



Digital Sequence information, Open Access, and Sustainable Benefit Sharing: Scientific Input to International Policy Decisions

10-11 March 2020, Brussels, Belgium

Venue: NH Collection Brussels Centre

The workshop was jointly organized by the BMBF-funded WiDSI project, the Leibniz Institutes DSMZ and IPK Gatersleben (Germany) and co-hosted by the Horizon 2020 Project, European Virus Archive (EVA) and the EVA institutes DSMZ, National Institute for Public Health and Environment (RVIM, Netherlands) and the Institut Pasteur (France).

REPORT

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Background and Brief Overview

The Parties to the Convention on Biological Diversity (CBD) were originally scheduled to meet in October 2020 in Kunming, China to negotiate and define the international biodiversity targets for the next 10 years¹. In parallel to these discussions, the issue of benefit sharing from “Digital Sequence Information on Genetic Resources” (DSI) will also be negotiated. At stake in these negotiations for biologists is open access to sequence data via the large public databases. In order to avoid worst-case scenarios, science-based solutions for benefit sharing that do not endanger open access are urgently needed.

The European scientific community – academia as well as industry -- must engage and proactively develop interdisciplinary and fair solutions for all concerned in advance of these negotiations. The German Federal Ministry of Education and Research (BMBF) has funded an interdisciplinary project (WiLDSI) led by the Leibniz Institute DSMZ and the Leibniz Institute IPK Gatersleben to research DSI policy options and involve the scientific stakeholder community. The project, “*Wissenschaftsbasierte Lösungsansätze für Digitale Sequenzinformation (WiLDSI)*”², aims to develop a scientifically sound concept for the DSI policy dilemma and to investigate its applicability and practicability so that German government and EU negotiators have a science-based tool kit for the upcoming negotiations in Kunming. Over the past six months, database, legal, scientific, and financing experts (that form the core members of the WiLDSI project) came together to research possible solutions for DSI and developed three scenarios that preserve open access but also enable monetary benefit sharing.

To this end, in order to proactively involve the European scientific community in the political discussions surrounding DSI, the workshop on Digital Sequence Information, Open Access, and Sustainable Benefit Sharing: Scientific Input to International Policy Decisions was held on 10-11 March 2020 at the NH Collection Brussels Centre, Brussels, Belgium. The workshop was jointly organized by the WiLDSI project and above institutes and co-hosted by the Horizon 2020 Project, European Virus Archive (EVA) and the EVA institutes DSMZ, National Institute for Public Health and Environment (RIVM, Netherlands) and the Pasteur Institute (France). The main objective and focus of the workshop was to discuss and test the feasibility of the three DSI open access scenarios³ developed by the WiLDSI project members.

The DSI workshop was attended by 47 participants from different European institutions, industrial sectors and infrastructures. The participants were a heterogeneous mixture

¹ This meeting has now been postponed due to the recent COVID-19 pandemic.

² For more information on the WiLDSI project: <https://www.dsmz.de/collection/nagoya-protocol/digital-sequence-information>

³ The background paper explaining the three scenarios can be found here: <https://www.dsmz.de/collection/nagoya-protocol/digital-sequence-information/dsi-workshop-march-2020>

compromising of academics, policy makers as well as industrial representatives from all over the European Union and the United Kingdom. A live webcast was offered for the first day of the workshop (March 10) that saw an average of 23 remote viewers. The possibility of following the workshop via live stream was offered due to the increasing number of last minute cancellations in light of the recent COVID-19 outbreak.

The workshop provided a basic understanding of what a future system in terms of DSI policy regulations might look like and helped clarify several important notions pertaining to the on-going political processes surrounding DSI. It provided a platform where the scientists could voice their opinion as well as discuss their views. The three proposed open access DSI scenarios were discussed in detail and a general consensus was that a hybrid scenario (B/C) of the two proposed multilateral systems was most favoured.

Day 1

The workshop was opened by Dr. [5.1.2e], (Leibniz Institute IPK, Germany) and Dr. [5.1.2e] [5.1.2e] (Institute Pasteur, France) who introduced the organisers and co-hosts, Dr [5.1.2e] [5.1.2e] (Leibniz Institute DSMZ) and [5.1.2e] (RVIM, Netherlands). Importantly, it was announced that the workshop will be conducted under the Chatham House Rules and any discussion during the course of the workshop would not be attributed to an individual. The overview of the 2 days was explained as well as the objective of the workshop was discussed whereby the participants were requested to openly voice their opinions and put forth their point of views. Dr. [5.1.2e] concluded by saying that the WILDSI project aims to provide a voice to the European research community- academia as well as industry- with respect to the political debate surrounding the DSI issue.

