NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.:	NMHS/2015-16/MG02/02

Date of Submission:	2	3	0	7	2	0	1	9
	d	d	m	m	y	y	y	y

PROJECT TITLE

COLLECTION, EVALUATION AND CONSERVATION OF NATIVE CROPS GERMPLASM FROM UTTARAKHAND HILLS AND PRE-BREEDING THROUGH COMMUNITY PARTICIPATION

Project Duration: *from* **31.03.2016** *to* **31.03.2019**.

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NMHS-Final Technical Report (FTR)

Demand-Driven Action Research Project

DSL: Date of Sanction Letter

3	1	0	3	**2**	**0**	**1**	**6**
d	d	m	m	y	y	y	y

DPC: Date of Project Completion

3	1	0	3	**2**	**0**	**1**	**9**
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	**NMHS/2015-16/MG02/02**							
ii.	Type of Project	Small Grant		Medium Grant	✓	Large Grant			
iii.	Project Title	Collection, evaluation and conservation of native crops germplasm from Uttarakhand hills and pre-breeding through community participation							
iv.	State under which Project is Sanctioned	UTTARAKHAND							
v.	Project Sites (IHR States covered) (Maps to be attached)	UTTARAKHAND							
vi.	Scale of Project Operation	Local	✓	Regional		Pan-Himalayan			
vii.	Total Budget/ Outlay of the Project	0.50,53,800/- (in Cr)							
viii.	Lead Agency	Pantnagar Centre for Plant Genetic Resources G.B. Pant University of Agriculture and Technology, Pantnagar-263145 Distt Udham Singh Nagar UTTARAKHAND							
	Principal Investigator (PI)	Dr Anand Singh Jeena Professor, Genetics and Plant Breeding							
	Co-Principal Investigator (Co-PI)	NA							
ix.	Project Implementing Partners	Himalayan Gram Vikas Samiti, Gangolihat (Pithoragarh)							
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Mr L D Bhatt Mobile No. +91-9456106896 E-mail : hgvs1990@gmail.com							

2. Project Outcome

2.1. Abstract

Background: Farmers are the key to success in agriculture as they are the owners of our rich bio-resources. Besides, conserving the biodiversity as farmers' varieties they have also selected / developed new strains which are suitable in their geographical areas. But the expansion of high yielding crop varieties the area under minor crop is going down, which threatened to existence of genetic resources of native crops of hills. Therefore, these indigenous strains developed and conserved by farmers need to be protected.

Objectives/ Aim: Survey, collection, Evaluation, characterization and In-situ as well as ex-situ conservation of germplasm / land races of native crops (millets and vegetables) of Uttarakhand.

Methodologys: Through the exploration visits, villages of different districts of Uttarakhand was surveyed as the Project Implementation sites. Germplasm was collected then purified and evaluated at PCPGR in the respective crop seasons and also characterized by biochemical and molecular markers. The same purified strain was provided back to the farmers for cultivation and in-situ conservation. Awareness programmes was launched for farmers to encourage them to conserve the germplasm in their farm itself and register their varieties in order to share benefits of conservation of valuable landraces.

Approach: Under the project, we covered the areas remain untouched with special reference to the minor crops like finger millet, barnyard millet, Kulthi etc. alongwith the genetic wealth with respect to vegetables like pahari muli (radish), pahari palak, pahari kakadi etc.

Results: A number of exploration visits (>40) were conducted during the three year period of the project in different villages by staff of NGO partner as well as PI and JRF for survey of the variability of genetic resources and collection of germplasm. A total of 9 farmers meetings and 9 farmers trainings were conducted during the three year time period of the project, in which a total of 556 farmers were participated including 347 women. A total of 832 germplasm accessions were collected during the time period out of which 87 accessions of different crops were found similar/repeated so those were discarded. Therefore final collection was of 745 germplasm accessions including Finger millet (104), Barnyard millet (98), Soybean (117), French bean (30), Horse gram (49), Brassica (44), Black gram (53), Sesame (26), Rice (25), maize (17) and others (306). Evaluation and morphological characterization of 89 strains of barnyard millet, 104 strains of finger millet, 32 strains of brassica, 49 strains of soybean, 13 Strains of lentil, 12 strains of barley, 17 strains of wheat have been carried out. The seed of three barnyard millet accessions PCPGR 7904, GP-2011-129 and PCPGR-7886 have been successfully multiplied and distributed to the farmers for seed production. Two germplasm accessions of lentil were also multiplied for seed distribution. Genomic DNA of 57 Barnyard millet and 50 finger millet accessions has been isolated as well as standardization of molecular protocols and molecular profiling had been carried out. The seed of all the evaluated and purified germplasm lines had been kept in mid-term storage facility in PCPGR, Pantnagar for ex-situ conservation of these germplasm.

