Decision support system based on database system of genetic resources for Central Kalimantan local crops to develop *ex situ* and *in situ* conservation

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Abstract. The results of exploration and inventory of local crop genetic resources from Central Kalimantan have been compiled into a genetic resource database system. The data and other information that have been integrated into a database system can be further developed systematically to become a decision support system so that it can be utilized as a useful tool in decision making. This system can be built by combining data, models and analytical tools in an application system with a user-friendly interface. This system can be utilized in the preparation of genetic resources development planning, such as for the determination of location for *in situ* and *ex situ* conservation areas in Central Kalimantan. The objective of this study was to develop such system, through the application of MS Access database as the Database Management System (DBMS) for storage (repository) and accessing database system applications that have been prepared interactively. The System is systematically designed to include geographic information system and based on the spatial analysis which can provide guidance and recommendation for zoning areas based on the suitability of plant commodities, both inside and outside of their natural habitat environment.

Keywords: system, support, decision, genetic resources, Central Kalimantan.

1. Introduction

Central Kalimantan province is located around the equator line with a total area of approximately 15 million hectares. It has vast natural biodiversity containing local plant genetic resources. In 2014, it was reported that there were approximately 937 species of genetic resources comprising food crops, horticulture, medicinal crops and fisheries/livestock [1]. They have been widely used and managed by local communities with indigenous knowledge through traditional farming system. The existence of this plant genetic resource is closely linked to the culture of those local communities. It should be therefore be conserved in order to preserve Indonesia's biodiversity and cultural richness [2,3].

Local crop genetic resources can be further managed and developed to support sustainable life in the future. As an important part of biodiversity, it is an asset for all sectors and contributes to sustainable development, food security and better nutrition [4]. The importance of plant genetic resources for humankind has been well recognized in the recent decades and many would argue that diversity is essential for allowing sustainable development of various human activities [5]. The need of conservation, utilization, monitoring and management of plant genetic resources for food and agriculture has been promoted since the '90s [6,7].

The initial stage of the effort to manage genetic resources involves inventory and data collection of local plant genetic resources. The information of plant genetic resources can then be used for long term preservation of agricultural crop genetic biodiversity in addition to enriching agro-biodiversity with new genetic resources to serve the needs of agricultural research [8]. This study was conducted in order to develop a database system as an integral part of a Decision Support System (DSS). Data compilation based on the result of exploration and inventory of biodiversity was incorporated into the system. The PC-based application called MS Access was utilized to develop a database system complete with its DSS. It is expected to generate valuable information for genetic resource management and planning, especially for determining zonation areas for conservation and for the development of those areas.

2. Materials and methods

This study was conducted using data that had been collected and compiled from exploration and inventory of plant genetic resources. Information regarding local crops was obtained through field surveys in several locations using a purposive sampling approach throughout the whole areas of Central Kalimantan, which covers 15,451,287 hectares (Figure 1).

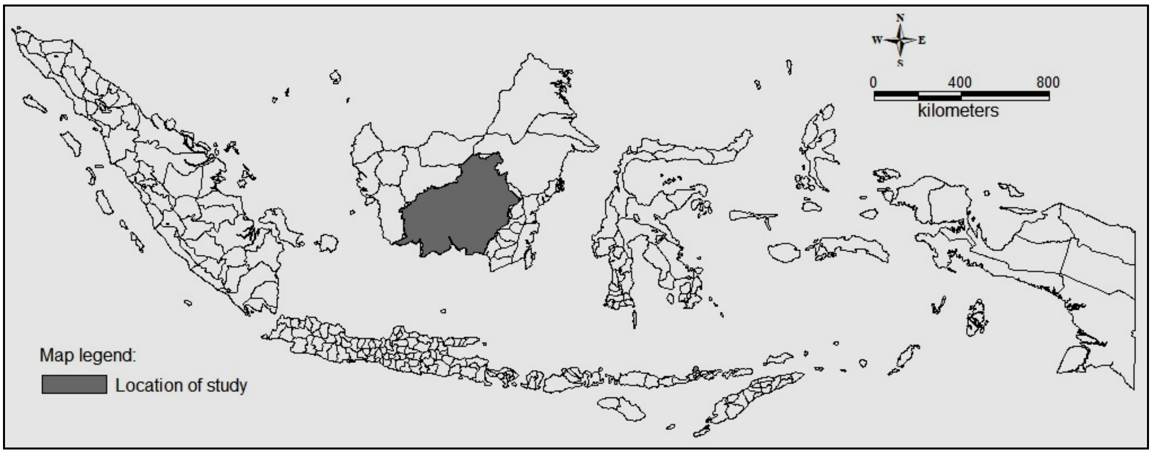

Figure 1. Situation map of Indonesia showing the location of the study.