Presentations

Overview of the CBD decision-making process surrounding DSI (Alicja Kozłowska)

Alicja Kozłowska (Policy Officer ABS, European Commission) gave us an informative overview, history and background on the CBD procedure surrounding DSI. She began by mentioning how the CBD, in 1993, put in place new principles and concepts whereby genetic resources were no longer 'heritage of mankind' and that the states have sovereign rights over their genetic resources. The CBD also introduced the concept of access and benefit sharing. The discussions on DSI are taking place in this context. She went on to explain how the Nagoya Protocol (NP) was agreed in 2010 in order to 'balance' the Aichi targets and to further advance the implementation of the 3rd objective of the CBD i.e. access and benefit

sharing (ABS). However, did this 'Grand Bargain' whereby the industrialized countries were supposed to get transparent access legislation and the developing countries fair and equitable sharing of benefits, really work in practise? Many amongst the developing countries were left frustrated with the narrow scope of the Protocol. Many are also dissatisfied with the insufficient money generated by the Protocol (which is also linked to unrealistic expectations attached). DSI began to be perceived as a loophole/leak in the system – a way to circumvent the NP obligations and the reason why no monetary benefits were being realised. Alicja Kozłowska explained that these considerations are in her view the main reasons why the whole discussion/debate is currently taking place at the CBD level and why DSI is such an important part of the deal. She then proceeded to describe how the DSI issue was addressed at the last two Conferences of the Parties (COP13 and COP14). She went on to explain the various steps that have been followed to date dealing with this issue with respect to the decisions made at the previous 2 COPs, the inter-sessional processes that were established as well the upcoming tasks of the Ad Hoc Technical Expert Group (AHTEG) in March 2020 and the third meeting of the Open-ended Working Group on the Post-2020 Global Biodiversity Framework (OWEG 3) in July 2020⁴. Importantly, as next steps, the OWEG 3 will proceed to discuss the results of AHTEG and then would recommend a decision on DSI for COP15 (at the time of the workshop planned to take place in October 2020). She stated that DSI will ultimately be a big part of the game on the post -2020 decisions and extensive knowledge is currently being gathered during this inter sessional period (2018-2020). Finally, she stressed that there are high expectations from the upcoming AHTEG and OWEG 3 meetings but the highest expectation is from the COP15 whereby the Global South/developing countries have very clearly stated that there will be no agreement on the Global Biodiversity Framework if there isn't any agreement made on the DSI issue. She concluded her talk by explaining that DSI is also currently being discussed by other fora such as the ITPGRFA, FAO CGRFA, WHO, BBNJ-UNCLOS and WIPO.

Open Access and the International Nucleotide Sequence Database Collaboration (Dr. 5.1.2e)

Dr. 5.1.2e (Head of the European Nucleotide Archive, EMBL-EBI) provided valuable information on open access public sequence databases in particular, the International Nucleotide Sequence Database Collaboration (INSDC). He began by stating that "Science proceeds through layers" whereby data published by one group of scientists is picked up by another group of scientists who build up on it and take it a little further. This is primarily how science advances layer by layer. He presented an interesting analogy by comparing the data generated from bioinformatics (Molecular Biology data) to an organic machine that runs autonomously which needs to be fed with DNA sequences (input) that is then processed in

⁴ The third meeting of the Open-ended Working Group on the Post-2020 Global Biodiversity Framework (OWEG) has been postponed due to the recent COVID-19 pandemic.