Conclusion: The study concluded with collection of vast range of variability for different native crops of Uttarakhand and the identification of some of accessions of millets, pulses and oilseeds which are superior in performance, tolerance to abiotic stress and better in mineral nutrition. Seed production

of these accessions had tried with the community which could be taken up further by the NGO partner. Farmers showing slackness in seed production mainly due to nigligible demand of millets and pulses seeds in hills, however, seed and seedlings of vegetable crops are in good demand. In-situ and ex-situ conservation of these accessions should be in cyclic pattern with contineous linking between germplasm savior community and the university so that all the conserved germplasm must be rejuvinated at farmers field after every three year period so that the accessions maintains its quality characteristics. All the collected accessions were kept in MTS at Pantnagr Centre for Plant Generic Resources for ex-situ conservation.

Recommendations: The study revealed that Uttarakhand hills are great reservior of genetic resources, especially for minir millets and pulses along with underutilized crops. The potenial must be exploited for the benefit of mankind as these minor millets and underutilized crops are rich source of mineral nutritions and nutraceuticals. Through the discussion with comminity, A model for germplasm conservation was drafted in which seed and seedling production of vegetbles should be promoted among the farmers for enhancing there income alongwith the condition to grow germplasm of cereals, millets and pulses etc for conservation. This model needs to be evaluated further as this was not possible to test within the time limit of this project.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1	Survey, collection and purification of germplasm / land races of native crops (millets and vegetables) of Uttarakhand.	A number of exploration visits (>40) were conducted during the three year period of the project in different villages by staff of NGO partner as well as PI and JRF for survey of the variability of genetic resources and collection of germplasm. A total of 9 Kisan Gosthies and 9 farmers trainings were conducted during the three year time period of the project. Finally 745 germplasm accessions were collected including Finger millet (104), Barnyard millet (98), Soybean (117), French bean (30), Horse gram (49), Mustard (44), Black gram (53), Sesame (26), Rice (25), maize (17) and others (306).
2	Evaluation and characterization of strains for identification of specific distinguishable traits by morphological characters and biochemical and molecular techniques	Evaluation and morphological characterization of 89 strains of barnyard millet, 104 strains of finger millet, 32 strains of brassica, 49 strains of soybean, 13 Strains of lentil, 12 strain of barley, 17 strains of wheat had been carried out during respective crop seasons. Evaluation and morphological characterization of 92 germplasm of Finger millet accessions and further

		evaluation for their response to PEG induced drought stress revealed that twelve entries namely GP-2016-116, GP-2016-120, GP-2016-126, GP-2016-130, GP-2016-131, GP-2016-141, GP-2016-187, GP-2016-272, GP-2017-393, GP-2017-396, GP-2017-461, GP-2017-652 were tolerant to drought stress based on their response to various concentrations of PEG. Results of morphological evaluation and characterization of soybean (49) germplasm revealed that 18 accessions performed significantly better than best check and GP-2018-1014 (259.22g), GP-2016-205 (250.56g), GP-2018-1000 (220.22g), GP-2016-175 (210.56g) and GP-2017-25 (204.22g) were the top performing accessions for grain yield. Lentil accessions namely PCPGR-7996 (199.67gm), GP-2018-1531 (189.67 gm), GP-2011-308 (169.67 gm), GP-2011-171 (154.33gm), PCPGR-7995 (135.33 gm), were found to be top performers among evaluated entries, for grain yield per plot. In barley top grain yielders among currently evaluated entries were PCPGR-783 (248.33 gm), PCPGR-783 (248.33 gm), PCPGR-786 (178.33 gm), PCPGR-823 (126.67 gm) and GP-2015-49 (126.67 gm). Results of morphological evaluation and characterization of wheat germplasm accessions revealed that GP-2017-495 (417.33 gm), GP-2018-1272 (376.25 gm), GP-2018-1260 (297.50 gm), GP-2018-1363 (284.24gm) and GP-2018-1255 (284.24 gm) were the best yielding entries. Genomic DNA of 57 Barnyard millet and 50 finger millet accessions has been isolated as well as standardization of molecular protocols and molecular profiling has been carried out.
3	In-situ conservation of identified strains (germplasm) by the community groups at the farmers' field and ex-situ conservation at Pantnagar Centre for Plant Genetic Resources (PCPGR), respectively for future use.	The seed of three barnyard millet accessions PCPGR 7904, GP-2011-129 and PCPGR-7886 have been successfully multiplied and distributed to the farmers for seed production and two germplasm accessions of lentil were also multiplied for seed distribution. The seed of all the evaluated and purified germplasm lines has been kept in mid-term storage facility in PCPGR, Pantnagar for ex-situ conservation of these