The PC-based MS Access application was employed in this study to create a database system which would be further developed to include DSS. This application is used due to its effectiveness for Database Management System (DBMS) [9]. The simple DSS was constructed as a planning database, where its logical data structure can be used to assist the decision makers for planning and management [10].

The Geographic Information System (GIS) application was also incorporated in order to supply the database with spatial data, as well as facilitating, improving, storing, displaying, future utilization and updating data [11–15]. As a part of GIS, the base map of the land system at reconnaissance scale was used in order to identify land suitability of each local crop according to its original habitat data. The use of land system information as part of spatial secondary data with its recurring pattern principle was used to determine other suitable areas for *in situ* and *ex situ* development based on the similarities of landform, soil and vegetation with the original habitat and having a relatively uniform climate [16–18]. The general procedure of this study is described in Figure 2.

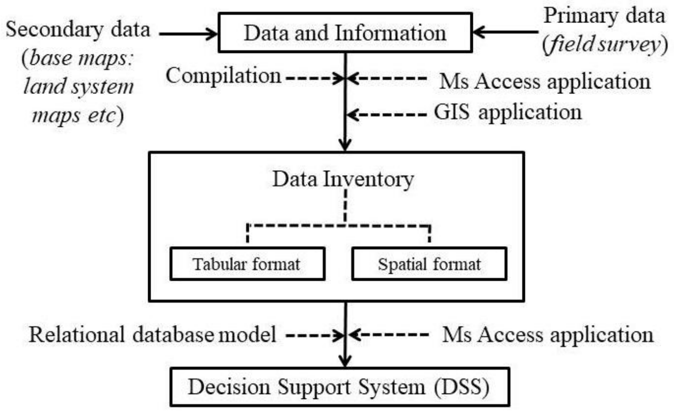

Figure 2. Flowchart of general procedure in this study.

3. Results and discussion

3.1. The status of plant genetic resources in Central Kalimantan

Central Kalimantan province is located between 00°46’58’’S–03°33’43’’S latitudes and 110°42’48’’E–115°50’39’’E longitudes. It consists primarily of drylands and wetlands typology with various agroecosystem within each typology [16,17]. The drylands, also known as upland areas, are located in central to northern part with an elevation range of 100 to 500 meters above sea level. The wetlands are found in the Southern part at an elevation below 100 meters. Most of the upland areas are highly weathered, acidic, infertile and have poorly buffered soils [20], while the southern part is dominated with lowland areas consisting of swamp and peatland. In general, with appropriate land management, the arable land has low to high potential for cultivation of wetland rice and moderate potential for dryland food crops and perennial crops [21]. This potential is further enhanced by climate condition within the tropics, which allows cultivation to be expanded based on habitat suitability.

Exploration has identified approximately 937 species of food crops, horticulture, medicinal crops and fisheries/livestock, and most of them have been cultivated traditionally with indigenous knowlege [1,22]. Geographically, they are scattered at many locations in the whole Central Kalimantan Province, as shown in Figure 3.

3.2. Developing a database management system

Relevant information regarding the plant genetic resources and inventory data were organized into a database system within MS Access environment. The PC-based application program called MS Access was used in this study because of its simplicity for developing database management [23].

Using a relational database model, all data was initially classified according to the group of crop, i.e. food crops, fruit crops, ornamental crops and medicinal crops. Species classification was then determined in each group, followed by addition of relevant information to provide useful information regarding general description, original habitat, spatial distribution, recommendation for *ex situ* and *in situ* conservation and propagation area, cultivation techniques and benefits value (for medicinal crops).

