Protection of Paddy Field and Recommendation of Regional Planning in Cianjur Regency, West Java, Indonesia

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Abstract. Cianjur Regency is one of “lumbung” paddies in West Java Province that can contribute to rice sufficiency for West Java 13.5%. However, conversion of paddy field into other land use still happen in Indonesia because of land rent of paddy field less than other land use and also the low commitment of Government to protect the paddy field to get food self-sufficiency. Objectives are analysis of paddy field protection and recommendation of regional planning. Paddy field protection was determined based on existing paddy field, land suitability, economic value and Regional Spatial Planning (RTRW). Recommendation of regional planning was determined based on priority level of paddy field protection, Regional Spatial Planning (RTRW) and rice sufficiency status. The results showed that land suitability, economic value and also allocating land for paddy field in the RTRW can support realization of paddy field protection. The paddy field that included into the first and third priority is 30.14% and 38.45%, respectively. The other priorities of paddy field protection are around 15%. This research is recommended that 87.5% of the paddy field existing can be protected to get rice sufficiency with surplus around 48.782 ton.

1. Introduction
In the period 2003-2013, the paddy field Indonesia increased with the rate of 23.553.8 ha/year due to the construction of new paddy field, but in West Java decreased with the rate of 909.8 ha/year (BPS of Cianjur Regency 2014). Likewise, the paddy field in Cianjur Regency also decreased 5, 438.4 ha for 2000-2015 because of conversion into land and dryland (Chairunnisa 2016). On the other hand, Cianjur Regency is one of “lumbung padi” in West Java that produced 839.776 ton in 2011 and increased to 882.622 ton in 2012 (BPS of Cianjur Regency, 2013).

Many factors that influence on paddy field conversion but the general factors are (a) land rent of paddy field less than the other land use, (b) the low commitment of Government to protect the paddy field to get food self-sufficiency. The land rent of paddy field, mixed garden and settlement are Rp. 44.12- Rp. 1070, 44 per m2 per year, Rp. 51.33 - Rp. 1.493.5 6 per m2 per year and Rp. 208,33 - Rp. 35.069,44 per m2 per year respectively (Rumiris, 2008). A comparison between land rent of paddy field and oil palm are 1: 1,11 (Hamdan, 2012) and according to Asni (2005) showed that land rent of paddy field and oil palm are Rp 1.387.577/hectare and Rp 5.735.203/hectare, respectively. Based on Sugandi et al., 2013 showed that land rent of paddy field and oil palm on Bengkulu are Rp7.650.590/hectare/year and Rp 11.104.076/hectare/year.
The low commitment of Government to protect the paddy field showing by building construct permit (IMB) on paddy field for settlements, industry and public facilities such as hospital, mosque, church. Indonesia has approved an agreement between states on Word Trade Organization (WTO) in Bali on 2013. It means that began in 2015 Indonesia have to accept foodstuffs from other countries. This would greatly disrupt the Government's efforts to achieve food sovereignty.

Therefore, the study on paddy field protection is urgently needed. The regulation on the paddy field protection has been published as Law No.41 of 2009 that recommends for each regency to establish sustainable paddy field. Cianjur Regency had planned 21,000 ha to be sustainable paddy field and has written on the Regional Spatial Planning Map (RTRW), however it is not realized yet in 2015 Objectives of this research are analysis of paddy field protection and recommendation of regional planning.

2. Material and Method

2.1. Study area
The study area (figure 1) is Cianjur Regency, West Java, Indonesia and has coordinate of 6° 21’- 7° 25’ S and 106° 42’-107° 25’ E. The total areas cover 361,435 ha, comprising 32 districts. Capital of Cianjur Regency is located in Cianjur District.

![Figure 1. Location of study area](image)

2.2. Distribution of paddy field on its land suitability and the Regional Spatial Planning Map
Distribution of paddy field on its land suitability and the regional planning of Cianjur Regency were obtained by overlapping between the Paddy Field Map, the Land Suitability Map and the Regional Spatial Planning Map (RTRW) and Administration Map. The secondary data includes Paddy Field Land Suitability Map with scale 1:50,000 (Munibah et al., 2015),
Regional Spatial Planning Map (RTRW) with scale 1:50,000 (Bappeda of Cianjur Regency 2015), Paddy Field Map with scale 1:10,000 (Department of Crop Farming and Horticulture, 2010), and Administration Map with scale 1:25000 (Agent of Geospatial Information).

