



## Analysis of the utilization of groundcherry (*Physalis angulata* L.) by the community around the Cibodas Resort Gunung Gede Pangrango National Park

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**Abstract.** *Groundcherry (Physalis angulata) is a medicinal plant originating from the Cibodas Resort forest, Gunung Gede Pangrango National Park. This study aimed to identify the actual potential of cecal plants and analyze perceptions, motivations, and perceptions of the impact of their utilization by the community around Cibodas Resort MGPNP. Research was carried out from September to November 2021, in Cibodas Resort MGPNP and Cimacan Village. The total number of groundcherrys found at an altitude of 1,000–1,600 masl is 148. Results of the Hawaii Pacific Weed Risk Assessment (HPWRA) for groundcherry are 20, which means they are high risk of becoming invasive in the area. The dominant characteristic of the Cimacan Village community is married to the last high school education level who works as an entrepreneur. The highest intensity utilization of the groundcherry is as an ingredient for food or drink consumption. Motivation of the community using groundcherry plants is same for religion, education, ecology, culture, recreation and society. Perceptions of impact of using groundcherry plants are uncertain to economic, social and cultural impacts. Perceptions of the ecological impact are considered disagreed by the surrounding community. Utilization by a community using a cultivation approach can be a solution to the high risk of invasiveness of groundcherry plants.*

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## INTRODUCTION

Groundcherry (*Physalis angulata*) is a plant species that belongs to the *Solanaceae* family. The *Solanaceae* Family originates in Central Europe, South Europe, and Asia (Tjitrosoepomo 1981). Most *Solanaceae* species are herbaceous with wet stems. Groundcherry has edible fruits in several regions of Indonesia that are used as medicine and fruit. The Groundcherry has hollow stems and sharp edges. The leaves were oval with a tapered tip. Leaf edges were flat and not long. Flowers are in the axils of leaves with upright stalks and are purplish, with nodding flower tips. The fruit has buns inside, which are round, elongated, and yellowish when ripe (Ritawati 2018). Groundcherry belongs to the herbaceous habitus; herbs (*terna*) are also defined as plants that have watery or soft stems because they do not form wood. Plants with little woody tissue do not have any part of the stem left on the ground when the plant dies.

This type of plant is annual, seasonal, or annual. Groundcherrys can live in tropical, subtropical, or temperate climates. This plant is also tolerant of the surrounding environment and partial shade. Groundcherrys are abundant in grasslands, plantations, fields, roadsides, open slopes, and open forest areas. Groundcherry can grow to 1,650 meters above sea level (Lim 2013). Groundcherry is included as a species that is not considered; therefore, not many people know about its benefits. *Physalis peruviana*, a plant belonging to the *Physalis* Genus at Cibodas Resort, has been declared invasive (Handayani and Hidayati 2020). Weeds are plant species that are introduced into other ecosystems. Invasive species cause biodiversity loss through species extinction and negatively impact ecosystem functions (Carford et al. 2009).

*Physalis angulata* L. is rich in polyphenols and flavonoids where flavonoids are the antioxidants found in plants that are needed by the body. The antioxidant effect of the flavonoids found in *Physalis angulata* L. can enhance the regeneration processes caused by free radicals by synthesizing competitive substrates for unsaturated lipids in membranes and accelerating the repair mechanism of damaged cell membranes (Jyothibas and Venkata 2014). Antioxidants are compounds whose function is to combat the negative effects of free radicals, which can cause damage to healthy cells. Antioxidants as neutralizers of the reactive nature of free radicals can prevent these diseases; however, the effect will be greater if consumed in their natural form. Groundcherry has been traded as a traditional medicinal ingredient in the form of dry ingredients or fresh fruit. Until now, most medicinal plant material has been taken from plants not cultivated intensively (Rengifo and Alana 2013).

Cimacan Village is the only village closest to Cibodas Resort. The wisdom of the local community in establishing a relationship with nature is generally identified in rural areas that have extensive biological areas. Many people in the area still work as farmers on special land and use their yards as a place to grow plants for their benefit, including planting medicinal plants. In the Cimacan Village area, Cianjur Regency, most people still work as farmers, and some still use medicinal plants as a cure for their health complaints. Research that discusses perceptions of utilization, motivation for utilization, and perceptions of the impact of using a groundcherry in national park areas is yet to be found. Therefore, it is important to understand the perceptions of using the groundcherry by the community, the motivation for using the groundcherry by the community, and the perception of the impact of using a groundcherry on the community, especially in the community around the Cibodas Resort area, Gunung Gede Pangrango National Park.

