based community micro-enterprise in the tribal clusters of Tripura for economic self-sufficiency was the brainchild of FRC-LE. Design development and promotion of low cost earthquake resilient Bamboo houses and establishing community micro-enterprise equipped with VPI (Vacuum Pressure Impregnation) machines for increasing the durability of Bamboo for producing Bamboo handicrafts were the main gears of this visionary idea.

2.2 Overview of the Major Issues to be Addressed (max. 1000 words)

- Lack of awareness on modern bamboo treatment techniques
- Lack of awareness on disasters and their management.
- Lack of capacity to adopt quake resilient measures.

2.3 Baseline Data and Project Scope (max. 1000 words)

- Employment generation: The model of community micro-enterprise is going to create employment in successive stages of value chain i.e. bamboo harvesting, transportation, machine operating. This may generate sufficient income to the rural youths.
- Capacity building: Besides the VPI based micro-enterprise, young entrepreneurs can opt for establishing bamboo handicraft making enterprises using the treated Bamboo which gets a hold of extended durability.
- Resource conservation: The extended durability of Bamboos has an indirect impact in reducing the pressure on Bamboo forests which are now extensively harvested.

2.4 Project Objectives and Target Deliverables (as per the NMHS Sanction Order)

(i) Skill upgradation and capacity building of hill communities on low-cost bamboo preservation technologies.

(ii) Entrepreneurship development for hill communities through participatory management of livelihood environment convergent models by establishing Bamboo Treatment Centre's.

(iii) Disaster risk reduction and Socio-economic upliftment of hill communities

(iv) Impact analysis and process documentation.

Target Deliverables:

(i) Interactive meeting with the communities-(FRCLE and TRIBAC).

(ii) Hands on training on bamboo treatment-(FRCLE).

(iii) Meeting with PRIs and SHGs and identification of target users (FRCLE and TRIBAC).

(iv) Training with tools and machines of bamboo harvesting and treatment (FRCLE).

(v) Identification of SHGs and strengthening them with necessary tools and techniques.

(vi) Setting up micro- enterprises on bamboo treatment and producing bamboo housing components.

(vii) Identification of two groups in each site for setting up of micro-enterprise and related formalities (FRCLE and TRIBAC).

(viii) Construction of earthquake resilient demo houses.

(ix) Awareness Generation program on DDR.

(x) Developing market linkages for treated bamboos and housing components.

(xi) Documentation of reasoning of success and failure, if any identification of appropriate approaches.

(xii) Development of construction manual.

3 METHODOLOGIES, STARTEGY AND APPROACH

3.1 Methodologies used for the study (max. 1000 words)

Methodology's:

- Hands on training on bamboo treatment techniques and construction of quake resilient bamboo houses (On-site –18 trainings).
- Start up support with viable business plan for risk mitigation.
- Earthquake resilient bamboo houses constructed through participatory approach.
- Studies conducted to assess the impacts of training and awareness generation.

Strategy:

Approach:

- Selection of target users/beneficiaries.
- Training and awareness for sensitization.
- Skill development on technical aspects of bamboo treatment and construction of bamboo made earthquake resilient houses.
- Setting up micro-enterprises on bamboo treatment business.
- Construction of bamboo made earthquake resilient houses.
- Process documentation and impact analysis

3.2 Preparatory Actions and Agencies Involved (max. 1000 words)

- Interactive meeting with the communities – (TRIBAC and FRCLE)
- Hands on training on bamboo treatment – (FRCLE)
- Meeting with PRIs and SHGs and identification of target users (TRIBAC and FRCLE)
- Training with tools and machines on bamboo harvesting and treatment (FRCLE)
- Identification of two groups in each site for setting up micro-enterprise and related formalities (TRIBAC and FRCLE)
- Setting up micro-enterprises on bamboo treatment and producing bamboo housing components

- Identification of SHGs and strengthening them with necessary tools and techniques
- Developing market linkages for treated bamboos and housing components.
- Construction of earthquake resilient demo houses
- Documentation of reasoning of success and failure, if any, identification of appropriate approaches
- Impact analysis of project activities

3.3 Details of Scientific data collected and Equipments Used (max 500 words)

Boucherie apparatus (6 units), Boiling Tank/Rolling Tank (2 units) and Vacuum Pressure Impregnated (VPI) Machine (2 sets) were purchased for conducting training and also for treatment of bamboos in commercial scale.

