Pranata mangsa and the sustainability of agricultural land resources management in Imogiri sub-district of Bantul regency

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Abstract. Pranata mangsa is a Javanese calendar used by farmers to start the planting period and agricultural activities. Pranata mangsa in a modern farming today no longer becomes a rule or "paugeran" in agricultural activities, especially wetland farming, but it serves as controllers of the existing farming activities. Pranata mangsa is still used by farmers in Imogiri sub-district as a controller of agricultural activities. As a controller, it provides considerations in performing agricultural land management. Those considerations are relevant with the sustainable land resources management. Its relevance deals with farmer's decision in determining the type of land use, crop rotation, and the type of dominant crop in Imogiri sub-district. This research aims at investigating: (1) the characteristics of agricultural land resource management in Imogiri sub-district, (2) how far the farmers in Imogiri sub-district utilize pranata mangsa to maintain the sustainability of agricultural land resource management. This research was conducted in Imogiri sub-district. The research location was determined purposively. The population of this research is farmers. The research sample consists of 369 farmers. The research data include primary and secondary data. The primary data were collected using observations and interviews, while secondary data were gathered using documentation techniques. The collected data were analyzed by employing quantitative-descriptive methods based on the frequency table data. The results show that: (1) the characteristics of agricultural land resource management in Imogiri sub-districts are based on: (a) the type of land use i.e. irrigated rice field, rainfed rice field, and dry land, (b) the rotation of crops i.e. irrigated rice fields include paddy-paddy-paddy, rainfed rice fields consist of paddy-paddy-palawija (secondary crops), and dry land consists of paddy-cassava, (c) the dominant types of agricultural crops i.e. irrigated rice fields is paddy, rainfed rice fields consist of paddy-palawija, and dry land consists of paddy-cassava (2) farmers in Imogiri sub-district utilize pranata mangsa to maintain the sustainability of agricultural land resource management i.e. 86.2% in irrigated rice field, 92.7% in rainfed rice field, and 88.6% in dry land.

1. Introduction
Land resources play an important role in supporting the development. It has unique characteristics due to the differences of rock type, climate, topography, and biotic which are also reflected from the differences of land [1]. Land resource management is often associated with local wisdom. The local wisdom includes a traditional timing system which has become a guideline for the community life accross generations, such as the Batak ethnic recognizes Porhalaan as a guidance to spread the seeds, Dayak recognizes Bulan Berladang as early guidance to start planting, the Balinese employs Wariga, Sundanese has Kerta Mangsa and Javanese utilizes Pranata Mangsa [2]. Pranata mangsa is a Javanese calendar created by Ronggowarsito which aims at introducing the time aligned with the Gregory calendar addressed to traditional farmers at that time. Its official use began during the reign of Sri Paku Buwono VII, the king of the Surakarta kingdom, on June 22,
From that moment on, pranata mangsa became the formal guidance in various social and economic activities of the community, especially cultivation [2]. Pranata mangsa is still practised today due to the great role of parents in preserving it, but the people’s care or awareness on pranata mangsa tends to decrease along with the increasing level of education [3].

Javanese farmers recognize pranata mangsa as a dating system that governs the workings of farmers or manages season as stated by Daljoeni (1983) [4]. Appropriate technology is one of the alternatives for managing rural resources by taking into account the capacity of resources and the ability of the community [5]. Pranata mangsa is one of the supporting capacities that plays an important role in the management of agricultural land resources in Imogiri sub-district which has abundant of resources and various landscapes. Land resource management based on the spread of landscape in Imogiri sub-district can be viewed from environmental factors based on the Minister of Environment Decree No. KEP.299 / 11/1996 which include the parameters of land use type, crop rotation, and dominant types of agricultural crops [6].

The topography of Imogiri sub-districts consists of plains, hills, and mountains which have its own reserves of natural resources. The utilization of natural resources of each region is adapted to the condition of landscape variations. Excessive use of natural resources in each region may cause environmental problems. Due to the variation of landscape, an effective management of agricultural land resources is required to maintain the sustainability of agricultural activities, one of them is utilizing pranata mangsa in managing the agricultural land resources.

