



The International Treaty

ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE



VISION PAPER ON THE DEVELOPMENT OF THE GLOBAL INFORMATION SYSTEM IN THE CONTEXT OF ARTICLE 17 OF THE TREATY

- i) *Article 17 of the International Treaty states that "Contracting Parties shall cooperate to develop and strengthen a global information system to facilitate the exchange of information, based on existing information systems, on scientific, technical and environmental matters related to plant genetic resources for food and agriculture".*
- ii) *At its Third Session, the Governing Body requested the Secretariat to develop a vision paper to be presented to the Fourth Session of the Governing Body to take stock of existing information systems and to outline a process for the development of this global information system.*
- iii) *The present document was presented to the Fourth Session and describes the existing major information systems on plant genetic resources for food and agriculture as well as number of related initiatives. The document outlines a number of activities that may be undertaken in the next biennium for the effective development and strengthening of a coherent global information system pursuant to Article 17 of the Treaty. The document also presents in the last section the guidance provided by Contracting Parties.*

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I. INTRODUCTION

1. Article 17 of the International Treaty, placed under Part V "Supporting Components", states that "*Contracting Parties shall cooperate to develop and strengthen a global information system to facilitate the exchange of information, based on existing information systems, on scientific, technical and environmental matters related to plant genetic resources for food and agriculture, with the expectation that such exchange of information will contribute to the sharing of benefits by making information on plant genetic resources for food and agriculture available to all Contracting Parties*".

2. At its Third Session, the Governing Body "welcome[d] the efforts underway to coordinate and improve information systems documenting plant genetic resources for food and agriculture, based on existing information systems, which should build the basis of the Global Information System, foreseen in Article 17, consistent with Article 12.3b, of the International Treaty".¹

3. The Governing Body also requested the Secretary "to continue to collaborate with FAO and other relevant stakeholders on information technologies to facilitate their contribution to the continuous development of the global information system in the context of Article 17 of the Treaty, in order to promote greater access to relevant information and information systems by Contracting Parties and other relevant stakeholders, and [...] the Secretariat to develop a vision paper to be presented to the Fourth Session of the Governing Body to take stock of existing information systems and to outline a process for the development of this global information system".²

4. The Commission on Genetic Resources for Food and Agriculture (Commission), at its Twelfth Regular Session, requested its Secretary "to collaborate with the Secretary of the International Treaty in the development of the vision paper that had been requested by the Governing Body of the International Treaty at its Third Session, to take stock of existing information systems and to outline a process for the development of the global information system in the context of Article 17 of the International Treaty, in order to ensure that the roles of the Facilitating Mechanism, WIEWS, and the National Information Sharing Mechanisms are adequately considered without duplicating efforts."³

5. This document constitutes the vision paper that the Governing Body requested. It contains:

- a. An analysis of Article 17 in the context of other articles of the International Treaty and the decisions adopted by the Governing Body;
- b. Preliminary information on the major existing information systems on plant genetic resources for food and agriculture (PGRFA);

¹ Resolution 4/2009, *The Multilateral System of Access and Benefit-sharing*, Part I, para. 2.

² Resolution 7/2009, *Cooperation with the Commission on Genetic Resources for Food and Agriculture*, para. 22.

³ CGRFA-12/09/Report, paragraph 27.

- c. An identification of some of the major gaps at global level in the area of information exchange;
- d. An outline of possible future work by the Secretariat in relation to the establishment of the global information system of Article 17 with a view to strengthening cooperation on this matter.

II. ANALYSIS OF ARTICLE 17 IN RELATION TO OTHER ARTICLES OF THE TREATY AND THE DECISIONS OF THE GOVERNING BODY

6. The main goal of the global information system, as described in Article 17.1, is

"to facilitate the exchange of information, based on existing information systems on scientific, technical and environmental matters related to plant genetic resources for food and agriculture with the expectation that such exchange of information will contribute to the sharing of benefits by making information on plant genetic resources for food and agriculture available to all Contracting Parties."