2.3. Calculating an economic value of paddy field
Parameters for calculating an economic of paddy field were obtained by interviewing with farmers about (1) budged for buying paddy seed, fertilizer and pesticides; (2) labors budged for tillage, seedbed, fertilizing, spraying pesticides, grass weeding, post-harvest, (3) productivities of paddy field, (4) selling price of paddy (Rp/ton). The samples size for primary data collection is 94 farmers distributed in all district in Cianjur Regency. The interviews with farmers were guided by a questionnaire.

2.4. Determination of paddy field protection
Determination of paddy field protection was based on land suitability, regional planning and R/C value with certain rules (Table 1). Based on the ease (low conflict) to protect the paddy field, it is determined priority level, such as priority 1, 2, 3 and 4. The smaller number showed the greater priority to be protected.

| Land use                          | Regional Spatial Planning (RTRW) | R/C value | Suitable (S2) | Marginally suitable (S3) | Not suitable (N) |
|----------------------------------|----------------------------------|-----------|---------------|-------------------------|------------------|
| Irrigated or rainfed             |                                  |           |               |                         |                  |
| Conservation forest area         | Priority_4                       | Priority_4| Priority_4    | Priority_4              |                  |
| Protected forest area            | Priority_4                       | Priority_4| Priority_4    | Priority_4              |                  |
| Production forest area           | Priority_3                       | Priority_3| Priority_3    | Priority_4              | Priority_4      |
| Industrial area                  | Priority_4                       | Priority_4| Priority_4    | Priority_4              |                  |
| Water bodies                     | Priority_4                       | Priority_4| Priority_4    | Priority_4              |                  |
| Plantation/annual crop area      | Priority_3                       | Priority_3| Priority_3    | Priority_4              | Priority_4      |
| Rural settlement area            | Priority_3                       | Priority_3| Priority_4    | Priority_4              | Priority_4      |
| Urban settlement area            | Priority_3                       | Priority_3| Priority_3    | Priority_4              | Priority_4      |
| Wetland agriculture area         | Priority_1                       | Priority_1| Priority_1    | Priority_1              |                  |
| Sempadan sungai                  | Priority_1                       | Priority_1| Priority_1    | Priority_1              |                  |
| Irrigated                        |                                  |           |               |                         |                  |
| Upland agriculture area          | Priority_1                       | Priority_2| Priority_3    | Priority_3              | Priority_4      |
| Rainfed                          |                                  |           |               |                         |                  |

For example: priority_1 means paddy field in the first priority to be protected.

2.5. Determination of rice sufficiency status
Determination of rice sufficiency status based on supply and demand of rice, with formula:

\[ S_{ki} = (A_{si} \times Y_{pi} \times IP_{pi} \times C) - (P_i \times S_j) \]

where:

- \( S_{ki} \) = Rice sufficiency status (surplus/minus)
- \( A_{si} \) = Paddy field area (ha)
- \( Y_{pi} \) = Average productivity (ton/ha)
- \( IP_{pi} \) = Average cropping index (times/year)
- \( P_i \) = Total population (people)
- \( S_j \) = Average rice consumption per capita for Cianjur Regency (105.85 kg/capita/year)
Conversion factor from paddy into rice = 0.6274

2.6. Determination of regional planning recommendation

Determination of paddy field protection was based on existing paddy field and the Regional Spatial Planning Map (RTRW) with certain rule (Table 2). There are three recommendations on actual paddy field: (1) paddy field protected, (2) reserve paddy field protected, and (3) paddy field that can be allocated according to the Regional Spatial Planning Map.

