Conservation strategy of Cuing (Cyclea barbata Miers) in Mount Ciremai National Park as forest functional food based on bioecology and utilization rate

I. K. Adiyaksa1*, E. A. M. Zuhud1, Siswoyo1

1Department Conservation of Forest Resources and Ecotourism, Faculty of Forestry, IPB University (Bogor Agricultural University), Bogor, Indonesia

*Corresponding author: ivankhofian14@gmail.com

Abstract. The potential of Cuing (Cyclea barbata) was found in utilization zone of Mount Ciremai National Park. Based on applicable laws and regulations of utilization in conservation area, species in national park are not allowed to be harvested but there were still some people who utilized plants or animals in national park illegally. The study was conducted in Mount Ciremai National Park and Cibuntu Village, Pasawahan Subdistrict, Kuningan District, West Java which is a buffer village of the national park. This research was aimed to formulate a conservation strategy, so that conservation and preservation of the area can be done simultaneously. The method used in this research was vegetation analysis and purposive sampling interview to have full understanding of its bioecological and utilization rate. The results showed that Cuing condition in nature were threatened by competition with Ipomoea sp and succession that lead to climax, made it difficult to get sun to grow. Illegal harvesting was carried out by outsiders while people in the village only utilized plant which grew in their village. Based on interview, villagers only consumed Cuing during dry season and Ramadhan. The in-situ conservation synthesis that can be done were to improve land productivity and strengthen AMAR stimulus in villagers, while ex-situ conservation synthesis that can be done by conducting cultivation in the village.

1. Introduction

Cuing (Cyclea barbata) belongs to green grass jelly product which also considered as functional food, that is raw or processed comestible contains functional compounds to support physiology functions run properly which are good for health [20]. Due to its role as food and medicine, Cuing has wide utilization range. As food, Cuing can be made to many various desserts [11]. As medicine, Cuing has already known for a long time ago to cure fever and stomach problem [2][21]. Furthermore, the bioactive compounds from Cuing are also proven scientifically to cure diabetes and malaria [3][15]. Beside of foods and medicines, pectin from green grass jelly is also have a potential as edible film and fragrance gell [13][5]. As an addition to these economic values, Cuing also has biodiversity values, which are existence value and bequest value that make it must to be conserved [7].

This potential of Cuing can be found in Mount Ciremai National Park and Cibuntu Village [4]. As a kind of protected area every animals and plants in national park area have limited access to use. This condition shows a disconjunction, where forest resources are meant to give walefare to community, yet
have been hindered by the regulation. In contrast, the paradigm of forest utilization for mass production may lead to scarcity and extinction [9]. Forest conservation is a discipline to utilize forest resources responsibly and wisely, so that the utilization of animals and plants can meet the sustainability [23]. The purpose of the study is to synthesize the conservation strategy for Cuing based on bioecology and utilization rate, so that utilization and preservation can be done simultaneously.

2. Methods

2.1. Location and Time
The study was conducted in Mount Ciremai National Park, Kuningan Management Section, at Utilization Zone and also Cibuntu Village as the nearest buffer village. The study was done in April 2019.

2.2. Materials and Equipment
Materials used in this study include interview guide and ecology tally sheet. Equipments used in this study include GPS, measure tape, camera, and flora identification book such as Flora Pegunungan Jawa [19] and Spot character: An aid for identification of families and genera [18].

2.3. Data Collection and Analysis

2.3.1. Bioecology Data
Bioecological study was done in order to understand Cuing condition and its living condition in Mount Ciremai National Park. These basic informations were collected using vegetation analysis and observation. Collected data include vegetation parameters, distribution, association and regeneration ability [10]. Vegetation analysis plot using cross square model as showed in Figure 1.