7. The reference in Article 17.1 to "*existing information systems*" suggests that there is a need for assessing carefully existing mechanisms, analyzing the relevance of their structure and content, and reviewing the interest and technical capacities of the institutions that operate those systems to contribute to the development and strengthening of a global system before new systems are established.

8. The reference to Article 17.1 to sharing of benefits through exchange of information reflects Article 13.2 which considers the exchange of information as part of the benefit-sharing in the Multilateral System:

"The Contracting Parties agree to make available information which shall, inter alia, encompass catalogues and inventories, information on technologies, results of technical, scientific and socio-economic research, including characterization, evaluation and utilization, regarding those plant genetic resources for food and agriculture under the Multilateral System. Such information shall be made available, where non-confidential, subject to applicable law and in accordance with national capabilities. Such information shall be made available to all Contracting Parties to this Treaty through the information system, provided for in Article 17."

9. The Governing Body discussed the linkage between the global information system and benefit-sharing at its Third Session, when, in fact, it welcomed the efforts underway to coordinate and improve existing information systems that should build the basis of the "*Global Information System, foreseen in Article 17*".⁴

10. Article 17.2 of the Treaty refers to "*early warning*" about hazards that threaten the efficient maintenance of plant genetic resources for food and agriculture (PGRFA) as one of the components of the information system, based on the notifications sent by Contracting Parties, with the aim of safeguarding the material. In fact, information is of fundamental importance to the conservation and sustainable use of PGRFA. While most genebanks

⁴ Resolution 4/2009, see footnote no. 1.

have some form of information system or inventory, it is not always easy to have access to them, as many of those systems and inventories are not online and there are still few linkages among them. Furthermore, the information on the status of *in situ* genetic material is more difficult to document, systematize and share.

11. It is to note that the Resolution refers not only to FAO, but also to “*other relevant stakeholders*” and that such decision broadens the scope of collaboration beyond the activity of information exchange as it refers to “information technologies”.

12. Article 17.3 of the Treaty states that

“Contracting Parties shall cooperate with the Commission on Genetic Resources for Food and Agriculture of the FAO in its periodic reassessment of the state of the world’s plant genetic resources for food and agriculture in order to facilitate the updating of the rolling Global Plan of Action referred to in Article 14”.

13. It can be concluded from the above analysis that the main thematic areas for which the global information system will be relevant are:

- a. Scientific, technical and environmental and socio-economic matters, including characterization, evaluation and utilization;
- b. Benefit sharing and access to genetic resources, deriving from:
 - i. catalogues and inventories;
 - ii. information on technologies;
- c. Early warning;

14. In addition, Article 17.1 requires Contracting Parties, in the the development and strengthening of the global information system, to cooperate with the Commission in its periodic reassessment of the state of the world’s plant genetic resources for food and agriculture in order to facilitate the updating of the rolling Global Plan of Action.

III. STOCK-TAKING OF MAJOR EXISTING INFORMATION SYSTEMS

1. Information systems and tools in support of the Multilateral System

15. The Multilateral System of Access and Benefit-sharing started its operation in January 2007 and since then the Secretariat of the International Treaty has been gaining experience on information systems. In the inter-sessional period from the First to the Second Sessions of the Governing Body, the Secretariat organized the First Technical Consultation on Information Technology In Support to the Implementation of the Multilateral System of Access and Benefit-sharing, as a forum to discuss ways in which information technology could support, simplify and, as far as possible, automate and reduce the transaction costs of the processes involved in the Multilateral System.