order to produce/generate knowledge (output). The processing of the sequences in turn could be performed by scientists, software, secondary databases, curation activities etc. This complex 'life science machine' needs to be therefore protected in order to gain knowledge. He then went on to emphasize the importance of open data with relevant examples. He spoke about the history, organisation and structure of the International Nucleotide Sequence Database Collaboration (INSDC) and the three main large sequence databases that belong to it: The European Molecular Biology Laboratory - European Bioinformatic Institute (EMBL-EBI), the DNA Databank of Japan (DDBJ) and GenBank, which is hosted by the National Centre for Biotechnology Information (NCBI). He briefly described the data submission process and presented numbers that indicated the significant scale at which the database operates as well as the enormous scale of usage of DNA sequences worldwide for EMBL-EBI. Additionally, he spoke about Nucleic Acid Research journal that has been tracking bioinformatics databases for over a decade and their registry of public databases. He also gave a brief description of secondary databases such as UniProt, MirBase, SILVA etc. He concluded by saying that high productivity drives scientific progress (referring to his life science machine analogy) and that high productivity drives access and benefit sharing (ABS). This could be monetary whereby the knowledge generated directly results in a commercial product as well as non-monetary where the machine itself is an open, accessible interface with science making it a crucial part of the ABS system. He stated that we need to understand this productivity and maintain it. We need to understand the risks that could damage the productivity of the machine, assert core features that need to be preserved and identify opportunities to improve it. Finally, he presented certain 'What if' scenarios that would negatively impact productivity and emphasized that it is extremely critical that data remains visible and that the terms of use must be uniform across sequences. Interestingly, he provided a scenario whereby the location information of the sequenced material could be scientifically informative enriching the data and could potentially be an opportunity to increase the productivity of the machine. He ended his presentation with an impressive figure/movie depicting worldwide usage/consumption of sequence data.

Brief inputs from different scientific perspectives

Three participants were invited to give short impulse talks (5min). The participants presented information regarding the usage of sequence data in their daily scientific life, the scientific questions they address as well the lessons learned from the Nagoya Protocol in this context. The impulse talks provided a diverse input from different scientific perspectives and helped set the stage.

Below are the names and affiliations of the 3 participants:

1. Prof. Dr. 5.1.2e, University of the Basque Country, EMBRC-Spain
2. Dr. Markus Wyss, DSM Nutritional Products Ltd.

3. Prof. Dr. Elżbieta Martyniuk, Warsaw University of Life Sciences.

Update on the current COVID-19 outbreak with respect to DSI and the Nagoya Protocol
(Dr. 5.1.2e and 5.1.2e)

In addition to the participant impulse talks, Dr. 5.1.2e (Institut Pasteur, France) gave an interesting insight into the implementation of the Nagoya Protocol at the Institut Pasteur with the recent SARS-COV-2 outbreak as a relevant and important example/case study. She began by providing basic background information on the Institut Pasteur and its mission. She mentioned that one of main scientific areas of the institute is the field of emerging infectious diseases. The Institut Pasteur hosts 14 National Reference Centre, 9 WHO collaborating centres and has the 5th most diverse bacterial culture collection in the world. The institute's legal department assists in the implementation of the Nagoya Protocol providing appropriate legal counsel to the researchers and necessary follow-ups with the National Focal Points. The Institut Pasteur has a strong collaboration with the French ministries and policymakers in order to analyse practical implications of novel policies and determine its feasibility. Moreover, the Institut Pasteur has an international network comprising of 32 member institutes that are spread over 25 countries. The institutes within this international network share their knowledge, research programs and provide on-going international health monitoring. Dr. 5.1.2e then proceeded to provide a very relevant and significant case study of the recent SARS-COV-2 outbreak. She detailed the timeline and the work developed by the National Reference Centre (NRC) for Respiratory Viruses during the SARS-COV-2 outbreak. The first confirmed case was detected in France on Jan 24th. A diagnostic test was developed using the Coronavirus sequences that were added in the GISAID (Global Initiative on Sharing all Influenza Data) database by the Chinese government highlighting the significance of open access information without which the scientific advances made during this current outbreak would have been virtually impossible. Interestingly, to date, the request to gain access to the Chinese DSI has been met with no response from the Chinese government. In China, DSI is already included in the definition of GR. This further emphasizes that any new regulation/implementation that is put in place should allow/enable an active and fast response from the competent authorities. The institute was the first in Europe to sequence the virus since the outbreak and the two full sequences have been submitted to the GISAID platform. On Jan 30th, a diagnostic test with 100% specificity for SARS-COV-2 was launched and on Jan 31st, SARS-COV-2 virus was made available by Pasteur for research purposes via the H2020 (EVA-Global) project. The Institut Pasteur is also sharing capacity building tools among the Institut Pasteur International Network (IPIN) members during this outbreak. Furthermore, a task force for COVID-19 was created on Jan 28th mobilizing Pasteur's scientific experts for the rapid development of diagnostic, preventive and treatment tools to tackle the novel coronavirus. She concluded by highlighting the visit of the Chinese Ambassador on Feb 14, 2020, supporting the activities carried out by the Institut Pasteur to control the outbreak. This was, however, in stark

contradiction/contrast to the fact that the response to gain access to the Chinese DSI is still pending.