![Figure 1. Cross square plot model where second and fourth lane were used as permanent plot to collect regeneration data](image)

Analysis used in this study include vegetation parameter, Morisita distribution index, Ochiai association and regeneration. Vegetation parameter is important information to understand Cuing population in nature. The informations include density, relative density, frequency, relative frequency and importance value index [16]. These informations were used to give description about its habitat. Formulas were used in this vegetation analysis as follow:
\[ K = \frac{\sum \text{individual of species}}{\sum \text{area of all plots}} \]  \hspace{1cm} (1)
\[ KR = \frac{\sum K \times \text{all species}}{\times 100\%} \]  \hspace{1cm} (2)
\[ F = \frac{\sum \text{plot of species was found}}{\sum \text{amount of plots used}} \]  \hspace{1cm} (3)
\[ FR = \frac{F \times \text{species}}{\sum F \times \text{all species}} \times 100\% \]  \hspace{1cm} (4)

Morisita distribution index was also used to identify distribution pattern of Cuing [6]. The distribution pattern is important information to have full understanding in harvesting Cuing and impact of harvesting [10]. The formula is shown as follow:

\[ \text{Mu} = \frac{x^20.975-a+\sum x_i}{(a+1)} \]  \hspace{1cm} (5)
\[ \text{Mu: degree of uniformity} \]
\[ \text{Mc} = \frac{x^20.025-a+\sum x_i}{(a-1)} \]  \hspace{1cm} (6)
\[ \text{Mc: Degree of clump} \]

The result then is used to count Morisita’s degree (Ip) using one of these possible conditions:

\[ \text{Ip} = 0.5+0.5 \left( \frac{\text{Id}-\text{Mc}}{\text{Mc}-1} \right) \]  \hspace{1cm} (7)
\[ \text{Id} > \text{Mc} > 1.0 \]
\[ \text{Ip} = 0.5 \left( \frac{\text{Id}-\text{Mc}}{\text{Mc}-1} \right) \]  \hspace{1cm} (8)
\[ 1.0 > \text{Id} > \text{Mc} \]
\[ \text{Ip} = -0.5 \left( \frac{\text{Id}-\text{Mc}}{\text{Mc}-1} \right) \]  \hspace{1cm} (9)
\[ 1.0 > \text{Mc} > \text{Id} \]
\[ \text{Ip} = -0.5+0.5 \left( \frac{\text{Id}-\text{Mc}}{\text{Mc}-1} \right) \]  \hspace{1cm} (10)

Ochiai assosiation index was also used in this study to identify Cuing creeping host and its host reference. This information can be used as basic knowledge habitat management in preservation Cuing. Model was used in this research is quoted from Ludwig and Reynolds model [8] as folllow:

\[ OI = \frac{a}{\sqrt{a+b}\sqrt{a+c}} \]  \hspace{1cm} (11)
\[ a: \text{amount of plots where both species A and B are found} \]
\[ b: \text{amount of plots where only species A is found} \]
\[ c: \text{amount of plots where only species B is found} \]

Regeneration analysis used in this study was using simple mean statistic. This information describe the regeneration ability of Cuing, so that impact of harvesting can be reduced. Models were used for this regeneration are shown below:

\[ \overline{PU} = \frac{\sum_{i=1}^{n} PU_i}{n} \]  \hspace{1cm} (12)
\[ \overline{PU} = \text{main shoot length mean (cm)} \]
\[ PU_i = \text{length of main shoot of i individual} \]
\[ P \overline{A} = \frac{\sum_{i=1}^{n} PA_i}{n} \]  \hspace{1cm} (13)
\[ P \overline{A} = \text{axial shoot mean} \]
\[ PA_i = \text{amount of axial shoot from i individual} \]
2.3.2. Utilization Data
Utilization study conducted in order to get information about utilization rate of Cuing by Cibuntu community. Data collected by using purposive sampling interview method with condition, respondents are someone who utilize Cuing either as food or medicine. The data include intensity of utilization, source of utilization, and purpose of the utilization. These information is basic key in order to understand the utilization type and paradigm [10][9]. The analysis of these data were using simple percentage.

3. Result and Discussion

3.1. Result

3.1.1. Bioecology condition
Results show that Cuing grew in young shrub succession where was still growing to mature shrub, this shown by some seedlings grew in some areas [19]. These data showed that Cuing belongs to early pioneer species, which needs direct sun light in order to grow [10]. This species grew well in daily mean temperature on around 28°C with mean daily relative humidity around 82%-92%. The soil was observed to be composed by organic matters due to forest fire, which also left a lot of massive rock clumps in the site. Cuing found in elevation on around 562 – 592 m asl with 9° slope.

