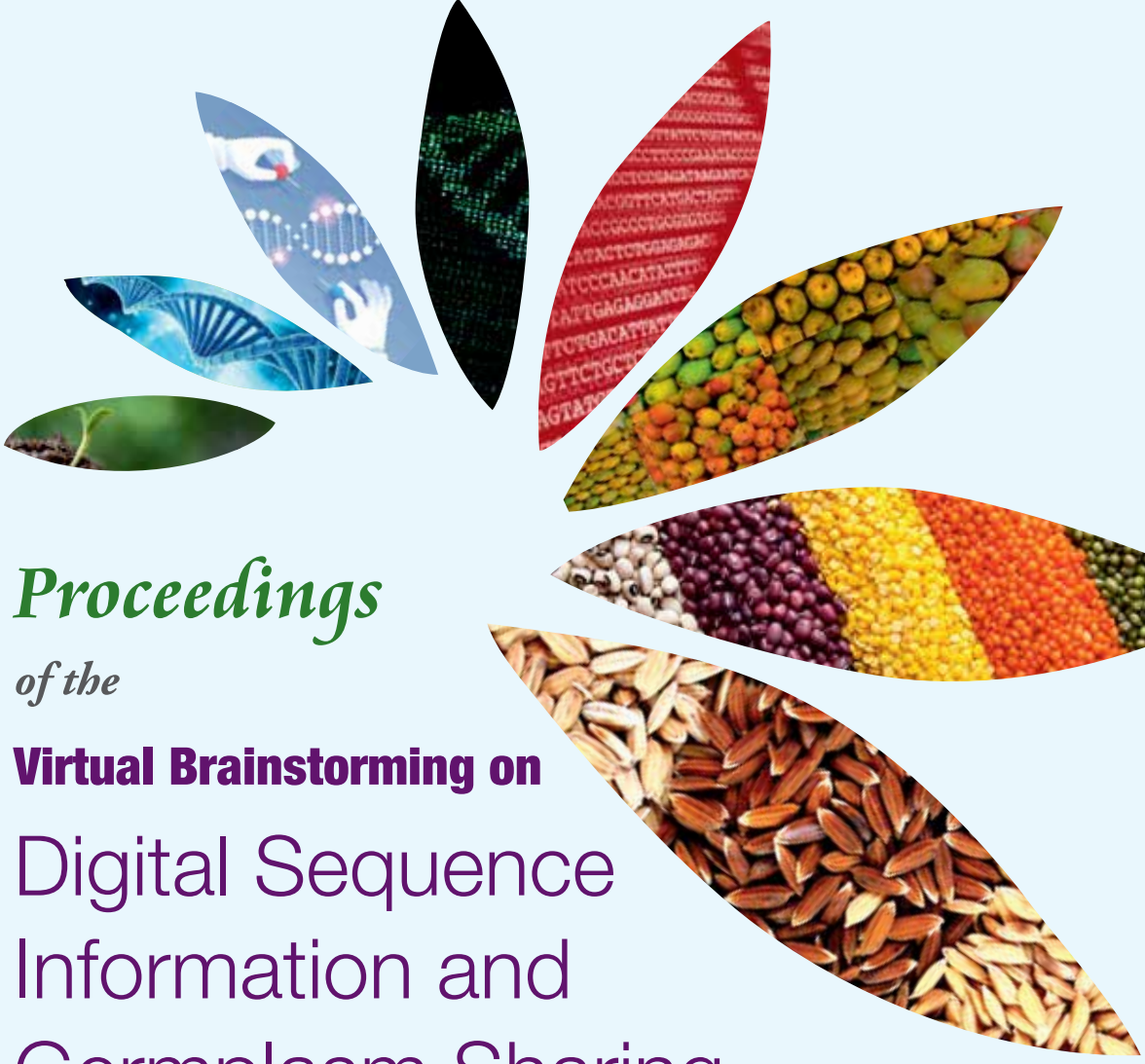


Proceedings

of the

Virtual Brainstorming on

Digital Sequence Information and Germplasm Sharing

March 1, 2021

Organized by

Indian Society for Plant Genetic Resources (ISPGR)

Pusa Campus, New Delhi - 110 012, INDIA

Proceedings

of the

Virtual Brainstorming on

Digital Sequence Information and Germplasm Sharing

March 1, 2021

Organized by

Indian Society for Plant Genetic Resources (ISPGR)

Pusa Campus, New Delhi - 110 012, INDIA

Indian Society of Plant Genetic Resources
c/o ICAR-National Bureau of Plant Genetic Resources
Pusa Campus, New Delhi - 110 012, India
Tel: +91-11-25802817; E-mail: ispgr2015@gmail.com
Website : http://ispgr.nbpgr.ernet.in

Citation : Anuradha Agrawal, Sunil Archak, Rakesh Singh, Amit Kumar Singh, R. Parimalan, Kuldeep Singh, R.C. Agrawal and R.S. Paroda (eds) (2021) *Proceedings of the Virtual Brainstorming on 'Digital Sequence Information and Germplasm Sharing'*. Indian Society of Plant Genetic Resources, New Delhi, India, p. 32+x.

ISBN No.: 978-81-950114-1-4

Recording of Webinar available at

Digital Sequence Information (DSI) and Germplasm Sharing (March 1, 2021)

https://www.youtube.com/watch?v=9L2qRo7gQTk

For copies

General Secretary
Indian Society of Plant Genetic Resources
ICAR-National Bureau of Plant Genetic Resources
Pusa Campus, New Delhi -110012, India
E-mail: ispgr2015@gmail.com
Website : http://ispgr.nbpgr.ernet.in

Printed at :

Malhotra Publishing House
B-6, DSIDC Complex, Kirti Nagar, New Delhi - 110 015
Phone: 011-41420246; E-mail: vinay.malhotra@gmail.com

CONTENTS

ISPGR
1987

PREFACE

A "Virtual Brainstorming on Digital Sequence Information and Germplasm Sharing" was organized on March 1, 2021 by the Indian Society of Plant Genetic Resources (ISPGR), New Delhi, India. Purpose of the event was to provide a forum to deliberate by experts and various stakeholders on Digital Sequence Information (DSI). This document provides briefly the deliberations held during the meeting and the major recommendations which emerged.

We are very grateful to Dr R.S. Paroda, President, ISPGR, and Chairman, Trust for Advancement of Agricultural Sciences (TAAS), for motivating and facilitating the organization of this webinar and also for providing his special remarks during the inaugural session. Both the Vice Presidents of ISPGR, Dr R.C. Agrawal, Deputy Director General (DDG), Education, Indian Council of Agricultural Research (ICAR), New Delhi and Dr Kuldeep Singh, Director, ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi, are thanked immensely for Co-Chairing the Session and providing all the necessary technical and logistic support in organization of this meeting. Our very special thanks to the two speakers - Ms. Anke van den Hurk, International Seed Federation and Mr Pierre Du Plessis, African Union, for providing the contrasting stakeholders' views and setting the tone for the brainstorming meeting. The success of the meeting was also due to active participation of all the 10 discussants, each of whom is gratefully acknowledged.

We thank all the members of the organizing committee for their help in smooth conduct of the event, specially the rapporteurs Drs Rakesh Singh, Amit Kumar Singh and R. Parimalan. Support provided by staff of ICAR-NBPGR (Mr V.K. Mandal) and ISPGR (Mr Sunil Bhardwaj and Mr Arup Das) in technical and logistic matters is sincerely appreciated. Finally, we thank all dignitaries and delegates who participated in the brainstorming meeting.

Editors

ISPGR
1987

ACRONYMS/ ABBREVIATIONS

ABS	Access and Benefit Sharing
BBJN	United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction of the Intergovernmental Conference
BDA	Biological Diversity Act, 2002
BS	Benefit sharing
BSF	Benefit Sharing Fund
Cas9	CRISPR associated protein 9
CBD	Convention on Biological Diversity
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIOPORA	International Community of Breeders of Asexually Reproduced Horticultural Plants
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CP	Contracting Parties
CoP	Conference of Parties
CWR	Crop wild relatives
CRISPR	Clustered regularly interspaced short palindromic repeats
DAC&FW	Department of Agriculture, Cooperation and Farmers' Welfare
DARE	Department of Agricultural Research and Education

DNA	Deoxyribonucleic Acid
DSI	Digital Sequence Information
FAO	Food and Agriculture Organization of the United Nations
FSII	Federation of Seed Industry of India
FTP	File Transfer Protocol
GB	Governing Body
GLIS	Global Information System
GRFA	Genetic Resources for Food and Agriculture
GRSD	Genetic resource sequence data
GoI	Government of India
ICAR	Indian Council of Agricultural Research
ICT	Information and Communication Technology
INSDC	International Nucleotide Sequence Database Collaboration
IP	Intellectual Property
IPR	Intellectual Property Right
ISF	International Seed Federation
ISPGR	Indian Society of Plant Genetic Resources
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LMOs	Living Modified Organisms
MAT	Mutually Agreed Terms
MLS	Multilateral System of Exchange (under the ITPGRFA)
MoA	Memorandum of Agreement
MoA&FW	Ministry of Agriculture and Farmers Welfare, Government of India
MoEF&CC	Ministry of Environment, Forest and Climate Change, Government of India
MoH&FW	Ministry of Health and Family Welfare, Government of India
MTA	Material Transfer Agreement
NAHEP	National Agricultural Higher Education Project
NARS	National Agricultural Research System

