

Digital object identifier (DOI) application for rice germplasm collection at Yogyakarta AIAT

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Abstract. In 2014, local rice exploration survey identified 76 local rice accessions from Yogyakarta. These local rice collections have been stored in Yogyakarta AIAT cooler facilities. Yogyakarta AIAT has assigned the digital object identifier (DOI) to 55 of its local rice collections. The assignation of DOI will be useful for the local rice collection for their availability for transfer with the Standard Material Transfer Agreement (SMTA) in the Multilateral System (MLS) of Access and Benefit-Sharing (ABS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Keywords: digital object identifier (DOI), information, local rice, Yogyakarta.

1. Introduction

Daerah Istimewa Yogyakarta (DIY) is one of the provinces in Java Island in Indonesia. DIY Province is bordered with the Indonesian ocean to the south, and several regencies of Central Java Province such as Klaten to the northeast, Wonogiri to the southeast, Purworejo to the west, and Magelang to the northwest. It lies between 7°33'-8°12' South Latitude and 110°00'-110°50' East Longitude of Greenwich and cover an area of 3,185.80 km² or 0.17% of Indonesia (1,860,359.67 km²). The province is divided into five districts, namely Sleman, Bantul, Kulon Progo, Gunungkidul and Yogyakarta City.

According to typology, the DIY Province consists of volcanic plateau, karst material to coastal sand dune from 0–2,910 m above sea level (m asl). The volcanic plateau is located in Sleman, where Mount Merapi is located, and some are in Gunungkidul that has a plateau with the primary material of karst or sediment. Some of the lowland areas are in Sleman, Bantul, Yogyakarta City and Kulon Progo. Coastal sandy and mangrove areas are in Kulon Progo [1]. Diversity of land typology in this province causes variations in genetic resources, in particular, food crops such as rice.

Rice cultivations in Sleman, Bantul and Kulon Progo are mostly irrigated rice cultivation, while in Gunungkidul, which has dry land characteristics, is rainfed rice cultivation. Agriculture areas in DIY according to BPS [1] were 53,553 ha. Rice production in 2014 was 945,136 tons; it increased 2.78% from the previous year [2].

Farmers in DIY usually cultivate paddy new superior varieties, such as IR 64, Ciherang, Situ Bagendit, Pepe and Inpari (Inbred Irrigated Fields Rice). However, with DIY land typology, there may be some farmers cultivate local rice variety. Local rice is a type of rice plant existed for a long time and is still being cultivated until today in certain regions [3]. Local rice is one of the potential genetic



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resources that are cultivated for specific food consumption reason. Local rice varieties majority have specific characters, such as unique taste, grain form and grain colour, resistance to a specific pest, disease or abiotic stresses on their specific location. These genetic advantages can be extracted in developing new rice cultivars [4].

In 2014, Yogyakarta Assessment Institute for Agricultural Technology (AIAT) which is one of the technical implementing units of Indonesian Agency for Agricultural Research and Development (IAARD), has a mandate for exploring DIY genetic resource potentials especially for local rice food crops [5]. The local rice exploration activity identified that DIY has around 76 accessions. The local rice exploration also identified local origin in this region [6,7]. The collected local rice accessions seeds are being stored in Yogyakarta AIAT.

The local rice seed collection is stored in a closed plastic container, labelled, and then put in the cooler. Their seed rejuvenation was tested both on farmers and in a limited form like pots. Rejuvenation purpose is to determine the level of diversity and save genetic diversity [8]. Several local white rice accessions in the collection have been characterized [9,10]. Their study revealed that DIY local white rice had a high genetic diversity based on its morphological characters.

Assessment on five local black rice accessions (Melik, Pari Ireng, Cempo Ireng, Jliteng and Bantul black rice) showed that their plant height and number of productive tiller characters had a wide genetic diversity [11]. On the other hand, the length and width of grain, number of filled grains per panicle and days of maturing characters had narrow genetic diversity.

Genetic diversity is not only seen through its morphological character, but can also be indicated by the biochemical characters. Biochemical character is carried out to find out the potential advantages of each local paddy of DIY. The genetic diversity of several local black rice cultivars based on rice colour parameters and total anthocyanin content had been identified [12]. Genetic factors provide a more significant role than environmental factors in determining the diversity of colour parameters and the total anthocyanin content.

DIY local rice showed a high level of genetic diversity. To save genetic material collections, conservation efforts are needed. Conservation is divided into three groups, namely *in situ* conservation, which is an effort to maintain collections in their original habitat, carried out by conservationists or participatory farmers; *ex situ* conservation, an effort to maintain collections from the place of origin until stored in gene banks; on-farm conservation, which is to maintain collections by rejuvenating (updating) collections made by breeders in government and private research institutions [13].