5.1.2e

MA LL.M (Coordinating Senior Counsel/Public Health Lawyer, RIVM, Netherlands) highlighted the importance of open access/open science by further elaborating and sharing his observations/experience on the recent COVID-19 outbreak. He began by stating that the RIVM is currently involved in the complex issue of negotiating the sharing of viral materials/sequences for producing antiviral compounds and eventually vaccines. This further highlights the need to share information openly and rapidly. Interestingly, the Coronavirus genomic sequence data seemed to be better shared as compared to the actual physical material. He explained that if DSI was to be considered as covered by the scope of the NP, lessons would need to be learned on the current situation with respect to the sharing of the Coronavirus physical materials. He stated that the global sharing of physical samples of the virus were dramatically late. The reason being that countries simply did not share their viral isolates and that they had to wait for patients in their own country in order to obtain relevant samples. Importantly, no isolate has been shared to date by the Chinese government. On the other hand, when scientists did share information/material, the receiving parties had no time and capacity for PIC/MAT negotiation. Due to the immense pressure for analysis, diagnostics tests, antiviral medication and vaccines, many research laboratories and public health institutes have been working together with materials without the documents required by Nagoya, as a result of which questions have been raised regarding future controls and compliance checks. Moving further, he spoke about genomic sequence data and stated that the recent COVID-19 outbreak requires international sharing of the viral sequence data and constitutes a key issue to control this outbreak. Interestingly, the sharing of COVID-19 sequence data has been comparatively better with respect to the previous MERS and SARS outbreaks. Further, he emphasized the need for speed on the sharing of genomic sequence data. He highlighted 2 main reasons for this; 1) rapid development of diagnostics tests/kits and 2) comparison of sequences (to develop phylogenetic trees) to study the transmission routes of the virus and determine/create response policies. If DSI was to be subjected to the NP rules, this rapid sharing of sequence data that is extremely crucial during an outbreak and subsequent studies to develop appropriate response policies would be impossible. He proceeded to speak about the GISAID platform and mentioned that the scientists studying the Coronavirus are predominantly using this database. Of note, there have been recent indications that the current rule of third party sharing of sequences from the GISAID database is being lifted in light of the recent events and without any further objections from the countries which are Parties to the NP. He concluded by stating that there has been a massive non-monetary benefit sharing/contribution taking place among research institutes across the world through their scientific research, free performance of diagnostics, large scale production of diagnostic kits with production partners against low/moderate prices, search for antiviral components and eventually vaccine production. At the moment, this large scale non-monetary BS is not being calculated/quantified or being made visible. However, one must keep in mind if this were to

be calculated or brought under MAT/MTA's, the people contributing to this BS for free may demand monetary compensation. This should be an important consideration if DSI was to be considered as falling under the NP regime. Lastly, he emphasized that it is extremely critical that the physical viral samples from the current COVID-19 outbreak be collected systematically and made freely available to scientists around the world in order to protect us from the next outbreak.

CBD negotiations surrounding DSI: what is needed from different sectors? (Dr. Hugo Schally)