Land use in Imogiri sub-district is getting complex as presented in Table 1 below:

| Land use in 2000 | Area (ha) | Percentage (%) | Land use in 2010 | Area (ha) | Percentage (%) |
|-----------------|-----------|----------------|-----------------|-----------|----------------|
| Settlement      | 1,056,94  | 20,35          | Bush            | 326,64    | 6,29           |
| Rice field      | 1,319,92  | 25,41          | Garden          | 7,13      | 0,14           |
| Mix             | 178,28    | 3,43           | Cemetery        | 1,07      | 0,02           |
| Dry land        | 2,438,44  | 46,95          | Sand Land       | 3,80      | 0,07           |
| Wilderness      | 12,32     | 0,24           | Settlements     | 1,566,58  | 30,16          |
| Homogeneous forest | 187,66  | 3,61           | Grass           | 7,00      | 0,13           |
|                 |           |                | Irrigated rice field | 830,07 | 15,98          |
|                 |           |                | Rainfed rice field | 271,97   | 5,24           |
|                 |           |                | Dry land        | 2,078,91  | 40,03          |
|                 |           |                | Body of water   | 100,39    | 1,93           |
| Total           | 5,193,56  | 100            | Total           | 5,193,56  | 100            |

Sources: Statistic Central Agency of Bantul Regency (2000, 2010) [7]

2. Data and Study Area

The research location is agricultural land in Imogiri sub-district, including landscape of plains, hills, and mountains. The location of the research was determined purposively. The population of this research is farmers. The sample consists of 369 farmers. The sample is then distributed proportionally for each village based on the spread of the landscape. The data of this research include primary and secondary data. Primary data were collected using observations and interviews, while secondary data was collected using documentation techniques. The collected data were analyzed by employing a quantitative-descriptive method based on frequency table data.
3. Research Methods

3.1 The Characteristics of Agricultural Land Resources Management in Imogiri sub-district based on the Type of Land Use

The types of agricultural land used by farmers in the research area include irrigated rice fields, rainfed rice fields, and dry land. The water sources of the irrigated rice fields derive from Opak-Oyo rivers which flow continuously and regularly throughout the year. Irrigated rice fields lie on the landscape of plains and hills. Meanwhile, rainfed rice fields rely on the rainfall; it does not require permanent irrigation buildings. Rainfed rice fields are located in the landscape of plains, hills, and mountains. The rainfed rice field is generally located in areas that are higher than irrigated rice fields, therefore it is impossible for irrigation water to reach. In addition, dry land has some characteristics such as the land is dry; the irrigations rely on rainfall, the surface of topography is uneven, the irrigation channels can’t be built, and the land is to be cultivated. The dry land is located in the landscape of the plains, hills, and mountains. The distribution of the types of agricultural land used by farmers is presented in Table 2.

| Table 2. Types of agricultural land use in Imogiri sub-district | Distribution of Landscape |
|---------------------------------------------------------------|---------------------------|
| Crop Rotation       | Plains Total (people) | Hills Total (people) | Mountains Total (people) | Total Total (people) |
|---------------------|----------------------|---------------------|------------------------|---------------------|
|                     |                      |                     |                        |                     |
| Paddy- Paddy- Paddy| 100                  | 15                  | 0                      | 115                 | 31,2                |
| Paddy- Paddy- Palawija | 10            | 65                  | 0                      | 75                  | 20,3                |
| Paddy-cassava       | 7                    | 33                  | 101                    | 141                 | 38,2                |
| Paddy-tobacco       | 6                    | 10                  | 22                     | 38                  | 10,3                |
| Total               | 123                  | 123                 | 123                    | 369                 | 100,0               |

Sources: Analysis or Primary Data (2015) [7]

The types of agricultural land use in the landscape of plains are dominated by irrigated rice fields (87.0%), hills are dominated by rainfed rice fields (58.5%), and mountains are dominated by dry land (82.1%). Pranata mangsa plays an important role in agricultural land resource management activities in Imogiri sub-district, especially in determining the type of agricultural land use under the condition that the season shifts occurring in this global climate change are still within the scope of the natural signs as mentioned in pranata mangsa system.