Ex situ conservation does not stop at the activity of storing collections in gene bank. However, it includes documented information processing activities related to specific identities that contain information on genetic diversity and specific potential of collections. Documented information related to the systematic genetic diversity of collections will make it easier for breeders to obtain sources of genetic diversity appropriately and used it in a specific improvement character.

In 2016, the Food and Agriculture Organization (FAO) collaborated with Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development (ICABIOGRAD), IAARD has signed a Letter of Agreement (LoA) for implementing a multicountry construction with a focus on the codevelopment and transfer of technology information related to genetic resources of food crops, especially local rice accessions. The objectives of the agreement are to bridge the gap between the information requirements of gene bank curators, rice breeder, and more targeted upstream biological researchers, and to support applied germplasm curation and forward-looking rice breeding programs and strategic rice research.

The specific agreement is to identify local rice genetic resource material into digital object identifier (DOI) which is a method for the assignation of global identifiers as the permanent and unambiguous method for the identification of rice accessions. This agreement also developed a platform to establish an automatized system to system connections to add value to the material being transferred within and from Multilateral System (MLS), and meeting both scientific need and legal obligations of the Standard Material Transfer Agreement (SMTA).

The purpose of this study was to provide a support for the agreement between FAO-ICABIOGRAD through registering DIY local rice, which has been collected by the Yogyakarta AIAT, on the application of a digital identification operating system through ICABIOGRAD registration system.

2. Materials and methods

2.1. Steps for registering genetic material

Genetic material application steps included:

- 1) Installing Oracle virtual box.
- 2) Installing Ubuntu.
- 3) Installing Php My Admin (Bitnami).
- 4) Registration (registration) of genetic material.

Before preparing to install the application, the descriptor must prepare a data description of local rice accordingly [14]. The data consisted of information about:

- 1) **Sample_id**: A string that identifies the Plant Genetic Resources for Food and Agriculture (PGRFA) that is being registered. It is a unique identifier for the PGRFA in the provider's management. Yogyakarta AIAT as a technical implementation unit had this ID number by registered materials to ICABIOGRAD.
- 2) **Date**: Date in which PGRFA became part of the collection. Date fragments (yyyy-mm and yyyy) are also accepted.
- 3) **Hold_wiews code**: FAO/WIEWS code of the breeding institution. We use ICABIOGRAD code number wiews.
- 4) **Hold_PID**: Uncomplicated SMTA PID of the breeding institution or individual if available. ICABIOGRAD would give the PID code number to Yogyakarta AIAT.
- 5) **Hold_name**: Surname and name for individuals or organization name where the PGRFA material is maintained. In this part, ICABIOGRAD will maintain Yogyakarta AIAT's material.
- 6) **Hold_address**: Address of the providing institution or individual, multiple lines are accepted. It will be Yogyakarta AIAT.
- 7) **Hold_country**: ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the providing institution or individual.
- 8) **Method**: Method through which the PGRFA has been acquired. Mandatory. See Table 1 for the codes accepted by this element.
- 9) **Genus**: The taxon of the genus for the PGRFA. At least one between <genus> and <cropname> must be provided.
- 10) **Species**: Authority for the scientific name.
- 11) **Spauth**: Authority for the subtaxon at the most detailed level provided.
- 12) **Subtaxa**: Any additional intraspecific taxon such as subspecies, variety, form, group and so on.
- 13) **Bio_status/Biostatus**: Biological status of the PGRFA. It can be a local name. See Table 2 below.
- 14) **MLs_status**: Code that identifies the status of the PGRFA about the MLS. See Table 3 below.
- 15) **Coll_sid**: Code number that identifies the materials came from.
- 16) **Coll_site**: Description of where the PGRFA was collected.
- 17) **Coll_source**: Code of the nature of the location where the PGRFA was collected. See Table 4 below.
- 18) **Coll_lat**: Latitude where the PGRFA was collected in either dd°mm'ss"X (where X is N or S) format or ddd.xxxxx (up to 5 decimals, preceded by a minus sign for S) format. No spaces are allowed.
- 19) **Coll_lon**: Longitude where the PGRFA was collected in either dd°mm'ss"X (where X is E or W) format or ddd.xxxxx (up to 5 decimals, preceded by minus sign for W) format. No spaces are allowed.
- 20) **Coll_elevation**: Elevation of collecting site in m asl.

- 21) Coll_date: Date on which the PGRFA was collected. Date fragments are also accepted when an only a year or year and month are known.
- 22) Ancestry: Pedigree or other description of the ancestry of the PGRFA and how it was bred. Please note that this column is a list of identifiers assigned to the PGRFA locally in your or somebody else collection (e.g. the accession number for gene banks).

Table 1. Code for a method of collection of PGRFA.