NBA	National Biodiversity Authority
NBPGR	National Bureau of Plant Genetic Resources
NGB	National Genebank
NGO	Non-Governmental Organization
NP	Nagoya Protocol
NTAC	Normally Traded as Commodities
PBR	People's Biodiversity Register
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PIC	Prior Informed Consent
PPV&FR	Protection of Plant Varieties and Farmers' Rights Act, 2001
PPV&FRA	Protection of Plant Varieties and Farmers' Rights Authority
PVP	Plant Variety Protection
R&D	Research and Development
RNA	Ribonucleic Acid
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SDG	Sustainable Development Goals
SMTA	Standard Material Transfer Agreement
TAAS	Trust for Advancement of Agricultural Sciences
UN	United Nations
UPOV	International Union for the Protection of New Varieties of Plants
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

ISPGR
1987

BACKGROUND

The conservation and use of plant genetic resources for food and agriculture (PGRFA) are primarily governed by two international agreements - Convention of Biodiversity (CBD) that governs all genetic resources and the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) which applies only plant species. Both are the main elements of the access and benefit sharing (ABS) framework. Recent advances in science and technology, especially genomics and synthetic biology is likely to bring another paradigm shift in germplasm sharing issues.

What is DSI?[1]

Digital Sequence Information (DSI) on Genetic Resources for Food and Agriculture (GRFA) currently in use includes multiple kinds of information (mainly DNA or RNA sequence information) about various biological materials found in genetic resources for food and agriculture (GRFA), used to manage GRFA, or to derive value from GRFA.

How DSI influences GRFA use?

DSI makes it easier to get value from a genetic resource (GR) without possessing it or even its DNA. Technologies that use DSI do not vary significantly across commodities (plant, animal, microbe, fishes, etc.). DSI is greatly useful for non-agricultural applications, such as drug, vaccine or pesticide development.

What is the apprehension to access DSI?

DSI is stored in electronic digital media. Publicly accessible DSI includes the content and functionality of >1,000 online databases hosted in developed countries. Continuing funding in an open access model is not assured and the amount of private DSI on GRFA is unknown. Private entities will have enormous opportunity to commercially use the GRFA in dematerialized form owing to

[1]DSI continues to be a placeholder term in the negotiations at CBD and ITPGRFA; DSI is defined here in a simple inclusive way for easy comprehension.

greater freedom-to-operate and enhanced possibilities of intellectual property rights (IPRs) protection.

How DSI is a game changer in GRFA regulation?

The CBD and Nagoya Protocol aim to regulate the physical access to and thereby use of biological resource from a provider country to a user, according to ABS agreement. The ITPGRFA aims to provide facilitated access to a subset of PGRFA in a multilateral system and manage consequent benefit sharing opportunities. This GRFA access and use paradigm has been disrupted by advanced technologies in genomics and synthetic biology. The genome sequence of a particular species can now be accessed without the need for any of the GRFA access instruments. Further, commercial use of DSI is not currently within the jurisdiction of CBD or ITPGRFA. As a result, global conventions and treaties are deliberating on whether ABS requirements should apply to the use of DSI from GRFA.

What do we need to address?

Dematerialized use of GRFA calls for a clear understanding of the impact of DSI on sovereign rights, community rights and IPRs, and to develop India's national position of various issues that surround DSI and their use. Not many countries have the luxury of rich bioresources, traditional knowledge, modern research and development (R&D) institutional framework and expertise in genomics as much as India possesses. Developing countries look up to India's leadership in international negotiations.

Hence, there is a pressing need to generate a formal policy debate involving stakeholders and technical experts to develop India's position/ opinion/response to disparate issues/concerns/questions pertaining to DSI of GRFA. This brainstorming meeting was targeted towards this gap.

Objectives and Format of Brainstorming

The meeting aimed to gather data for formulation of policy about inclusion of DSI in national and international statues that relate to access, exchange and benefit sharing of GFRA, based on views of various stakeholders including scientists, technologists, policy makers, farmers and private sector. This was to demystify the complexity of issues relating to DSI for GRFA and suggesting potential ways for developing comprehensive mechanisms for governance and fair use of genetic resources.

Two international experts on the subject, Ms. Anke van den Hurk, International Seed Federation, and Mr. Pierre Du Plessis, African Union Commission, provided the divergent views on the topic. Thereafter, PGR experts from India's public sector, scientists, private seed industry, farmer representative and legal experts deliberated on the subject.

INAUGURAL SESSION

Dr R.S. Paroda, President, ISPGR, presided the inaugural session which was Co-Chaired by the two Vice-Presidents of ISPGR, Dr R.C. Agrawal, Deputy Director General (Education), Indian Council of Agricultural Research (ICAR) & National Director, National Agricultural Higher Education Project (NAHEP) and Dr Kuldeep Singh, Director, ICAR-National Bureau of Plant Genetic Resources (NBPGR). Dr Sunil Archak, National Fellow, ICAR-NBPGR and Editor-in-Chief, Indian Journal of Plant Genetic Resources (IJPGR) moderated the meeting. The virtual brainstorming was conducted through the zoom platform and some 200 participants attended from India and abroad.

At the outset, **Dr Kuldeep Singh** welcomed the invited dignitaries and speakers, and all participants of the virtual gathering. He said that with the technological advances in the area of genome sequencing and genome editing, there has been a paradigm shift in the thinking about sharing of genetic resources, which was not conceivable even about a decade or two ago. He provided a background on the importance of DSI *vis-à-vis* genetic resources sharing and the need to focus on this complex yet important issue. He said countries had divergent views about DSI sharing at various international fora, including the CBD and ITPGRFA. He informed that in the 8th Governing Body (GB) meeting of the ITPGRFA, no consensus could be reached regarding DSI benefit sharing, and would likely to be a debatable point even in the 9th GB meeting, scheduled in India in December 2021 (in fact now rescheduled in 2022). He thanked Dr R.S. Paroda, President, ISPGR for motivating ISPGR to hold this

brainstorming to understand the divergent viewpoints before India's viewpoint on this issue is formalized.

Dr R.S. Paroda also welcomed participants of the brainstorming session on DSI, a topic of considerable significance. He said due to the recent emergence of the subject, most were still learning. He said that since antiquity, GR were considered as common heritage of humankind and shared freely among nations, till the concern for conservation of biological diversity were raised during the CBD in 1993. Protection of GR was called for either by a *sui generis* or other existing system. He briefly explained the historical milestones pertaining to the changing paradigms in exchange of GR (multilateral system under ITPGRFA, and bilateral system under Nagoya Protocol), Farmer's Rights (FRs), Plant Breeder's Rights (PBRs), and introduction of national laws to govern these issues. Notwithstanding these changes, it was clear that continued exchange of GR was essentially required to meet the emerging challenges related to natural resource degradation, human nutrition, climate change and so on. This requires understanding the role of *in situ* conservation, besides strengthening *ex situ* strategies and the related ABS issues, which in turn calls for building of human resource capacity and institutional support. Dr Paroda expressed his happiness that India was relatively in a much better position amongst less developed nations, in this regard. He urged that GR issues should be addressed holistically including plants, animals, fish, microbes, insects etc.

Advances in science has changed how plant breeding and crop improvement is being undertaken. Dr Paroda expressed his happiness that the 2020 Nobel Prize in Chemistry was awarded to remarkable women scientists - Emmanuelle Charpentier from France (currently in Max Planck Unit for the Science of Pathogens, Berlin, Germany) and Jennifer Doudna from University of California, Berkeley (also an investigator at Howard Hughes Medical Institute, San Francisco, USA) who developed

precise genetic scissors, the CRISPR-Cas9 system. This discovery and other advances in biotechnology provide ample and rapid opportunities for genetic enhancement. In this context as well as the rapid strides in information communication technology (ICT) has made the global village as one. The concern today is that genetic sequence information available in the public domain is enough for the commercial development of products with no need for physical access

of genetic resources, aided by revolutionary technologies, including gene editing technologies, big data and synthetic biology. This raises issues about how use of DSI impact individuals and groups, who have invested time and effort in augmenting and refining valuable characteristics in genetic resources. The use of DSI have raised ethical and legal questions which call for better understanding, putting in place mechanisms for this issue, with diversified viewpoints from multiple stakeholders. Dr Paroda recalled how as Chairman of Working Group on Farmers' Rights under the ITPGRFA it was difficult to deliberate about the definition, and application of Farmers' Rights, taking almost two year. Similarly, he said DSI may also take some time before it is accepted. He urged all to take the advancements in science in their stride and capitalize on opportunities of ABS not only through physical access of GR but also though information exchange. He appreciated that ISPGR, which had hosted the 1st International Agrobiodiversity Congress in New Delhi in 2016 and came out with the 'Delhi Declaration on Agrobiodiverity Management' (with ABS and knowledge management as key issues), has also taken an initiative on DSI dialogue which would have implications on developers, conservers and users of GR.