Research on weeds in national parks has not been widely conducted in Indonesia. Thus, this study aimed to identify the density of groundcherry plants, the invasive potential of groundcherry plants, and the use of groundcherry plants by the surrounding community, and analyze the intensity, motivation, and perceptions of the impact of using groundcherry plants at the Cibodas Resort MGPNP. In the long term, this data is important in an effort to manage weeds in the Cibodas Resort area and overcome them by encouraging people to use them conventionally. The methods used in this research included observations, interviews, and questionnaire distribution. This method was used to obtain data based on expected goals. Inventory and assessment data from the Hawaii Pacific Weed Risk Assessment (HPWRA) of groundcherry plants were analyzed to obtain data on the actual potential of the groundcherry. The results of the interviews and questionnaires were analyzed to obtain data on utilization by the surrounding community.

## **METHOD**

### **Study Area**

The research was conducted in the Mount Gede-Pangrango National Park (MGPNP), Cibodas Resort, and Cimacan Village for three months, namely September – November 2021. The selection of village locations for research was based on the consideration that the village is the only village with close access to the Cibodas MGPNP Resort. The people of Cimacan Village still use groundcherry plants as first aid for health complaints.

**Data Collection**

The tools used in this study were groundcherry plant inventory tally sheets, HPWRA tally sheets, and questionnaires. An inventory was created to determine the amount that can be found at each altitude. Quantitative data collection was performed using cruising or roaming methods. This method is carried out by exploring every corner of a location that can represent the types of ecosystems or vegetation in the area being studied (Rugayah et al. 2004). The cruising path, in the form of a long transect line, is placed following the path that has been provided, which returns to the starting point. Groundcherry passed along the route will be counted in the data on the number of individual plants (Kusmana 1997). The location of the groundcherry plant inventory was at every altitude from 1,000 to 1,500 masl. Path traversing was repeated weekly during the study period to ensure data accuracy. The width of the track is 20 meters, and the length of the path from one point to the next is 100 meters so the total path length is 1,000 meters in one elevation.

Interviews with managers were conducted to determine the invasive potential of groundcherry plants. Interviews were conducted with the community to determine the use of the groundcherry. Questionnaires were distributed using a purposive sampling method that was given directly to respondents who were willing and still used the groundcherry as medicine. The number of people who became respondents was 45 people because they were close to the normal distribution (Riduwan 2004). Questionnaires were distributed to obtain data on the intensity, motivation, and perception of the impact of groundcherry plant use by the community. The data collection in this study consisted of primary and secondary data. The type of primary data presented are data collected directly in the field and used for data processing. The data are groundcherry inventory data and analysis of cencedet utilization by the community. Secondary data are those supporting the research results obtained from various related sources. These data include HPWRA data.

**Data Analysis**

The data from Groundcherry describe physical form, taste, and use. In addition, it describes the results of an inventory of groundcherry plants found. The inventory calculated the density of species in one resort area. Species density is used to determine the density level of each group of plant species in a management area per unit of the management area. Then, the density and the average distance between plants are calculated using the equation 1. Furthermore, the results of the WRA were analyzed based on the values obtained with the provisions of the value below one low risk, 1–6 further evaluations, and above 6 high risks (Table 1). The results of this value will be considered for the utilization of the groundcherry.

$$\text{Density (K)} = \frac{\sum \text{individual plants found in the study area}}{\text{resort area extensive}}$$

Table 1 HPWRA score analysis

<b>Score</b>	<b>Information</b>
< 1	Low risk
1 – 6	Further evaluation
> 6	High risk

(Source: HPWRA 2019)

The method used for community utilization was descriptive qualitative analysis. Qualitative descriptive analysis was intended to obtain information about various field conditions, including responses and views on the community's use of groundcherry plants. Qualitative descriptive analysis was used to describe the data obtained in terms of community characteristics, perceptions of utilization, motivation for utilization, and perceptions of impact. Community utilization data were assessed using Likert (1932) assessment indicators, namely, 1–5. Each value contains a description that depends on the indicator being assessed. Community

perception indicators start with Never, Rarely, Sometimes, Often, and Always. Community motivation indicators started from Very Low, Low, Medium, High, and Very High. Indicators of community perception of impact start with Strongly Disagree, Disagree, Doubtful, Agree, and Strongly Agree. The results of the data analysis were processed in graphs and percentages.

## RESULT AND DISCUSSION

### Number and Density of Groundcherry

The amount of data is a part of the actual potential. The number of groundcherry individuals is required to determine the number of groundcherry individuals in the Cibodas Resort area as basic data to determine the density of plant species. The number of groundcherrys can be an indicator of invasiveness and the ease with which it can be obtained by the community for utilization. Found 148 groundcherry individuals in the area at an altitude of 1,000–1,600 m above sea level (Table 2).