		germplasm.
4	Development of model mechanism for in-situ conservation linked with seed production (millets and pulses) and seedling production (vegetables) of identified unique germplasm for income generation	Seed production activity was taken up with best performing barnyard millet and lentil accessions, involving the farmers but there is slackness on the part of farmers mainly due to nigligible demand of seeds of millets and pulses in hill farming. However, seed and seedlings of vegetable crops are in good demand. Hence it was revealed through the discussion with comminity that farmers should be promoted to seed and seedling production of vegetbles for enhancing there income alongwith the condition to grow germplasm of cereals, millets and pulses etc for conservation. The community would be supported for income generation activities with the condition to conserve the germplasm resources.

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	Development of database and knowledge products on traditional crops	Database on traditional crops/ races developed (No of species/ races) Framers/	**No. of Species: 39** **No. of accessions collected: 745** **No. of farmers contacted: 245** **Catalogue developed: 03** (Passport data catalogue for 745 accessions of 39 different crop species found in hilly regions of Uttarakhand have been created. Passport data summary catalogue and Evaluation data catalogue had been prepared)	

2	Establishment of pilot scale model for in-situ conservation of germplasm on farmer's field	No of in-situ conservation plots/ models (Nos)	**No. of plot developed : 05** Five in-situ conservation plot were developed and the purified strain was provided to the farmers for cultivation.	
		Community groups trained (Nos)	**26 SHGs (240 members)**	
3	Creation of ex-situ conservation model at GBPUAT	Publications of knowledge products (No.)	**Catalogue developed: 03** **Research paper published/submitted: 04**	
4	Income generation model through seed production at village level	Income increased (Rs/ per capita/ %)	Not estimated	Seed production activity was taken up with the farmers but it was not turned to income generating mainly due to nigligible demand of seeds of millets and pulses in hill farming.

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

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	**Catalogue developed: 03** (Passport data catalogue, Passport data summary catalogue and Evaluation data catalogue had been prepared)	
5.	New Patent, if any	-	
6.	Others (if any)	-	

3. **Technological Intervention-not applicable**
4. **New Data Generated over the Baseline Data- not applicable**

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.	Kisan Gosthies	9 (259 participants)	These gosthies were organized on "Importance and Conservation of crop germplasm particularly Land races and farmers' varieties" and for creating awareness about PPVFRA and its functioning as well as the support provided by the University			152	259
2.	Farmers' Trainings	9 (297 participants)	Trainings were conducted on in situ conservation of germplasm, maintaining seed purity and quality of the germplasm during in situ conservation and Processing and packaging of seed of Land races and farmers' varieties and nursery production for income generation			195	297
3.	Academic Supports	Junior Research Fellow	For research work in the project			01	02

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)	02 Zero hunger 12 Responsible consumption and production 13 Climate action	Nine kisan gosthies and 9 farmers' trainings were organized on Importance and Conservation of crop germplasm particularly Land races and farmers' varieties, In situ conservation of germplasm, maintaining seed purity and quality of	556 particiants including 347 women.

			the germplasm during in situ conservation, Processing and packaging of seed of Land races and farmers' varieties and Nursery production for income generation.	