Thereafter **Dr Sunil Archak** introduced the two speakers **Ms. Anke van den Hurk** and **Mr Pierre Du Plessis** and invited them to present their views on the topic.

EXPERTS VIEWS

DSI, is it wise to regulate it?

Ms Anke Van den Hurk is Deputy Director, Plantum NL, the Dutch association for breeding, tissue culture, production and trade of seeds and young plants, an organization in which has been working since 2001. During 1996 – 2001 she worked at the International Plant Genetic Resources Institute (now known as Alliance for Bioversity International & CIAT) in Rome and Cali, Colombia as Associate Expert on training in plant genetic resources and on complementary conservation strategies. During 1995-96 she worked at Mekel University College in Ethiopia as a teacher in various agricultural subjects, including plant breeding. From 1992-95 Ms Van den Hurk worked as vegetable breeder at Nunhems Zaden in the Netherlands.

Ms ANKE VAN DEN HURK
About the Speaker

She obtained her Masters degree in Plant Breeding from the Wageningen University, Netherlands and worked on taxonomy, plant breeding in Ethiopian barley landraces and growth models. Among others, she is specialized in the field of biodiversity, in particular ABS. She participates in the various meetings of the ITPGRFA and the CBD as representative of the seed sector. She is also active in the various industry fora dealing with ABS, such as the International Seed Federation (ISF), European Seed Association, CIOPORA and International Chamber of Commerce. Within ISF she is Chair of the working group dealing with biodiversity.

The DSI has been on the international policy agenda for several years now. Ms Hurk proposed to pose a few questions before deciding whether to regulate DSI or not. She said that her presentation would be based from a plant breeders' perspective and the possible implications of these regulations on plant breeding industry.

At the outset she delved on the reasons why deliberations on DSI had started. The two points that triggered the discussion were : (i) Expectations on benefit sharing were not reached and (ii) the fear that DSI will be used to circumvent the use of GR to avoid benefit sharing through CRISPR-Cas or other equivalent genome editing technology using the DSI.

She said that breeders agree that expectations on BS were not reached as stakeholders are very far apart. Also, BS was expected on resources exchanged in the past, which is legally problematic. Furthermore, the time to develop a product was not always taken into account. In the ITPGRFA meeting of 2013, discussions started on revamping of the MLS, just six years after the coming into existence of the Standard Material Transfer Agreement (SMTA). A plant breeding cycle, especially when crop wild relatives (CWR) or Farmers varieties are used, takes at least six years, more often 15-20 years. Thus, BS could not have come by 2013. Breeders have several criteria to select GR for use in breeding programs – crossability, knowledge on characters present, and lastly, ABS requirements.

Another element to deal with the expectations is the non-monetary BS. Plant breeders have always been ready to collaborate with universities and research institutes, and help in capacity building, especially in developing countries. The valuation of these activities in terms of BS is difficult. The breeders' exemption is another BS mechanism. Finalized products from plant breeders (protected from PBRs) are free from research, breeding and commercialization of the products out of it. Modern varieties are used often used both in participatory and scientific plant breeding and the benefits to use advanced cultivars for introgression of a useful trait without resorting to CWR is a benefit itself.

Hence, many questions remain on how to solve the issue of equitable BS and managing the expectations of stakeholders. It is believed by some people that the use of GR itself is circumvented by free access to DSI. Ms Hurk opined that this is not realistic in case of plant breeding, at least for the foreseable future. Moreover, it is very expensive to

use DSI in gene editing. The new age gene editing technologies may be complimentary tool in the breeders toolbox, but not replace the work of a conventional plant breeder. Biotechnology researchers may think differently, but the same opinions prevailed at the start of the transgenic discussion as well. According to Ms Hurk, plants will not be created synthetically from building blocks of DNA; their physiological and metabolic pathways and interaction of traits with their environment are far too complex.

Plant breeders make many crosses each year. Depending on the crop and size of the program, this may vary from few dozens to hundred of thousands. They use over 95 per cent advanced and improved materials for this and only rarely use other materials like farmers varieties, landraces and CWR. This can introduce new diversity in elite materials in a crop for intended traits; but from a diversity point of view the less visible genetic diversity, the value of which cannot be assessed at all. Some may say that the use of DSI may be in the new age gene editing technologies in the future. The most impressive gains will be when applied in perennial and polyploid crops, the breeding of which is extremely slow.

The other important question is whether one wants to make a fundamental change on legal availability of knowledge, as opposed to physical resources (like GR). There is increasing realization in organzations the need for open source data policies, as evidenced from the fact that more and more scientific journals and papers are freely accessible. Plant breeders in general are very critical about patents on plants that provide leagally exclusive rights on their use. Instead, the open innovation system of PBRs has been developed that provides support to investments in breeding, without restricting access to knowledge. Thus, the moot question is whether one wants to go in the opposite direction. If yes, fundamental questions that need to be addressed include (i) its effect on innovation and diversity in crops that farmers can choose from; (ii) the amount of BS that can be expected and (iii) consequence for use and conservation of biodiversity.

We live today in the era of big data. Ms Hurk said that with restricted sharing of information, we go back to 1970's in terms of R&D progress. She gave the example of use of remote sensing to study the behaviour of plants under flood conditions, to monitor the growth process. Such studies require DSI information to generate abiotic stress tolerant varieties. Implementation of retrictions on easy access to DSI would significantly impact the nutritional food security and crop improvement and will not give a fair and equitable opportunity for all researchers. Ms Hurk opined that breeders did not have a very positive experience under the current Nagoya Protocol and the access to GR itself. The process to access GR is often long, uncertain, disappointing, not leading to a workable colloboration and/or BS arrangement.

Commenting on potential impact of controlled DSI on Indian innovation capacity, Ms Hurk informed that in the past India has been a net user of DSI from big

genetic databases, and what would happen if the country would need to pay for all the data accessed freely so far. Further, in the current scenario where public-private partnership is on the rise in R&D sectors related to crop development, restricting free access to DSI would negatively impact such collaborations. Would the generators of DSI be in a position to use that information for products development, and if yes, under what conditions? Further, the risk of every DSI developer taking care of his or her own datasets to avoid dealing with the public DSI. This will enhance the duplication of efforts leading away from real innovation steps, thereby wasting the resources and money in repetition of work, that could be avoided through mere sharing. Also it would widen the gap between the small, medium and large organizations. Ms Hurk opined that open access systems do work, as exemplified by the Portection of Plant Varieties and Farmers' Rights Act (PPV&FRA) of India, which has breeder's exemption. Under this, breeders have access to all the extant varieties and GR to develop new materials, without having any additional obligations towards the owner of the original material.

The regulation of DSI may be seen as attractive for BS in monetary or non-monetary terms but one needs to understand the implications clearly. Would the cost of regulating DSI be beneficial enough to compare with cost of generating DSI? The CBD calls for collaboration and cooperation for its implementation, including that under Nagoya Protocol. Under Article 10e of CBD (sustainable use of components of biological diversity), contracting parties (CP) have committed to 'encourage cooperation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources'. In the Annex 2b to the Nagoya Protocol, CP are urged to encourage 'collaboration, cooperation and contribution in scientific research and development programs, particularly biotechnological research activities, where possible to the Party providing genetic resources', as part of non-monetary benefits. Good examples of such cooperation are the public-private projects aimed at sequencing food crops such as gene-sequencing consortium of spinach genome, Centre for Biosystem Genomics and international wheat consortium. With financial support from private sector, universities and research organizations generate sequence information which after a short confidentiality period, becomes available worldwide though publications and open databases. This allows other researchers to apply and build upon these results in their own research, while also improving sequence data itself. The current transaction cost of the Nagoya Protocol, often outreach the BS gain.

With respect to consequences of regulation of DSI on use and conservation of biodiversity, Ms Hurk stated that DSI is essential for *ex situ* conservation to identify and eliminiate duplicates, and reduce operational costs of genebanks. DSI is also needed for *in situ* conservation, to measure genetic diversity and genetic drift due to environmental impacts.

Hence, restriction to DSI information would impact this aspect too.