| Regional Spatial Planning Map (RTRW) | Priority_1 | Priority_2 | Priority_3 | Priority_4 |
|-------------------------------------|------------|------------|------------|------------|
| Conservation forest area            |            |            |            | (1) Reserve paddy field protected OR (2) Paddy field that can be allocated according to the Regional Spatial Planning Map (RTRW) |
| Protected forest area               |            |            |            | Reserve paddy field protected |
| Production forest area              |            |            |            | Paddy field that can be allocated according to the Regional Spatial Planning Map (RTRW) |
| Industrial area                     |            |            |            | Reserve paddy field protected |
| Water bodies                        |            |            |            | Paddy field that can be allocated according to the Regional Spatial Planning Map (RTRW) |
| Plantation/unnual crop area         |            |            |            | Reserve paddy field protected |
| Rural settlement area               |            |            |            | Paddy field that can be allocated according to the Regional Spatial Planning Map (RTRW) |
| Urban settlement area               |            |            |            |            |
| Wetland agriculture area            |            |            |            |            |
| Sempadan sungai                     | Paddy field protected | Reserve paddy field protected | |
| Upland agriculture area             |            |            |            |            |

3. Result and Discussion

3.1 Distribution of paddy field on its land suitability

The paddy field in Cianjur Regency have been occupying the land with suitability class S2 (suitable) and class S3 (marginally suitable) with an area of 21.54% and 78.33% respectively. Only a little of paddy field were found on the land with suitability class N (not suitable) with an area 0.13%. The limitation factor of land suitability class S2 and S3 were drainage (r), C-organics, pH, (f) and N total (n).

Table 3 and figure 2 showed that paddy field was distributed in Northern Cianjur (47.5%), Southern Cianjur (30.0%) and Centre Cianjur (22.5%). Based on the land suitability analysis where paddy field in Cianjur Regency has high potential to be protected.
Table 3. Distribution of paddy field on its land suitability

| Land suitability for paddy field | Northern Ciajur | Centre Cianjur | Southern Cianjur | Total |
|---------------------------------|-----------------|----------------|-----------------|-------|
| Suitable (S2)                   | 6,017.1         | 4,957.7        | 3,102.4         | 14,077.1 |
| Marginality Suitable (S3)       | 24,941.0        | 9,773.5        | 16,477.4        | 51,191.9 |
| Not Suitable (N)                | 79.7            | 1.8            | 6.6             | 88.2 |
| Total (ha)                      | 31,037.8        | 14,733.0       | 19,586.4        | 65,357.2 |

Figure 2. Spatial distribution of paddy field based on its land suitability

3.2. Distribution of paddy field on the Regional Spatial Planning Map (RTRW)

Table 4 and figure 3 showed that paddy field in Cianjur Regency have been occupying on land that accord with the Regional Spatial Planning Map (RTRW), such as wet agriculture area (28.34%) and dryland agriculture area (43.72%). While, paddy field have been occupying on land that did not accord with the Regional Spatial Planning (RTRW), such as rural settlement, sempadan sungai, urban settlement and plantation/annual crop area in range (4.13–8.71%).

Based on the Regional Spatial Planning Map where Cianjur Regency still has the large paddy field to be protected, especially paddy field in wet agriculture area (28.34%) and dryland agriculture area (43.72%). The irrigated paddy field dominantly found in the Northern Cianjur and the other hand the
high conversion of paddy field will be happened in the Northern Cianjur too. Therefore, the Government’s commitment needs to be improved in term of paddy field protection.

### Table 4. Distribution of paddy field based on the Regional Spatial Planning Map

| Regional Spatial Planning Map (RTRW) | Northern Cianjur | Central Cianjur | Southern Cianjur | Total |
|-------------------------------------|-----------------|----------------|-----------------|-------|
|                                     | ha   | %   | ha   | %   | ha   | %   | ha   | %   |
| Conservation forest area            | 120.2| 0.2 | 0.1  | 0.0 | 318.9| 0.5 | 439.2| 0.67|
| Protected forest area               | 8.7  | 0.0 | 401.5| 0.6 | 560.1| 0.9 | 970.3| 1.48|
| Production forest area              | 414.9| 0.6 | 314.5| 0.5 | 902.0| 1.4 | 1,631.4| 2.50|
| Industrial area                     | 52.2 | 0.1 | 0.0  | 0.0 | 0.0  | 0.0 | 52.2 | 0.08|
| Water bodies                        | 21.4 | 0.0 | 25.3 | 0.0 | 10.1 | 0.0 | 56.9 | 0.09|
| Plantation/annual crop area         | 1,985.0| 3.0 | 1,552.8| 2.4 | 2,154.3| 3.3 | 5,692.1| 8.71|
| Rural settlement area               | 1,295.6| 2.0 | 1,140.7| 1.7 | 263.6 | 0.4 | 2,699.9| 4.13|
| Urban settlement area               | 3,965.1| 6.1 | 0.0  | 0.0 | 0.0  | 0.0 | 3,965.1| 6.07|
| Wetland agriculture area            | 17,001.2| 26.0 | 1,055.4| 1.6 | 462.5 | 0.7 | 18,519.1| 28.34|
| Sempadan sungai Dryland agriculture area | 738.2 | 1.1 | 990.7 | 1.5 | 1,027.6 | 1.6 | 2,756.5 | 4.22|
|                                     | 5,435.3| 8.3 | 9,252.0| 14.2 | 13,887.3| 21.2 | 28,574.5| 43.72|
| Total (ha)                          | 31,037.8| 47.5 | 14,733.0| 22.5 | 19,586.4| 30.0 | 65,357.2| 100.00|

