

# Knowledge Management Model and Strategy of Genetic Resources and Traditional Knowledge in Indonesia

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## Abstract

The knowledge management of genetic resources and traditional knowledge has become an urgent need since Indonesia has the second largest potential wealth of genetic resources in the world. Besides, there have been many researchers conducted related to that. However, the results of the studies are still managed by the research institutes and the researchers connected to the studies, and as the result, the access is limited for the public. On the other hand, the traditional knowledge which has existed in the society for centuries is not likely to be well-recorded, even there is no database for this; therefore the traditional knowledge related to genetic resources might disappear.

This paper will discuss the knowledge management model and strategy which are suitable applying the management of genetic resources and traditional knowledge in Indonesia. The research objective is providing the availability of the knowledge management model and strategy of genetic resources and traditional knowledge in Indonesia. This research choose descriptive method, which applied "soft system methodology" by using data and information from research institutes. This knowledge management becomes essential as a means of mapping and defensive protection resources genetic owned by Indonesia.

**Keywords :** *KM model, KM Strategy, Genetic Resources, Traditional Knowledge, Soft System Methodology*

## 1. Introduction

Recently, genetic resources, which have become traditional knowledge in the society, begin to disappear, even be claimed by other countries due to no integrated system of recording. The database of genetic resources which has actually existed is not accessible to the public via the Internet, which in fact the data has been managed for years. Therefore, a

system which can display and pack the data in an integrated way is needed.

Based on that reason, a knowledge management model needs developing in order to store, manage, display and integrate the data and information of genetic resources and traditional knowledge in Indonesia. By doing this, the model is expected to connect research institutes, policy makers, and security (customs and police), and also the sale of the mechanisms relate to genetic resources.

Hansen, Nohria dan Tierney (1999) argued that the organization strategies to manage the knowledge consist of codification strategy and personalization strategy. The former is when the knowledge is codified explicitly and stored in a data basis which can be accessed by the public. Meanwhile, the latter is when the knowledge is transferred in an intensive personal relationship. In this case, the main function of computer network (either intranet or the Internet) is not only to store the knowledge, but also to facilitate the communication between individuals or researchers, either to find some information or to utilize the new knowledge to support their researches.

This paper aims to create the knowledge management model and strategy of genetic resources and traditional knowledge (GRTK) which can be used by research institutes and the owners of genetic resources so that the integration and knowledge exchange networks can take place.

## 2. Knowledge Management Model and Strategy

Knowledge creation is achieved through the introduction of the synergistic relationship between tacit knowledge and explicit knowledge (NONA 1995). Ikujiro Nonaka and Takeuchi in 1991 and 1995 distinguished between tacit knowledge and

explicit knowledge, and divided knowledge conversion model into 4 as follows:

- a. Tacit knowledge to Explicit knowledge is called externalization
- b. Tacit knowledge to Tacit Knowledge is called socialization
- c. Explicit knowledge to Explicit knowledge is called combination
- d. Explicit knowledge to Tacit knowledge is called internalization

GRTK management can use Zack's frame of mind as a tool in an attempt to determine what knowledge should be owned and has already been owned. Zack's frame of mind [6] is described as follows:

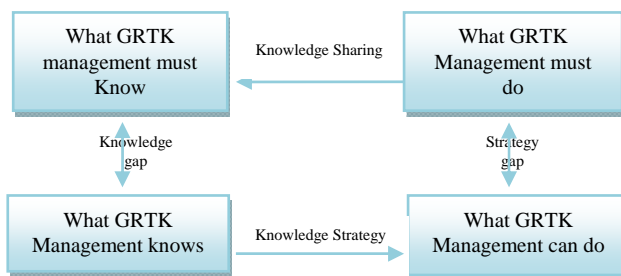


Fig. 1. Diagram of the knowledge strategic gap analysis based on high-level framework of Zack [6]

Figure 1 shows that the knowledge gap analysis is basically an activity that is difficult to separate from the activities of the making of GRTK management strategies.

Assessment of the current position activities of GRTK knowledge management requires the documentation of existing asset (fourth step of ten steps of Knowledge Management roadmap). However, for this analysis knowledge can be classified into three frameworks: core knowledge, advanced knowledge and innovative knowledge. [6]).