16. In the following inter-sessional period, the Secretariat organized a second consultation in December 2008 and worked with potential providers and recipients of material from the Multilateral System in order to better identify users' needs as well as simplify and automate the use of the Standard Material Transfer Agreement (SMTA), and develop and test responsive prototypes.
17. Both consultations gathered representatives from Contracting Parties, stakeholders and experts on information systems on PGRFA and other relevant fields. They promoted fruitful discussions among managers of information systems and databases in order to identify potential synergies for implementation of the Multilateral System.
18. Based on the outcomes of such consultations, the Secretariat designed an information system in support of the Multilateral System that facilitates the reporting obligations of SMTA parties and other activities relevant to the smooth operation of the Multilateral System.
19. The Secretariat also developed, in collaboration with the French Agricultural Research Centre for International Development, a stand-alone information tool to facilitate the generation of SMTAs for the transfer of material within the Multilateral System.
20. The Secretariat reported to the Governing Body at its Third Session in 2009 on these achievements and on a three-party project with Bioversity International and the Global Crop Diversity Trust which led to the design and implementation of a new system called "Genesys". The system is described below in this document.
21. Since its inception, the Secretariat of the Treaty has informally collected information on the main features and status of systems and tools with high potential synergies for a possible integration into a global system information system on PGRFA.

2. Early warning systems and monitoring and facilitating tools

22. In the last twenty years, FAO has accumulated relevant experience on information systems on PGRFA, especially since the establishment of the World Information and Early Warning System (WIEWS) in 1993.
23. WIEWS was established as a world-wide dynamic mechanism to foster information exchange among FAO Member Countries by the gathering and dissemination of information on PGRFA, in conformity with Articles 7.1 (e) and (f) of the International Undertaking on Plant Genetic Resources. WIEWS has evolved over the years: in 1998 its first web version was released allowing users to retrieve information on about 6 million accessions from 1,400 *ex situ* collections; in 2000 remote updating capabilities were added to the web system to facilitate direct information uploading from national programmes. Automatic data gathering procedures for the update of the *ex situ* collections database have also been activated for web published genebank documentation systems and inventories for plant genetic resources for food and agriculture, such as CGN, USDA GRIN, EURISCO and SINGER.
24. WIEWS has been a key information source for the periodic assessment of the state of the world's plant genetic resources for food and agriculture in 1996 and 2009, in particular with its unique meta-database on germplasm *ex*

situ holdings which now covers over 7.4 million accessions conserved in some 1,750 genebanks around the world.

25. A global network of country correspondents for information exchange on plant genetic resources for food and agriculture, who are officially nominated by their respective governments has served as focal nodes for information flows between countries and WIEWS.

26. Article 5 of the International Treaty requires Contracting Parties to survey and inventory PGRFA, assessing threats and to minimize or, where possible, eliminate them. The long-term objective of the early warning system as stated in para 281 of the Global Plan of Action, is "*assembling information to enable remedial or preventive action to be taken*".⁵ WIEWS works towards this goal through its network of correspondents, who are asked to provide information on threats to PGRFA. This network mechanism presents a great potential and should be expanded, to further facilitate the exchange of additional information among its members and others interested users. In this regard, three main forms of reporting on cases of plant genetic resources loss, including *ex situ* collections, crop wild relatives and local varieties, have been made available through WIEWS. However, further research on genetic erosion is required to define key indicators and methods for assessing it and its drivers over time.

27. Information exchange is one of the areas specifically listed in Article 14 of the International Treaty, as follows:

"Recognizing that the rolling Global Plan of Action [...] is important to this Treaty, Contracting Parties should promote its effective implementation, including through national actions and, as appropriate, international cooperation to provide a coherent framework, inter alia, for capacity-building, technology transfer and exchange of information, taking into account the provisions of Article 13."

28. Through the network of WIEWS country correspondents that currently covers more than 110 countries, participatory and capacity building activities for monitoring the implementation of the Global Plan of Action has been conducted in more than 65 countries worldwide during the past seven years. As part of this monitoring effort, key national PGRFA stakeholders have established National Information Sharing Mechanisms (NISM) and published through web portals and databases detailed information on the state of conservation and sustainable use of PGRFA in their respective countries. NISM data, which *inter alia* includes information on more than 24,000 publications, 18,000 projects, 61,000 cultivars and 18,000 stakeholders, can be accessed also through the World Information Sharing Mechanism on PGRFA and automatically feed the WIEWS database on *ex situ* collections.