Finally, Ms Hurk raised the issue whether DSI regulation is practically possible, implementable and enforceable. She said that this was a very complex question and not easy to answer. In her opinion, not regulating DSI may be the best option for global and local food and nutirion security, and humans well-being. Several elements need to be agreed upon before it can be analysed whether the regulation of DSI could work towards the defined objectives and what the collateral damage could be. The following elements require looking into:

(1) Definition of DSI usage terms: whether it includes DNA, RNA, proteins and metabolites, or any information related to a GR? A clear definition of DSI would be required before it can be regulated.

(2) Understanding the scope of DSI: Which DSI would be included in a system before it is regulated? Would that comprise information found in public databases, and if so in which databases. Would organizations be required to register those databases? If it is from a signatory country, would ownership be with the country where server is located? How to deal with countries that do not participate and what if organizations including private ones do not want to participate-how to deal with those? In such cases how would the regulation be started? Ms Hurk opined that it would be difficult situation to tackle. In many cases uniqueness of DSI is questioned, if it is available in other species or in different place or in different organisms and how the rules of DSI will affect such scenario?

(3) Who is the owner of DSI: Would it be the one that does the research to create the data, or is it the country of origin of the GR or the country that has acquired the GR in accordance with a convention? Should anyone intending to sequence DNA have prior informed consent (PIC) and mutually agreed terms (MAT) and what would be done if owner of DSI cannot be determined? Would DSI be regulated bilaterally or multilaterally and how does one avoid double payment?

(4) Participation of users in the system: How can a user make a choice to participate or not in a regulatory system of DSI, with clear cut rules? Under the current Nagoya Protocol it has been seen in many countries that legislation occurs but to really make an ABS agreement in practice is often difficult. Will this be different for DSI?

(5) Possibility of control: It may be tough to make rules for regulation of DSI, and even harder to implement and control such systems. Although many ideas are currently floating around, questions persist on whether these are possible, implementable and controllable. Ms Hurk opined that based on past ABS experience, DSI should remain in public domain.

In conclusion Ms Hurk said that it is important that before it is decided to regulate DSI, three important questions need to be addressed: (i) why the discussions on regulating DSI started and could there be other ways to solve those issues to match the expected benefits? (ii) Do we want to regulate knowledge and what does this imply for innovation worldwide and in particular in India? and (iii) Could regulation of DSI be possible, implementable and controllable?

Dematerialized access to dematerialized benefit sharing: The problems and opportunities associated with DSI on PGRFA

Mr Plessis opened his discussion by stating that he had a divergent view on the matter, than the previous speaker. He informed that the issue was first raised during GB5 meeting of ITPGRFA at Oman in 2013 where it was pointed out the DSI represents the dematerlized form of genetic resources, and could be a potential problem for the MLS. Shortly therefater, DSI was discussed during the Pandemic Influenza Preparedness Framework of the WHO, in the context

MR PIERRE DU PLESSIS
About the Speaker

Mr Pierre du Plessis studied Economic History and has worked in sustainable development for 34 years. In 1999 he started concentrating on the sustainable commercialisation of indigenous natural products from Africa and soon after developed a specialist focus on access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation. He was one of Africa's lead negotiators during the development of the Nagoya Protocol and has frequently represented Namibia and Africa at the CBD, WIPO and FAO, including the ITPGRFA, where he participated in the Working Group to Enhance the Functioning of the Multilateral System, co-chaired the Committee on the Funding Strategy and served on the Scientific Advisory Committee on the Global Information System. He is currently technical advisor to the African Union Continental Coordination Committee on Biodiversity, Biosafety and ABS.

of by-passing BS arrangements in the case of influenza viruses. At CBD it was first discussed in the context of synthetic biology, when genetic engineering techniques were being used to modify yeast to produce high value industrial products, as substitution for natural products, with no BS mechanisms for the county of origin. The term DSI was formally coined in 2016 at the CBD CoP13, as "dematerialized genetic resources", in the context of the MLS.

Arguments regarding the terminology continue on whether DSI is a 'genetic resource'. As genetic resources are considered as 'material' that contain 'functional units of hereditory', Mr Plessis argued that if a genetic sequence can by shared over an email and information used for constructing a virus, for example, then the sequence becomes a 'functional unit of heredity'. Regardless, DSI is clearly something "arising from the utilization/use of genetic resources", and as per the Nagoya Protocol and ITPGFRA, obligations to share benefits come into play.

An expert committee (that included Mr Plessis) under the CBD carried out defining the 'information related to genetic resources', to include:

(i) Group 1 comprising DNA and RNA (nulceic acid sequence reads, associated data to nulceic acid reads, non-coding nucleic acid sequences, genetic mapping and structural annotations);

(ii) Group 1 + proteins + epigenetic modifications (amino acid sequences, information on gene expression, functional annotations, epiegentic modifications, molecular structure of proteins, molecular interaction networks)

(iii) Group 2 + metabolites and other macromolecules (information on biochemical composition of a genetic resource, macromolecules, cellular metabolites)

(iv) Associated information – Traditional Knowledge associated with GR, information associated with DSI (Groups 1, 2, 3), other types of information associated with a genetic resource or its utilization.

Mr Plessis then enumerated the importance of DSI for PGRFA. Most use would be by breeders to use online databases for quickly searching accessions with target sequences, in cases where sequences are known to be associated with a particular trait. This would significantly shorten the breeding time by preselecting accessions making the excersice easier, cheaper and quicker. DSI would also be helpful for gene editing of desired sequence or traits, especially in agronomically stable lines. DSI would also lead to the synthetic biology replacing the high value natural products. Further, since sequences are drawn from many large datasets and put together and the sheer volume of information, it will become difficult to track and trace them under the current legal ABS regimes. Mr Plessis said that use of gene editing is now a reality in crops and not part of science fiction any more. He gave

the example of a visual analytics asd1`web tool for barley genebank genomics, which allows one to search 22,626 barley accessions from a German genebank and look for any sequence (including simplified graphic user interface) to quickly find traits or genes for editing, which one is looking for in barley breeding and other related grains. Another example he cited was a 'Symposium on Plant Genome Engineering: From lab to land', in which for a very low fee, scientists were willing to teach how to move this technology from labs to field. This illustrates how wide this technology has become. It has now led to energence of 'gene foundaries' and a whole industry is assosciated with it. If one can design a gene sequence on a computer, it can be sent to these companies for adding the chemicals and provide the genes physically to the clients. There are few examples of gene editing in plant breeding and it has been an issue to draw the attention of commercial enterprises, European Commission and European Intelletual Property Office.

Elaborating on the importance of DSI for ABS, Mr Plessis agreed on the fact that ABS had so far had a very bilateral architecture, which has been a problem. He said that issues of innovation pointed out by Ms Hurk did not come from DSI but from lack of ABS implementation. He elaborated the reason for this bilateral architecture of ABS, which emananted from Stockholm Conference of 1970's followed by Brundtland Report ('Our Common Future") by the World Commission on Enviroment and Development (1987). In the context of the decolonization narrative and countries fighting to get freedom (including India), the reason why soverign rights over genetic resources arose in the CBD and why the doctrine of 'common heritage of humankind' was abandoned. According to Mr Plessis, the doctrine of genetic resources being 'common heritage of humankind' never existed. The history of genetic resources shows very clearly that they were quiet tightly held in certain cases. For example in the colonial times, the Dutch would put one to death if anyone smuggled propagating material of spices from Indonesia and Chinese would do the same for silkworm. The spread of large number of crops around the world was in fact an instrument of colonialism (e.g. tea, rubber), based on war, slavery and misappropriation. In the post-colonization era after the world wars, the permanent soveriegtnity of nations over their natural resources (including genetic resources) came into existence. After the CBD when ABS got discussed, it was primarily for access to GR by developed countries. The developing nations insisted that access would be subject to increasing their economic development. That is why the BS aspect of CBD got translated later into the ITPGRFA and other instruments. Access to GR for developed countries were made with reference to have a compromise by the developing countries to accept the BS, though the results so far have not been up to the mark. This is especially so in the context of mobilizing resources for conservation and sustainable use of biodiversity, where latest reports estimate a funding gap of about 700 billion USD a year (=~ 1% of global GDP).

It is, therefore, important to bear in mind the one is not only talking about expectations of BS, but actually well-founded economic arguments about how much BS do we need to save biodiversity in a sustainable way.

Dr Plessis re-empahsized that new technologies have made genetic sequencing cheap, fast and ubiquitous. The vast growth in ICT has faciliated increased capacity to store, search and share the data. Presently several global open-access databases (3x major in INSDC; >1,000 others with various terms and conditions) have huge datasets, besides several unknown private sector data collections that have copies of the public data and their own data (constantly updated via FTP servers) but not transparent. Hence, DSI makes it possible to bypass access to GR for many purposes (for some one still needs the physical resource) and thereby avoid or reduce BS obligations.

In many less-developed countries, there is very low capacity to benefit from DSI data availability. Although capacity building is offered one of the BS mechanisms, after 35 years of CBD negotiations, technology transfer and capacity building was never implemented and premises of technology transfer is no longer credible.

