Proposal for Extension in the term of the ICAR National Fellow Project (From 27.11.2019 to 26.11.2024)

1. Name and Address	SUNIL ARCHAK, Principal Scientist ICAR-NBPGR, New Delhi 110012
2. Date of birth / present age	29-10-1970, 48 years
3. Date of joining as ICAR National Fellow	27.11.2014
4. Term of the present project ends on	26.11.2019
5. Salient achievements from the project so far	Please see Annexure 1
6. List of publications during the last five years	Please see Annexure 2
7. Honors and awards during the last 5 years	Please see Annexure 3

8. Proposed extension in the project (with full justification, technical program with activity milestones and time-frame, Budget and expected outcome/impact)

8A. Title of the Project (original title retained):

Development and implementation of Novel Algorithms and Software Modules for PGR Informatics

8B. Objectives (new objectives based on achievements of the first term):

1. To develop PGR informatics applications for crowd-sourcing PGR information
2. To develop PGR analytics applications harnessing diverse strategies including GIS, Big Data and bioinformatics
3. To develop agrobiodiversity policy notes on Data Sharing, Accessibility, and Data Reposition for implementation at national and international levels

8C. Name and address of the sponsoring institution:

ICAR-National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi 110012

8D. Detailed justification for the proposal:

The Setting

1) **Genebank operations are vital**: ICAR-NBPGR houses the second largest genebank in the world with more than 400,000 accessions. NBPGR is responsible for collecting, conserving, characterizing, documenting, and distributing plant genetic resources for research, education and breeding purposes.
2) **PGR Informatics facilitates germplasm use**: Utilization of genebank accessions to broad-base the breeding programs has been limited. Selecting the right accessions that ensure breeding success is not a straightforward process. It has been established that linking morphological, agronomic, biochemical, nutritional, response to various biotic and abiotic stresses, genomic and geo-reference information to genebank accessions. It is also important that the data are publicly available in a form and nature that is easy to access.
3) **There are diverse strategies to add value to germplasm**: Trait specific germplasm can be identified through either of the following- (i) Public data mining; (ii) ITK and user feedback; (iii) Large scale phenotyping; (iv) Developing core and mini core collections; (v) Focused identification of germplasm strategy; (vi) Marker assisted selection; (vii) Genome wide association.
4) **Big Data Analytics has some answers**: The size and the value of data are growing exponentially in all areas of research. However, upon proper and pertinent analyses, data can produce much more than information. In expert hands, it can generate intelligence. Big Data Analytics has established many ways to understand mammoth data sets in genomics and crop breeding or in climate modelling.
5) **Open access databases and a blockchain can exist together**: Existence of multiple open access databases necessitates linking them within an ecosystem related to germplasm accessions. On the other hand, a blockchain is resistant to modification of the data. Blockchain and open access databases share principles of transparency, equality of access and reorganisation of data exchange between stakeholders.
6) **National Fellow project on PGR Informatics has laid foundation**: As the major outcome of the NF Project (first 5 years), India now has a bouquet of robust PGR Informatics applications (covering all aspects of PGR management) that function on the bases of scalability, interoperability, flexibility, neutrality and utility. The applications are accessed globally (please visit http://pgrinformatics.nbpgr.ernet.in/ for details).

Justifications

1. **ICAR National Fellow Project enabled development and implementation of world class PGR Informatics applications** that were lacking in India. Some of the applications like PGR Map and PGR Clim are developed for the first time by any genebank in the world.

2. However, effective **PGR Analytics applications remain to be developed**. Existing algorithms related to Big Data, FIGS, blockchain, etc. need to be harnessed to develop applications modules that facilitate PGR Analytics.

3. In the past, availability of data and technology has driven many of the ideas and concepts in the PGR informatics field. The extension term proposes to elicit ideas and concepts to drive development of new methodologies and conversion of data into data resources. Power of GIS needs to be recruited to **accomplish congruence among disparate data related to PGR to answer conservation questions at habitat level**.

4. Special emphasis is required to **associate phenotypic and genomic data** to enhance the choice-based selection of germplasm lines. Algorithms need to be developed to compute "**Genebank Index**" for efficient management of the genebank operations and support policy decisions.

5. The power of **crowdsourcing, to document PGR** occurring at various sites in India, has not been utilized so far. The proposal includes development of applications to involve students, researchers, farmers, communities, NGOs, biodiversity committees, etc. in documenting (text, images and videos in local language) resources and indigenous technical knowledge (ITK) related to PGR.

6. Development of policy notes related to Data Sharing and Accessibility, and Data Reposition related to agrobiodiversity for implementation at national and international levels. It is imperative that a **specialized project on PGR Informatics** also come up with **Policy Guidelines.**

Technical Programme (with activity milestones and time-frame):

	Activity Milestone	Year1		Year2		Year3		Year4		Year5	
1.	Commissioning of the personnel										
2.	Development of software modules for PGR Informatics										
3.	Development of software modules for PGR Analytics										
4.	Development of policy resources related to PGR informatics										
5.	Report writing, Publications of manuals and books										

1. () Developing "Genebank Index" for evaluating genebanks and prioritization and monitoring of PGR activities

Expected output(s) particularly on time scale:

	Expected output	Year1		Year2		Year3		Year4		Year5	
1.	Software modules for PGR Informatics Crowdsourcing applications (web and mobile) useful in case of on-farm conservation, custodian farmers, community participation, etc.										
2.	Software modules for PGR Analytics (GIS based habitat linking; FIGS; Bioinformatics modules related to PGR)										
3.	Algorithms and index (Operational Genebank Index; linking open access with blockchain)										
4.	Development of policy resources related to PGR informatics (Policy papers, guidelines, notes related to access, use and reposition)										

Expected impact of the output(s) on the agriculture of the country:

A robust set of applications including national PGR Portal and PGR analytics for researchers, students, breeders, policy makers, and farmers expected to facilitate **greater utilization of plant genetic resources and accelerated incorporation of diversity into varietal chain.**

Budget requirement (year-wise, head-wise, with list of equipment) Rs. 290 lakh

Figures in Lakh Rupees	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Revenue Costs						
Manpower[$]						
Fellow @ 2.3/month	28	28	28	28	28	**140**
1 RA @ 0.49 /month	6	6	6	6	6	**30**
2 SRF @ 0.36 /month	8	8	8	8	8	**40**
Research contingency[#] (@10/year)	10	10	10	10	10	**50**
TA/DA (@ 1/year)	1	1	1	1	1	**5**
Total recurring cost	**53**	**53**	**53**	**53**	**53**	**265**
Capital Cost						
Equipment*	5	5	5	0	0	**15**
Furnishing and fixtures	5	5	0	0	0	**10**
Total non-recurring cost	**10**	**10**	**5**	**0**	**0**	**25**
Total cost	**63**	**63**	**58**	**53**	**53**	**290**

$ Justification for project staff: three persons with different skill sets are essential for achieving projected objectives:
One Research Associate with experience and expertise in developing web applications and mobile apps related to PGR (C++, dot net, SQL, Android and iOS).
One SRF with experience and expertise in analysing spatial data related to PGR (GIS with using open source as well as licensed software; using satellite and hyperspectral data; python)
One SRF with experience and expertise in bioinformatics to implement analytics and integrating genomics data.

includes operating costs, meetings, conference and symposia (organizing and attending), publication charges, contractual manpower and secretarial assistance, buying consumables, and other petty expenses.