3.2 The Characteristics of Agricultural Land Resources Management in Imogiri sub-district based on Crop Rotation

The rotation of crops performed by farmers in the agricultural field within the research area can be classified into 4 (four) namely paddy-paddy-paddy, paddy-paddy-palawija, paddy-cassava, and paddy-tobacco. The distribution of crop rotation in the research area is presented in Table 3:
Table 3. Crop rotation performed by farmers in Imogiri sub-district

| Crop Rotation       | Plains          |                | Hills          |                | Mountains      |                | Total          |                |
|---------------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                     | Total (people)  | %              | Total (people) | %              | Total (people) | %              | Total (people) | %              |
| Paddy- Paddy- Paddy | 100             | 81,3%          | 15             | 12,2%          | 0              | 0              | 115            | 31,2%          |
| Paddy- Paddy- Palawija | 10             | 8,1%           | 65             | 52,8%          | 0              | 0              | 75             | 20,3%          |
| Paddy-cassava       | 7               | 5,7%           | 33             | 26,8%          | 101            | 82,1%          | 141            | 38,2%          |
| Paddy-tobacco       | 6               | 4,9%           | 10             | 8,1%           | 22             | 17,9%          | 38             | 10,3%          |
| Total               | 123             | 100,0%         | 123            | 100,0%         | 123            | 100,0%         | 369            | 100,0%         |

Sources: Analysis of Primary Data (2015) [7]

The dominant crop rotations performed by farmers in the landscape of plains include paddy-paddy-paddy (81.3%), the hills are dominated by rice-palawija (52.8%), and mountains are dominated by paddy-cassava (82.1%). The different crop rotation dominance in each landscape indicates that the management of agricultural land in the research area depends on the availability of water. The sufficient water availability throughout the year in the plains allows the crop rotation of paddy-paddy-paddy. Growing paddy throughout the year in the plains is not only due to the water availability factor but also the ease of managing agricultural land in the plains. The limitations of land conditions are hardly found in the plains landscape so that the management of agricultural land for paddy crops throughout the year can be optimal. The growing of rice crops is much easier since fertilizer needs are fulfilled through a good institutional access in the plain areas.

The crop rotation of paddy-paddy-palawija carried out in the landscape of hill is determined by the farmers considering the availability of water which is only sufficient for 2x planting terms and interspersed with palawija (secondary crops). The availability of water in the hills that rely on rainwater as a source of irrigation forms a crop rotation pattern. If water availability is sufficient for planting paddy, the farmers will plant paddy, if not they will plant palawija.

The crop rotation of paddy-cassava performed in the landscape of mountains also considers the water availability. Farmers grow paddy for one term and the rest of the planting term will be cassava. Moreover, the agricultural land will not be cultivated when the water availability is not sufficient. The limited land quality is mostly found in mountains, therefore the cultivation of agricultural land for planting paddy is not optimal. The water availability can be predicted using mangsa (season) which has been stated in pranata mangsa. Therefore, the farmers are able to perform best crop rotations by considering the water availability and pest attacks.

3.3 The Characteristics of Agricultural Land Resources Management in Imogiri sub-district viewed from the Dominant Agricultural Crops

The selection of crop types is influenced by some factors which include: water availability, productivity, ease of marketing, and infrastructure. The dominant types of agricultural crops cultivated by farmers in the research area can be classified into 4 (four), namely paddy; paddy and palawija (secondary crop); paddy and cassava; and paddy and tobacco. They are presented in the following table.
Table 4. Types of dominant agricultural crops grown by farmers in Imogiri sub-district

| Types of Dominant Agricultural Crops | Distribution of Landscape |
|-------------------------------------|---------------------------|
|                                     | Plains | Hills | Mountains | Total |
|                                     | Total (people) | %  | Total (people) | %  | Total (people) | %  |
| Paddy                              | 100   | 81,3 | 15        | 12,2 | 0       | 0       | 115 | 31,2 |
| Paddy and Palawija                 | 10    | 8,1  | 65        | 52,8 | 0       | 0       | 75  | 20,3 |
| Paddy and Cassava                  | 7     | 5,7  | 33        | 26,8 | 101     | 82,1    | 141 | 38,2 |
| Paddy and Tobacco                  | 6     | 4,9  | 10        | 8,1  | 22      | 17,9    | 38  | 10,3 |
| Total                              | 123   | 100,0| 123       | 100,0| 123     | 100,0   | 369 | 100,0 |

Sources: Analysis of Primary Data (2015) [7]

The type agricultural crops grown by farmers in the research area in plains landscape is dominated by paddy (81.3%), the hills are dominated by paddy and palawija (52.8%), and the mountains are dominated by paddy and cassava (82.1%). The dominance of paddy crops in the plains is due to the availability of sufficient water for fulfilling the water needs of the crops. The availability of adequate water in the plains which is supported by a good irrigation system will support the farmers in growing rice crops so that productivity meets the expectations.