In the PGR community there is consessus on issues like mutual PGRFA interdependency, which in fact was important part of negotiating the MLS of the ITPGRFA. There is also recognition that CGIAR in-trust *ex situ* collection form an important global public good. It is also fair to acknowldge the benefit derived by the facilitated access to PGRFA under the ITPGRFA, as a major benefit (~85%) has been used by public sector breeders of developing countries. Although under Article 17 of the ITPGRFA, i.e. the Global Information System, the exchange of PGRFA information is considered as a form of benefit sharing, nobody had imagined the volumious data that would be generated by DSI. The MLS itself needs its functioning enhanced in terms of more material, information and benefits. It is also recognized that a trust building process is needed and farmers and their rights are crucial for their role in *in situ* on-farm conservation and evolution of varieties. Within the ITPGFRA the benefit sharing fund (BSF) is supposed to support such activities.

There are several issues where there is no consensus. For instance it is known that improved commercial seeds displace *in situ* genetic diversity (and associated on-going selection and evolution) leading to genetic erosion. While we cannot expect farmers to be the conservators on their own, it is important that seed industry realize its role in displacing this on-farm genetic diversity and take a more active role in countering that genetic erosion. There is also divergence about how important is facilitated access and for whom. For the public breeders, there is big value in it; but the seed industry is not sharing commercial benefits from the access to the world's GRs and gives inadequate support for *in situ* conservation work. One of the outcomes is that germplasm collections under MLS are largely avoided by the seed industry because

of the defective SMTA. Another problem is that DSI information system is firmly anchored in the INDSC architecture which has an uncompromising ideological position that "all data should be free".

The efforts made in six years for enhancing the functioning of the MLS of the ITPGRFA did not reach an agreement in the GB8 meeting (November 2019). This was due to inability to resolve the issue of DSI. Mr Plessis ascribed three main reasons for it – (i) Reluctance on part of countries to have not ratified the 'Nagoya Protocol' to put their material into the MLS, because they see that they might be able to get more benefits from the Nagoya Protocol under bilateral ABS arrangements. These parties believe that use of MAT would be better for DSI; (ii) No way to stop DSI being misappropriated for the use outside of "Treaty space" i.e breeding, education and sustainable use and not for pharmaceutical and bioengineering purposes; (iii) use of DSI is fine for those under subscription system, but what criteria to be kept for occasional access or users for the DSI. The seed industry has not included its material (or DSI) in the MLS, which undermines trust issues. Another point of contention has been the view that farmers are robbed of their rights by IP (e.g. native trait patents) which prevent farmers from sharing and saving their own seeds.

While the GB8 failed to reach consensus, there have been informal consultations on the enhancement of the MLS and DSI thereafter (although progress is frustrated by COVID pandemic). India as the next host of GB9 meeting may need to have more consultations on the matter. The DSI is on agenda of CBD, NP, FAO-CGRFA, WHO-PIPF, UN-BBNJ. In the CBD there are studies being undertaken by an ad hoc technical expert group (AHTEG), which would later be discussed in an Open-Ended Working Group (OEWG 3) and later in CoP 15. There is a very great risk that unless there is consensus on the issue of BS on DSI, the adoption of the post-2020 Global Biodiversity Framework (GBF) may not take place. There also seems to be a growing consensus in the ongoing dicussions that the only way to deal with this issue is to have a multilateral approach to BS (details to be decided). On the other hand many countries already have provision to regulate the use of DSI through bilateral PIC and MAT. As this tendency grows, the whole system of DSI would be undermined (questions about track and trace).

Hence, we need to see whether we need a sectoral or universal solution for the DSI. First issue is that INSDC is reluctant to engage in discussions about changing their rules and regulations and have resisted the call that they should change their terms and conditions of data hosting. It is also clear that most scientists prefer one large open database, with reluctance to the idea of specialized databases with separate terms and condition. There is also the possibility that enhanced MLS and revised SMTA could address DSI directly but only if MLS has a dedicated database (with terms and conditions based on SMTA). Under this recipients could keep DSI secret and publish only on MLS database, and use of DSI outside Treaty space would be prohibited

and effectively penalised. The CGIAR would be the obvious host for such a DSI database. Alternatively, ITPGRFA can take its chance on CDB reaching consensus on global multilateral ABS solution for DSI in the Post-2020 GBF, subject to all contracting parties (especially USA?) and farmers accepting the solution.

Issues that need further reflection are: (1) capacity of CGIAR to run and support MLS DSI database; (2) is there political willingness for data ecosystem for PGRFA, outside INSDC?; 3) in the universal solution option, would the MLS benefits spill to general CBD global fund?; 4) agricultural sector being held for biodiversity loss due to expansion of agriculture and farming – in the context of who will bear the cost of loss; 5) influence of GB on the CBD for shared monetary benefits to PGRFA; 6) feasibility of resolving farming vs conservation through synergies; 7) how long open access can be a free access?

Mr Plessis concluded by stating that for a comprehensive, ambitious and transformative solution (as being discussed in CBD and GBF), some of the above-mentioned issues should be resolved. It may also provide opportunities to move orphan crops and under-utilized species from Nagoya to MLS, where there may be more expertise, funding and resources available to work on them. Such plants have an important role to play in climate change adaptation and meeting the SDGs.

PANELISTS' VIEWS

Panelists viewpoints in brief are presented hereunder.

Dr R.S. Rana

Technology advances in accessing and using DSI on genetic resources are welcome developments. They have raised the expectations of end-user of product especially in health and agrisector. It beholds the global community to rise to the occasion and formulate enabling framework. Dr Rana raised some ground-reality check issues, namely : (i) DSI does not have a precise and agreed upon defintion, as already mentioned by the speakers. The term includes both genome data and additional associated information and this is critical with respect to genes for adaptation for climate change, amongst other in crops, mdecicinal plants and animal breeds; (ii) there is notable capacity differential globally, with only few nations engaged in developing and applying the technology; (iii) most contested aspect remains the IPR related issues. Soverign rights are not really related to pre-independence era of developing countries. In fact the problem arose when the varieties started getting patented. Then came the UPOV (1978) and some developed countries were not satisfied with the exemption for researchers and breeders and came to a stronger version of UPOV (1991). The CBD came later in 1993. Researchers require incentives, investor's want good returns on investment and these

expectations need to be balanced with rights of conservors and providers of GR.

Dr Rana said that based on his 17 years association of working with the National Biodiversity Authority (NBA) of India, he said he was no longer a supporter for monetary benefits, but would like non-monetary benefits to be elaborated, including unrestricted access to protected products to researchers and breeders. The nodal ministry for implementation of CBD in India is MoEF&CC, which has constituted expert committee for forthcoming negotiations and we may like to link with them. The DSI was first discussed at the global level in 2016 by the CBD COP-13 and the Nagoya Protocol MoP-2, where it was recognized as a cross-cutting issue relevant to all the three objectives of the CBD. Since then it is under active discussion by several fora at national regional and global levels. Ongoing discussions at the UNEP-CBD, FAO-ITPGRFA, WHO and Law of the Sea do not appear to move towards any convergence. In 2018, two years later than the Cancun negotiations, the DSI remains a highly controversial issue. Informal virtual meetings of the SBSTTA of CBD held in March 2021, discussed synthetic biology including DSI, wherein products developed using DSI and synthetic biology be treated as LMOs and handled under Cartagena Protocol on Biosafety, need to be used with a precautionary approach with regard to organisms with engineered gene derivatives. Dr Rana suggested that a multidisciplinary expert group for horizon scanning of developments in this area of active research be constituted.

Dr B.S. Dhillon

While recalling the amazing journey on access to GR and easy sharing of germplasm in the Green Revolution period, to the post-CBD scenario on ABS, Dr Dhillon expressed satisfaction that present day changes in ABS was technology led rather than that under WTO, where it was due to IPR issues and economic considerations. He raised the question whether genetic resource is more important or DSI or DSI based on genetic resources, which have taken several years

to evolve. Those who are conserving GR is always at some cost and they need to be compensated. Giving the example of India, Dr Dhillon compared the farmers culivating high-yielding varieties of staple crops in the Indo-Gangetic plains versus those in the growing landraces/farmers varieties in the Himalayas. There is need to have some sort of compensation for the later. He recalled the discussion of BS during the negotiations of the ITPGRFA, where biodiverse rich nations (including India) insisted that BS should be

strictly implemented. In so far as information sharing by private sector stakeholders was concerned, he said that there has always been a long lag phase between information generated and sharing in public domain, due to IPR issues. Dr Dhillon supported the suggestion made by Mr Plessis regarding placing DSI information under the MLS. He suggested that more deliberations and consensus was required on the topic, with GR following a cycle of free-flow to restricted flow and then again to free-flow (dematerialized GR).