- a. **Core knowledge** is the **knowledge** required to run business. Basically, it does not generate something which differentiates competitors.
- b. **Advanced Knowledge** is the knowledge that makes an organization possible to compete (competitively viable) in which this knowledge allows the company to produce something that differentiates the organization.
- c. **Innovative knowledge** is the knowledge that enables the company to lead its industry and that distinguishes it from competitors.

Meanwhile, technology components to enhance the added value of an organization are:

- a. Physical Facilities – techno ware
- b. Human Capabilities – human ware
- c. Documented Facts – info ware
- d. Organizational Frameworks – orgaware

Indication factors that can be used to determine whether KM can be applied in GRTK management are as follows:

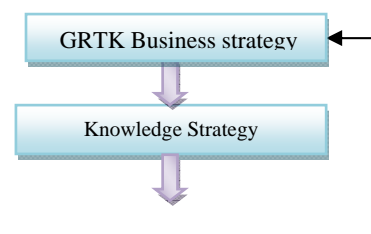
- a. **Scanning imperative.** Finding the most important things that must exist in GRTK.
- b. **Corporate culture.** Culture that supports knowledge sharing activities in GRTK management.
- c. **Begin with what you know.** Conducting an evaluation of what is already owned and then improve it before doing something new.

Figure 2 shows the relationship between GRTK management, knowledge strategy and knowledge management (KM). General strategy known for the knowledge strategy is the codification strategy and personalization strategy. Both strategies are usually further divided into four knowledge strategies, which are:

- a. *Intellectual Asset management Strategy*
- b. *Personal Knowledge Asset Responsibility Strategy*
- c. *Knowledge Creation Strategy*
- d. *Knowledge Transfer Strategy*

Referring to the picture above, to arrange the strategies of GRTK management needs to be supported by:

- a. The analysis of environmental conditions of GRTK management
- b. Determining the key success factors of GRTK management
- c. Applying GRTK management strategies in the plan of activities in the future
- d. Identifying knowledge already possessed
- e. Assessing GRTK knowledge position through the system and the existing documentation.





**Fig. 2 Relationship between GRTK management strategy, Knowledge Strategy and KM**

### 3. Methodology

The methodology used in this study is Soft Systems Methodology (SSM) which was first developed by Peter Checklan and Brian Wilson. Soft Systems Methodology (SSM) is an approach to solve complex problem situations that are not structured based on a holistic analysis and systems thinking. SSM is also a participatory methodology that can help different stakeholders to understand their perspectives. The focus of SSM is to create a system of human activities and relationships within an organization or group in order to achieve a common goal [7].

SSM departs from the basic premise that if a person's participation in the process meets a problem situation and he knows how to fix it, then that person will prefer to understand the expected improvements, feel having that problem, and be committed to change. In addition, SSM is a methodology suitable to assist an organization in clarifying their goals and then design a system of human activities to achieve those goals [3].

Primary data obtained through interviews with informants and focus group discussions with parties relating to the GRTK, and the discipline backgrounds are to enrich the analysis and the relevance to the study of this KM. The collection of data and information was conducted through secondary data from the research results of genetic resources and traditional knowledge existing in the public, either those which have been managed in a database or not. The stages of the implementation of the research are as follows:

1. collecting secondary data from research institutions and community related to GRTK,
2. identifying the knowledge assets of genetic resources and society traditional knowledge in order to gather explicit and tacit knowledge that can be used as knowledge sharing,
3. collecting activities of the management of genetic resources and traditional knowledge which is currently implemented (database, seminars, focus group discussions, mailing lists, etc.),
4. mapping of explicit and tacit knowledge in conversion and content knowledge mode to determine the flow of knowledge in research institutions and community related to GRTK.

5. making the design of a GRTK management system from the database of research institutions that manage genetic resources and associated with traditional knowledge in the community,
6. creating a database structure of "explicit knowledge",
7. developing KM model from the results of the study.

### 4. Discussion

The results of genetic resources and traditional knowledge management identification in research institutes and societies are shown in table 1 and 2. These resources are now managed by research institutes, ministries, universities, and even the public. Management of these resources are grouped into three, namely:

- The resources that have been managed into a database and accessible;
- The resources that have already been managed in simple database but is not accessible by the public;
- The resources that have not been managed yet and are still in the hands of researchers or the public.