Boucherie Apparatus (6 nos.):- Boucherie apparatus (patented by RFRI-ICFRE) for Bamboo treatment consisting of a main tank (made up of 10 SWG MS Sheet) fitted on a stand with a pressure gauge, level indicator, release valve and 03 nos. of adapters (4"– 1 no, 3"- 1 no, 2"-1 no.) fitted on one side of the tank and proper arrangements made for operating the adapter individually, including the following accessories-

1. Foot Pump- 01 no
2. Adapter-03 nos.
3. Clamps-06 nos.

Rolling Tank /Boiling Tank (2 nos.):- Boiling Tank for Bamboo treatment consisting of a main tank (made up of 4 mm MS Sheet) mounted on 04 legs with a cover hinged (made up of 20 SWG GI Sheet) with proper locking facilities as per drawing enclosed.

Dimension of the Tank:

Length-144", Width- 20", Depth-10" and Stand height- 20"

VPI (Vacuum Pressure Impregnation machine):-

- Cylinder for bamboo chamber with one side lid mount on 06 legs (length-11.5', Diameter- 20" made up with 4 mm Ms Sheet)
- Chemical Tank mount on 3 legs (4 mm Ms Sheet)
- Sap Collector mount on 3 legs (2 mm Ms Sheet)
- Vacuum pump
- Compressor
- Connecting GI pipes (1" and 1.5")

3.4 Primary Data Collected (max 500 words)

3.5 Details of Field Survey arranged (max 500 words)

3.6 Strategic Planning for each Activities (max. 1000 words)

- Training modules for construction were designed.
- Training imparted to beneficiaries on *bamboo preservation techniques and its importance*
- Location were demarcated for Bamboo Treatment Centers at project site through participatory approach
- Trainings on capacity building were extended to the committees formed for treatment of bamboos for construction of the Bamboo houses as proposed under the project. Design of earthquake

resilient buildings was finalized. Construction work for Bamboo houses at both the project sites were conducted with participatory planning and approach by conducting training program.

3.7 Activity wise Time frame followed [using Gantt/ PERT Chart (max. 1000 words)] (Project Proposal)

4 KEY FINDINGS AND RESULTS

4.1 Major Research Findings (max. 1000 words)

- Study on consumption of preservatives by different species during the process of treatment under various methods has been planned.
- Treatment time for different species under some selected methods was studied.
- Under the project, a VPI plant has been designed which needs studies for its performance in regard to a rapid treatment of bamboos in support of commercialization for development of community micro-enterprise. Based on the findings/observations the machine can be improved and upgraded for better performance and commercial output.
- The outcomes and experiences from this project are being utilized in our new project being conducted in collaboration with IIT, Guwahati on “Evaluation of Bamboo Houses for Earthquake resistance”.
- In future projects, it will provide an opportunity to study the durability of bamboo made housing components like posts, truss, wall panels etc. made out of treated bamboo of different species.

4.2 Key Results (max 1000 words in bullets covering all activities)

- Training imparted to 100 target users on bamboo preservation techniques and its importance.
- Location has been demarcated for Bamboo Treatment Centre’s at project site through participatory approach. Boucherie Machine (6 Nos.), Boiling Tank /Rolling Tank (2 no’s) and Vacuum Pressure Impregnated (VPI) Machine (2 nos.) were purchased for conducting training program and bamboo treatment.
- Training on capacity building has already been completed and committees has been formed and participated in treating the bamboos for construction of the Bamboo houses proposed under the project. Design of earthquake resilient buildings has been finalized. After that construction work for Bamboo building at both the project sites were executed through a participatory approach by conducting training program.
- Better participation in planning process.
- Awareness among 100 families on treatment techniques.