The dominant crop of paddy and palawija in the hills is due to the availability of sufficient water needs for the crops during the rainy season. The availability of water in the hills will be sufficient if the farmers build the pools for water storage during rainy season so that farmers can carry out an optimal cultivation of rice crops in the rainy season. When dry season, the stored water can still be used to irrigate agricultural land and the farmers can start planting palawija. The optimum management of agricultural land which is supported by water availability during the rainy season will increase rice productivity. Although the availability of water in the dry season is limited, it is sufficient for fulfilling the water needs of palawija crops, so that the productivity of previous agricultural land for rice crops is continued with palawija.

The paddy and cassava crop in the mountain landscape is dominant because the availability of water during the rainy season can fulfill the needs of water for rice crops therefore the source of water for irrigation derives from the rain water. The water needs for paddy in the mountains is not sufficient if only relying on rain water. In other words, it must be supported by a good irrigation system therefore farmer’s community can grow paddy and obtain crop’s productivity as expected. Selection of paddy as a crop in the rainy season and cassava in the dry season is performed by farmers communities in the mountains to meet food needs.

Pranata mangsa serves to determine the types of dominant agricultural crops. It is assumed that pranata mangsa uses natural signs as a consideration to determine the type of crops to grow by observing the natural conditions of the crop which are relevant with pranata mangsa system. This is carried out to anticipate the pest attack against certain types of plants which have been notified in pranata mangsa, therefore farmers are able to anticipate the attacks.

3.4 Farmer’s Community in Imogiri sub-district that Utilizes Pranata Mangsa to Maintain the Sustainability of Agricultural Land Resources Management

The Javanese farmer’s community has a distinctive belief system regarding the appropriate time to cultivate the agricultural land and grow crops. Also, they believe in good or bad days for harvesting crops. This belief is preserved, although some consider this irrational. The local wisdom existing in this belief system is not covered in the study of legal anthropology. Whereas, if it is scientifically studied, it may provide invaluable contributions to the legal practices, especially in the field of agriculture. Through the development of pranata mangsa system, the peak fluctuation of pest population does not coincide with the stage of growth and development of the most sensitive crops. Furthermore, Simanjuntak, et al. (2010) state that pranata mangsa is used by farmers as a rule to do something to reduce risks and avoid high production costs [8]. Pranata mangsa is used to determine
the best time to start planting and harvesting crops.

The utilization of pranata mangsa performed by farmer’s community in Imogiri sub-district is a form of local wisdom in the management of agricultural land resources. Pranata mangsa should be utilized based on its original function as a rule or paugeran in the management of agricultural land resources and does not neglect the science and advancement of modern agricultural technology. The introduction of traditional timing system for growing crops presented in the pranata mangsa can be used for guidance of various activities. The problem is that the utilization of pranata mangsa is not based on clear base or simply just follow the word of parents passed from the older generations [3]. Pranata mangsa is a "season management". It helps farmers determine the best planting period. Pranata mangsa utilizes natural signs as a guide for growing crops, for example: the condition of plants, the phenomenon of "bediding" (a striking temperature change occurred at early dry season), animal behaviors, and movement of celestial objects especially constellations. Natural signs allow the the farmers to determine the best time to start and carry out all agricultural activities to increase successful harvest opportunities [9]. Distribution of farmer’s communities that utilize pranata mangsa and farmers who do not use pranata mangsa in agricultural activities is presented in Table 5.