* Equipment include license subscriptions; various system and application software; workstations, mobile workstations, printer and other accessories (Internal and external hard-drives, flash-drives, etc.); networking hardware and accessories. The purchase will be made as per latest specifications in vogue and as per needs. Total equipment cost is <10% of the total budget.

The proposal for the extension of the project is hereby submitted for consideration.

Date 9th Aug 2019

Place New Delhi

Signature of the nominee

Name SUNIL ARCHAK

Forwarding note by the Head of the Institution in support of the research contributions/extension proposal

The project "Development and Implementation of Algorithms and Software modules for PGR management" has been going extremely successfully contributing to development of several Algorithms and apps, but most importantly the "PGR Portal" which has become backbone for PGR Management. I Strongly recommend extension of the Fellowship to Dr Sunil Archak so that the activity is completed.

Signature of the Head of the Institution

11.08.2019

निदेशक
Director
राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो
National Bureau of Plant Genetic Resources
पूसा कैम्पस, नई दिल्ली–12
Pusa Campus, New Delhi-12

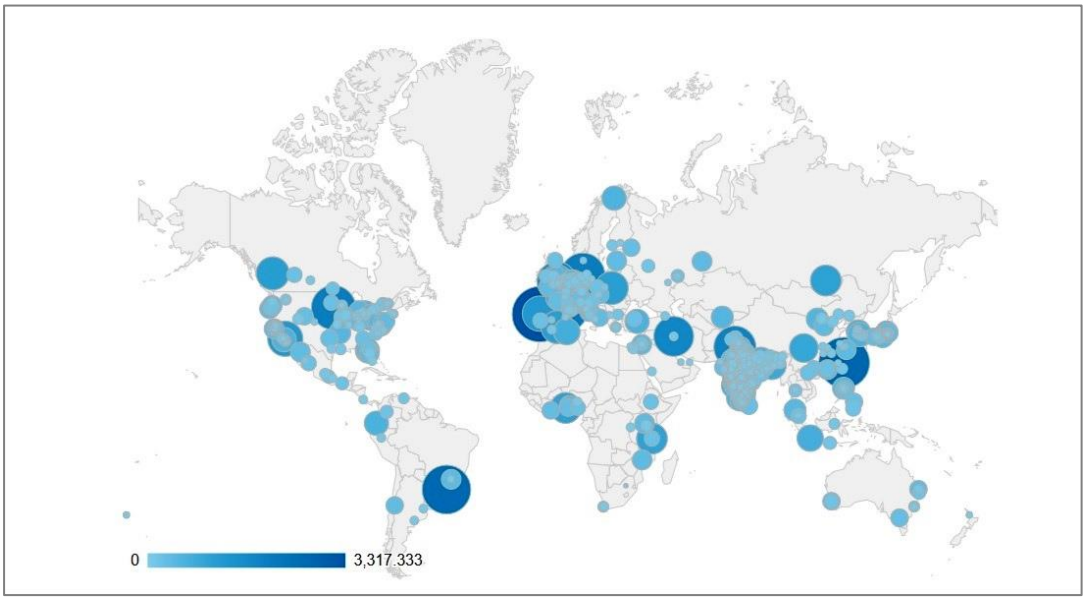
To
The Deputy Director General (Agri. Edn.)
Indian Council of Agricultural Research
KAB-II, Pusa
New Delhi 110012

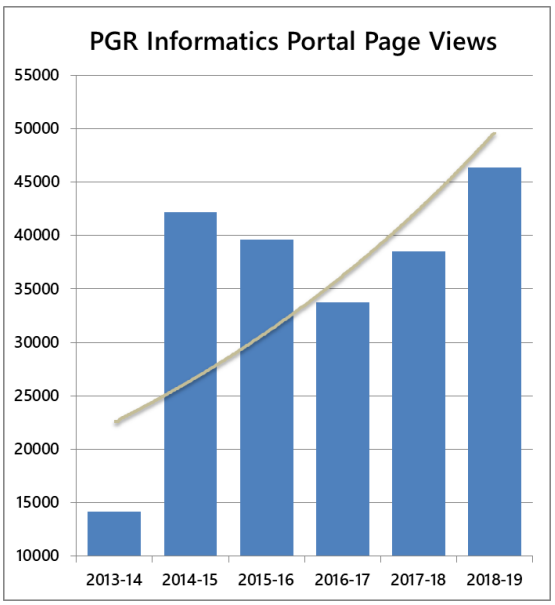
Annexure 1

Salient Achievements

Details of the ICAR-NF project titled "Development and implementation of Novel Algorithms and Software Modules for PGR Informatics" including list of web-applications and mobile apps, annual reports and SoEs are available at: http://pgrinformatics.nbpgr.ernet.in

All the PGR Informatics products developed in ICAR-NF project are listed here. These were developed based on novel/improved algorithms. Many of them are first of their kind in the world and are accessed world over. **Use of these web-apps and mobile-apps by researchers in many countries demonstrate the significance of these applications and the immense impact of the ICAR-NF project.**





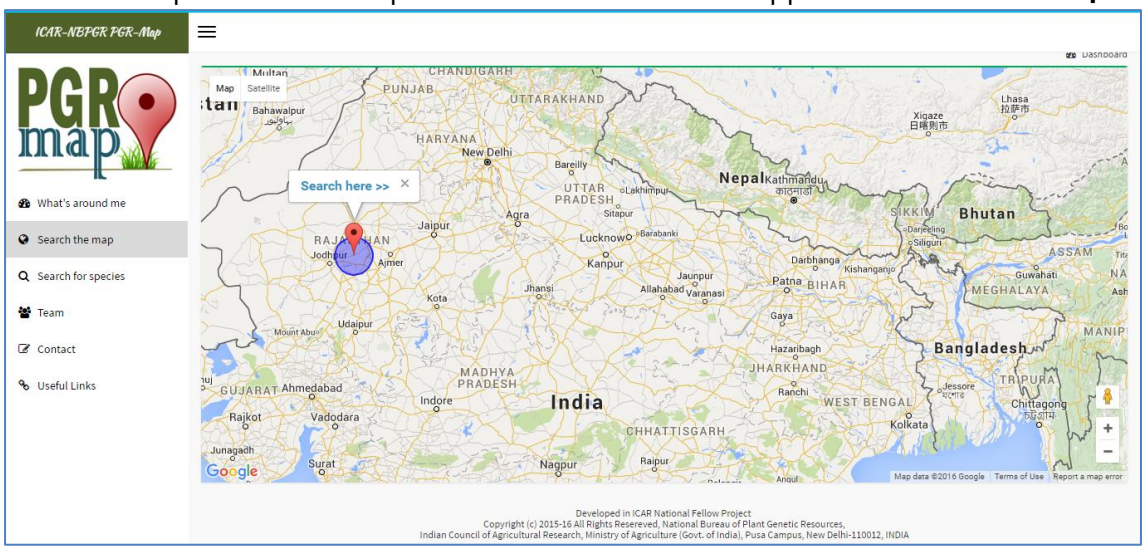
Usage statistics of PGR Informatics Portal (left) and locations from where accessed (map above).