Code	Description
Acqu	Acquisition
Ihcp	In-house copy
Ihva	In-house variant
nodi	Novel distinct PGRFA
obna	Observation–Natural
Obin	Observation–Inherited

PGRFA = Plant Genetic Resources for Food and Agriculture.

Table 2. Code for the biological status of PGRFA.

Code	Description	Code	Description
100	Wild	414	Inbred line (parent of hybrid cultivar)
110	Natural	415	Segregation population
120	Semi-natural/Wild	416	Clonal selection
130	Semi-natural/Sown	420	Genetic stock
200	Weedy	421	Mutant
300	Traditional cultivar/landrace	422	Cytogenetic stocks
400	Breeding/research material	423	Other genetic stocks
410	Breeder's line	500	Advanced or improved cultivar
411	Synthetic population	600	GMO
412	Hybrid	999	Other
413	Founder stock/base population		

PGRFA = Plant Genetic Resources for Food and Agriculture.

Table 3. Code for identification of the status of PGRFA about the MLS.

Code	Description
0	No available under MLS
1	Available under MLS
11	The PGRFA belongs to a crop listed in Annex I and is under the management and control of a Contracting Party to the Treaty and declared to be in the public domain
12	The sample is in a collection subject to an agreement concluded under Article 15 of the Treaty
13	The holder received the sample with SMTA
14	The holder has voluntarily placed the PGRFA into the MLS
15	The PGRFA is derived from, and distinct from, material previously received from the MLS is still under development and not yet ready for commercialization, and may be made available at the discretion of the developer

PGRFA = Plant Genetic Resources for Food and Agriculture, MLS = Multilateral System, SMTA = Standard Material Transfer Agreement.

Table 4. Source/code for description.

No.	Description	No.	Description
10	Wild habitat	25	Pasture
11	Forest or woodland	26	Farm store
12	Shrubland	27	Threshing floor
13	Grassland	28	Park
14	Desert or tundra	30	Market or shop
15	Aquatic habitat	40	Institute, experimental station, research organization, gene bank
20	Farm or cultivated habitat	50	Seed company
21	Field	60	Weedy, disturbed or ruderal habitat
22	Orchard	61	Roadside
23	Backyard, kitchen or home garden (urban, peri-urban, or rural)	62	Field margin
24	Fallow land	99	Other

All data must be input on Microsoft excel (.xls) program and upload in excel CSV (comma delimited; .csv) format.

3. Results and discussion

In 2014, Yogyakarta AIAT had successfully explored, invented, and carried out activities on 76 Yogyakarta local rice. By the end of 2014, based on the identification and characterization activity, there was 55 accessions of Yogyakarta local rice that were ready to be registered in the DOI. The results of the registration of the digital numbering have been archived in the ICABIOGRAD registration system.

The 55 accessions of Yogyakarta local rice have a variety of features, such as rarity or can only be found in a specific location in DIY. Other features included specific pericarp colour (white, red, or black), specific aroma, the potential value such as high production and some other accessions had potential on drought-resistant rice accessions. There was specific accession on irrigated rice, upland rice, and sticky rice. Unfortunately, in this DOI system there is no column that contains a character or specific characteristics of local rice.

Information related to Yogyakarta local rice digital numbering can be accessed through <https://ssl.fao.org/glis/>. Yogyakarta local rice that have been registered through the ICABIOGRAD digital numbering system is listed in numbers 05020-30654 up to numbers 05020-30654. It is believed that in the future, DOIs will become the global standard for public identification of PGRFA, which facilitate linkage between the material and diverse sources of information associated with the material. DOIs platform will give many beneficial opportunities. This platform could establish automatized system-to-system connections to add value to the material being transferred within and from MLS, thus meeting both scientific needs and legal obligations of the SMTA. More specific beneficial is a simple reliable mechanism to identify accessions that are duplicated across gene bank [14]. Importantly, this system could bridge the gap between the information requirements of gene bank curators, rice breeders, and more targeted upstream biological researchers, and support the applied germplasm curation and forward-looking rice breeding programs and strategic rice research.

According to the DOIs beneficial mechanism as a gene bank, they will directly have benefit from the adoption of better tools and methodologies for the documentation of PGRFA information related to rice accessions. Rice plant breeders and users of the multilateral system could get facilitated from a globally access of associated information beyond the passport data. For research institutions, they will get additional information on the availability of accessions that may help the decision-making process

on regeneration, conservation, and improvement of specific characteristic needed in developing a new rice cultivar, thus will have a positive impact on national plant breeding programs.

4. Conclusions

Yogyakarta AIAT has registered 55 local rice through ICABIOGRAD registration system. Registration of local rice genetic resources is needed as one of the efforts to complete information that meets the needs of digital communication between gene bank curators, rice breeders and other agricultural researchers who have interest in accessing genetic resources that can be used to regenerate, conserve, and also improve specific characteristics that is needed in developing a new rice cultivar.

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