Table 5. The use of pranata mangsa by farmers’ communities in Imogiri sub-district

| The Use of Pranata Mangsa | The distributions of Landscape |  |
|---------------------------|---------------------------------|---|
|                           | Plains (people) | %        | Hills (people) | %        | Mountains (people) | %        | Total (people) | %        |
| Yes                       | 106             | 86,2     | 114           | 92,7     | 109              | 88,6     | 329            | 89,2     |
| No                        | 17              | 13,8     | 9             | 7,3      | 14               | 11,4     | 40             | 10,8     |
| Total                     | 123             | 100,0    | 123           | 100,0    | 123              | 100,0    | 369            | 100,0    |

Sources: Analysis of Primary data (2015) [7]

Most farming communities in the research areas utilizes pranata mangsa i.e. 86.2% in the plains, 92.7% in the hills, and 88.6% in the mountains. Based on the results of interviews with farmers, the reasons for utilizing pranata mangsa in agricultural activities include: first, pranata mangsa is used by farmer’s communities to determine the right time to start and perform agricultural activities so that crop’s productivity increases; second, pranata mangsa is carried out by performing a learning process of "niteni" or noticing the natural signs associated with agriculture; third, the utilization of pranata mangsa in the management of agricultural land resources can overcome the problems dealing with agricultural activities; fourth, pranata mangsa in the research area is still obeyed (ugemi) or practiced by the farmer’s community due to the tradition and cultural factors that are strongly attached to the farmer’s community; fifth, the knowledge of pranata mangsa is mostly inherited from the parents or previous generations.

4. Conclusion and Recommendation

Based on the results and discussions, the conclusions are as follows:

1. The characteristics of agricultural land resource management in Imogiri sub-district are:
   a. The types of agricultural land use in plains landscape are dominated by irrigated rice fields (87.0%), the hills are dominated by rainfed rice fields (58.5%), and the mountains are dominated by dry land (82.1%). Pranata mangsa in agricultural land resource management activities in Imogiri sub-district serve to determine the type of land use under the condition that the seasonal shifts that occur in this global climate change are still within the scope of the natural signs mentioned in pranata mangsa.
   b. The dominant crop rotation in the plain is paddy-paddy-paddy (81.3%), the hill is dominated by paddy-paddy-palawija (52.8%), and the mountain is dominated by paddy-cassava (82.1%). Different crop rotation dominance in each landscape indicates that the management of agricultural land in the research area depends on the availability of water. The water availability...
can be predicted using mangsa (season) which has been stated in pranata mangsa. Therefore, the farmers are able to perform best crop rotations by considering the water availability and pest attacks.

c. The dominant agricultural crops cultivated by farmers in the research area in the plains landscape is paddy (81.3%), while the hill is dominated by paddy and palawija (52.8%), and the mountain is dominated by paddy and cassava (82.1%). Pranata mangsa serves to determine the types of plants in which pranata mangsa utilizes natural signs as a consideration to determine the type of plant to grow by observing its natural conditions in accordance with the description pranata mangsa system. This is to anticipate pest attacks against certain types of plants that are notified in the system of pranata mangsa, so that farmers are able to anticipate the pests.

2. The farmer’s community in Imogiri sub-district utilizes pranata mangsa to maintain the sustainability of agricultural land resource management i.e. 86.2% in the plains, 92.7% in the hills, and 88.6% in the mountains. The reasons of utilizing pranata mangsa consist of:
   a. Pranata mangsa is used to determine the right time to start and perform agricultural activities.
   b. Pranata mangsa is carried out by performing a learning process of "nitendi" or noticing the natural signs associated with agriculture.
   c. The utilization of pranata mangsa can overcome the problems dealing with agricultural activities.
   d. Pranata mangsa in the research area is still obeyed (ugemi) or practiced by the farmer’s community due to the tradition and cultural factors that are still strongly attached to the farmer’s communities.
   e. The knowledge of pranata mangsa is mostly inherited from the parents or previous generations.

Recommendations in relation to the research findings are as follows: Pranata mangsa as a local wisdom inherited from generation to generation should be utilized based on its original function i.e. as a "paugeran" or rule in the management of agricultural land resources. Its function as "paugeran" or rule must be completed with clear base in accordance with current climate conditions. Thus, pranata mangsa is expected to overcome the problems dealing with agricultural activities therefore it sustains the agricultural land resource management.

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