Dr K.C. Bansal

While stating that the issue of DSI was complex, Dr Bansal also reiterated that green revolution was possible because of free flow of materials. But the advances in science and technology has played a big role in plant breeding, currently dominated by tools of genomics and gene editing to address issues of climate change and loss of biodiversity (particulary from farmers' fields). With respect to flow of germplasm, the scenario changed after the advent of CBD (1993) and

it may be difficult to roll back for free flow of GR. He asked whether we need to revisit the CBD itself, especially the third objective of fair and equitable sharing of benefits arising out of use of biodiversity. He agreed with Ms Anke that there has not been any significant discussion on what is 'equitable and fair' particularly for the farmers of developing countries (including India). He said that while ITPGRFA mechanism for BS was negotiated, it was not envisioned that BSF under the Treaty would take many years before it can be used by the CP to benefit the GR providers. He said that DSI is an issue that is now a reality (pan-genome, 'one earth biogenome') and concerns are being raised whether the information be treated as traditional knowledge is done for seeds? Genomic data such as stress related and adaptive genes has great value. He also emphasized that DSI needs to be defined well, and should be based on DNA information, as all other data on RNA, proteins, metabolites etc. emanate from it. Can DSI be treated as an equivalent physical resource as a seed? From a conservation and utilization perspective, DSI (full sequence or part of genome) should be available freely, but keeping in mind the basis of Nagoya Protocol. Since GR are not free-for-all anymore, so therefore DSI also cannot be free-for-all, and needs to be regulated in a manner to promote utilization of GR for food and nutritional security. Users of DSI would be different, e.g. public sector, private sector, NGOs, MNCs and a balanced view is required between free acceess to DSI while also giving fair and equitable benefits to the

providers of GR. He opined that there is need for greater representation of scientists in the Governing Body Meetings of treaties and conventions, than what has been the practice so far. He suggested that in the context of DSI, the whole issue of ABS and GR exchange be revisted under CBD as well as ITPGRFA.

Dr S.K. Sharma

Dr Sharma suggested that India needs to follow a middle path on the DSI regulation, from what was elaborated by both the invited speakers with divergent views. He also agreed that the term DSI needs to be defined in a globally accepted manner. He said DSI would definitely be important in fulfilling the first two objectives of the CBD (conservation and sustainable use of biodiversity). As such now in the negotiations, there are divergent views of the CP as the issue is very complex. With passage of time and disussions, Dr Sharma was of the opinion that consensus would be soon reached. DSI is not only relevant in CBD and ITPGRFA, but also for other fora like WHO, WIPO Convention on the Law of Sea, CITES, and therefore all ministries in India (MoA&FW, MoEF&CC, MoH&FW) concerned with DSI should work collectively to put forth a common view. Representatives from all the stakeholders should be present in inter-ministerial committees and their view should be invited on DSI and ABS. All the stakeholders from India (academia, institutions, researcher's, farmers, seed industry etc.) must be invited for awareness on DSI and how their work may be affected. Since India has regulations and policies related to GR, these can be modified by inclusion of DSI in bioprospecting permits like PIC, MAT, MTA etc. The Indian position on DSI should be debated in the country, clarified and finalized before it is discussed in the COP15 to be held in China in 2021, and the GB-9 meeting to be held in New Delhi, India.

Dr Daniele Manzella

Dr Manzella noted that the discussions in the current meeting were in fact a reflection of the global discussions on the topic, which in his opinion would not only effect governance of the GR, but also impact genomics research and innovation. The global frameworks around PGR were designed to pursue global goals such as biodiversity conservation and sustainable use, a context where the informational components were always associated to physical samples of GR, and benefit sharing was based on the use of such materials. The increasing use of genetic information, including through new tools for gene editing, will lead to a decreased need for physical samples. Both ITPGRFA and CBD

have started discussions on the implications of DSI, but remain polarised and inconclusive so far. Other foras are also debating the issue and operating in a very contrasted landscape.

With respect to COVID-19, Dr Manzella said that a recent survey conducted by the Treaty Secretariat demonstrates further complications into this contrasted framework. The discontinued management of crop biodiversity may result in the loss of some of such essential diversity for food and agriculture as the movement of genetic material from crop genebanks was discontinued due to the pandemic emergency. Data flows were arguably increased, data driven research was prioritized, and technology solutions were in very high demand. Due to COVID-19 disruptions, technical cooperation for development of programs for capacity building were substantially reduced. In the aftermath of this, learning from the urgency to develop critical progress and technology, the paradigms of open access to data and research collaboration are reinforced in science. But along side with this, civil society and developing countries continue to amplifying concerns related to BS as an essential condition for global public goals, including in the PGRFA context. Many advocate for international cooperation and multilateral solutions to overcome the crisis. But we are all seeing that the dividing lines in the variuos global governance fora are actually deepened and even more exposed. Dr Manzella opined that COVID-19 brought forth challenges and opportunities for the global governance of genomic research and genetic resources diversity, to be conceived and implemented in synergy and not in isolation. He said that DSI present a formidable challenge to ABS but also an opportunity to bring the issue of capacities in the centre of discourse of the various global governance fora. He said that the solution to the DSI will likely not be holistic and straight forward to implement and that, as such, different solutions may go through a process of experimentation at both global and national levels problem.

Dr Vibha Ahuja

Dr Ahuja said that as we draw our positions and move ahead, we have to actually very carefully think about how DSI can be used by start-ups and other related industries and the kind of research making headway. She suggested young researchers and enterpreneurs be approached to take opinions as to how their work might be effected with respect to DSI being considered as a genetic resources and how much translation of products can happen from DSI. She said that India is one

of the largest users of DSI as indicated by studies by the CBD. Hence before taking a position on DSI, views of not only industry association, NGOs, etc., but also down to the ground level and talk to all stakeholders

Dr. Shivendra Bajaj

Free use of DSI encourages innovation. As indicated already, terminology of DSI is not clear and so Dr Bajaj proposed the use of a term called 'genetic resource sequence data (GRSD)'. He said that the focus of any discussion on DSI should include value creation and sharing, resulting from the continued access and exchange of DSI/ GRSD. India being a significant user of the DSI (>6% users from India, while only 3.5% contribution from India), and hence regulating such data may have negative impact on innovations. If a strong case is made for sharing the DSI/GRSD, we have to be legally certain because lack of legal certainty is costly and time consuming and conflicts with the aim of NP. Capacity building is very important before making any decision. It should be effective, more value sharing, more inclusive and it can provide significant benefits to public and private research organizations. He concluded by stating that he represented a sector that was in favour of open access of DSI and looked forward to positive deliberations in the forthcoming GB-9 meeting of the ITPGRFA.

Dr Neeti Wilson

The technological use of DSI in a rapidly changing scientific, legal and policy scenario requires the implication of regulating DSI to be addressed immediately. This is becoming an increasingly complex challenge. Ms Wilson flagged five discussions points

requiring clarity, especially from a legal and commercialization perspective: (i) On the definition of DSI, consensus is required with common terminology by the scientific community, as this would have far reaching consequences about its legal implications; (ii) The second issue relates to ownership, whether DSI is a product *per se* (big data) or an IPR. As a product the question of ownership would be whether it is private, or public or soveriegn. For IPR, copyrights, patents, trade secrets, plant variety protection, all apply on DSI. India has seen court cases in all aspects of IPR related to DSI. Ms Wilson suggested that there is potential to have a specific *sui generis* method for DSI. The IP law is always evovling and new innovations require new forms of protection; (iii) For regulation on access of DSI, whether under ITPGRFA or CBD, monetary or non-monetary benefits needs to be defined. The limitations of coverage of crops under the Treaty is a big issue. The existing local laws and the system under the CBD and NP can be utilized. The access provisions under the CBD have to be seen from the sustainable use perspective, which could be for research, local use, transfer outside the country or region, or transfer for commercialization. Research and commercial access need to be viewed seperately. Open access by way of acknowledgement or access by way of payments (monetory or non-monetory) need to be specifically defined; (iv) The issue of valuation for BS is more complex. The reward of the innovators is what the IP system has been built and prevention of biopiracy is what the CBD is targeting. A right balance is essential in a fair and equitable manner to make sure that valuation estimates are correct. The BS valuation with respect to GR itself is very difficult. In case of DSI what would be the basis of valuation? Would it be the length of the sequence, the number of genes characterized within a sequence, the commercial value of sequence in question, etc. Legally, there needs to be logical justification for all the value placed to define the formula; (v) It is important to address the issue of DSI in a holistic manner to include not not food and agriculture crop but other species as well.