Source: Google Analytics (1 Oct 2014 to 07 Aug 2019).

Note the impetus provided by the ICAR National Fellow Project adding value to PGR Portal with multiple web-apps and mobile-apps.

PGR Map (http://pgrinformatics.nbpgr.ernet.in/pgrmap/)

Map-based data retrieval provides easy and intuitive access to PGR information. The process is vital for developing mobile apps. Computational algorithms for map based applications in PGR were developed and were implemented as an interactive application called "**PGR Map**".

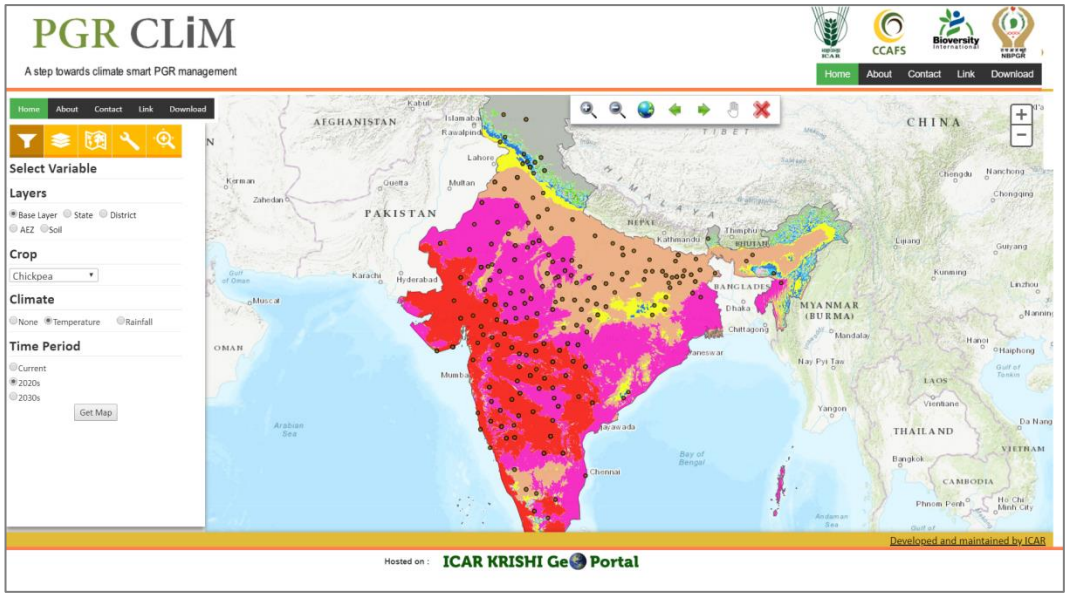


PGR Map offers three benefits:

- "What's around me" helps user to obtain quickly the accessions that have been collected and conserved in the genebank from a particular location in India where the user is located at the moment
- "Search the map" helps user to list the accessions that have been collected and conserved in the genebank from any selected location in India
- "Search for species" helps user to map the collection sites of a crop species

Geo-informatics portal in PGR (http://pgrinformatics.nbpgr.ernet.in/pgrclim)

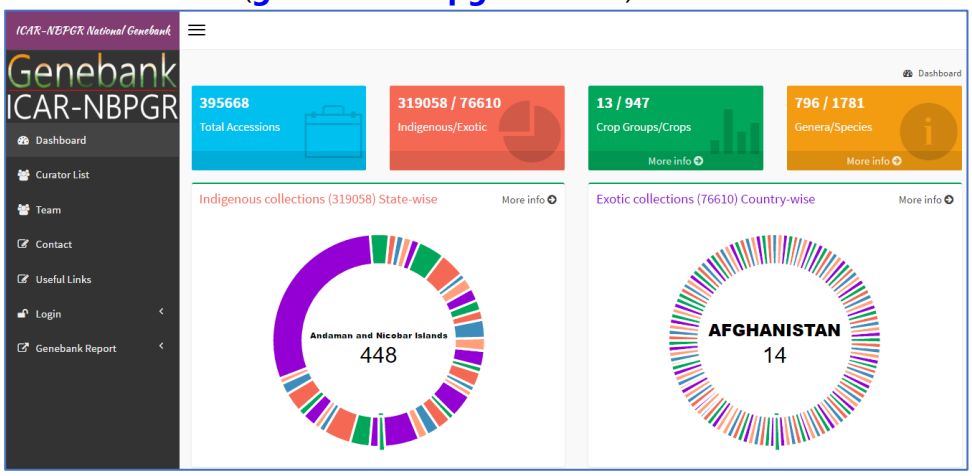
A GIS-server based interactive application was implemented comprising of layers of germplasm accessions of ten major crops; soil type; AEZ; temperature and rainfall (current, 2020 and 2030). The data for the PGR Clim was generated in a CCAFS funded project to link germplasm to changing climatic regimes.



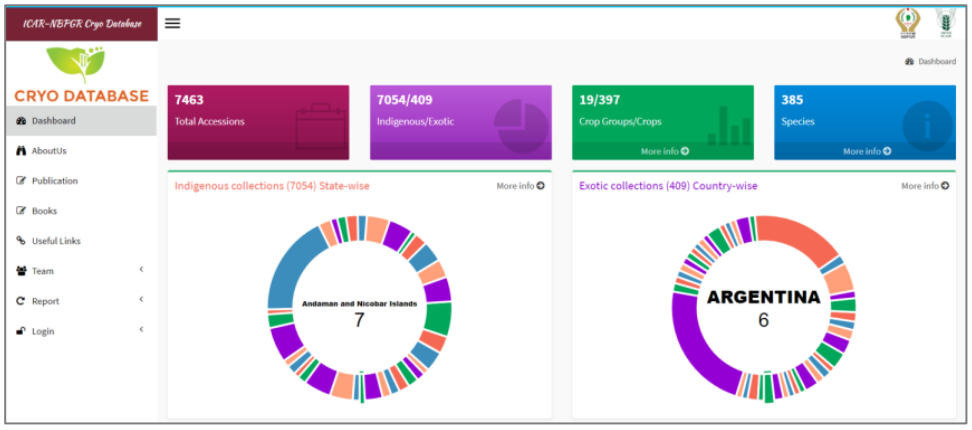
Genebank applications

A quick access to the information on number of germplasm accessions conserved in the National Genebank has been a long pending demand. User friendly dashboards were designed, developed and implemented to provide a personalized quick access to genebank information to PGR workers, breeders, students, research managers and administrators. The dashboard figures are dynamically updated as and when genebank databases are updated.

