

1.1 Std. Doc.: NMHS/PG-FTR
National Mission on Himalayan Studies – 2019

Template/Proforma for Submission

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.:	NMHS/2016 17/SG12/01
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Date of	1	9	0	5	2	0	1	9
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PROJECT TITLE (IN CAPITAL)
ECOLOGICAL MONITORING AND STATUS OF FISH FAUNA IN HYDROPOWER
AFFECTED ALAKNANDA RIVER

Project Duration: from 20-05-2016 to 19-05-2019

Submitted to:

Er. Kireet Kumar
Scientist 'G' and Nodal Officer, NMHS-PMU
National Mission on Himalayan Studies, GBPNIHESD HQs
Ministry of Environment, Forest & Climate Change (MoEF&CC), New Delhi
E-mail: nmhspmu2016@gmail.com; kireet@gbpihed.nic.in; subratbose@nic.in

Submitted by:

Prakash Nautiyal
HNB Garhwal University, Srinagar Garhwal
9412987878
pn.mahseer@gmail.com

NMHS-Final Technical Report (FTR) template
Demand-Driven Action Research Project

DSL: Date of Sanction Letter
Completion

2	0	0	5	2	0	1	6
d	d	m	m	y	y	y	y

DPC: Date of Project

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Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	NMHS/2016-17/SG12/01					
ii.	Type of Project	Small Grant					
iii.	Project Title	"Ecological monitoring and status of fish fauna in hydropower affected Alaknanda river"					
iv.	State under which Project is Sanctioned	Uttarakhand					
v.	Project Sites (IHR States covered) (Maps to be attached)						
vi.	Scale of Project Operation	Local	Regional	Pan-Himalayan			

vii.	Total Budget/ Outlay of the Project	Rs. 21, 32,400 (Rupees Twenty one lakh thirty two thousand four hundred only)
viii.	Lead Agency	HNB Garhwal University, Srinagar Garhwal, Uttarakhand
	Principal Investigator (PI)	Prof. Prakash Nautiyal
	Co-Principal Investigator (Co-PI)	Nil
ix.	Project Implementing Partners	People's Science Institute, Dehradun
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Dr Anil Gautam Ph: +911352763649 Email : anil_psi@yahoo.com

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).

Like Bhagirathi the river Alaknanda constitutes headwater ecosystem of the Ganga basin in the Indian Himalayan Region (IHR). The river is serially impounded for hydropower (HEP's) at Vishnuprayag and Srinagar. The study aims to assess impacts on the river within and between these projects. The major objectives were, (i) Long term ecological monitoring of the river Alaknanda (ii) Assessing the threat status for the fish fauna. To understand how a HEP influences the river, it was sampled ca. 1 km u/s of impounded river, section, ca.5-10 km d/s dam and 15 km d/s PH (power house) and in the free flowing stretch. Stations S1, S2 and S3 fall in VHEP, while S5, S8 in SHEP. Sampling for water chemistry, benthic assemblages (macroinvertebrates, diatoms) and fish fauna was conducted from September 2016 to August 2018. Standard methodology was adopted for analysing physico-chemical parameters and benthic communities. Data analysis(SIMPER, ANOSIM & Kruskal-Wallis) was performed using the software CAPS. Bio-assessment was done using BMWP, ASPT and LIFE scores for macroinvertebrates and Van Dam ecologic values plus indices for diatoms using OMNIDIA software. To assess the threat status, reduction in total catch was assessed by comparing with 1995 data. Abundance and CPUE (catch per unit effort) were used as supporting information.

