

Spatial Planning Concept for Genetic Resource of Local Paddy Development to Support Sustainable Agriculture in Central Kalimantan

Konsep Perencanaan Wilayah untuk Pengembangan Sumberdaya Genetik Padi Lokal Dalam Rangka Mendukung Pertanian Berkelanjutan di Kalimantan Tengah

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(Received: 21 July 2022, Accepted: 17 March 2023)

Citation: Bhermana A, Susilawati S. 2023. Spatial planning concept for genetic resource of local paddy development to support sustainable agriculture in Central Kalimantan. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*. 12 (1): 34-41. DOI: 10.36706/JLSO.12.1.2023.593.

ABSTRAK

Wilayah Kalimantan Tengah dengan luas mencapai 15.451.287 Ha memiliki keanekaragaman hayati yang sangat banyak termasuk di dalamnya sumber daya genetik (SDG) tanaman padi lokal. Salah satu ancaman terhadap kelestarian SDG padi lokal di Kalimantan Tengah antara lain adalah intervensi aktivitas manusia melalui pemanfaatan lahan dan alih fungsi kawasan hutan untuk ekspansi industri perkebunan. Ketersediaan sumber daya lahan dengan potensi luas wilayahnya sebagai habitat asli SDG tanaman pangan di Kalimantan perlu dikelola secara kewilayahan yang rasional dan berkelanjutan melalui penyusunan konsep perencanaan wilayah. Tujuan dari studi adalah untuk menyusun konsep perencanaan wilayah untuk menentukan alokasi kawasan konservasi. Metode survey eksplorasi digunakan untuk menginventarisir keberadaan SDG padi lokal sebagai objek analisis untuk penyusunan konsep perencanaan. Aplikasi sistem informasi geografis (GIS) digunakan untuk membantu proses analisis spasial untuk menghasilkan informasi spasial perencanaan wilayah sebagai bagian dari GIS. Hasil inventarisasi dan analisis spasial menjelaskan bahwa keragaman jenis SDG tanaman padi lokal di lahan basah mencapai jumlah 55 jenis sedang pada lahan kering terdapat 68 jenis padi lokal, secara spasial terdapat pada jalur-jalur aliran sungai yang berasosiasi dengan persekitaran kawasan pemukiman. Konsep perencanaan wilayah untuk alokasi kawasan konservasi pada lahan basah diarahkan pada kabupaten Kotawaringin Barat, Kotawaringin Timur, Seruyan, Pulang Pisau dan Kapuas dengan prioritas ditujukan pada kabupaten Kotawaringin Timur dan Pulang Pisau. Alokasi untuk lahan kering diarahkan pada kabupaten Lamandau, Kotawaringin Barat, Katingan, Gunung Mas, Pulang Pisau, Kapuas, Barito Timur, Barito Utara dan Murung Raya dengan prioritas dititik beratkan pada kabupaten Lamandau dan Katingan.

Kata kunci: Kalimantan Tengah, sumberdaya genetik, padi lokal, perencanaan wilayah

ABSTRACT

Central Kalimantan region with an area of 15,451,287 hectares has in large number of biodiversity including genetic resources of local paddy plant. One of the threats to the preservation of genetic resources for local paddy in Central Kalimantan include the intervention of human activity through land use and conversion of forest land for plantation industries expansion. The availability of land resources with its geographic areal potential as the original habitat of genetic resource of food crops in Central Kalimantan need to be managed rationally and sustainable through preparing spatial planning concept. The objective of study was to establish the concept of regional planning in order to determine land allocation for conservation area. Exploration survey methods was used to inventory the existence of genetic resource of local paddy plant as objects of analysis for drafting planning concept. Geographic information system (GIS) application was used to assist the process of spatial analysis in order to produce spatial information of regional planning as part of the GIS. The results of the inventory and spatial analysis explained that number of diversity of genetic resource for local paddy in wetlands was 55 plants while in for uplands, there were 68 plants of local paddy, spatially located at river streams associated with settlement areas. The concept of regional planning for the allocation of wetland conservation area involve Kotawaringin Barat, Kotawaringin Timur, Seruyan, Pulang Pisau dan Kapuas, with areas priority of Kotawaringin Timur and Pulang Pisau. Meanwhile, for uplands, the allocation was addressed to Lamandau, Kotawaringin Barat, Katingan, Gunung Mas, Pulang Pisau, Kapuas Barito Timur, Barito Utara dan Murung Raya with priority emphasis on Lamandau and Katingan regency.