Dr. Hugo Schally (Head of Unit, Multilateral Environmental Cooperation EU DG Environment, European Commission) gave the participants a political insight into the CBD negotiations surrounding DSI. The issue of DSI is complex and one must consider the original statement of the CBD i.e. recognizing the sovereign rights of States over their genetic resources. Genetic resources have specific regulations applied to them at their point of origin and it is not difficult to imagine a claim that information that has been sequenced in digital form is therefore subsequently subjected to the rules of the CBD, and if applicable to the NP. However, this does not necessarily imply that all information in the databases would be subjected to the NP. Taking some guidance from the previous participant impulse talks, the important points to consider are: predictability, legal certainty, clarity and uniformity of rules that are applied. There was a very clear understanding at the recent OEWG 2 (Second Meeting of the Open-ended Working Group on the Post-2020 Global Biodiversity Framework) in Rome (February 2020) that the discussion on ABS would be related to the broader concept of resource mobilization and the generation of financial resources that would eventually flow back to countries that are centres of biodiversity worldwide. This was the discussion surrounding Goal E of the Global Biodiversity Framework. Coming to the history of the NP, the Protocol was adapted in 2010, in the context of the Aichi Biodiversity targets, with the aim to achieve one of the three objectives of the Convention: the fair and equitable sharing of benefits arising from the utilization of genetic resources. It was an agreement to provide a legal framework for genetic resources. Unfortunately, prior to Nagoya, there was a lack of appropriate dialogue/ in-depth discussions with the scientific research community and the industrial sector in order to better understand the contribution that the research community would have been willing to make and what solution would have best fit the needs of science and research in the context of an overall framework. After Nagoya, many questions were left open (e.g. genetic resources of uncertain origin) that eventually added to the frustrations of the developing countries. These countries began to recognise DSI/sequence data (perceived as a loophole to circumvent NP obligations) as being the major reason for the absence of the flow of benefits. It is for this reason that the topic of DSI is being currently and intensively discussed in the context of the 2020 Biodiversity Framework. The biggest challenge therefore at the moment is to find a solution that; 1.

Preserves open science, 2. Respects the legitimate concerns of the developing countries, 3. Establish a system whereby financial benefits flow from the users to the providers. An important aspect is to include the industrial stakeholders, as this sector is potentially the main source of the monetary benefits. Unless we come up with a workable solution, it is possible that we may end with another agreement which might bring DSI under the realm of the compliance measures of the NP i.e. PIC/MAT and traceability. The scenarios/options that have been developed and that will be discussed during the course of the workshop are creative enough if the scientific community is ready to adapt. In order to break out of the mould of the bilateral system that the NP offers, there needs to be readiness to engage in an alternative solution which may lie in the reflection on one of the options presented at this workshop. Finally, the scientific community needs to actively contribute to the political solution that will be eventually achieved in Kunming, China this year.

Initiating the Dialogue: ‘Fish Bowl’ discussion

The talk by Dr Hugo Schally was followed by an hour long intensive and interactive discussion where the participants could put forth their questions concerning the political debate/negotiations surrounding DSI and ABS.

The main points addressed during this discussion:

- The loose ends/open questions of the Nagoya Protocol and getting closure through a political solution.
- Due to time limitation, there can be no agreement at the COP15 (Kunming, China) on a workable system, but a solution on a system can be agreed upon.
- A solution that allows the linking of specific research activities to the eventual commercial application thereby in turn determining the contribution of the specific information to the development of a product. This however doesn't imply the direct and fully fledged tracking/tracing system but a way to confirm the direct link between a product and the research activity that contributed to it thereby establishing the utilization of that particular information. A possibility to link the development of a commercial application arising out of GR or out of DSI derived for GR to research being performed and the commercial application.
- The Global Biodiversity Framework 2020 will try to repair what was not achieved by the Aichi Biodiversity targets.
- The policy makers would like to have an understanding of the ‘business model’ that the scientific community would be able to work with (with respect to the paradigm of open science and also in the context of the proposed scenarios). What are the acceptable levels of change? What is the level of constraint that is acceptable as a licence to operate? There is a gradual understanding that is being reached especially through discussions such as the one currently taking place in this workshop.

- The complexity of tracking and traceability of the sheer volume of information in the databases.
- The broader concept of resource mobilization and innovative finance mechanisms. The concept of a global biodiversity fund.
- The data economy in the field of research and science is still very rudimentary whereas in other fields data is already a monetizable commodity.

The WiLDSI project & overview of the 3 open-access DSI scenarios (Dr.