- Motivated target user groups shall be using the technology.
- The two teams selected for micro-enterprise development were trained for operationalization the set-up for business development.
- The two microenterprises were equipped with tools and techniques for bamboo treatment and bamboo housing.
- Two microenterprises were operationalized for production of bamboo housing and other components as per the market demands.
- The two groups have been capable to run the micro-enterprise.
- 6 bamboo houses were constructed and now, it is ready.
- Awareness generation on earthquake resilient bamboo structures organized in the two sites.
- Market linkages for supply of treated bamboos developed. Opportunities were explored with PMAY under NBM as provisioned.
- The construction manual has been prepared and submitted.

4.3 Conclusion of the study (maximum 500 words in bullets)

- Bamboo houses are eco-friendly and earthquake resilient. Moreover the FRC-LE developed design of Bamboo house is a low cost house design which can be afforded by the low income groups of people in North-East India. When treated Bamboos switch used it makes the structure more durable and the Bamboo house may be maintained for even 50 years.

5 OVERALL ACHIEVEMENTS

Achievement on Project Objectives [Defining contribution of deliverables in overall Mission (max. 1000 words)]

- Participatory planning through interaction with the communities under Anand Marg Sanstha and Twisa Watalok was done with the help of Jana Unnayan Samiti Tripura (JUST) and Tripura Bamboo and Cane Development Centre (TRIBAC).
- 4 trainings on Bamboo harvesting and preservation were organised covering both the sites. The Boucherie machines and Treatment Tanks (Boiling and Soaking) were demonstrated in the field during these hands on trainings. The selected target communities in both the sites are equipped with necessary tools like bamboo cutter, bamboo pruner, drill machines, Boucherie apparatus and Boiling Treatment Tanks.

- A 15 members' Group at Barkathal site has been identified for management and operationalization of the proposed micro enterprise and related activities. Construction of earthquake resilient bamboo houses was carried out with community participation.
- Training imparted to 541 target users on bamboo preservation techniques and its importance.
- The VPI plants, Boucherie machines and Treatment Tanks (Boiling and soaking) were installed and demonstrated in the field during hands on trainings.
- Capacity building of the committees has been done by providing training on bamboo treatment techniques and strengthening the bamboo treatment techniques for entrepreneurship development.
- A Linkage Awareness on impact of bamboo treatment on conservation aspects has been generated through regular meetings has been developed for supply of treated bamboos for the purpose of construction of bamboo structures.
- Construction of 6 houses were completed covering both the sites
- Cost involved in Construction of each Bamboo House (400 sq ft) has been calculated and it comes to Rs. 1, 00,000 only with participatory approach.
- Construction manual prepared and draft submitted to the funding agency.

5.1 The machines and tools provisioned for community Micro-enterprise support have been procured. Boucherie apparatus (6 units), Boiling Tank/Rolling Tank (2 units) and Vacuum Pressure Impregnated (VPI) Machine (2 sets) were purchased for conducting training and also for treatment of bamboos in commercial scale.

Boucherie Apparatus (6 nos.):- Boucherie apparatus (patented by RFRI-ICFRE) for Bamboo treatment consisting of a main tank (made up of 10 SWG MS Sheet) fitted on a stand with a pressure gauge, level indicator, release valve and 03 nos. of adapters (4"– 1 no, 3"- 1 no, 2"-1 no.) fitted on one side of the tank and proper arrangements made for operating the adapter individually, including the following accessories-

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Dimension of the Tank:

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- Chemical Tank mount on 3 legs (4 mm Ms Sheet)
- Sap Collector mount on 3 legs (2 mm Ms Sheet)
- Vacuum pump
- Compressor
- Connecting GI pipes (1" and 1.5")