Keywords: Central Kalimantan, genetic resource, local paddy, spatial planning

INTRODUCTION

Central Kalimantan province with total area of 15.451.287 hectares has land resource potential including wetlands and upland typology with various agro-ecosystems (Bhermana et al., 2021). This region, geographically located equator line has in large number of biodiversity. A total of 15,000 plant species involving food and horticulture crops has been identified and as germplasm or genetic resources of Kalimantan, they were beneficial for life that should be conserved and developed (Susilawati et al., 2015).

As part of biodiversity, genetic resource of food crops especially for paddy was important local resource for sustainable agricultural production (Commission on Genetic Resource for Food and Agriculture, 2012). In addition to economic purposes, the cultivation of this commodity was also for consumption (Devy et al., 2015). Therefore, the sustainability of local rice genetic resource needs to be considered as

an alternative reserve to meet future food needs. The role of genetic resource for local rice plants should be able to ensure sustainable improvements not only in agricultural production and productivity, but also to provide new genes for improvement of plant varieties, contribute to effective agroecosystem functions and provide other output values in the form of bio-product development.

Several threats to the sustainability of local rice in Central Kalimantan include intervention of human activities through land use and conversion of forest areas for expansion of plantation industry; natural influences in the form of forest fires due to climate change, and the absence of an integrated management of maintenance, rejuvenation and development of local rice genetic resources specific to location. Land conversion as a result of region development rate and increasing population was a challenge in efforts to meet food availability. Furthermore, the rate of land use change needs to be controlled and the

management of original habitat for local rice genetic resources also should be implemented appropriately through spatial planning for development areas including conservation areas based on land resource (Metternicht, 2017; Amelia et al., 2016).

The objective of this study was to develop a spatial planning concept to determine and delineate development areas including conservation areas for local rice genetic resources in Central Kalimantan. The concept of regional planning was prepared based on the results of an inventory of the presence of food plant genetic resources for paddy which was integrated into a geographic information system (GIS).

MATERIALS AND METHODS

The main procedure used in this study involve exploration and inventory. The methods of exploration was conducted to collect plant information at several locations of existing local paddy geographically and other relevant information (Helmanto et al., 2021; OECD, 2017). Data inventory was then built based on characteristics of plant morphology in order to register process. Field survey was then conducted at 14 districts administratively in Central Kalimantan province during the last 5 years, in 2015 to 2020. Purposive sampling approach was also used in this survey to determine appropriate location where the specific plant exist. This technic was used for saving time because this study covered the hole areas of Central Kalimantan regionally.

The geographic information system (GIS) technology was employed to develop database and spatial analysis as basic for developing spatial concept (Jebur, 2021; Abdelrahman et al., 2016). In addition, in this study, it was used to generate spatial information based on the result of spatial

analysis. The overlay technique and spatial buffer analysis was used within GIS environment to complete spatial analysis based on geographic features (Taryadi et al., 2019; Wahyutomo et al., 2016; Dibs, 2013). PC-based GIS called ArcGIS 10.3 and Global Mapper including Global Positioning System (GPS) hardware was used in this study to collect and record field data during survey activities. Several base maps as reference used in this study include land resource information such as soil maps, land system maps, Digital Elevation Model (DEM) maps and administrative maps.

RESULTS

Spatial Distribution of Existing Local Paddy Genetic Resource in Central Kalimantan

The results of field survey and exploration based on GPS record through geocoding process as part of the GIS showed that locations of local rice genetic resources were scattered throughout Central Kalimantan and found at almost all districts in both wetlands and uplands (Figure 1). Several types of local paddy were then managed and compiled into an inventory of tabular data format. General information of existing local paddy include location and number of findings with local names was provided at Table 1 and 2.

The results of further spatial analysis based on distribution patterns, land availability and the adaptive suitability of plants to surrounding environment, development and conservation area planning concept could then be formulated to maintain, preserve, and develop the existence of local paddy in Central Kalimantan (Figure 2 & 3). The concept of regional planning is outlined in a spatial information format as part of GIS for further consideration in making decision for land use planning.