3.3. Economic value of paddy field

Economic of paddy field that was calculated based on R/C value (Avenue/Cost), if R/C value >1 means the land rent of paddy field is still profitable. Based on Table 5 showed that R/C value of the land rent of paddy field on all districts in Cianjur Regency >1, it means that paddy field is still profitable that can support the program of paddy field protection.

Table 5 showed that average of R/C value is 2.18 with the profit of Rp 11,203,006,-/ha/planting season, while the R/C maximum and minimum are 2.73, with the profit of Rp 15,535,750,-/ha/planting season and 1.67 with the profit 7,086,100, respectively. Other studies have shown that R/C value of irrigated paddy field in Cihea village, Cianjur Regency is 2.13 with the profit Rp 7,342,200,-/ha/planting season (Kurniadiningsih 2012). However, the profits of the land rent of paddy field can’t be sufficient the life needs of farmer family; it is supported by the data in which almost all farmers have other jobs besides farming, such as trade, ojeg.

The R/C value of paddy field in Northern Cianjur is slightly higher than in Central and Southern Cianjur because of productivity difference. Most of Irrigated paddy field was found in Northern Cianjur that has productivity slightly higher than Rainfed paddy field that found in Central and Southern Cianjur.
Figure 3. Spatial distribution of paddy field based on the Regional Spatial Planning Map

| Code | District       | R/C Value | Code | District       | R/C Value |
|------|----------------|-----------|------|----------------|-----------|
| 250  | Bojongpicung   | 2.12      | 110  | Campaka        | 2.06      |
| 200  | Cianjur        | 2.10      | 260  | Campakamulya   | 1.85      |
| 120  | Cibeber        | 1.67      | 070  | Kadupandak     | 1.73      |
| 240  | Cikalongkulon  | 2.49      | 100  | Pagelaran      | 1.86      |
| 140  | Cilaku         | 2.53      | 430  | Pasirkuda      | 2.68      |
| 410  | Cipanas        | 1.91      | 080  | Takokak        | 1.97      |
| 170  | Ciranjang      | 2.26      | 060  | Tanggeung      | 1.85      |
| 210  | Cugenang       | 2.26      | 090  | Sukanagara     | 2.20      |
| 400  | Northern Cianjur | Gekbrong | 2.41 | 010 | Agrabinta     | 1.97      |
| 420  | Haurwangi      | 2.07      | 050  | Cibinong       | 1.87      |
| 190  | Karangtengah   | 2.54      | 030  | Cidaun         | 2.58      |
| 180  | Mande          | 1.87      | 290  | Cijati         | 2.49      |
| 150  | Sukaluyu       | 2.59      | 170  | Cikadu         | 1.90      |
| 220  | Pacet          | 2.30      | 040  | Naringgul      | 2.60      |
| 230  | Sukaresmi      | 1.69      | 280  | Leles          | 2.23      |
| 130  | Warungkondang  | 2.73      | 020  | Sindangbarang  | 2.30      |
3.4. Paddy field protection and recommendation of regional planning
Based on the land suitability, the Regional Spatial Planning Map, R/C value and certain rules in table 1 were obtained the priority level of paddy field protection. Based on table 6 and figure 4 showed that area of the paddy field in Cianjur Regency included into the first priority for protected is 30.14% of which 27.4% found in Northern Cianjur. The paddy field that included into the third priority for protected is 38.45% of which dominant found in Central and Southern Cianjur. The other priorities of paddy field protection are around 15%.