Study of problem introduction through a process of in-depth interviews is carried out to the managers of genetic resources and traditional knowledge at the Research Institute. The preliminary description is used in the process of coding and problem categorization in the management of genetic resources and traditional knowledge. The data results of coding and categorization are then used to build the next stage of the SSM, which is problem expression (Rich Picture).

Problem expression is a visual diagram that describes the condition of the management of genetic resources and traditional knowledge which is currently obtained from the results of in-depth interview transcript analysis of the participants.

Table 1 Identification Results of Genetic Resources Management

No	Name	Administrators
1	Database Plant Resources of South East Asia (Prosea)	Research Center for Biology – Indonesian Institute of Sciences
2	Database specimen Collection and Zoologi Museum	
3	STORMA (stability of rainforest Margins in Indonesia).	
4	Database Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	
5	Database of National Biodiversity Information	

	Network (NBIN)	
6	Database of Microbial Culture	Research Center for Biotechnology - Indonesian Institute of Sciences
7	Database of Invitro Tissue Culture	
8	Database of Germplasm Garden	
9	Database of genes and gene mutations for food	
10	Information Database of Infectious Diseases in Indonesia	
11	Database Collection of Plant Breeding	Botanical Garden - Indonesian Institute of Sciences
12	Rare Plant Collections Database	
13	Herbarium Collection Database	
14	Orchid Collection Database	
15	Grains Collection Database	
16	Database of Medicinal Plants	
17	Database of Germplasm	Agricultural R&D Agency
18	Database of Coral	Research Center for Oceanography - Indonesian Institute of Sciences

Table 2 Identification Results of Traditional Knowledge Management

No	Name	Administrators
1	Database of Indonesian Natural Medicines	The National Agency of Drug and Food Control
2	Database of Protection of Medicinal Plants and Traditional Medicine	Centre for Scientific Documentation and Information - Indonesian Institute of Sciences
3	Protection of Traditional Knowledge of Ingredients Natural Dyes	(PDII-LIPI)

Figure 3 shows the problem expression in condition of genetic resources and traditional knowledge management in Indonesia. Blue arrows indicate the current condition, in which exploration and research have been carried out by researchers from various R & D institutions and universities, but the results of these studies are managed in a limited run in the form of databases by research institute, so that they cannot be accessed by the public. Apart from that, there is a lot of traditional knowledge in the community which has not been recorded and documented in the form of database. Therefore, traditional knowledge, especially of natural medication and dyes, might disappear.

Red arrow shows the plan of genetic resources and traditional knowledge management which is scattered in research institutes and the public can be integrated nationwide through a single portal. Meanwhile, the black arrow indicates the expectations of the scientific community and the general public to be able to access genetic resources from one portal so that the map of genetic resources and traditional knowledge can be

known and identified. As the result, the international community can recognize the genetic resources and traditional knowledge of Indonesia and also avoid the smuggling of wildlife and rare plants of Indonesia to foreign parties.

CATWOE Identification (Customer, Actor, Transformation, Weltanschauung / World View, Owner, Environment) is used as a tool to construct the meaning of value.

The meaning of the value obtained is that the management of genetic resources and traditional knowledge must be supported by technology and applications that can ensure data and information of genetic resources and traditional knowledge can be stored, processed, integrated, distributed, and used throughout the world using electronic networks and social networks so that the process of genetic resource management in research institutions and communities can be run more effectively.

The important thing from CATWOE analysis, especially analysis of T (transformation) is that society and research institutes want the changes to the conditions GRTK information management which is still less effective because it faced many obstacles in the process of sharing knowledge, which becomes more effective in the presence of one model of integrated GRTK information system management.

Development of a conceptual model is a transformation of the meaning of values that have been built as a foundation to build information systems of integrated genetic resources. Elaboration of each concept consists of three main things, namely reality, system thinking and effectiveness to be achieved, as shown in Figure 4.

Furthermore, conceptual model is compared with reality model. This model is gained by evaluating the results of in-depth interviews to obtain the respective roles of genetic resource managers to realize the conditions for knowledge sharing of genetic resources and traditional knowledge in Indonesia. After that, the interview was used as a guide in the arrangement of genetic resource information systems as shown in Table 3.