5.2 Establishing New Database/Appending new data over the Baseline Data (max. 1500 words, in bullet points)

5.3 Generating Model Predictions for different variables (if any) (max 1000 words in bullets

5.4 Technological Intervention (max 1000 words)

- The outcomes and experiences from this project had been utilized in our project conducted in collaboration with IIT, Guwahati on "Evaluation of Bamboo Houses for Earthquake resistance".
- It provides an opportunity to study the durability of bamboo made housing components like posts, truss, wall panels etc. made out of treated bamboo of different species.
- Assessment of socio-economic impact of the bamboo preservation based community micro-enterprises is also an integral part of the project.
- Under the project, a VPI plant has been designed which needs studies for its performance in regard to a rapid treatment of bamboos in support of commercialization for development of community micro-enterprise. Based on the findings/observations the machine can be improved and upgraded for better performance and commercial output.

5.5 On field Demonstration and Value-addition of Products (max. 1000 words, in bullet points)

- A total of 541 individuals participated in all the trainings, field demonstrations etc.
- Nos. of low cost bamboo houses were constructed in the two project sites through training and demonstration
- Demonstration on operation of VPI plant in both the sites.
- A low cost bamboo treatment plant based on principle of Vacuum Pressure Impregnation was developed and fabricated for installation in the two sites.
- Hands on training on application of Boucherie apparatus and boiling tanks for treatment of bamboos.
- Two NGOs ***viz.*** "Youth for Integration" and "Growing Seeds" have been connected with the beneficiaries for their hand holding and development of market linkage.

5.6 Promoting Entrepreneurship in IHR

- 4 Trainings Training programs on 'Awareness generation and skilling in bamboo treatment methods' covered a total of 102 participants. The bamboo users are realizing the necessity of bamboo treatment techniques due to the awareness generation and publicity through media.
- One more training program on Bamboo preservation, Joints and joinery techniques and truss making was organized for familiarization of 30 participating users with the machines and tools procured for making bamboo houses.

5.7 Developing Green Skills in IHR

- FRCLE conducted trainings on "Awareness cum Skill Training on Bamboo Harvesting and Preservation for Earthquake Resilient Green Buildings" in Barkathal, West Tripura and Bhuvanpur, Unakoti Tripura.
- Construction work for Bamboo building at both the project sites are continuing through a participatory approach by conducting training program. FRCLE imparted training on "Importance of Bamboo Preservation, Joints and Joinery Techniques and Truss Making" at Barkathal, West Tripura.

5.8 Addressing Cross-cutting Issues (max. 500 words, in bullet points)

Climate Change: The project envisages extensive awareness on use of treated bamboos for construction of earthquakes resilient and eco-friendly building materials instead of non-ecofriendly materials like bricks cement and iron rods in structures. Use of treated bamboo can help in sustainable conservation of bamboo resources by increasing its durability and reducing the consumption at the same time.

Gender Equality: As the houses are equally owned by men and women in the society. The project has given the women groups an equal opportunity. The activities under the project had an important space for women to play their role in terms of both decision making as well as use of the resources. The interested and motivated women SHGs may also generate income by establishing small enterprises for trade of treated bamboos to meet the demand of as low-cost ecofriendly and earthquake resilient building materials.

Communications: The project had a provision for organizing awareness programs and trainings through which the technology and its advantages to the target users and other stakeholders like related departments, SHGs, NGOs, Media, policy makers have been communicated. The models developed under the project were popularized through publications, demonstration and media publicity.

6 PROJECT'S IMPACTS IN IHR

6.1 Socio-Economic Development (max. 500 words, in bullet points)

- Capacity building on bamboo treatment techniques and sensitization in adoption of quake resilient housing and structures.
- Setting up of two community micro-enterprises.
- Livelihood promotion for tribal and rural communities in the two project sites.