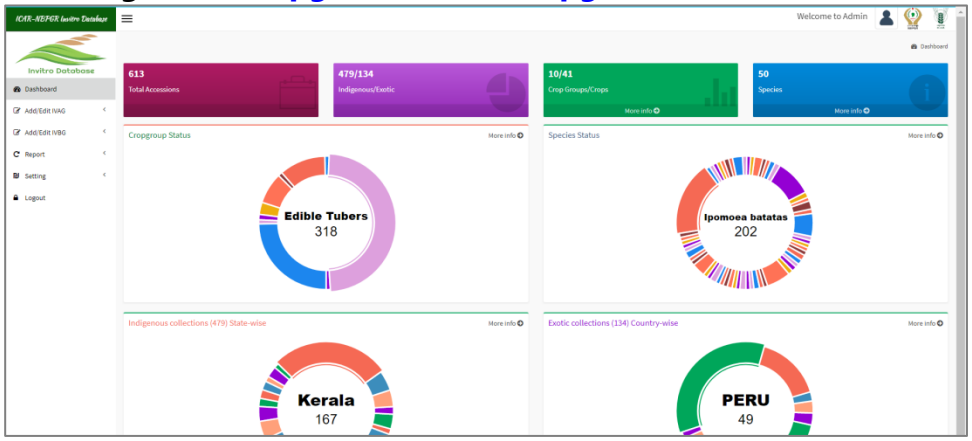
Seed Genebank (genebank.nbpgr.ernet.in)



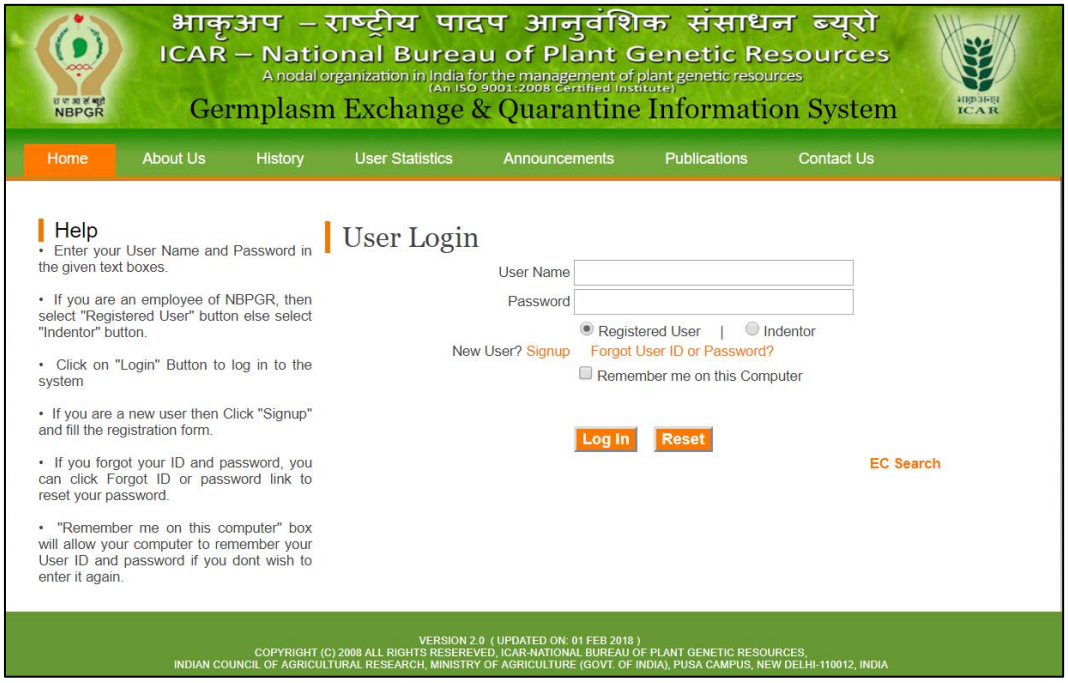
Cryo genebank (pgrinformatics.nbpgr.ernet.in/cryobank)



In vitro genebank (pgrinformatics.nbpgr.ernet.in/invitro)



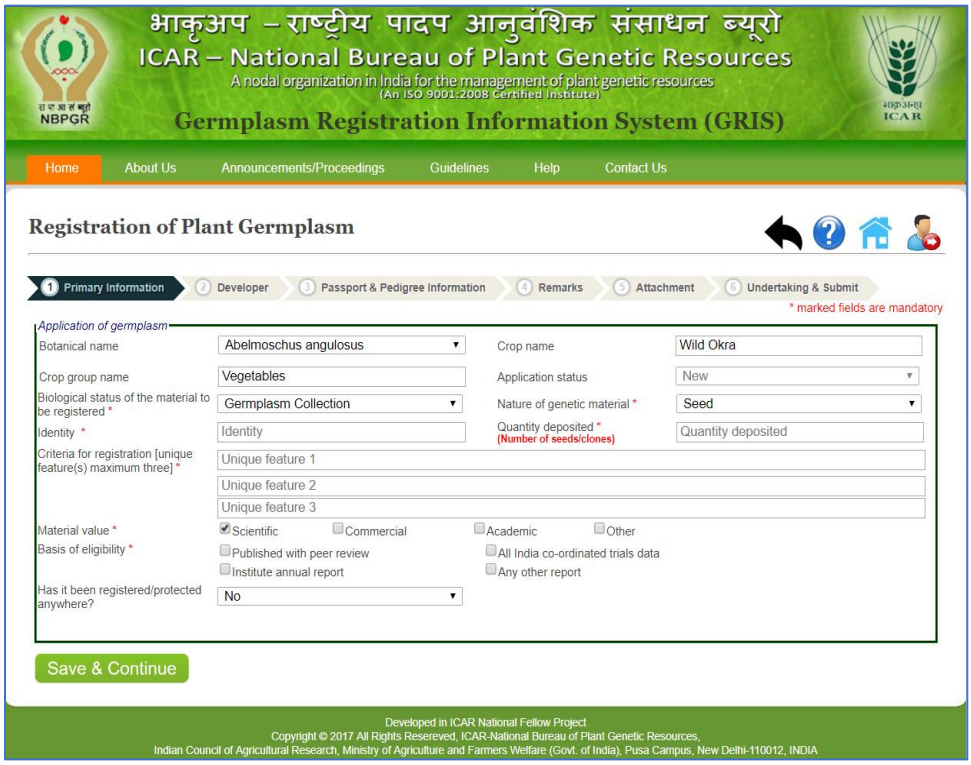
Germplasm Import Version 2.0 (exchange.nbpgr.ernet.in)