Dr Pooja Bhatnagar-Mathur

As a molecular biologist Dr Mathur presented views as a researcher working on trait enhancement using transgenic and gene editing tools for precise and accelerated varietal development. She informed that a lot of her work had benefitted from open-access genetic information. Hence DNA sequence data which forms a part of DSI, is certainly not used individually, but has benefit or value when it is from multiple sources like reference

sequence and re-sequence. The lack of access of these DSI does not only effect potential users but also for the countries blocking the access. Isolation of countries for access to DSI will negatively impact on research growth. In the race of innovation with the changing scenario and environment, how DSI will cater the requirement without negative impact. Already it has been seen in the case of access to PGRFA beyond Annexure 1 require bilateral access, which is time-consuming and hampers R&D in a technologically rapidly advancing world. Dr Mathur highlighted the stand of CGIAR in ABS, focussing on the non-monetary benefits arising through collaboration and cooperation. She opined that the multilateral subscription system under the ITPGRFA possibly could limit complexity for DSI users.

Mr Tanmay Joshi

Mr Joshi, a practising farmer from Central India invovled with NGOs, said the DSI is to be considered as a GR and treated as per Nagoya Protocol. Further, no patent rights or IPR rights should be given on DSI. There is also need for transparency on the procedures adopted for developing new varieties/ products, including the DSI, which is currently lacking. He said that it is the peasant community from where the germplasm has originally come that is now stored in national and international genebanks, and from where DSI is being derived. Many materials are used by the private sector and no direct benefits come to these orginal providers of GR. In fact restrictions have been placed on

farming community/farmers. While Mr Joshi appreciated the PPV&FR Act of India, he observed that laws sometimes get changed without due deliberations and inclusiveness. Thus, to protect farmers rights, not only one Act but several other means need to be adopted. He also critiqued on the effect of corporate monopolies by restrictions on farmers and breeders from public sector are used primarily to accelarate the concentration of seed industries and restrict access through patents. Several MNCs have created huge databases of DSI and taken patents on them. They also have many patents on GMOs. Mr Joshi said that large transnational seed companies have a monoply on the agricultural seeds, pestiicides, markets etc and force the farmers to be dependant on them. He gave examples of countries where DSI can be patented and the presence of those sequences in a varietey render them patented also. Patents on native traits without traceability is another area of concern, as it bypasses NP or ITPGRFA provisions of ABS. Lastly, Mr Joshi felt that since DSI based new varieites lack evolutionary adapatation, they would require greater inputs from the TNC.

REMARKS BY CO-CHAIRS

Dr R.C. Agrawal summarized the session and thanked the invited speakers for their diverse views. He informed that in the last GB-8 meeting of ITPGRFA, DSI was the only issue that lacked consensus, and was left for deliberations in GB-9. In fact the objective of holding the current brainstorming meeting was to generate awareness and views on DSI and possibly have a position for India and Asia. One of the most important issue is who is the owner of DSI. Also whether IPR can be obtained on products using DSI. Many factors such as government policies, scientific practices, requirement by journals, funding agencies, IPR authorities dictate governance of DSI. Dr Agrawal said that every change in technology is accepted with hesitancy in the beginning, but later accepted, giving the example of ATM cards and use by all general public. The divergent nomenclature for DSI also require consensus which is under deliberations in CBD, ITPGRFA, GIF etc. Taking into consideration the divergent views by speakers and panelists in the meeting, would form the basis to have more thinking, keeping in view all stakeholders and interest of farmers, country, food security, proper utilization of resources for food and agriculture. He said that SMTA, ABS and all such matters need to organically evolve to incorporate the rapid changes related to DSI science and technology. Another issue is whether bilateral or multilateral agreements are applied for DSI. He said that the deliberations of the meeting would help in the forthcoming GB9 meeting.

Dr Kuldeep Singh appreciated the divergent views on the subject which would help others to develop their own opinion on this complex subject. He informed that in

the GB-8 meeting of the ITPGRFA, there was a very clear mandate from the Indian government about expansion of Annex 1 crops. However, due to stalemate on DSI the issue was stalled. He said that the BS from the use of DSI which was the main issue, and not open access *per se*. If DSI is not regulated, what would be its impact on conservation of PGR and will it restrict the availability of sequence data? Dr Singh opined that DSI should be an integral part of ITPGRFA, with ways and means to be identified to see how the benefits arising out of their use is shared by the groups who are originators or custodian of the original GR.

The Session concluded with a vote of thanks by Dr Anuradha Agrawal, General Secretary, ISPGR, to all the dignitaries, participants and organizers of the virtual brainstorming.

CONCLUSIONS

- Participants, in unison, appreciated the initiative of organizing the multi-stakeholder-brainstorming on DSI for the first time in India.
- Indian participants unanimously identified DSI and the potential dematerialized use of PGRFA to be significant and crucial factors in access to PGR, their utilization and the eventual benefit sharing.
- Stakeholders appeared to be polarized on the post-DSI paradigm of accessing genome sequence of a particular genotype without the need for any of the PGRFA access instruments.
- Stakeholders maintained divergent views on whether ABS requirements should apply to the use of DSI from PGRFA and, therefore, whether commercial use of DSI is within the jurisdiction of CBD or ITPGRFA.
- Indian participants highlighted the lack of awareness and clarity among stakeholders, and absence of case studies on DSI disrupting the ABS template.
- India must embark on initiatives to make stakeholders (including researchers, farmers, communities, seed industry and bureaucrats) aware of DSI and its potential consequences on ABS, sovereign rights, community rights and other forms of IPRs.
- A wider inclusive consultation on every aspect of DSI including its influence on enhanced utilization of PGRFA, need for regulation, options for inclusion in existing bilateral and multilateral instruments is a pre-requisite to a formal policy debate involving stakeholders and technical experts.
- It is crucial to develop India's position/ opinion/ response to disparate issues/ concerns/ questions pertaining to DSI of PGRFA.

PROGRAM

Co-Chairs : **Dr R.C. Agrawal** (Vice-President, ISPGR) and
Dr Kuldeep Singh (Vice-President, ISPGR)

3:00 – 3:05 PM	**Welcome**	**Dr Kuldeep Singh**, Director, ICAR-NBPGR & Vice President, ISPGR
3:05 – 3:10 PM	**Special Remarks**	**Dr R.S. Paroda**, Chairman, TAAS & President, ISPGR
3:10 – 3:15 PM	**Introduction of Speakers**	**Dr Sunil Archak**, National Fellow, ICAR-NBPGR & Editor-in-Chief, ISPGR
3:15 – 3.45 PM	**Expert View** 'DSI, is it wise to regulate it?'	**Ms Anke van den Hurk**, International Seed Federation
3:45 – 4:15 PM	**Expert View** 'Dematerialized access to dematerialized benefit sharing: The problems and opportunities associated with DSI on PGRFA'	**Mr Pierre Du Plessis**, African Union
4:15 – 5.00 PM	**Panel Discussion**	**Dr R.S. Rana**, Former Director, ICAR-NBPGR. **Dr B.S. Dhillon**, Vice Chancellor, PAU **Dr S.K. Sharma**, Former Director, ICAR-NBPGR

		Dr K.C. Bansal, Secretary, NAAS **Dr Daniele Manzella**, Technical Officer, ITPGRFA **Dr Vibha Ahuja**, CGM, BCIL **Dr Shivendra Bajaj**, ED, FSII **Dr Neeti Wilson**, Partner, Anand & Anand **Dr Pooja Bhatnagar-Mathur**, Theme Leader, ICRISAT **Mr Tanmay Joshi**, ICCFM, LVC & IPC
5.00 – 5:15 PM	**Open Session**	Participants
5:15 – 5:25 PM	**Remarks by Co-Chairs**	**Dr R.C. Agrawal**, DDG (Education) & Vice-President, ISPGR **Dr Kuldeep Singh**, Director, ICAR-NBPGR & Vice-President, ISPGR
5:25 – 5.30 PM	**Vote of Thanks**	**Dr Anuradha Agrawal**, Principal Scientist, ICAR-NBPGR & General Secretary, ISPGR

SPEAKERS & PANELISTS

Dr R.S. Paroda
President, Indian Society of Plant Genetic Resources, New Delhi, &
Founder Chairman, Trust for Advancement of Agricultural Sciences (TAAS)
Avenue II, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110 012, India
Email: raj.paroda@gmail.com; taasiari@gmail.com

Dr R.C. Agrawal
Deputy Director General (Education) & National Director, National Agricultural Higher Education Project (NAHEP)
Indian Council of Agricultural Research, Krishi Anusandhan Bhavan-II, Pusa Campus, New Delhi-110 012, India
Email: ddgedn@gmail.com; agrawal_rakesh_chandra@yahoo.com

Dr Kuldeep Singh
Director, ICAR-National Bureau of Plant Genetic Resources (NBPGR)
Pusa Campus, New Delhi-110 012, India
Email: director.nbpgr@icar.gov.in; kuldeep.singh4@icar.gov.in

Ms Anke van den Hurk
International Seed Federation, Deputy Director International Seed Federation - Plantum
Vossenburchkade 68, Gouda, The Netherlands
Email: a.vandenhurk@plantum.nl