From the intervention phase clear description was obtained, which is about complex situation involving many factors that must be corrected in the process of management of genetic resources and traditional knowledge. The process should consider a variety of subjective points of view between the various stakeholders to ensure the information system

architecture design of genetic resources and traditional knowledge in accordance with business processes and

work culture in research institutions

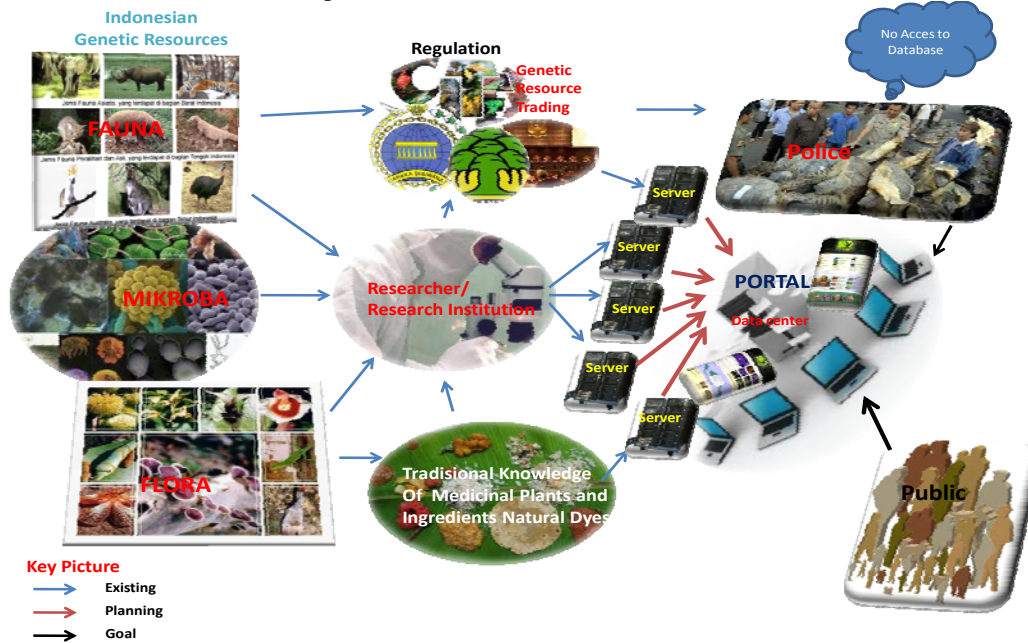


Fig. 3. Problem Expression (Rich Pictures) Management of Genetic Resource and Traditional Knowledge in Indonesia

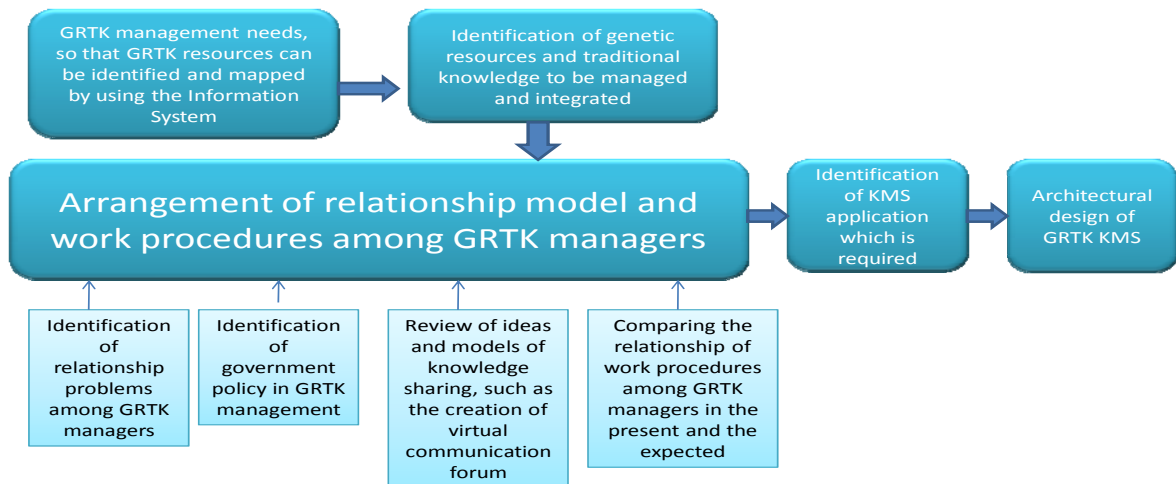


Fig. 4. GRTK management conceptual model

Table 3. Comparison of conceptual and reality model of GRTK management

No.	Conceptual Model	Reality Model	Implementation
1	GRTK management needs, so that GRTK resources can be known and mapped using the KMS	Creating a policy on legal aspects of GRTK management.	Ministry of Justice and Human Rights, Ministry of Foreign Affairs, Ministry of Research and Technology, LIPI
		Policy making on the need for the sharing of knowledge through the Knowledge Management system which will be built, including concerns about the awards for	Consortium of GRTK Manager