Table 2 Number of groundcherry at each altitude at Resort Cibodas MGPNP

Location altitude (masl)	Number	Density
1,000	13	6.5
1,100	17	8.5
1,200	30	15
1,300	35	17.5
1,400	25	12.5
1,500	20	10
1,600	8	4
Total	148	74

The table above shows the number of groundcherry individuals that can be found at each altitude. The last can be found at an altitude of 1,600 m above sea level; even higher, you can no longer see the groundcherry. Groundcherry found 148 individuals in the Cibodas Resort area, covering an area of 14 ha. The highest number can be seen at 1,200–1,300 masl, with 30 and 35 individuals, respectively. The higher the altitude of the location, the less groundcherry that can be found. The results of the calculation of the type density were 74/14 ha. The presence of saplings of tree species in the forest reflects the ability of the forest to regenerate. This is also influenced by several factors, one of which is the use of plants by the community for harvesting them. Groundcherry plants are not widely harvested directly from forests. Communities tend to harvest species with direct benefits and contribute to the economy. According to Mirmanto (2014), the plant density graph is based on the explanation that the smaller the growth phase, the greater is the number of individuals. Likewise, the number of small plants found was categorized as a large number at the herb level.

### Invasive Potential of Groundcherry

The HPWRA assessment is an important benchmark for determining whether groundcherry plants are declared invasive or not. The assessment results cannot be considered the same for all regions. This is due to the environmental factors in different areas (HPWRA 2019). Based on the assessment of the points on the HPWRA, the final score was 20. The HPWRA provisions showed a value of 20 above 6, which is the final limit for a species, is declared to be at high risk of becoming invasive in an area (Table 3). In this case, groundcherry can be declared invasive in the MGPNP Cibodas Resort area. In India, one of the countries in Asia, *Physalis* has several species with inappropriate differences, the first because of its recognition as a weed and cultivated species, and the second because of the hybridization of several species. Consequently, many *Physalis* species and their natural hybrids exist as persistent weeds that affect the landscape and other tropical crops (Singh et al. 2019).

Table 3 HPWRA value of groundcherry plants at TNGGP Cibodas Resort

Question point	Assessed indicators	Score
1	Domestication/cultivation	2
2	Climate and distribution	3
3	Weed elsewhere	5
4	Unwanted trait	4
5	Plant type	1
6	Reproduction	4
7	Distribution mechanism	0
8	Tenacity/endurance	1
Total Score		20

Description: < 1 = Low risk, 1–6 = Further evaluation, > 6 = High risk

Groundcherry, also called ceplukan, is a native American plant that is widespread in tropical and subtropical regions of the world (Murali 2013). Considering its origin, America can be assumed to have experienced naturalization in many countries before Indonesia. Although it is considered a weed, this plant can be cultivated by selecting the appropriate herbicide to obtain yields with the same level of benefits as those harvested directly in the forest. In addition, choosing an appropriate herbicide can reduce crop damage from other weeds during cultivation (Khodadadi et al. 2023).

**Use of Groundcherry by The Community**

Groundcherry has several benefits for each plant part, namely the roots, leaves, and fruit. Roots and leaves are beneficial for diabetes, lumbago, colds, and stomach. The fruit is beneficial for treating epilepsy, lung disease, sore throat, canker sores, and bleeding gums, and increases immunity. The people of Cimacan Village have grievances (Table 4). This causes people not all to use the same parts and ways in consuming groundcherry plants (Table 5). This data is based on the results of interviews with the people of Cimacan Village who still use groundcherry plants.

Table 4 Procedure to use groundcherry plant parts by the community

No.	Utilized section	Disease	How to consume
1	Root	Diabetes, back pain, colds, stomach	Choose plants that have fruit and are old, remove the plants and take the roots and then clean them. Before boiling, it's better to let the groundcherry roots stand for a while until they wilt. Then boil the groundcherry roots with 3 cups of clean water, and wait until the stew is boiling and only one glass of water is left. Next, take the remaining water and strain it until it is clear from the roots, drink once a day and do it regularly.
2	Leaf	Diabetes, back pain, colds, stomach	How to consume groundcherry leaves as medicine is to choose 3-5 old plant leaves. The leaves are cleaned with running water and then boiled with about 500 ml of water. After boiling, strain the cooking water and let it cool. After that drink 2 times a day.
3	Fruit	Epilepsy, lung disease, sore throat, canker sores,	- The way to treat epilepsy/epilepsy is to consume about 10 pieces of groundcherry fruit every day.