Germplasm Supply (pgrinformatics.nbpgr.ernet.in/mts)

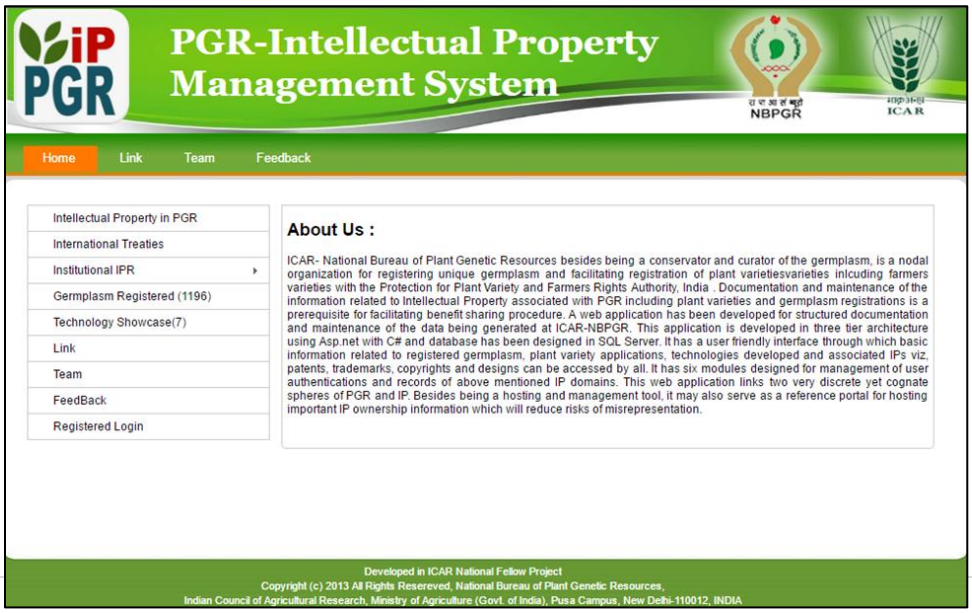
Germplasm Registration Information System (**www.nbpgr.ernet.in/registration**)

The Germplasm Registration Information System has been developed to make the entire process of germplasm registration—submission of application, evaluation by experts and decision by Plant Germplasm Registration Committee—online, easy and fast. The system is expected to provide genebank managers, breeders and plant researchers with a hands-on tool for management of germplasm registration process, and to policy makers with a reliable source of information. With the advent of this system, it is expected that the entire process of germplasm registration is made simple and transparent.



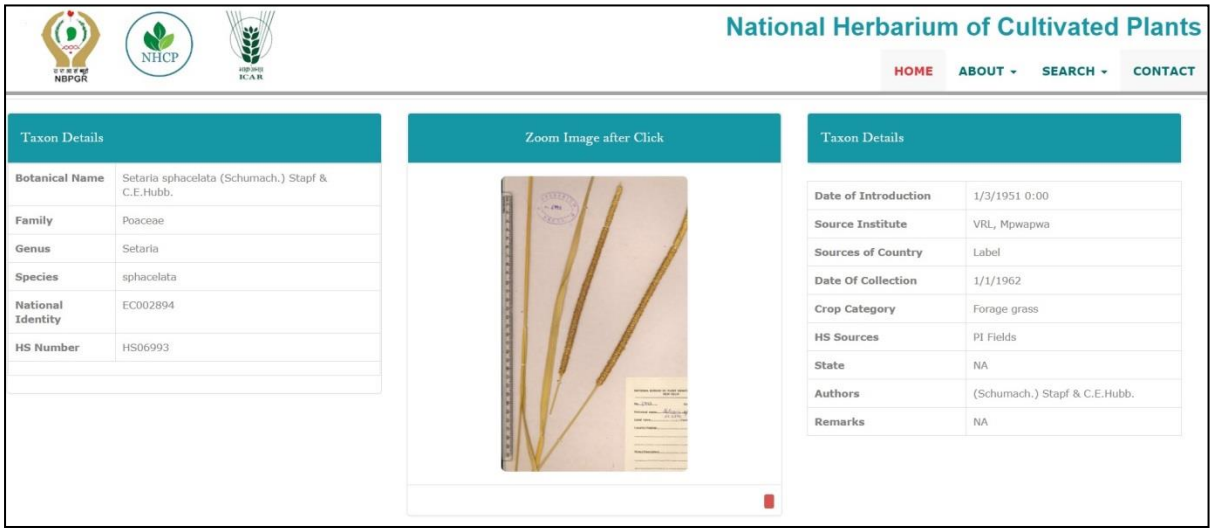
PGR IP-Management System (pgrinformatics.nbpgr.ernet.in/ip-pgr)

Systematic documentation and management of information related to IPs associated with PGR is a prerequisite for facilitating benefit sharing mechanism. This application facilitates access to various stakeholders.

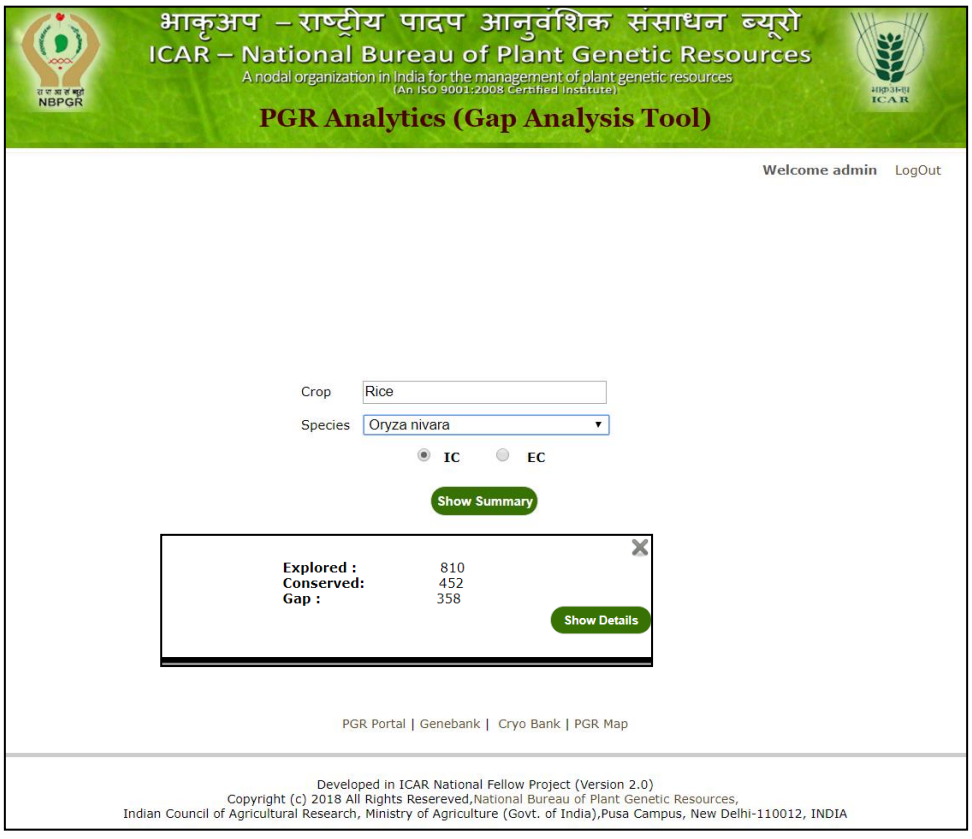


Virtual Herbarium of the National Herbarium of Crop Plants (http://pgrinformatics.nbpgr.ernet.in/nhcp)