Physico-chemical characteristics showed increasing trend in water temperature and conductivity while water velocity, dissolved oxygen, total alkalinity and total hardness lacked trend at longitudinal scale. Macroinvertebrate density showed decreasing trend u/s and d/s sections of V-HEP while no trend was observed in DFS. The diatom and macroinvertebrate community features too are impacted, though differently. The diatom richness and density (<100 cells mm⁻²) remain low along the course of the river. The macroinvertebrate richness was quite low and its density was moderate (<600 indiv. m⁻²). The densities of both communities varied significantly among stations. At all the stations, assemblages show high temporal variability. The magnitude of variability declines in the dam free/free-flowing stretch of the river. The dominants are quite consistent at S5 and S8 but assemblage kept changing at S8. The macroinvertebrate assemblages varied longitudinally and temporally during both the years; as predominant. Baetidae was replaced by Heptageniidae, indicating shift from heterotrophic to autotrophic state. However, level of similarity continued between S3 and S5 compared to S4. Macroinvertebrate community was absent from S6 to S8 during both years except February and May at S8 during 1st year. SIMPER analysis for both communities showed the increasing similarity from VHEP to SHEP locations in diatoms and VHEP to DFR in macroinvertebrates. Similarity however, did not differ significantly among locations for both communities. Classification of river stretches based on diatom and macroinvertebrate abundance reveal more similarity among S1-S2 and S4-S5 (both similar to S3), S8 being outlier.

Diatom indices show mild pollution, degradation and eutrophication in HEP areas, less in VHEP and moderate in SHEP (but notably low degradation at S5). This is supported by undesirable changes in **van Dam ecological values** along the course of the river for pH, trophic state (mesotrophic at S3, S4; eutrophic state (49%) at S5) and aquatic-aerophilic from S1 to S3 while occasionally-aerophilic from S4 to S8. BMWP scores show that the water quality declines tremendously d/s of both dams, but not in DFS (S4 alone or S3-S5). LIFE Scores indicated highly variable flows at all stations categorising from Slow to Rapid indicating unstable regime for the biotic communities.

The IUCN status for three *Schizothorax* species was assessed as Vulnerable. Fish catch was relatively low at Langasu if compared to Srinagar during 1st year. Similar trend was seen during 2nd year also with 5-17 Kg at Langasu and 3-19 Kg at Srinagar. Yield increases slightly d/s Srinagar PH. However, observations on daily catch yielded catch of 12-40 kg during March at d/s PH Srinagar.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1.	Long term ecological monitoring of Alaknanda- river system of Uttarakhand.	<ul style="list-style-type: none"> • Community features ○ Low SR, low density and perturbation (longitudinal and temporal) in assemblages in particular are suitable monitoring indicators for rivers impacted by HEP's. ○ Diatoms were used successfully for Bioassessment of pollution, degradation and eutrophication in HEP areas. The van Dam ecological values also supported these results with high degree of accuracy especially w.r.t saprobic and trophic state besides moisture conditions because of alternate desiccation and flooding during hydropeaking. ○ The benthic macroinvertebrates based Bioassessment using BMWP (ASPT) scores exhibited less accuracy in depiction of water quality d/s of both dams compared to free flowing section of the river (S3 to S5). In terms of flow conditions, LIFE was a better indicator of perturbations in flow regime.
2.	Assessing IUCN threat status for the fish fauna including endemic elements inhabiting these rivers.	<ul style="list-style-type: none"> • The fish catch reduction in Alaknanda was >30% compared to the past. • The Snow trout species were assessed Vulnerable (A2b) regionally.

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
1.	Database on ecological state of the Alaknanda river ecosystems.	Community features of benthic communities and	• Diatom density (cells mm ⁻²): was very low compared to 1994-96 in the Alaknanda	

		Bioassessment using these communities	<p>Bhimtala to Srikot-Srinagar.</p> <ul style="list-style-type: none"> • Diatom assemblages: lack of consistency, both temporal and longitudinal; • Macroinvertebrate density: lack of any trend. • Macroinvertebrate assemblages: Different dominants prevailed from year to year. • Bioassessment: different categories of ecologic values, water quality and flow conditions prevailed. 	
2.	Quantitative database on threat status of fish fauna in general and endemic in particular.	Fish catch as an index of abundance	<ul style="list-style-type: none"> • <30% reduction compared to past. • Endemic snow trout constitute 90-99% of landings, assessed as Vulnerable (A2b). 	
3.	Strategy for conservation of fish fauna in selected river system.	Fish catch and CPUE	E-flows for management and restoration of Alaknanda river ecosystem.	