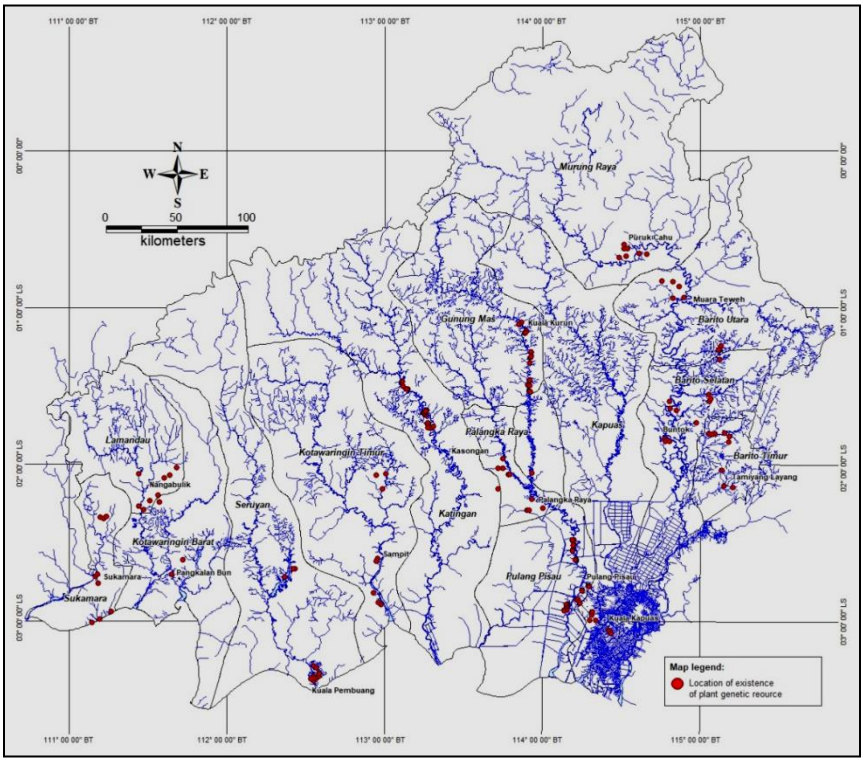

Figure 3. The distribution of identified plant genetic resources from explorations in Central Kalimantan.

The decision-making part of DSS was constructed and built based on its logical data structure so that managers will find it easy to use. Several screen-captures representing parts of DSS are shown in Figure 4.

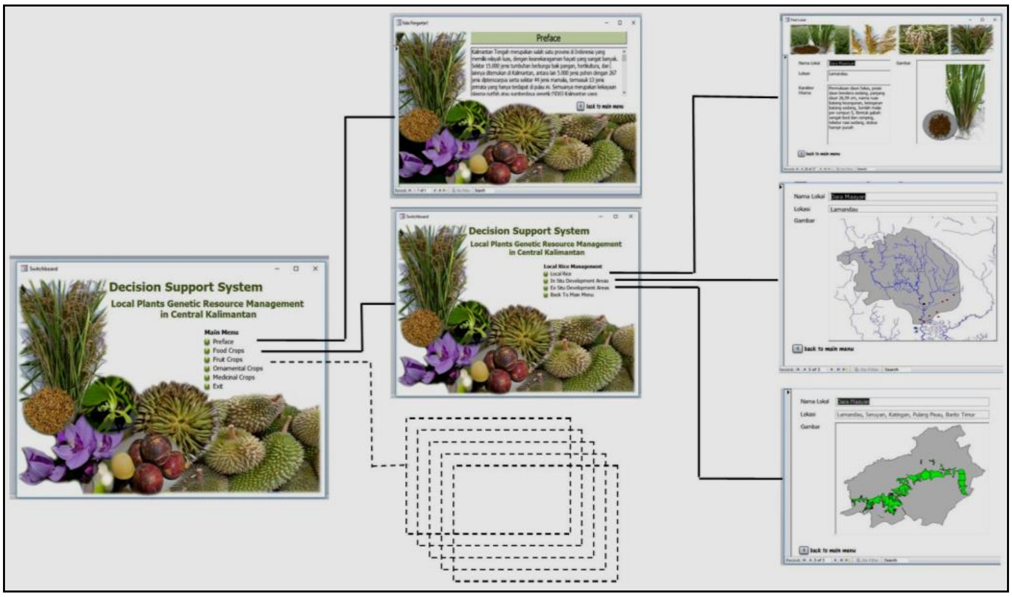

Figure 4. Several windows view representing part of DSS for genetic resources management in Central Kalimantan.

4. Conclusions
In order to support preservation and management of local crops, relevant information of plant genetic resources should be organized into a database system that can be further developed to become a decision support system. It can assist the planning process of preservation and management of local crops through the determination of development areas for *ex situ* and *in situ* conservation.

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