Vegetation composition in young shrub succession was composed by shrubs, terna and vines. Table 1. below shows the vegetation competition which builds Cuing habitat. The highest importance value index shown by Impatiens platypetala ssp. nematoceras. This species in Java only can be found around Mount Ciremai, Linggarjati and Ciamis [19]. Ipomoea sp also has highest importance value index in vine habit. Species from Convolvulaceae seems to be the most common species in composing shrub vegetation [19]. This species also observed to compete with Cuing in getting sun light and creeping host.

| Vernacular Name | Scientific Name | Vegetation Index Value (%) |
|-----------------|-----------------|-----------------------------|
| Terna and Shurb |                 |                             |
| Pacar air       | Impatiens platypetala ssp. nematoceras | 44.58 |
| Ki Rinyuh       | Chromolaena odorata | 36.80 |
| Babadotan       | Ageratum conyzoides | 32.94 |
| Bunga Putih     | Clibadium surinamense | 32.13 |
| Jungkut         | Paspalum sp      | 15.82 |
| Vine            |                 |                             |
| -               | Ipomoea sp.      | 65.82 |
| Cuing           | Cyclea barbata  | 50.05 |
| Gadung          | Dioscorea pentaphylla | 28.72 |
| Kahitutan       | Paederia foetida | 18.62 |
| Gadung          | Dioscorea bulbifera | 11.12 |

Interaction and association of Cuing with another species is described in Figure 2. Chromolaena odorata seems to be most associated with Cuing as creeping host with Ochai index value on around 0.92. C. odorata is an invasive species belongs to Asteraceae family which has small and light seeds, due to that C. odorata may disperse in quite wide rage [17][1]. This increase a chance of two species to interact more frequent. Beside of its role as creeping host, this species also belongs to Invasive Alien Species (IAS), foreign plant which has aggresive growth and its exisstance may cause imbalance in ecosystem [19].
Figure 2. Ochiai association index of creeping host of *Cuing*

Species in Figure 2. also can be classified into 4 type habits, such as vine, terna, seedling and shurb (Table 2). Based on table below, *Cuing* is more likely to host toward shurb than other habit. It is because shurb may give more chance for *Cuing* to get more light than terna and seedling, especially vines which may lead to competition [12]. Vine becomes the most diverse creeping host for *Cuing* because in young shurb vegetation vines become the most important component in ecosystem, this condition known as botanical cover [19]. This condition triggers *Cuing* to adapt by climbing onto other vine species as host.

### Table 2. Classification creeping host *Cuing* based on habit

| No | Habit     | Total Species                                                                 |
|----|-----------|-------------------------------------------------------------------------------|
| 1  | Vine      | 4 *P. foetida*, *Ipomoea* sp, *D. pentaphylla* and *D. Bulbifera*             |
| 2  | Terna     | 3 *A. conyzoides*, *Paspalum* sp, and *I. platypetala* ssp *nematoceras*      |
| 3  | Shurb     | 2 *C. odorata* and *Mimosa* sp                                                |
| 4  | Seedling  | 2 *Breynia* sp and *Allophylus* sp                                            |

The living condition of *Cuing* was observed to highly rely on soil, sun light and host. Soil becomes pivotal living condition because it spread unevenly due to erosion after forest fire in September 2018. This living condition explains the distribution pattern of *Cuing*. Based on Morisita distribution index, *Cuing* has clumped type distribution with Ip 0.22, due to dispersed living conditions [14]. *Cuing* was also observed to grow 8.11 cm/week with axillary shoot growth about 2.17 shoots/weeks. However, this axillary shoot growth would only happened if the main shoots were damage because of stress or eaten by caterpillar.

#### 3.1.2. Utilization rate

The utilization study held in Cibuntu Village collaborated 31 respondents, with composition 16 females and 15 males. Villagers utilize *Cuing* rarely and only in Ramadhan or dry season. This result can be seen in Figure 3. This type of utilization was affected by thier belief, that is utilizing *Cuing* in wet or rainy season may not produce as much as jelly and is not as delicious as *Cuing* which is harvested in dry season. Based on this information, it can be understood that villagers only use *Cuing* to complete their basic needs. Beside villagers, *Cuing* was also utilized by outsider which collect its leaves in Ramadhan and sold it to Cirebon and Indramayu. In contras, the utilization *Cuing* by outsider was to meet the demand of green grass jelly product in Ramadhan season. This paradigm of forest as source for mass production may lead *Cuing* to scarcity [9].
Figure 3. Intensity of utilization of Cuing by villagers

Interview shows the most common place to harvest Cuing was from nature. Villagers usually collected Cuing from rice field, yard, or near graveyard in Cibuntu Village, meanwhile outsiders collected Cuing from Karang, a name given by villagers to point Utilization Zone of Mount Ciremai National Park. This result can be seen in Figure 4.