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

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

S. No.	Particulars	Number/ Brief Details	Remarks/ Enclosures
1.	New Methodology developed		
2.	New Models/ Process/ Strategy developed		
3.	New Species identified		
4.	New Database established		
5.	New Patent, if any		
	I. Filed (Indian/ International)		
	II. Granted (Indian/ International)		
	III. Technology Transfer(if any)		
6.	Others (if any)		

3. Technological Intervention - NA

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		
2.	Diffusion of High-end Technology in the region		
3.	Induction of New Technology in the region		
4.	Publication of Technological / Process Manuals		
	Others (if any)		

4. New Data Generated over the Baseline Data- NA

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
	NIL	Flora: 140 species from locations in proximity of S3, S4 and S7	NIL
	SR (Species richness) along the course of Alaknanda R.	SR at locations in proximity of Birahi (S3), Langasu(S4) and Srinagar (S7)	Quantifying impact through loss of richness and hence biodiversity
	Density along the course of Alaknanda R.	Density at locations in proximity of S3, S4 and S7	Quantifying impact on nos. of organisms/unit area, a measure of decline/increase in production at primary and secondary level

	<p>Assemblages along the course of Alaknanda R. mostly dominated by <i>A.minutissimum</i> and <i>A. pyrenaicum</i> from S1 to S8 in case of Diatoms. Macroinvertebrate dominants: Yr 2016-17: Baetidae Yr 2017-18: Heptageniidae</p>	<p>Assemblages at locations in proximity of S3, S4 and S7 mostly dominated by <i>Achnanthes nodosa</i> at Bhimtala, <i>Cymbella laevis</i> at Srinagar Heptageniidae close to Lambagarh Chironomidae at Srinagar</p>	<p>Inconsistent and hence very high no. of assemblages (26-1st yr; 21 2nd yr) in contrast to fewer assemblages (4-5) in natural hydrological regimes. Dominants also change. Yr-wise variation in macroinvertebrate dominants. This shows that the ecosystem is temporally fluctuating from heterotrophy to autotrophy indicating perturbed primary production and hence producer community as well as enhanced levels of organic detritus in the river.</p>
	<p>Bio-assessment</p>		<p>Bioassessment using diatoms indicated pollution, degradation and eutrophication in HEP areas while benthic macroinvertebrates showed deteriorated water quality d/s of both dams. LIFE indicated perturbations in flow regime responsible for damaged ecosystem and its functional impairment..</p>

**Lambagarh to Devprayag which is additional ca. 50 km river stretch towards Badrinath and 30 km d/s of Srinagar towards Devprayag compared to earlier studied stretch of Alaknanda R. from Bhimtala to Srikot (Nautiyal R 2005).*

5. Demonstrative Skill Development and Capacity Building/ Manpower Trained- NA

S. No.	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	ST	Woman	Total
1.	Workshops						
2.	On Field Trainings	2	School Students				
3.	Skill Development						
4.	Academic Supports						
	Others (if any)						

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

S. No.	Linkages /collaborations	Details	No. of Publications/ Events Held	Beneficiaries
1.	Sustainable Development Goal (SDG)			
2.	Climate Change/INDC targets	MoU with University of Copenhagen, Denmark	Week-long workshop on October 11 th ~ 22 th , 2019 on Arctic and Alpine Aquatic Science- implications of climate change on proglacial freshwater ecosystems functioning and services	Himalayan inhabitants
3.	International Commitments			
4.	Bilateral engagements			
5.	National Policies			
6.	Others collaborations	MoU with NBFGR, (ICAR), Lucknow	Signing ceremony Dec 5 th 2019	

7. Project Stakeholders/ Beneficiaries and Impacts - NA

S. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats		
2.	Govt Departments	(Agriculture/ Forest)	
3.	Villagers		
4.	SC Community		