Table 1. Several types with local name of local paddy in wetlands

Location (distict names)	Local Names
Kotawaringin Barat	Sei Sekonyer
Kotawaringin Timur	Bulan, Buntutkuda, Buntut Raja, Buyung, Cirendah, PulutBire, Pulut Kenta, PulutSerang, Raja, Saguirut, Sanyung, Siam Banjar, Siam Epang, Sibung Rendah, Tabakang, Siam EpangRandah, Siam Epang Tinggi, Srikaya, Tamputuk, Umbang Banjar, UmbangInai, Umbang Kencana, UmbangPutih
Seruyan	Siam Seruyan
Pulang Pisau	Bajang, Balimau, Banyu Bilis, Barinsai, BehasAmuntai, Behas Bahandang, Brenti, GadingGaharu, Lawai, Lentera, Merah, Padi Anjir, Siam Linggis, Pulut Bire, Pulut Blirik, Pulut Kenta, Siam Krinti, Siam Putih, Tambangan, PulutSerang
Kapuas	Gadabung, Padi Kahayan, Padi Lemo, Siam Landak, Siam Lantik, Siam Mutiara, Siam Pedang, Siam Puduk, Siam Putih, Siam Unus

Table 2. Several types with local name of local paddy in wetlands

Location (distict names)	Local Names
Lamandau	Glinti, Tampui, Nilon, Pare Tiung, PulutHitam, RoniMentaya, Sahui, Sepang, Ubai, SinuaKuning, TampuiGading, TampuiSaluang, TampuiBeringin, Tampui Sahui, DaraMaanyan, Kumpang Mas, Tempokong, TaringPelanduk, Glinti, Siam TaringPelanduk, Tekpokong
Kotawaringin Barat	KumpangEmas
Katingan	UmbangBilis, Mangbetik, UmbangBahenda, Karundang, Kencana, KetanLadang, Kowong, Tambangan, Mangbetik,Pahakung, Palapas, Papuyu, Payung, Pentet, Pikat, TikuhTupai, UmbangPutih, Uwei
Gunung Mas	Gilai, Lungkuh, Tamuun, Munau, Mungkolandik, PereiBuntutBawui, PareiPandan, PareiJelei
Pulang Pisau	Goyangpinggul, HumbangInai, Manjuhan
Kapuas	Manyahi, Siam Gunung, Garagai, Kalanis, KarangDukuh
Barito Timur	Siam Cantik
Barito Utara	Padidarat, PadiGunung, Talon, TalunBajang, TalunBitik, Talunpulut
Murung Raya	Jala, KarangDukuh, PulutNyaling, Talun, Usdek

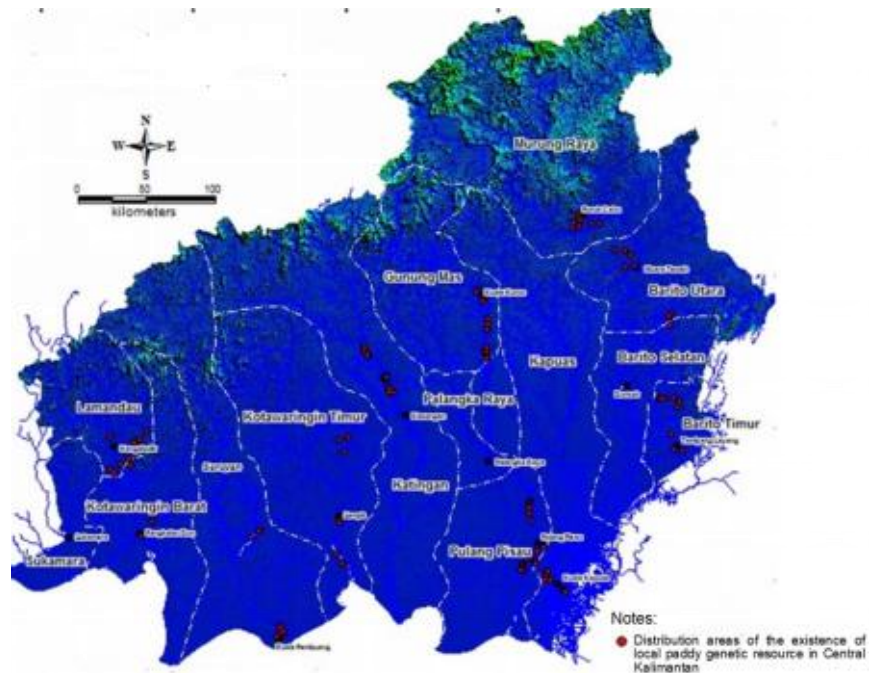


Figure 1. Inventory of the existence of local paddy genetic resource in Central Kalimantan