29. It is worth noting that the Commission on Genetic Resources for Food and Agriculture stated that WIEWS should be further developed in the context of developing the Global Information System on Plant Genetic Resources for Food and Agriculture of the International Treaty. The Commission on Genetic Resources for Food and Agriculture expressed its willingness to work with the Governing Body of the International Treaty for

⁵ <http://typo3.fao.org/fileadmin/templates/agphome/documents/PGR/GPA/gpaeng.pdf>

this purpose, and further invited the Governing Body to consider utilizing national information sharing mechanisms established through WIEWS, as contributions to the development of its global information system⁶.

30. In order to promote the provision of technical and financial resources to developing countries - especially least developed countries, and to countries with economies in transition - to address national priorities, FAO, together with Bioversity International and the Global Forum on Agricultural Research (GFAR), in 2007 launched the web-based portal of the Facilitating Mechanism for the implementation of the Global Plan of Action. The portal is a friendly access point to information on sources and availability of financial, technical and information resources on subjects related to the priority activity areas of the Global Plan of Action. Under the Facilitating Mechanism more than 730 funding programmes can now be searched for funding opportunities.

3. Information systems and research at the international level

31. Conservation of crop diversity in genebanks involves a wide range of diverse activities, each of which is necessary for the safeguard of the collections and to make that diversity available to other users. In doing so, there is no doubt that the Centres of the Consultative Group on International Agricultural Research (CGIAR Centres) have also accumulated large expertise in information exchange on PGRFA individually and in a collaborative way. Almost all the CGIAR Centres have developed their own documentation systems and inventories.

32. One of the most well-known initiative is the System-wide Information Network for Genetic Resources (SINGER)⁷, which is the germplasm information exchange network of the CGIAR Centres and its partners. Together, the members of SINGER hold around 693,752 samples of crop, forage and tree diversity in their germplasm collections.⁸ SINGER, which is an initiative of the CGIAR System-wide Genetic Resources Programme, provides easy access to information about that diversity.

33. As mentioned above, the Secretariat of the International Treaty, in partnership with Bioversity International and the Global Crop Diversity Trust, has supported the development of Genesys,⁹ which is an online information portal capable of linking all genebanks worldwide. The project has started to connect existing information systems, such as SINGER, and EURISCO, the web-based catalogue of European National Inventories for Plant Genetic Resources hosted at and maintained by Bioversity International on behalf of the Secretariat of the European Cooperative Programme for Plant Genetic Resources (ECPGR). At present, EURISCO provides passport information of more than 1 million samples (accessions) of crop diversity representing 5,383 genera and 34,823 species conserved *ex situ* in 41 European countries.

⁶ *Report of the Eleventh Regular Session of the Commission on Genetic Resources for Food and Agriculture*, CGRFA-11/07/Report, para 37.

⁷ <http://singer.cgiar.org/>

⁸ <http://www.itpgrfa.net/International/sites/default/files/gb4i05e.pdf>, page 4.

⁹ <http://www.genesys-pgr.org/>

34. Genesys is an accession level information system with a user-friendly interface that is being developed to improve the global information exchange. Practically, it works as a gateway distributing information on germplasm accessions. It is currently the largest catalogue of accession information obtainable by breeders, scientists and other interested users. At the end of year 2010, it published full data updates from EURISCO, SINGER and GRIN which lead to an increase in the total number of data records up to 2.33 million. This update also included an increase in the number of accessions with geo-references which doubled from 300,000 to 610,000.

35. The portal invites users to generate searches not only by using accession number or name, but also based on certain desired traits such as plant height, growing periods at given locations, seed color, response to specific pests or diseases and response to various climatic conditions. That type of characterization and evaluation data, along with environmental data based on the longitude and latitude at collection sites is included in the portal complementing the passport data currently available.

36. At the time of this document, the portal provides information on accessions for all major food crops with a focus on the following twenty-two crops: banana, barley, beans, breadfruit, cassava, chickpea, coconut, cowpea, faba bean, finger millet, grass pea, lentil, maize, pearl millet, pigeon pea, potato, rice sorghum, sweet potato, taro, wheat and yam. All of them belong to the list in Annex I of the International Treaty. It is foreseen that the portal will expand to a wider number of crops by including further information from databases.