5.	ST Community		
6.	Women Group		
	Others (if any)		

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received*	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	10,32,000.00	937,174.00	90.8
II.	Travel	4,00,000.00	378,683.00	94.6
III.	Expendables & Consumables			
IV.	Contingencies	45,000.00	38,437.00	85.4
V.	Activities & Other Project cost	3,00,000.00	251,750.00	83.9
VI.	Institutional Charges	355,400.00	355,400.00	100
VII.	Equipments			
	Total	21,32,400.00	1,961,444.00	92
	Interest earned	31,918		
	Grand Total	2,164,318.00		

* Funds received includes the amount "on hold".

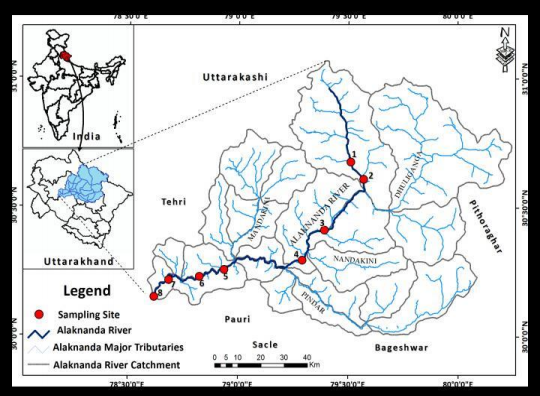
Please attach the consolidated and audited Utilization Certificate (UC) and Year wise Statement of Expenditure (SE) separately, *ref. Annexure I.*



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

S. No.	Name of Equipment/ Peripherals	Cost (INR)	Utilisation of the Equipment after project
1.	Nikon accessory (MQA25010 DS-U2 MAIN BOARD of Digital Imaging system).	1,29,375.00	In lab for identification and documentation of diatom species.
2.	Software OMNIDIA ver 6.0.8	29,669.00	For computing different diatom indices and ecologic values as the diatom assessment related work is carried in the lab.

**Details should be provided in details (*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	
2.	Project Site/ Field Stations Developed	9	
3.	New Methods/ Modeling Developed	-	
4.	No. of Trainings arranged	2	
5.	No of beneficiaries attended trainings	-	
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	JPF AND FA	
7.	SC stakeholders benefited	-	
8.	ST stakeholders benefited	-	
9.	Women Empowered	-	
10.	No of Workshops Arranged along with level of participation		
11.	On field Demonstration Models initiated (attach maps about location & photos)	
12.	Livelihood Options promoted	-	
13.	Technical/ Training Manuals prepared	-	
14.	Processing Units established (attach photos)	
15.	No of Species	-	

	Collected		
16.	New Species identified	-	
17.	New Database generated (Types):	-	
	Others (if any)	-	  <p>A) Community level survey In Village Gandasu B) Women pointing out damage to fields due to leakage from tunnel in Village Naur</p>

11. Knowledge Products and Publications:

S. No.	Publication/ Knowledge Products	Number		Total Impact Factor	Remarks/ Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	19 (01*)	05	NAAS rating 4.54	IF of other papers nil to 3.299
2.	Book Chapter(s)/ Books:	06 (02)*			
3.	Technical Reports				
4.	Training Manual (Skill Development/ Capacity Building)				
5.	Papers presented in Conferences/Seminars	15	07		
6.	Policy Drafts/Papers				
7.	Others:				

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

01* Those with asterisks are publications from NMHS project.

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

Particulars	Recommendations
Utility of the Project Findings	<ul style="list-style-type: none">• Current status of biological communities and hence ecosystem in the river perturbed by flow regulation.• Aspects related to hydropeaking, climate change, riverscape need to be addressed
Replicability of Project	
Exit Strategy	<ul style="list-style-type: none">• E-flows.• Management and restoration of river ecosystem.

(PROJECT PROPONENT/ COORDINATOR)

(Signed and Stamped)

(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Place:

Date:/...../.....