National Herbarium of Crop Plants (NHCP), established in 1985 at NBPGR, has 23,665 specimens representing 267 families, 1,521 genera and 4,271 species. In order to make students and researchers across the world to access the invaluable information by the click of a button, ICAR-NF collaborated with NHCP to develop an online application creating a virtual herbarium with over 3,500 species of crop genepools complete with taxonomic information and about 7,000 images.

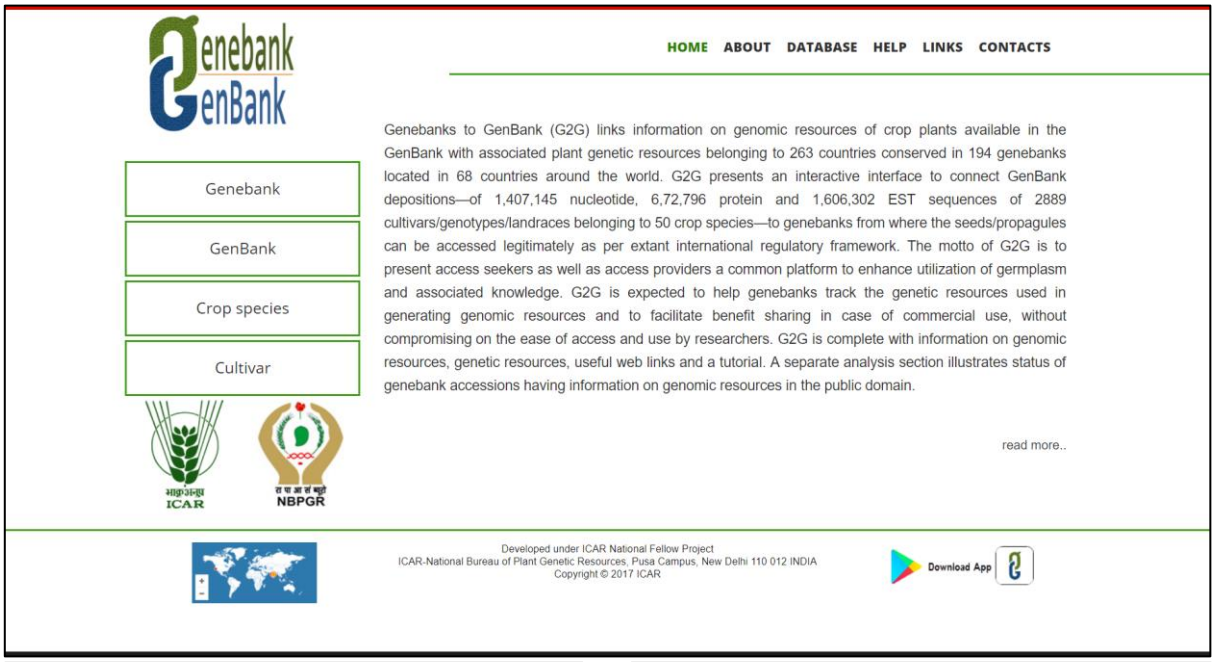


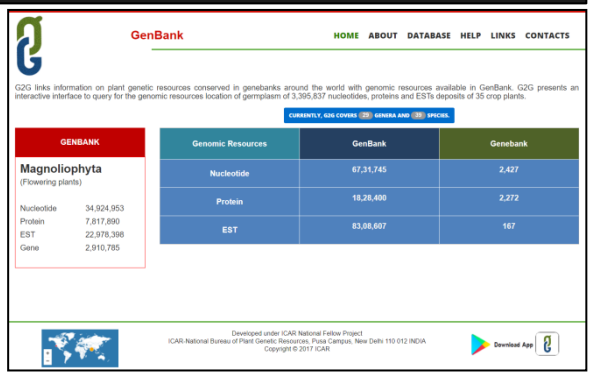
Gap Analysis Version 2.0 (Meant for internal use of NBPGR scientists)

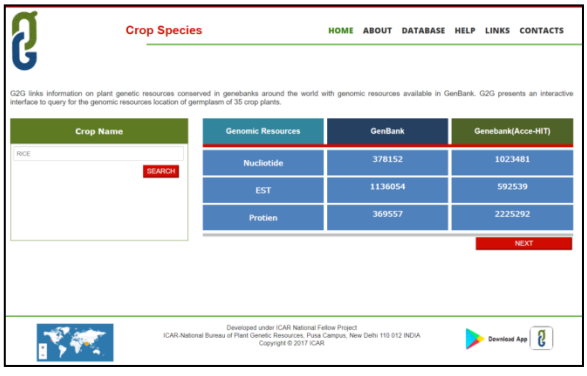


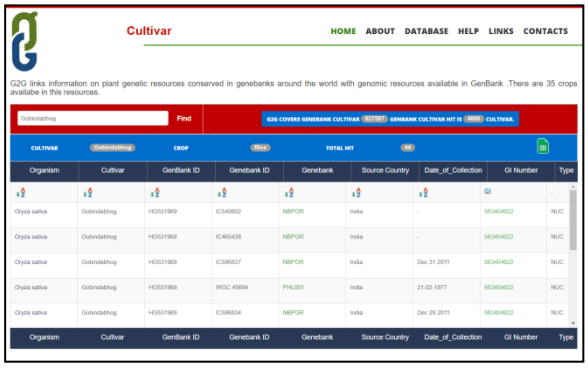
Genebank to Genbank G2G (http://pgrinformatics.nbpgr.ernet.in/g2g)

G2G links information on genomic resources of crop plants available in the GenBank with associated plant genetic resources belonging to 263 countries conserved in 194 genebanks located in 68 countries around the world. G2G connects GenBank depositions—of 1,407,145 nucleotide, 6,72,796 protein and 1,606,302 EST sequences of 2889 cultivars/ genotypes/ landraces belonging to 50 crop species—to genebanks from where the seeds/propagules can be accessed legitimately as per extant international regulatory framework. The motto of G2G is to present access seekers as well as access providers a common platform to enhance utilization of germplasm and associated knowledge.