5.1.2e

5.1.2e)

Dr. Amber.H.Scholz (Deputy to the Director, Leibniz Institute DSMZ) presented a brief history of the WiLDSI project as well as described the three open access DSI scenarios that would be the main focus of discussion during day 2 of the workshop. She began by highlighting that the Leibniz Institute DSMZ is the first registered collection under the EU Regulation 511/2014 and actively takes over a portion of the user's due diligence obligation. She went on to provide relevant examples to underscore the harsh lessons learned from the NP with respect to the compliance issues, and the huge delays caused in biodiversity research. In a study to investigate how users comply with the ABS regulations worldwide, every country (~200) in the ABS-Clearing House (ABSCH) was contacted by email. Interestingly, keeping track of the response rate from the individual countries (National Focal Points or Competent National Authorities) over the last three years, highest numbers were seen for lack of answers/absence of information when combined with the waiting list responses. Another survey of academic research projects by 20 Leibniz institutes involved in Biodiversity research highlighted the delays caused in order to obtain the required permits (PIC/MAT). These studies emphasized the frustrations of the research community with the current system. Furthermore, with respect to the current political dilemma surrounding DSI, Dr. Scholz proceeded to explain how the WiLDSI project came into being and the four main reasons why it was decided to actively engage in the DSI policy process; a. importance and exponential growth of sequence data, b. acknowledgement that DSI can reduce but not replace physical GR, c. biodiversity needs DSI and d. strong link between the DSI issue and post-2020 Biodiversity Framework. She went on to provide a crash course on the DSI core infrastructure i.e. the INSDC and downstream public and private databases. In brief, this core infrastructure can be perceived as the nucleus from where the rest of the biological database landscape builds upon whereby 99.9% of the NSD databases depend on the INSDC. Half of the INSDC is out of geographical scope with nearly 52% of the NSD being generated by the following 4 countries: China, United States, Canada and Japan. Approx. 37% i.e. one third of the INSDC is out of material scope since the INSDC also includes human sequences, sequences from model organisms etc. She further explained some key lessons learnt from the CBD study on DSI databases and traceability⁵. Based on the understanding of the DSI

⁵ Rohden, F., Huang, S., Dröge, G., and Scholz, A., (2020) Combined Study on Digital Sequence Information (DSI)

infrastructure, the WILDSI project came up with 7 project goals of what a new DSI ABS system should be:

1. Compatible with free, open access INSDC
2. Integrated and NOT a stand-alone system (e.g., blockchain)
3. Administratively nimble or invisible for scientists
4. Ideally compatible with other international fora
5. Income-generating without explicit public sector funds
6. Acknowledge the demands of the developing world
7. Stop being „DSI“ and become something else

Finally, she described the three proposed DSI scenarios stating that these scenarios were meant to present to the audience the spectrum of ideas that are compatible with open access and which meet the requirements of the 7 above stated project goals. Importantly, in order to connect the WILDSI project results to international discussions, the figures in the background paper have been taken directly from the first global ABS Dialogue in Pretoria, South Africa (November 2019)⁶.

Day 2

Dr. 5.1.2e gave a short recap of the previous day and then proceeded to explain the overview of Day 2 and how the group work would be divided. The primary objective of the group work was to test the three DSI open access scenarios, examine feasibility, propose new adaptations, and refine accordingly.

Testing the scenarios

Discussion of the 3 scenarios

in Public and Private Databases and Traceability. Secretariat of the Convention on Biological Diversity, Montreal, Canada. <https://www.cbd.int/meetings/DSI-AHTEG-2020-01>.

⁶http://www.absinitiative.info/fileadmin//media/Events/2019/68_November_2019_PretoriaSouth_Africa/Report-First-Global-DSI-Dialogue-SouthAfrica-201911.pdf

Five homogenous groups (7-8 participants /group) were formed based on the professional background of the participants i.e. academics, policy makers and industrial representatives.

Each group was assigned with the task of discussing all three scenarios and to assess and write for each of the scenarios:

1. The practical implications/ consequences of the scenario in their everyday work?
2. Possible amendments
3. Ranking the scenarios according to the respective groups preference

After approx. 105 minutes of intense discussion, each group representative reported their respective group results.

Outcome of the group discussions

Some groups addressed certain general points/questions that would need to be considered and kept in mind:

- Important to set the frame in which direction the negotiations should go.
- With respect to the funds, who will pay, for what and how much?
- How is it related to sovereign rights over GR?
- How is it related to the still existing ABS systems?
- To keep in mind the perspectives of other international fora.
- More facts need to be brought to the table.
- There exists a big mistrust amongst the provider countries and this should be considered when proposing a system. It is important to consider the different stakeholders. We need to think of a fair solution if we want to get everyone on board.