Figure 4. Source of utilization of Cuing

3.2. Discussion

In order to synthesis conservation strategy, national park manager has to strengthen villagers AMAR stimulus conservation [22]. This concept is developed by understanding three stimulus or signals which were given by Cuing to villagers. If this signals are accepted by villagers, conservation behaviour will be formed and lead to real conservation action. Current villegers AMAR stimulus condition can be seen in Figure 5.
Figure above shows stimulus of *Cuing* has not yet fully accepted by villagers. This neglected stimulus lead to incomplete conservation behaviour where overt action are not formed. This condition causing an ignorance of forest resource especially *Cuing*, which causes lack of awareness in *Cuing* and forest conservation action.

3.2.1. In-situ conservation synthesis

Results above show *Cuing* condition in nature was in poor condition. This lead to small productivity and low quality if it happened to be utilized. Habitat management needs to be done in order to improve its productivity and its existance in nature. Habitat management recomendations that can be done are reducing *Ipomoea* sp and maintaining the succession in young shurb. Reducing *Ipomoea* sp and maintaining succession in young shurb can be done manually by cutting *Ipomoea* sp which has same creeping host with *Cuing*, while cutting down *C. odorata* and some aggresive shurbs will help to restrain succession growth.

This habitat management option may has big input, but it can be minimize by empowering villagers. Firstly, villagers must be guided by national park by utilizing *Cuing* and securing national park area [23]. The guidance include education, supervision and counseling in utilizing *Cuing* and securing national park area. Secondly, villagers need to be given legal aspect mechanism to utilize *Cuing* in national park [23]. It has to be emphasized that *Cuing* utilization in national park for economic benefits is only an access to the germplasm to support cultivation program in the village. If villagers have a good access in utilizing *Cuing*, they will have a willingness to conserve. Finnally, AMAR stimulus can be strengthen and conservation behaviour completed. This concept can be seen easily in Figure 6.
3.2.2. Ex-situ conservation synthesis

Ex-situ conservation strategy is designed to promote economic benefit in Cueng conservation. This strategy also built to support in-situ conservation in nature [23]. Cultivation is designed in Cibuntu Village in order to collaborate with Cibuntu Village tourism programs, which have already existed, as intangible economic value [7]. The first step in composing Cueng cultivation is by economic approach. Villagers have to be made sure that what they plant will give promising economic result. This step can be can be done by socializing utilization and benefits in planting Cueng with targets, such as farmer groups and communities who also utilize Cueng. The second step is to design the cultivation. It should be made by considering location, placement arrangement and facilities based on agroecoedutourism. The third step is by guiding villagers in cultivating Cueng to build villagers and other stakeholders participation [23]. Finally, when cultivation is done, it is ready to collaborate with existance tourism program and can be developed based on agroecoedutourism. This ex-situ conservation synthesis can be seen in Figure 7.

**Figure 6. In-situ conservation strategy concept**

- Education, supervision, and counseling on preservation and utilization of Cueng in Mount Ciremai National Park
- Legal aspect mechanism for villagers in utilizing Cueng for economic benefits and to fulfill basic needs
- AMAR stimulus can be strengthen and conservation behaviour formed
- Real forest conservation action can be realized

**Figure 7. Ex-situ conservation strategy concept**

- Economic approach of utilization and benefits of Cueng cultivation with a systematic product development and marketing strategy
- Cultivation design and development in Cibuntu Village based on agroecoedutourism
- Guidance of Cueng cultivation in planting, harvesting, and processing techniques to product manufacturing
- Stimulus of benefit value, religious value and behaviour aspect such as overt action is formed
- Appreciation of Cueng as a forest functional food and forest conservation action are manifested
4. Conclusion

Based on the condition above, it can be conclude that the conservation strategy must be done through in-situ and ex-situ conservation. In order to synthesize conservation strategy, the first step that national park manager must do that is to have fully understand and strengthening AMAR stimulus conservation in the village. After these stimulus accepted, In-situ conservation strategy can be built by improving land productivity by empowering villagers as participant. Furthermore, Ex-situ conservation strategy needs to be built to promote economical benefit by planning and building cultivation of Cuing in Cibuntu Village based on agroecoedutourism.

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