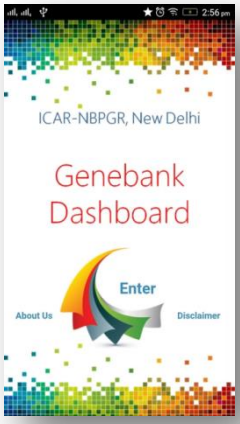


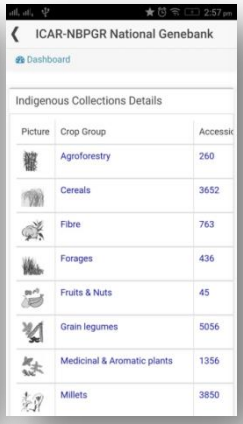


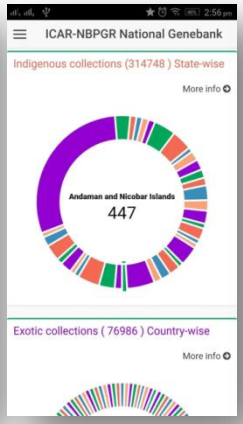


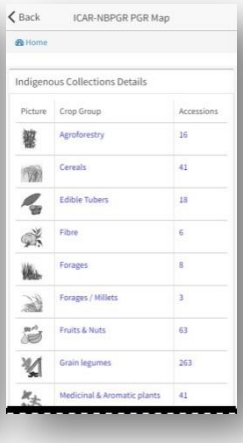
Mobile Apps in PGR Informatics

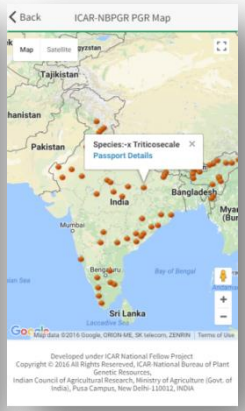
Genebank and **PGR Map** are developed as mobile apps **for both Android and iOS users**. Both the apps are first of their kind among all the genebanks.











Teaching and Research Guide

I hold a dual faculty position at IARI, New Delhi:

- Faculty of Plant Genetic Resources, NBPGR
- Faculty of Bioinformatics, IASRI

I taught/continue to teach the following courses as Course Leader:

1. BI 504 Evolutionary Biology (2+1)
2. BI 624 Genome Wide Association Study (2+1)
3. PGR 507 Information Management in Plant Genetic Resources (2+1)
4. PGR 500 Biodiversity and Plant Genetic Resources (2+0)
5. PGS 503 Intellectual Property and its Management in Agriculture (1+0)

Research Students

Plant Genetic Resources

1. Mr. Shailendra Solanki, 10648, *Analysis of genetic variation in Artocarpus hirsutus (Wild Jack) collections from Western Ghats*
2. Ms. Shephalika Amrapali, 10854, *Olfactory, biochemical and molecular profiling of rose germplasm for fragrance*
3. Mr. Puneeth, 11304, *Development of Informatics System to Document on Farm Conservation: A Case Study*

Bioinformatics

4. Ms. Soumya Sharma, 10778, *Development of database of genes and gene families responsible for nutritional content in field crops*
5. Ms. Sneha Murmu, 11006, *Computational approaches to understand host-pathogen interactions between wheat and its blast fungus*
6. Ms. Shweta Kumari, 11007, *Comparative Analysis of Domestication Related Genes in Minor Pulses*
7. Mr. Dipro Sinha, 11227, *Deep learning methods to link germplasm and genomic data*

Organizing workshop/brainstorming meeting

1. A brainstorming meeting on "Strategies for Implementation of Delhi Declaration on Agrobiodiversity Management in India" was co-organized by NBPGR at New Delhi on August 28, 2017. The objective was to chalk out a plan for effective implementation of the 12-point Delhi Declaration on Agrobiodiversity Management. I contributed, as Chair, Technical Program, Proceedings and Publication Committee in conceptualization, preparation of background note and compiling and printing of proceedings that included action plan.

2. A "Regional Workshop on the Preparation of the National Reports on the Implementation of the International Treaty on PGRFA" was organized by the Secretariat of the International Treaty in collaboration with the Ministry of Agriculture and Farmers Welfare, Government of India, the FAO Representation in India and NBPGR. The workshop was organized at NASC, Pusa, New Delhi, from 11 to 13 December 2018. About 25 Participants from thirteen countries (Afghanistan, Bangladesh, Bhutan, Fiji, Indonesia, India, Italy, Malaysia, Philippines, Mongolia, Philippines, Nepal, Thailand and Papua New Guinea) took part in the Workshop. I contributed as a local organizer as well as a technical expert.

Annexure 2

Publications (2015-2019)

Research articles[1]

1. Archak S, Gaikwad AB, Gautam D (2015) Molecular genetic diversity analysis of commercial mango (*Mangifera indica* L.) cultivars employed as parents in hybrid development in India. *Indian Journal of Plant Genetic Resources* 27: 209-216. [5.12]
2. Saxena S, …Archak S, et al (2015) Development of novel simple sequence repeat markers in bitter gourd (*Momordica charantia* L.) through enriched genomic libraries and their utilization in analysis of genetic diversity and cross-species transferability. *Applied Biochemistry and Biotechnology* 175: 93-118. [7.80]
3. Archak S, Singh A, Ahmad F. (2017). PGR-Clim: climate atlas of genetic resources of five crops. *Indian Journal of Plant Genetic Resources* 30(1): 77-79. [5.12]
4. Archak S, Rana JC, Singh P, Gaikwad AB. (2017). Potential of gene-specific sequence-tagged-sites (STS) as trait specific markers in buckwheat (*Fagopyrum* spp.). *Journal of Plant Biochemistry and Biotechnology* 26(2):160–171. [6.77]
5. Archak, Tyagi RK, Agrawal A, Mathur PN (2017). Delhi Declaration provides a roadmap for agrobiodiversity management. *Indian Journal of Plant Genetic Resources* 30(1): 88-91. [5.12]
6. Kumar S, Archak S, Tyagi RK, Kumar J, Vikas VK, et al. (2016). Evaluation of 19,460 Wheat Accessions Conserved in the Indian National Genebank to Identify New Sources of Resistance to Rust and Spot Blotch Diseases. *PLoS ONE* 11(12):e0167702. [8.77]
7. Archak S, Tyagi RK, et al. (2016). Characterization of chickpea germplasm conserved in the Indian National Genebank and development of a core set using qualitative and quantitative trait data. *The Crop Journal* 4: 417–424. [NA]
8. Jamla M, Gaikwad AB, Jacob SR, Archak S (2017). Text-mining for Identifying Abiotic Stress Candidate Genes to Screen Bread Wheat (*Triticum aestivum*) Germplasm. *Indian Journal of Plant Genetic Resources* 30(2): 162-164. [5.12]
9. Chourey SK, Solanki S, Gaikwad AB, Pandey CD, Archak S. (2017). SSR marker analysis points to population admixture and continuum of genetic variation among Indian landraces of brinjal (*Solanum melongena*). *Scientia Horticulturae* 224: 68-73. [7.76]