A) Nagoya plus (Dialogue Option 2)

- This scenario is linked to the internationally recognized certificates of compliance (IRCCs) system making it difficult and disadvantageous as this system is currently not working (few IRCC issuing countries, often absent or difficult to find legislation). Obligation to use one document and one system that is machine readable. This system would eventually need to be updated to respond to all the needs.
- Would require tracking and tracing. Technically feasible but would require high costs.
- In terms of benefits: could the cost of this system outweigh the benefits.
 - Depending on how much sequence information is being used and in what way, could this affect the distribution of benefits? Would it dilute it?
- Being a traceable system, could provide a certain amount of legal certainty.
- Would enhance jurisdiction shopping.
- Potential risk that users would start to filter out the data that is tagged in some way.

- Will also cause huge delays unless rigid rules are set in place.
- How to track, measure and calculate the contribution of each nucleotide sequence (NS) to the commercial product?
- Would only be feasible if a highly standardized MAT would be in place for all NSD
- No clear distinction between commercial and non-commercial use.
- One advantage of this scenario is that it builds off an existing system.
- This bilateral model would be attractive from a provider country's perspective as this model could potentially guarantee that the provider country gets something back in return.
- This model could only work if conditions of BS are standardized either a universal or a restricted set of IRCCs.
- Part of the burden falls on the researcher who uploads the data and has to make the link to the standardized IRCC.
- The users would need to read carefully the conditions and understand their obligations.
- Possible amendments:
 - To include a time limitation on obligations.
 - PATs having certain types of data use exemptions.

In all, it was agreed that this scenario was the least attractive of the three scenarios, and garnered the highest criticisms. Several challenges are associated with this scenario and requires several changes.

B) Country tag (Dialogue option 4)

- Country tag increases the value of the data from a scientific perspective, has scientific value.
- Subscription fee could be considered as a hindrance. Is it still considered open access as there is already a link with subscription fee??
- Difference between commercial and non-commercial use (not clearly defined).
- With respect to the funds:
 - Who pays and how much?
 - How to distribute the funds? How to dedicate the funds and to which countries?
 - Lack of governing of the funds.
 - Developing countries would have to contribute to the funds too.
 - Are public research institutes expected to pay? Would it be possible for the government to pay some fee that then allows users in their jurisdiction to operate?
 - A big question for the companies, why would it be attractive to pay? How much to pay?

- Provide incentives for subscription for e.g. Biodiversity conservation.
- There could be a certain misunderstanding due to the formulation of this scenario that country that uploads data would benefit from the system. (Needs to be stated clearly that country of origin of the GR from where the DSI is generated).
- How much a country contributes to the system is not really a good measure of how benefits should be distributed? Question of quality of the data etc.
 - Would this system incentivize data production (upload more data)?? Depending on how much data you put in, you would get the benefits?? The question of garbage/junk DSI comes in??
- It is unclear what role the databases will play? How would this system work legally? How would they police the terms and conditions??
- Possible amendments:
 - With respect to the BS issue, addition of certain notions (for e.g. change of intent at a certain stage in the process)
 - Address the non-monetary benefits
 - One suggestion: to pilot such a system for a limited time period and see how it works.

C) De-coupled (Dialogue option 3)

- No tracking and tracing required. This system is very close to the philosophy of open access.
 - Preserves open access
- Comparatively cost saving as no tracking and tracing involved (in terms of transaction costs)
- One could buy legal certainty depending on the actual modality of the system
- Voluntary nature of the payment
 - Politically this won't 'fly'. How to make it fly??
 - This option is attractive because of its simplicity and potential money generation.
 - Coalition of the willing
 - Make this commitment to the coalition of the willing stronger (e.g. Pledges)
 - Coalition of the committed (maybe better than coalition of the willing as the implication of voluntarism may not be accepted politically)
 - Declaration/commitment of companies (prior to COP) that they will be willing to contribute to some sort of fund (for Biodiversity conservation)?
 - The idea of corporate responsibility of the companies. Companies might be happy to participate if built into the corporate responsibility programs. To introduce some sort of branding and recognition??