Mr Pierre Du Plessis
ABS Expert African Centre for Biodiversity (AC-BIO)
13 The Braids Road, Emmarentia, 2195, Johannesburg, South Africa
Email: : pierre.sadc@gmail.com

Dr R.S. Rana
Former Director, ICAR-NBPGR
D-43, Indraprastha Apartments, Plot 1, Sector 14, Rohini, New Delhi-110 085, India
Email: rairana2006@yahoo.com; rairana.9@gmail.com

Dr B.S. Dhillon
Vice-Chancellor, Punjab Agricultural University (PAU)
Ludhiana 141 004, Punjab, India
Email: dhillonbaldevsingh@gmail.com

Dr S.K. Sharma
Former Director, ICAR-NBPGR
Shanti Kunj, Ghuggar Tanda, Palampur-176 06, Himachal Pradesh, India
Email: s.k.skspbg@yahoo.co.in

Dr Kailash Chander Bansal
Former Director, ICAR-NBPGR
A-81, Carlton Estate 4, DLF Phase 5, Sector 53 Gurugram 122001, Haryana, India
Email: kailashbansal@hotmail.com; kcbansal2001@yahoo.com

Mr Daniele Manzella
Technical Officer, Secretariat of the ITPGRFA
FAO, Viale delle Terme di Caracalla, Rome, Italy
Email: daniele.manzella@fao.org

Dr Shivendra Bajaj
Executive Director, Federation of Seed Industry of India (FSII) and Alliance for Agri Innovation (AAI)
FSII, 10 A, 10th Floor, Vandhana Building,Tolstoy Marg, Janpath, Connaught Place,
New Delhi – 110001, India
Email: shivendra.bajaj@fsii.in

Dr Neeti Wilson
Partner, Anand & Anand
First Channel Building Plot No. 17A, Sector 16A, Film City, Noida, Uttar Pradesh 201301 India
Email: neeti@anandandanand.com

Dr Vibha Ahuja
Biotech Consortium India Limited
5th Floor, Anuvrat Bhawan, 210, Deen Dayal Upadhyaya Marg, New Delhi - 110 002, India
Email: vibhaahuja@biotech.co.in

Dr Pooja Bhatnagar-Mathur
Principal Scientist & Cluster Leader – Cell & Molecular Biology and Trait Engineering, ICRISAT,
Patancheru 502324 Telangana, India
Email: p.bhatnagar@cgiar.org

ORGANIZING COMMITTEE

Chair	:	**R.S. Paroda**, President, ISPGR raj.paroda@gmail.com
Co-Chairs	:	**R.C. Agrawal**, Vice-President, ISPGR agrawal_rakesh_chandra@yahoo.com *and* **Kuldeep Singh**, Vice-President, ISPGR kuldeep35@pau.edu
Convenor & Moderator	:	**Sunil Archak**, Editor-in-Chief, IJPGR, ISPGR sunil.archak@icar.gov.in sunil.archak@gmail.com
Convenor	:	**Anuradha Agrawal**, General Secretary, ISPGR anuradha.agrawal@icar.gov.in; anuagrawal1@yahoo.co.in
Rapporteurs	:	**Rakesh Singh**, Joint Secretary, ISPGR rakesh.singh2@icar.gov.in, singhnbpgr@yahoo.com **Amit Kumar Singh**, Councillor (North Zone), ISPGR amit.singh@icar.gov.in **R. Parimalan**, Senior Scientist, ICAR-NBPGR r.parimalan@icar.gov.in
Online Assistance	:	**Mr Vijay Mandal**, Technical Assistant, AKMU, ICAR-NBPGR vijay.mandal@icar.gov.in, mandalvijay@gmail.com

Indian Society of Plant Genetic Resources (ISPGR)

C/o ICAR-National Bureau of Plant Genetic Resources (NBPGR)
Pusa Campus, New Delhi-110 012, India

About ISPGR

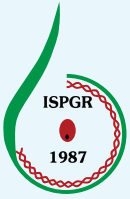
The Indian Society of Plant Genetic Resources (ISPGR) was founded in 1987 as a multidisciplinary scientific body involved in the various issues of plant genetic resources (PGR) and related fields. It currently has >850 members, nearly 815 of them being life members. The ISPGR was formally registered under the Indian Societies Act (1860) on November 3, 1987 with the Registrar of Societies, Delhi (Registration No. S/18336 of 1987). Membership is open to all persons interested in the field of PGR in India and abroad.

The genesis of the society was from the initiative taken by the scientists at the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, under the leadership of Dr R.S. Paroda, the then Director of NBPGR and presently Chairman, Trust for Advancement of Agricultural Sciences (TAAS). A 'National Symposium on Plant Genetic Resources' was organized by the NBPGR, on March 3-6, 1987 to commemorate completion of a decade of NBPGR's establishment. The symposium was attended by 300 scientists from India and2 0 from abroad, including those from International Centres like International Rice Research Institute(IRRI), Philippines, International Maize and Wheat Improvement Centre (CIMMYT), Mexico and International Centre for Research in Semi-arid Tropics (ICRISAT), India. During the symposium, Dr R.S. Paroda proposed the creation of ISPGR, which was welcomed by all the delegates of the symposium. The Constitution of ISPGR was drafted under which the General Body (GB) comprising all members of the Society was designated the supreme authority and elected an Executive Council (EC) biannually for management of all the activities. The Constitution was revised in 2007 and since then EC tenure has been changed to three years.

The ISPGR regularly publishes the 'Indian Journal of Plant Genetic Resources' (IJPGR) as its official publication. Being the only journal in the area of PGR, the journal aims to provide a forum for discussion and debate on current issues of PGR, and to disseminate knowledge on PGR research and application. For publication in the journal, the authors must be a member of the Society (annual or life). Besides the IJPGR, the Society also publishes proceedings, books, monographs and other publications emanating from activities organized by the Society or subject-specific contributions by its members.

Major Activities Organized/Co-Organized by ISPGR (2016-2021)

Event	Venue	Date
	International	
1st International Agrobiodiversity Congress (IAC 2016)	Vigyan Bhavan and National Agricultural Science Centre (NASC) Complex, New Delhi, India	Nov. 6-9, 2016
Satellite Symposium on Dryland Agrobiodiversity for Adaptation to Climate Change	Indana Palace Hotel, Jodhpur, Rajasthan, India	Feb. 13, 2019
Webinar on Implementation of Access to Plant Genetic Resources and Benefit Sharing (ABS)	Virtual	Aug. 27, 2020
Virtual Brainstorming on Digital Sequence Information and Germplasm Sharing	Virtual	March 1, 2021
	National	
Awareness Seminar cum Brainstorming Meeting on Access and Benefit Sharing: Striking the Right Balance	India Habitat Centre, New Delhi	Oct. 22, 2016
2nd Dr. AB Joshi Memorial Lecture by Padma Vibhushan Prof. M.S. Swaminathan, on 'Agrodiversity and nutrition security'	NASC Complex, New Delhi	April 5, 2017
ISPGR Award Function (2015, 2016)	NASC Complex, New Delhi	April 5, 2017
Brainstorming Meeting on Implementation of 'Delhi Declaration on Agrobiodiversity Management' in India	National Academy of Agricultural Science (NAAS), New Delhi	August 28, 2017
1st Dr Dilbagh Singh Athwal Memorial Lecture, by Dr Gurdev Singh Khush on 'Preservation and use of biodiversity for human welfare'	ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi	March 13, 2018
ISPGR Award Function (2017)	ICAR-NBPGR, New Delhi	March 13, 2018
3rd Dr A.B. Joshi Memorial Lecture by Dr B.S. Dhillon on 'Plant Genetic Resources for Food and Nutritional Security	ICAR-NBPGR, New Delhi	May 10, 2019
ISPGR Award Function (2018)	ICAR-NBPGR, New Delhi	May 10, 2019
2nd Dr Dilbagh Singh Athwal Memorial Lecture by Dr Kamal S. Bawa on 'Securing our biodiversity and our future: New opportunities and challenges'	ICAR-NBPGR, New Delhi	Jan. 31, 2020
National Seminar on Crop Breeding for Wider Adaptation	Birsa Agriculture University, Ranchi, Jharkhand	March 21-22, 2020
ISPGR Award Function (2019 and 2020)	Krishi Anusandhan Bhavan-2, New Delhi (hybrid mode)	Aug. 7, 2021
4th Dr A.B. Joshi Memorial Lecture by Professor Anil Gupta on 'Farmers' varieties, grassroots innovations and the emerging role of global genebanks'	Virtual	Aug. 27, 2021



Organized by

Indian Society for Plant Genetic Resources (ISPGR)

c/o ICAR-National Bureau of Plant Genetic Resources

Pusa Campus, New Delhi - 110 012, India

Tel: +91-11-25802817; E-mail: ispgr2015@gmail.com

Website : http://ispgr.nbpgr.ernet.in