		researchers, institutions and communities that do knowledge sharing.	
2	Identification of potential knowledge of genetic resources to be managed.	Motivating R & D institutions and communities to share knowledge. Identifying the genetic resources available in each research institute / community	Indonesian Institute of Science (LIPI)/ Ministry of Research and Technology Research Institute
3	Arrangement of relationship model and work procedures among GRTK administrators Identifying the relationship among GRTK managers <ul style="list-style-type: none"> <li>• Comparing the work procedures relationship between managers working procedures GRTK on current and in the future</li> <li>• Identifying government policies in the GRTK management</li> <li>• Reviewing ideas and models of knowledge sharing, such as the creation of virtual communication forum</li> </ul>	Coordinating with R&D Institution Coordination and communication with R & D institutions to the process of integration of GRTK data and information. Coordination and communication with R & D institutions to determine the extent of the integration process that has been done. Arranging employee recruitment purposes in GRTK management to comply with the required competence. Develop facilities and infrastructure needs required in the integration process Arranging quality standards of GRTK data and information processing.	Indonesian Institute of Science (LIPI)/ Ministry of Research and Technology
4	Identification of KMS application required	Identification of the required KMS applications	Indonesian Institute of Science (LIPI)/ Ministry of Research and Technology
5.	The architectural design of KMS	Creating KMS architectural design	Indonesian Institute of Science (LIPI)/ Ministry of Research and Technology

In the last stage of SSM a proposed KMS architecture design built from the results of in-depth interview, confirmation, focus groups, and literature review was filed. KMS architecture design is made to facilitate the sharing of knowledge between research institute and society. The architectural design is expected to ease the development process of GRTK information systems so that access to GRTK data and information can be more effective.

From the architectural design, and a model of the concept of knowledge management of genetic resources and traditional knowledge in Indonesia is then constructed. This management model adopted five stages in the cycle of knowledge management. These stages are knowledge acquisition, knowledge extraction, knowledge storage, knowledge sharing, and knowledge updates [8]. For the image of GRTK management model KMS is shown in figure 5.

Figure 5 illustrates the concept of knowledge creation application starting from knowledge acquisition to genetic resources and traditional knowledge. All knowledge, either tacit or explicit knowledge of the researchers, scholars / experts and the public about data and information of genetic resources is managed by the knowledge officer. Then, the knowledge is classified through knowledge extraction, making it

easier to reuse existing knowledge. Existing digital content in the knowledge map can be images, photographs, and documents. After that, the knowledge officer do Knowledge storage of knowledge acquired and stored in a database system. Knowledge can then be accessed online through the web by first doing authentication to maintain data security, which is called knowledge sharing. Through this model, all the knowledge that has been generated can be reviewed and updated again based on the latest findings by researchers or the public and this process is in knowledge update cycle.

Knowledge management cycle of the knowledge flow in organizations can be a means to understand the impact of knowledge management in the GRTK management in Indonesia. Seici model proposed by Nonaka and Takeuchi has been investigating the relationship between tacit knowledge and explicit knowledge as proposed in the framework of the theory. The purpose of implementing knowledge management is to create a number of tacit knowledge that can be applied by individuals to solve problems. Knowledge holders can perform knowledge sharing / transfer to Knowledge seeker through socialization or create knowledge and store it in storage (knowledge repository).



Fig. 5.

Knowledge Management System (KMS) Model of Indonesian Genetic Resources and Traditional Knowledge

In connection with the GRTK management strategy in Indonesia, competitiveness demanded then is cooperative advantage, which indicates the occurrence of cooperation among research institute, universities, industry, policy makers to support the innovation of GRTK management. Efficiency due to inter-institutional research will be mutually sustainable and does not overlap, and even duplication of research activities. Besides, the industry does not need to do research, but only need to harness and optimize the results of research into products that are economical and have high value.