37. The work of the CGIAR Centers on crop informatics has also rapidly expanded in the last years, in particular on maize and rice. IRRI's International Rice Genebank Collection Information System (IRGCIS) publishes passport, as well as characterization and evaluation data of more than 112,952 accessions. Published data from other information systems and databases on germplasm for this crop is also very wide. An indicative sample list is being provided in *Appendix 2* of this document for reference.

4. The Clearing House Mechanism of the Convention on Biological Diversity

38. Article 17.1 sets forth that

"In developing the Global Information System, cooperation will be sought with the Clearing House Mechanism of the Convention on Biological Diversity."

39. The Clearing-House Mechanism (CHM) of the CBD, which is coordinated by the Executive Secretary, has been established based on Article 18.3 of the Convention.¹⁰ Its mission is to contribute significantly to the implementation of the Convention through the promotion and facilitation of technical and scientific cooperation, among Parties, other Governments and stakeholders. *The Strategic Plan of the Clearing-House Mechanism* identifies three major goals:

¹⁰ <http://www.cbd.int/convention/articles.shtml?a=cbd-18>

- a. the promotion and facilitation of technical and scientific cooperation;
- b. the promotion and facilitation of information exchange among Parties, other Governments and stakeholders;
- c. a fully operational mechanism with the participation of all CBD Parties and an expanded network of partners.

5. National and regional initiatives

40. There are quite a large number of national and regional networks initiatives, including NISM, that currently address knowledge and information exchange on plant genetic resources, among other activities such as training and capacity building. They support the sharing of expertise and provide backstopping in cases where certain members of the network lack the capacity to implement certain activities.

41. In the area of characterization and evaluation of PGRFA, a number of national genebanks have published collection data on the web over recent years or are in the process of doing so, often offering the option of ordering material online.

42. However, a significant imbalance exists among regions and countries within regions, according to the *Second Report of the State of the World on Plant Genetic Resources for Food and Agriculture*, which was released in October 2010.¹¹

43. The large majority of countries still do not maintain an integrated national information system on germplasm holdings and *"important ex situ holdings in at least 38 countries are still, at least partly, documented only on paper (16 countries) and/or in spreadsheets (32 countries). 21 Dedicated information management systems are used to manage passport and characterization data on ex situ collections in only 60 percent of the countries that provided information on this topic, while generic database software is used in about 34 percent of countries."*¹²

44. The lack of a freely available, flexible, up-to-date, user-friendly, multi-language system has limited improvements in documentation in many countries, although in some cases regional and/or bilateral collaboration has helped meet information management needs through the sharing of experiences and tools.

45. A global analysis of existing information indicates that where characterization and evaluation data exist, there are yet frequent problems in standardization and accessibility, even for basic passport information.

IV. PRELIMINARY IDENTIFICATION OF GAPS AND NEEDS AT GLOBAL LEVEL

¹¹ <http://www.fao.org/docrep/013/i1500e/i1500e00.htm>

¹² *Second State of the World's Plant Genetic Resources for Food and Agriculture, chapter 3.*
<http://www.fao.org/docrep/013/i1500e/i1500e03.pdf>

46. Based on the above preliminary information and experience gained, the Secretariat of the Treaty has identified a number of areas where needs and gaps exist and where further activities could support Contracting Parties in developing a strategic vision of the global information system under Article 17 of the Treaty. Those areas and activities are the following:

- a. Facilitating further work on information standards related to PGRFA, including the updating of the multi-crop passport descriptors (MCPD) to reflect the new set of information available under the Treaty, including the legal status of the material and its status with respect to the Multilateral System.
- b. Promoting free and flexible multi-language systems and tools for the characterization and evaluation of PGRFA and the necessary training of staff for their adoption.
- c. Coordinating partnerships for the connection of existing inventories and documentation systems with databases containing molecular information on PGRFA.
- d. Promoting the integration of online data sets related to PGRFA with information on other seed related issues (e.g. OECD; UPOV; etc.).
- e. Enhancing linkages within existing international, regional and national information repositories on PGRFA (e.g. EURISCO, SINGER, USDA-GRIN, NISM, etc.).
- f. Establishing linkages with traditional and indigenous knowledge information systems, with particular emphasis on the documentation of techniques and practices for the conservation and sustainable use of PGRFA.
- g. Conducting regular surveys of users' needs and creating feed-back mechanisms and tools to gather users' preferences.
- h. Harmonizing the international networks of national focal points providing information on PGRFA.

47. All the above listed needs and gaps are to be further detailed and investigated in collaboration with major organizations and networks.

V. THE ROLE OF THE SECRETARIAT IN THE ESTABLISHMENT AND STRENGTHENING OF THE GLOBAL INFORMATION SYSTEM

48. The large number of ongoing initiatives on PGRFA information, their diverse nature and scope, and the variety of stakeholders involved, may require a further intensive and detailed assessment of needs and the definition of concrete activities and partnerships for those activities at the global level, for the progress of the global information system in the long term.

49. The development of the global system may benefit from the definition of general principles, which not only form the basis of the system but also shape the content of implementing activities and constitute the core elements of collaborative partnerships. The principles of the global information system may be the following:

- a. voluntary;
- b. coherent;
- c. neutral;
- d. quality focused;
- e. user oriented;
- f. sustainable;
- g. decentralized;
- h. supportive of decision-making.

50. The following are some general strategic activities that the Secretariat of the International Treaty could undertake during the 2012/2013 bienium, if the Governing Body so wishes, in response to the current gaps and needs for the initial development of the global information system of Article 17:

- a. Establishing a forum for the harmonization and sharing of PGRFA data with experts from Contracting Parties and relevant stakeholders;
- b. Preparing a detailed elaboration of existing gaps in the development and strengthening of the global information system based on the results of a world survey on user's needs by target groups;
- c. Elaborating an up-to-date detailed inventory of existing strategic initiatives with a high potential for integration into the global information system;
- d. Starting a pilot global system, based on existing advanced systems and users' needs and available financial resources ;
- e. Consulting relevant stakeholders for the development of a comprehensive strategy and a work plan to be presented to the Governing Body at its next session.

51. A number of technical strategic studies may be envisaged to pave the way for those activities. The list and content of those studies is described in *Appendix 1* of this document.

52. The global information system should support the main programmes of the International Treaty, in particular the Multilateral System of Access and Benefit-sharing, and the role of the Secretariat could be the promotion of international partnerships and cooperation, the exchange of information and the development of a network of partners, building on existing networks and initiatives. The System should ensure universal access to the Treaty's official records reports and documents, with similar functions to those of the CBD's Clearing House Mechanism.

VI. FURTHER DEVELOPMENT OF THIS VISION PAPER

53. At its Fourth Session in March 2011 the Governing Body "welcome[d] the efforts underway to coordinate and improve information systems documenting plant genetic resources for food and agriculture, based on existing information systems, in order to develop and strengthen the Global Information System, foreseen in Article 17, consistent with Article 12.3b, of the International Treaty, and requested the Secretary to further develop this Vision Paper".

54. It also "Recognize[d] that improving access to and availability of information in the Multilateral System continues to be an important priority and that there is a need to support the relevant authorities and entities, particularly in developing countries, in improving their capacity to provide, manage or access information in respect of the Multilateral System".

**COMPENDIUM OF TECHNICAL STRATEGIC STUDIES FOR THE
IMPLEMENTATION OF ARTICLE 17 OF THE INTERNATIONAL TREATY¹³**

The technical strategic studies will be elaborated by the Secretariat of the International Treaty during the 2012-2013 biennium in collaboration with regional and international organizations and other stakeholders, as appropriate, for the implementation of Article 17.