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Villagers	Eight kisan gosthies and 12 farmers' trainings were organized on Importance and Conservation of crop germplasm particularly Land races and farmers' varieties, In situ conservation of germplasm, maintaining seed purity and quality of the germplasm during in situ conservation, Processing and packaging of seed of Land races and farmers' varieties and Nursery production for income generation.	Awareness about the genetic resources and their conservation was increased and farmers were motivated to come forward for conservation of their traditional seeds.
2.	Women Group	26 SHGs (398 women) were participated in the Kisan gosthies and farmers' trainings	Self-confidence of women folk increased and they were motivated to take part in decision making.
	Others (if any)		

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	1648800.00	1451989.00	88%
II.	Travel	440000.00	328413.00	75%
III.	Expendables &Consumables	575000.00	645313.00	112%
IV.	Contingencies			
V.	Activities & Other Project cost	166888.00	270000.00	161%
VI.	Institutional Charges	172973.00	172973.00	100%
VII.	Equipments	1450000.00	1450000.00	100%
	Total	4453661.00	4318688.00	97%
	Interest earned	123639.00		
	Grand Total	4577300.00		

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

S. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	PCR thermal cycler	2,71,400.00	The equipment is being utilized for molecular work at the laboratory and University students are working on it.
2.	Seed Dryer	22500.00	Farmer SHGs are utilizing these driers for drying of their seed and other produce on custom hiring basis.
3.	Small equipments: Sealing machine (05)	19995.00	Farmer SHGs are utilizing these sealing machine for packaging of seed and other produce on custom hiring basis.
	pH meter (01) Chemical Balance (01) Digital vernier calipers (01) Air filter (01) UPS (01) Water bath (01)	26035.00 92169.00 1796.00 8505.00 24400.00 25137.00	All these equipments are being used in laboratory work.

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	01	
2.	Project Site/ Field Stations Developed	05	
3.	New Methods/ Modeling Developed	01	
4.	No. of Trainings arranged	9 trainings	
5.	No of beneficiaries attended trainings	297	
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	02	
7.	Women Empowered	347	
8.	No of Workshops Arranged along with level of participation	9 kisan gosthies (259 participants)	
9.	No of Species Collected	39	

10.	New Database generated (Types):	Passport data catalogue, Passport data summary catalogue and Evaluation data catalogue had been prepared	Soft copies attached
	Others (if any)	-	

11. Knowledge Products and Publications:

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	4			
2.	Book Chapter(s)/ Books:	-	-		
3.	Technical Reports	14			
4.	Papers presented in Conferences/Seminars	03			
5.	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	• Best high yielding accessions were identified in Barnyard millet, Finger millet, Soybean, Lentil, Barley and Wheat, which can be given to farmers for seed production as well as increasing their production levels. • The NGO partner could take up seed production of these accessions further. • In-situ and ex-situ conservation of germplasm accessions should be in cyclic pattern with contineous linking between germplasm savior community and the university so that all the conserved germplasm must be rejuvinated at farmers field after every three year period so that the accessions maintains its quality characteristics.

	• All the collected accessions were kept in MTS at Pantnagr Centre for Plant Generic Resources for ex-situ conservation, which can be utilized by the crop breeders in future breeding programme.
Replicability of Project	• The study revealed that Uttarakhand hills are great reservior of genetic resources, especially for minir millets and pulses along with underutilized crops. The potenial must be exploited for the benefit of mankind as these minor millets and underutilized crops are rich source of mineral nutritions and nutraceuticals. Therefore, the similar project could be repeated to explore other areas of the Uttarakhand.
Exit Strategy	• Through the discussion with community, A model for germplasm conservation was drafted in which seed and seedling production of vegetables should be promoted among the farmers for enhancing their income alongwith the condition to grow germplasm of cereals, millets and pulses etc for conservation. NGO partner under guidance of PI will evaluate this model further. The university will phase out from the area and the collaborating NGO's will take care of the farmers group and in-situ conservation activities. However, university will maintain the germplasm in its gene bank at PCPGR and continue the pre-breeding work so that the identified strains contributing characters of interest may be utilized in the crop improvement programme and benefits will be delivered to the farming community preserving the germplasm and using the improved varieties as well.

(**PRINCIPAL INVESTIGATOR**)
(Signed and Stamped)

(**DIRECTOR RESEARCH**)
(Signed and Stamped)

Place: PANTNAGAR
Date: 23/07/2019