[1] *PGR informatics applications developed in the project are first of their kind. They are opened to public access according to the guidance of National Advisory Board on Management of Genetic Resources. Publications describing these PGR applications were deliberately held back till their functioning is validated for THREE years of public access. The manuscripts shall be communicated in 2019-20.*

10. Sharma S, Jaiswal S, Archak S (2017). Annotation of gene sequence and protein structure of brinjal EDS1. *Bioinformation* 13 (3), 54. [NA]
11. Jamla M and Archak S (2019). Genomic Resources of Plant Abiotic Stress Tolerance: An Overview of Functional and Regulatory Proteins. *Indian Journal of Plant Genetic Resources* 32:93-106. [5.12]
12. Singh B, Gaikwad AB, Chandra R and Archak S (2018). DNA Profiling of pomegranate (*Punica granatum* L.) field genebank Semi-Feral collection by using ISSR markers. *Indian Journal of Plant Genetic Resources* 31:191-193. [5.12]
13. Jamla M, Gaikwad AB, Jacob SR and Archak S (2017). Text-mining for Identifying Abiotic Stress Candidate Genes to Screen Bread Wheat (*Triticum aestivum*) Germplasm. *Indian Journal of Plant Genetic Resources* 30:162-164. [5.12]

Booklets

1. Paroda RS, Archak S et al (Eds). (2017). Proceedings of the Awareness cum Brainstorming Meeting on Access and Benefit Sharing (ABS): Striking the Right Balance, New Delhi, India, October 22, 2016. Indian Society of Plant Genetic Resources, New Delhi, 32 p.
2. Gupta K, Archak S, Pradheep K, Kumar S, Jacob SR, Tyagi V, Rana MK, Gupta S, Kumari J, Randhawa GJ and Singh S (2018). ICAR-NBPGR: Bridging Science and Service (2012-2018). ICAR-National Bureau of Plant Genetic Resources, New Delhi, 74 p.

Book Chapter

1. Rana JC, Singh M, …and Archak S. (2016). Genetic resources of buckwheat in India. In: Zhou et al. (Eds.), *Molecular Breeding and Nutritional Aspects of Buckwheat*. Academic Press. pp. 109-135.
2. Dutta M, …. Archak S, … Bansal KC (2015) Development of core set of wheat (*Triticum* spp.) germplasm conserved in the national genebank in India. In: Ogihara et al. (Eds.), *Advances in Wheat Genetics: From Genome to Field*. Springer Open. Pp. 33-45.

Participation in conference/workshop/trainings/meetings etc.

Speaker/Resource Person

1. Delivered invited talk on "Eco-geographic surveys and GIS in PGR management" during ICAR-Sponsored Short Course on Crop Wild Relatives: Identification, Collecting and Utilization, NBPGR, New Delhi on 27 Aug 2015.
2. Resource person on PGR Informatics during International Workshop on Genebank operation and advanced learning (GOAL) organized by Crop Trust, Crawford Fund, Bioversity International and ICAR-NBPGR from 16-21 Nov 2015, NASC, New Delhi, India.
3. Resource person on PGR Informatics during Training on "Conservation of Plant Genetic Resources" for the Scientists from Forest Research Institute, Dehradun. ICAR-NBPGR. 28-06-2016.
4. Made oral presentation on "India as a Crucible to Develop Integrated Information Systems" during the International Agrobiodiversity Congress 2016, 6-9 Nov 2016, New Delhi.
5. Resource person on PGR Informatics during Centre for Advanced Faculty Training (CAFT) on "Advance Computational and Statistical Tools for Omics Data Analysis", IASRI, New Delhi. 16-11-2016.
6. Resource person on PGR Informatics during Training on "Advanced Statistical Techniques in Genetics and Genomics", IASRI, New Delhi. 09-03-2017.
7. Resource person on PGR Informatics during Training on "Management of Plant Genetic Resources of Fruit Crops" for the scientists of AICRP (Fruits), ICAR-NBPGR. 23-03-2017.
8. Made oral presentation on PGR Clim application during ICAR-KRISHI Geoportal Workshop-Experts, NBSS&LUP, Nagpur. 27-03-2017.
9. Participated in the International Workshop for Software Testing on DOI Implementation, ITPGRFA-BSF project in Bogor, Indonesia 22 Apr– 1 May, 2018.
10. Convener of Session on *Ethics, IPR and Regulations for use of gene/genetic resources* during the 1st National Genetics Congress, New Delhi on 15-12-2018.

Participation

11. International Conference on Low Temperature Science and Biotechnological Advances. 27-30 April 2015, New Delhi.
12. Awareness Seminar cum Brainstorming Meeting on "Access and Benefit Sharing: Striking the Right Balance" India Habitat Centre, New Delhi. 22-11-2016.
13. Roundtable on "Sustainable Inputs for Agriculture" at Rashtrapati Bhavan, New Delhi. 09-03-2017.
14. Strategic meeting on Biotechnological contributions for increasing farm income held at Department of Biotechnology, New Delhi 18 May, 2018.
15. Group discussion on Convergence of Plant Biotech Inventions and Plant Variety during the Global LES APAC Conference 2018 Le Meridien, New Delhi 12 Nov, 2018.
16. Indo-German International workshop on DNA based system & Techniques for consolidated DUS organized by PPV&FRA, New Delhi [20-21 November 2018].
17. National Conference on Biodiversity and Plant Genetic Resources for Future, UAHS, Shivamogga 15-03-2019.

Annexure 3

Peer recognition

A. Membership of various committees/working groups (International)

i. Scientific Advisory Committee of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).
ii. Ad Hoc Open-ended Working Group to enhance the functioning of the Multi-Lateral System International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

B. Membership of various committees/ working groups (National)

i. Scientific Advisory Committee (RAP-SAC), Center for DNA Fingerprinting and Diagnostics, Hyderabad.
ii. Department of Biotechnology Expert committee on Platform for Genomics to Breeding, New Delhi.
iii. PPV&FRA Task Force Committee on Complementing DUS characterization through DNA fingerprinting.
iv. Department of Biotechnology Technical Expert Committee (TEC) on Agriculture Biotechnology.
v. Department of Biotechnology Technical Expert Committee (TEC) on Agriculture Biotechnology and Allied Sciences for North East Region (NER).
vi. Shastri Indo-Canadian Institute, New Delhi evaluator for overseas programmes/ fellowships/ scholarships and grants.
vii. Institute Management Committees of
    a. ICAR-Central Tobacco Research Institute, Rajahmundry.
    b. ICAR-National Bureau of Fish Genetic Resources, Lucknow.

C. Editor of a NAAS rated Journal

Editor-in-Chief of Indian Journal of Plant Genetic Resources.