Figure 6 gives design of user interface for GRTK management model and figure 7 gives an overview of the knowledge capture that occurs from one species "Bunga Pukul Empat" (Mirabilis Jalapa) in which the knowledge was obtained from several institutions such as taxonomy (scientific classification from Research Center for Biology, description and distribution of plants from Bogor Botanical Garden, researches related to the chemical content from universities, and traditional knowledge related to the properties of the species obtained from the public. Meanwhile, these images and videos of species are from research institutes, universities and the public.



Fig. 6 Design of user interface for GRTK management model

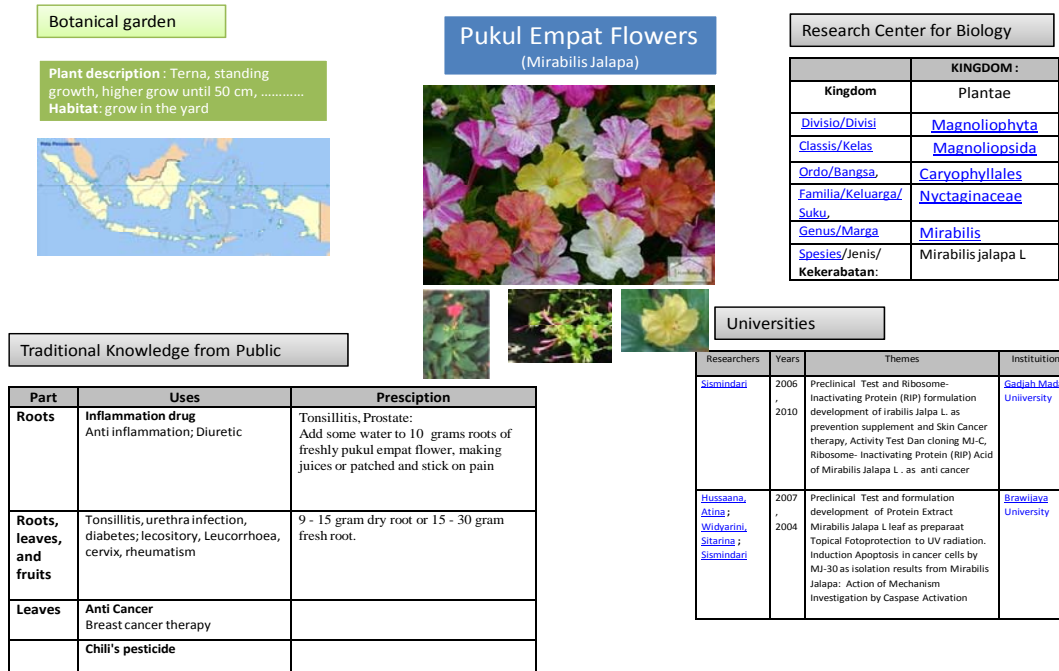


Fig. 8 Sample Knowledge Capture for GRTK management model

## 5. Conclusions

Data and Information of Indonesia's genetic resources in research institutions and traditional knowledge in today's society have not been managed effectively. The data and information are still scattered in research institutes and societies, so that if there is no action of integrated management, the data and information will be lost. Therefore, it is necessary to develop a knowledge management model of genetic resources and traditional knowledge in Indonesia that will hold, process and integrate genetic resources, so that they can be identified, mapped and accessed by the public. This paper has produced a knowledge management model and strategy of GRTK information system management.

The impacts of this model application include:

- Identification of genetic resources and traditional knowledge information which are needed, sought and used
- Creation of the knowledge of genetic resources and traditional knowledge
- GRTK development strategy to foster a culture of innovation in order to face of global competition
- Identification of knowledge cycle in the management of genetic resources and traditional knowledge
- Map of the availability of genetic resources and traditional knowledge of Indonesia.

- Means of defensive protection to recognition of wealth of Indonesia's genetic resources and traditional knowledge at international level

The recommendations of this paper is the development of an advanced research in order to:

- Build a framework in order to be able to carry out the process of connecting the interoperability of systems that are managed differently from research institutions in interoperability.
- Research related to the framework of artificial intelligent of any genetic resources that can detect genetic resources which will be traded..

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