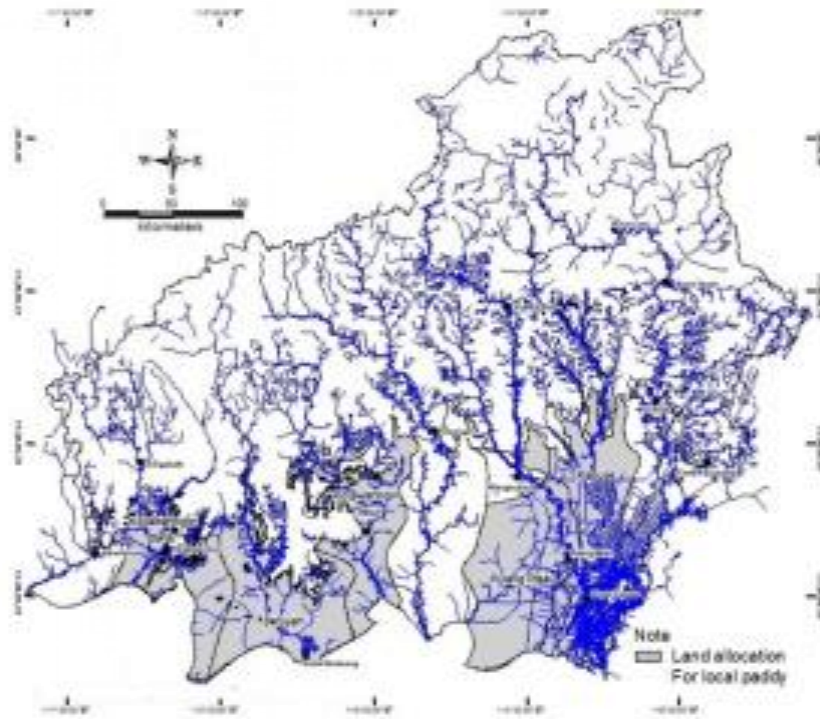


Figure 2. Spatial land use planning for local paddy in wetlands

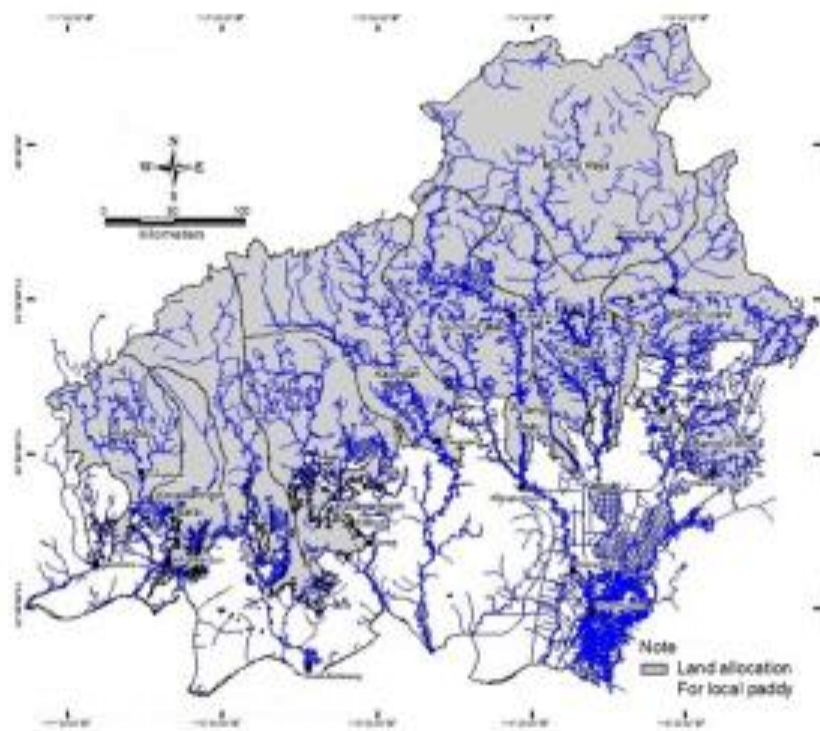


Figure 3. Spatial land use planning for local paddy in uplands

DISCUSSION

The Existing Genetic Resource of Local Paddy in Central Kalimantan

Based on Table 1, for wetlands, there are 2 (two) districts that have the highest number of local paddy types, namely Kotawaringin Timur district (23 local names) and Pulang Pisau district (20 local names). While in uplands, there were also 2 areas with highest number of diversity i.e. Lamandau district (21 local names) and Katingan district (18 local names).