Technical study 1 on users' needs by target groups and thematic areas

This document will gather valuable information on gaps, expectations and ways in which users from different ways would benefit from a strengthened global information system. It will help to establish priorities and how to best meet their needs and on training requirements.

Technical study 2 on inventories of existing strategic initiatives and networks on PGRFA

This document will generate an up-to-date internet-based index of globally distributed networks of interoperable databases that contain scientific, technical and environmental information related to PGRFA. It will be useful for the identification of content and to avoid duplication of efforts. It will also provide information on governance and institutional mandates and capacities across countries and at regional level.

Technical study 3 on the harmonization and sharing of PGRFA data

This document will include an analysis of information infrastructure and community-developed tools, standards and protocols. It will serve as the basis for future technical discussions. Data must be made more accessible and data format should be compatible as much as possible across different systems.

Technical study 4 on the linkages of the Global Information System with the CBD Clearing House Mechanism and other relevant systems

This document will analyse the main functions of the CBD Clearing House Mechanism and other reporting systems of the multilateral environment agreements and will put together lessons learnt and recommendations for the future development of the global information system.

¹³ This is the proposal presented to Contracting Parties at the Fourth Session of the Governing Body.

Appendix 2

MAJOR RICE DATABASES ON THE WEB RELEVANT FOR RESEARCH

There are many rice databases available on the world Web that are helpful for rice research. The following are presented to provide the reader with a general idea of the number and nature of them.

1. BGI-RIS - <http://rice.genomics.org.cn/rice/index2.jsp> .The Beijing Genomics Institute -Rice Information System (BGI-RIS) is reputed to be the most up-to-date integrated information resource for rice genomes as well as a benchmark for comparative genomic analysis among cereal crops.
2. DRTF (Database of Rice Transcription Factors) - <http://drtf.cbi.pku.edu.cn/> . It is a collection of known and predicted transcription factors.
3. Gramene - <http://gramene.org/> . It is a curated, open-source, data resource for comparative genome analysis in the grasses.
4. IRGSP - <http://rgp.dna.affrc.go.jp/IRGSP/> . The International Rice Genome Sequencing Project (IRGSP)
5. MOsDB - <http://mips.helmholtz-muenchen.de/plant/rice/> . The MOsDB is a resource for publicly available sequences of the rice (*Oryza sativa* L.) genome.
6. NCBI - <http://www.ncbi.nlm.nih.gov/> . The National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information.
7. OrygenesDB - <http://orygenesdb.cirad.fr/> . The aim of this *Oryza sativa* database was first to display sequence information resulting from the activities of our group, such as the T-DNA and Ds flanking sequence tags (FSTs) produced in the framework of the French genomics initiative
8. Oryzabase - <http://www.shigen.nig.ac.jp/rice/oryzabase/top/top.jsp> . Integrated rice science database.
9. NIAS (Rice Database). - <http://www.dna.affrc.go.jp/database/> . It consists on a collection of rice databases for genome annotation, proteome, mutant, cDNA, microarray, cis-acting regulatory protein and other databases.
10. REDB (Rice EST Database) - <http://bioinfo.hzau.edu.cn/> , It builds on the recent development in genomics research of rice at National Center of Plant Gene Research.

11. Rice Array Database - <http://www.ricearray.org/> . It is a public resource for gene expression analysis in rice.
12. RiceChip - <http://www.ricechip.org/> . It is a support for Annotation & Functional Analysis of the Oryza sativa Genome.
13. Rice Databases by Meyers Lab - <http://mpss.udel.edu/rice/> .
14. Rice functional genomic express database (RiceGE) - <http://signal.salk.edu/cgi-bin/RiceGE>
15. Rice Genome Annotation Project - <http://rice.plantbiology.msu.edu/> .The MSU Rice Genome Annotation Project Database and Resource is a National Science Foundation project and provides sequence and annotation data for the rice genome.
16. Rice Kinase Database - <http://phylomics.ucdavis.edu/kinase/>
17. RicePLEX - <http://www.riceplex.com/> . MIAME/Plant-compliant and Plant Ontology enhanced expression database for rice microarray data.