- Include a broader and more diverse spectrum of users. Companies who make money using the services provided DSI. For e.g. Oil companies who use DSI to predict where to drill? These companies should also contribute towards a payment.
- How much money is needed?
- How much are people willing to pay for legal certainty?
- Think about guarantees and policing/enforcing of the mechanisms in terms of thinking of ways to keep people in the system.
- The chicken and the egg problem: Who will step in onto this first? Who will initiate?
- One way to make the voluntary system work is to leave the bilateral system in place and offer an opt-in option.
- Governance of fund not predefined. How will the money be distributed? Who will collect the money?
 - An international body that governs the funds??
 - One suggestion: Can the country tag in scenario B be a useful modality for the distribution of funds?
 - Use the funds for capacity building in countries that really need it.
- One downside is that money is shown late as compared to scenario B where money appears earlier (upfront payment via subscription versus at point of commercialization).
- Some countries would buy this proposal more easily (Africa) whereas some would require more convincing (Brazil).
- Depending on the actual governance/modality of the mechanism could convince more countries to step into this proposal. Make it more specific.
- This system however does not exclude digital biopiracy.
- How to measure the contribution of specific DSI to the final commercialized product?

Summarizing, there was a strong and mutual agreement on preserving and maintaining open access. There was also a strong preference for a multilateral system as compared to the bilateral system. It was also agreed that country tag should be included as it enhances the scientific value. There were intense discussions regarding the redistribution of monetary funds with respect to:

- Countries that upload high amounts of DSI
- Country of origin of GR of the DSI
- Developing countries regardless of their DSI contribution
- Bilaterally at point of commercialization.

It was generally agreed that money should be used for biodiversity conservation as well as capacity building and technology transfer.

In terms of ranking the proposed scenarios (in order of most preferred to least preferred):

Group I: B, C and A

Group II: B, with A and C at the same level.

Group III: preferred not to rank

Group IV: C, B and A

Group V: B, C and A

Scenario B was the preferred option although there was a general consensus that Scenario B showed several caveats and still required several amendments. There was an interesting proposal of a hybrid scenario B and C i.e. a hybrid system of the 2 multilateral options. To merge the strengths of both the proposed MLS options and develop one hybrid proposal.

Synthesis and Way forward: Where do we go from here?

The workshop was concluded following an interactive discussion session conducted by Dr. Amber.H.Scholz and 5.1.2e. Questions that were addressed during this session were

- a. What is important for this stakeholder community with respect to what any potential DSI scenario offers?
- b. What should the proposed hybrid scenario encompass?

The following points were summarized based on the feedback and opinions from the participants:

- No tracking and tracing
- Open Access guaranteed
- Fairness (contribution of provider countries), shows “energy” of system
- Legal certainty for sale (at what price)
- Coalition of the willing from **both**:
 - Countries (laws)
 - Users (commitments)
- Country tag (GPS reporting systems)
 - INSDC informs and fund distribution based on indicators such as novelty, re-use and geography
- Elimination of jurisdiction shopping
- Include broader spectrum of users
- Corporate responsibility (branding/labelling)
- Market access fee (e.g if you use biodiversity data)

- Transparency measures
 - Self-declaration of coalition of the willing
 - Country tag
- Monetary options
 - Subscription
 - Certification scheme
 - Micro-levy
 - Option (but more expensive) to contribute at time of commercialization (but want to avoid free rider problem and encourage early financial returns accrue, too hard to regulate)
 - Trigger?
- Eliminate/decreased compliance.
- Obligatory MLS
 - Different sectors pay different rates

Summary

The workshop on Digital Sequence Information, Open Access, and Sustainable Benefit Sharing: Scientific Input to International Policy Decisions held on 10-11 March 2020, in Brussels, enabled the European scientific community – academia as well as industry -- to actively engage in the political discussions surrounding DSI. The participants were informed about the on-going political processes involving DSI as well as what a future system in terms of DSI policy regulations might look like. The WiLDSI project, its goals and the three DSI open access scenarios developed during the course of the project were also explained. The main objective and focus of the workshop was to discuss and test the feasibility and applicability of the three proposed scenarios. The workshop provided a platform to the European scientific community to discuss their views with respect to the political dilemma around the DSI issue as well as offer their expert opinion on the three DSI scenarios. Summarizing, there was a strong and mutual agreement on preserving and maintaining open access. There was also a strong preference for a multilateral system as compared to the bilateral system. In conclusion, with respect to the three proposed scenarios, participants put forth the notion of merging the different aspects from the two proposed multilateral scenarios and to develop and describe a hybrid scenario in further detail.