The highest number of local paddy was found in uplands as many as 68 types with each its local name. While in wetlands, there are 55 types. The results of spatial analysis described that geographical distribution pattern of local paddy was mostly found at river stream areas and the results of overlaying land cover information indicated that the presence of local plants were commonly found at settlement areas. The results of the exploration also confirmed that most of the local paddy found in Central Kalimantan have been cultivated on lands around housing. The cultivation activities was carried out using traditional system that has been going on for generations as subsistence farming.

Ecosystem is an inseparable part of the existence of land resources and local climate. Based on the results of field observations, most of the presence of food plant genetic resources was found in various agro-ecosystems or ecological environment, which have been modified or changed by humans so that they are able to produce products required to meet needs. Moreover, the natural condition of agroecosystems occurs based on human intervention to the biophysical environment. Therefore, the new forms of ecological interactions occur (Jordano, 2021). The existence of several agro-ecosystems in this region can be considered as the habitat of genetic resource that have been or are being developed. The sustainability of agroecosystem itself cannot be separated from the conservation

and biodiversity aspects (Cabell & Oelofse, 2012). Any effort is then required to maintain agro-ecosystems in order to provide optimal and sustainable results. Thus, appropriate management was required with the presence of plant genetic resources as part of biological diversity (Purnomo et al., 2020; Jarvis et al., 2013).

Spatial Land Use Planning for Development and Management Areas

Establishing land use areas for plant conservation purposes is an integral part of regional planning that is oriented towards sustainability (Supartini & Pramukanto, 2014). The concept of conservation area planning is focused on ex situ conservation with the aimed of maintaining the existence of local rice genetic resources that may be lost due to land conversion at in-situ origin areas. Furthermore, delineation areas for development and conservation areas is also intended to support breeding and biotechnology that have an impact on increasing productivity in addition to protect plant's adaptability to environmental changes (Fitrian et al., 2022; Harjianto et al., 2016; Fiani, 2015). Land use planning for development and conservation areas of local paddy genetic resources specific to wetland can be allocated to 5 (five) districts that have a wetland typology, namely Kotawaringin Barat, Kotawaringin Timur, Seruyan, Pulang Pisau and Kapuas districts with a total area of about 3,127,011 ha (Figure 2).

Meanwhile, zonation areas for uplands areas were directed at central to northern part, across from the west to the east of the Central Kalimantan region i.e. Lamandau, Kotawaringin Barat, Katingan, Gunung Mas, Pulang Pisau, Kapuas Barito Timur, Barito Utara and Murung Raya district with total area of 10,460,102 Ha (Figure 3). Regional priority for development and conservation areas in wetlands is more directed at the Kotawaringin Timur and Pulang Pisau districts considering the number of types of local paddy in these two areas is the highest. Meanwhile, for uplands

areas, allocations can be prioritized to Lamandau and Katingan district. The results of spatial analysis with support of GIS technology also represent geographical distribution pattern of the presence of local paddy genetic resources was generally found in river stream areas associated with residential areas. This can then be used as basic consideration for further planning in land use.

CONCLUSSION

The concept of regional planning for local paddy development and conservation areas in Central Kalimantan can be allocated to wetlands areas in Kotawaringin Barat, Kotawaringin Timur, Seruyan, Pulang Pisau and Kapuas district, with priority of Kotawaringin Timur and Pulang Pisau district. While for uplands, the allocation is directed to Lamandau, Kotawaringin Barat, Katingan, Gunung Mas, Pulang Pisau, Barito Timur, Kapuas, Barito Utara and Murung Raya district with priority focused on Lamandau and Katingan district. The results of spatial analysis with support of GIS technology also represent geographical distribution pattern of the presence of local paddy genetic resources can then be used as basic consideration for land use planning at regional scale in Central Kalimantan

ACKNOWLEDGEMENTS

The authors would like to thank The Indonesian Agency for Agricultural Research and Development (IAARD) for funding for this study.

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