Table 6. Priority level of paddy field protection

| Priority level of paddy field protection | Northern Cianjur | Central Cianjur | Southern Cianjur | Total   |
|-----------------------------------------|-----------------|----------------|-----------------|---------|
|                                         | ha              | %              | ha              | %       | ha       | %            |
| The first priority (priority_1)         | 17,898.4        | 27.4           | 1,287.0         | 2.0     | 513.9    | 0.8          | 19,699.4    | 30.14    |
| The second priority (priority_2)        | 2,793.6         | 4.3            | 4,026.9         | 6.2     | 3,485.0  | 5.3          | 10,305.4    | 15.77    |
| The third priority (priority_3)         | 4,907.6         | 7.5            | 7,557.9         | 11.6    | 12,663.6 | 19.4         | 25,129.1    | 38.45    |
| The fourth priority (priority_4)        | 5,438.3         | 8.3            | 1,861.1         | 2.8     | 2,923.9  | 4.5          | 10,223.4    | 15.64    |
| Total                                   | 31,037.8        | 47.5           | 14,733.0        | 22.5    | 19,586.4 | 30.0         | 65,357.2    | 100.0    |

Figure 4. Priority level of paddy field protection
Based on the priority level of paddy field protection, the Regional Spatial Planning Map and certain rules in table 2 were obtained 4 recommendations of regional planning that showed by table 7.

**Table 7. Recommendation of paddy field protection**

| No. | Recommendation of paddy field protection | Paddy field (ha) | Total |
|-----|------------------------------------------|------------------|-------|
|     |                                          | Irrigated | Rainfed | ha   | %    |
| 1   | Paddy field protected                     | 22,283.9   | 7,720.9 | 30,004.8 | 45.91 |
| 2   | Reserve paddy field protected             | 1,714.7    | 25,454.1 | 27,168.9 | 41.57 |
| 3   | Reserve paddy field protected OR allocated based on the Regional Spatial Planning Map (RTRW) | 3.3   | 1,406.3 | 1,409.6 | 2.16 |
| 4   | Paddy field area that can be allocated based on the Regional Spatial Planning Map (RTRW) | 5,220.2 | 1,553.8 | 6,774.0 | 10.36 |
|     | Total (existing paddy field)              | 29,222.1   | 36,135.1 | 65,357.2 | 100.0 |

**Figure 5.** Recommendation of regional planning that protect paddy field
Status of rice sufficiency was calculated based on ratio between supply and demand with assumptions:
1) Average of paddy productivity is 5.6 ton/ha
2) Cropping index for irrigated and rainfed paddy field are 2 times/year and 1 times/year, respectively
3) Total population is 2,225,316 people
4) Average rice consumption per capita for Cianjur Regency is 105.85 kg/capita/year
5) Conversion factor from paddy into rice = 0.6274

Table 8 showed that surplus status of rice sufficiency will be achieved if (a) existing paddy field (scenario 1) and (b) paddy field protected and reserves paddy field protected (scenario 3) will not be converted into other landuse.

| Scenarios                                      | Paddy field | Total Population | Supply   | Demand   | Status     |
|------------------------------------------------|-------------|-----------------|----------|----------|------------|
|                                                | Irrigated   | Rainfed         | (ha)     | (people) | (ton)      | Status     |
| 1. Existing paddy field                        | 29,220.6    | 36,135.1        | 2,225,316| 331,031  | 235,550    | 95.481 Surplus|
| 2. Paddy field protected                       | 22,283.9    | 7,720.9         | 2,225,316| 182,859  | 235,550    | -52,691 Minus |
| 3. Paddy field protected and reserves paddy field protected | 23,998.6    | 33,175.0        | 2,225,316| 284,332  | 235,550    | 48,782 Surplus |

4. Conclusion
Conclusions of this research are:
1) Land suitability, economic value and also allocating land for paddy field in the RTRW can support realization of paddy field protection.
2) The paddy field that included into the first and third priority is 30.14% and 38.45%, respectively. The other priorities of paddy field protection are around 15%.
3) This research is recommended that 87.5% of the paddy field existing can be protected to get rice sufficiency with surplus around 48.782 ton.

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