6.2 Scientific Management of Natural Resources In IHR (max. 500 words, in bullet points)

- Number of watersheds studied/plans prepared and executed.
- Number of spring-sheds investigated and treated/ rejuvenated.
- Management decisions are supported by the database.
- Periodic studies on utilization of groundwater and aquifers and their recharge to ensure sustainability.
- Development of a database on utilization and recharge of groundwater and aquifers.

- Studies on watershed management to ensure increase in recharge of ground water and aquifers.

6.3 Conservation of Biodiversity in IHR (max. 500 words, in bullet points)

- Bamboo raw materials were judiciously utilized and hence promoted conservation.
- The communities in remote communities can now treat their bamboo to put in quake-resilient structures and other uses like fencing etc.

6.4 Protection of Environment (max. 500 words, in bullet points)

- The project envisages extensive awareness on the use of treated bamboo for constructing earthquake-resilient and eco-friendly building materials instead of non-ecofriendly materials like bricks, cement and iron rods in structures. Use of treated bamboo will certainly help in the sustainable conservation of bamboo resources by increasing its durability and reducing its consumption at the same time.
- Entrepreneurship development for hill communities through participatory management of livelihood-environment convergent models by establishing Bamboo Treatment Centres.
- Disaster risk reduction and Socio-economic upliftment of hill communities.

6.5 Developing Mountain Infrastructures (max. 500 words, in bullet points)

- Entrepreneurship development for hill communities through participatory management of livelihood-environment convergent models by establishing Bamboo Treatment Centres.
- Impact analysis and process documentation

6.6 Strengthening Networking in IHR (max. 700 words, in bullet points) NA

7 EXIT STRATEGY AND SUSTAINABILITY

7.1 How effectively the project findings could be utilized for the sustainable development of IHR (max. 1000 words)

Tripura and North-eastern India come under Zone V of the earthquake susceptible zone. It is difficult for the marginalized population in hilly areas of Tripura to afford pucca houses to them. High degree of earthquake susceptibility in hilly regions makes the high-cost pucca houses unfeasible and risky for the low-income groups of hill communities. The northeastern part of India is blessed with ample Bamboo resources. The tensile strength of 28000 pounds per square inch makes Bamboo one of the strongest building materials. The strong mechanical properties of bamboo enable it to withstand heavy loads of concrete during building construction.

7.2 Efficient ways to replicate the outcomes of the project in other parts of IHR (Max 1000 words)

- The model of Community Micro-enterprises developed under the project can be very well replicated in other parts of the State by Capacity Building and awareness generation and networking among the target groups.

7.3 Identify other important areas not covered under this study needs further attention (max 1000 words)

7.4 Major recommendations for sustaining the outcome of the projects in future (500 words in bullets)

- The target groups should get exposure to the complete value chain and operationalization of the community micro-enterprise with efficient management of mobilizing the resources.
- A wider marketing network needs to be developed for the supply of treated bamboo. The buyers should get convinced about the technology and the importance of treatment at the site so that the fresh bamboo is treated perfectly.
- Demand for different product components should be generated so that the transportation cost is reduced and bamboo is treated with an investment of resources, including chemicals.

8 ACKNOWLEDGEMENT

The authors would like to acknowledge and thank the National Mission on Himalayan Studies (NMHS) implemented by the Ministry of Environment, Forest and Climate Change (MoEFCC) under the nodal and serving hub with G.B. Pant “National Institute of Himalayan Environment” (NIHE) for the financial support for carrying out this Project.

APPENDICES

Appendix 1 – Details of Technical Activities

Appendix 2 – Copies of Publications duly Acknowledging the Grant/ Fund Support of NMHS (Construction Manual for Bamboo Houses)

Appendix 3 – List of Trainings/ Workshops/ Seminars with details of trained resources and dissemination material and Proceedings

Appendix 4 – List of New Products (utilizing the local produce like NTFPs, wild edibles, bamboo, etc.)

Appendix 5 – Copies of the Manual of Standard Operating Procedures (SOPs) developed

Appendix 6 – Details of Technology Developed/ Patents filled

Appendix 7 – Any other (specify)