No.	Utilized section	Disease	How to consume
		bleeding gums, increase immunity	<ul style="list-style-type: none"> <li>- The way to help lower high blood pressure/hypertension is to take groundcherry fruit of approximately 5 grams and boil it in approximately 100 ml of water for 10 to 15 minutes while stirring continuously. Then strain the cooking water and cool it for a while and drink 2 times a day.</li> <li>- The way to treat lung disease is to take all parts of the groundcherry and then clean it with running water. After that, boil it until it boils with 3 or 5 cups of water, then filter it and drink it 3 times a day regularly.</li> <li>- The way to increase immunity is by eating fresh groundcherry fruit regularly every day.</li> </ul>

Table 5 Percentage of groundcherry plant parts used by the community

No.	Utilized section	Disease	Total	Percentage (%)
1	Root	Diabetes	2	4.44
		Back pain	3	6.67
		Colds	10	22.22
		Stomach	5	11.11
2	Leaf	Diabetes	5	11.11
		Back pain	5	11.11
		Colds	10	22.22
		Stomach	5	11.11
3	Fruit	Epilepsy	3	6.66
		Lung Disease	5	11.11
		Sore Throat	10	22.22
		Canker Sores or Bleeding Gums	10	22.22
		Increase Immunity	17	37.78

Each part of the plant is beneficial for the treatment of various diseases. The roots and leaves were used for the same disease. However, the percentage of people who used it was slightly different. Cold disease had the highest percentage of utilization of roots and leaves (22.22%). In the root part for healing diabetes, it has a small percentage (4.44%) because most people do not know the benefits of groundcherry roots and leaves as diabetes medicine. In the part of the fruit, the greatest utilization is to increase immunity. People believe that consuming groundcherry fruit is the same as consuming other fruits, which can increase immunity and contain vitamins that are beneficial for the body. *Physalis angulata* is an annual plant with glabrous, irregularly serrated leaves, cross crown 0.6–1.3 mm. Without dark purple spots or with faint internal specks, the berry-green species *P. angulata* is widely distributed as a weed and may also be cultivated for a variety of uses, including medicinal, food, forage, ornamental, and other uses (Mahalakshmi and Nidavani 2014). Most people in Southwest Ethiopia choose modern medicine, and only a few of them people prefer the use of traditional medicine for all types of diseases. The reasons for choosing traditional medicine include affordability and religious affiliation (Chali et al. 2021).

### Intensity, Motivation, and Perceptions of The Impact of Using Groundcherry

The intensity of the utilization of groundcherry plants had an overall average value of 2 (Figure 1). This value indicates that the overall use of groundcherry plants in the Cibodas Resort by the community around the area is rare. The final value consists of several utilization points that also have a certain value. Rahayu (2013) showed the utilization of flora groups for medicinal plants and food and drink (consumption), which is carried out on a subsistence basis (household scale needs).

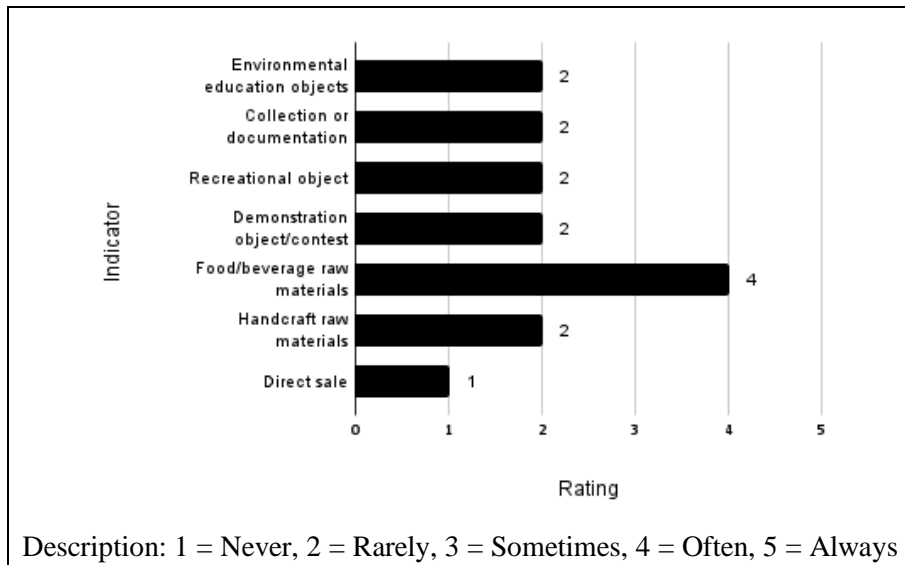


Figure 1 Graph of the intensity of use of groundcherry by the community

The motivation for using groundcherry plants gets a score of 2 (low) for one indicator and a score of 3 or moderate for the other, and the lowest is adding a source of income with a value of 2 (low) (Figure 2). These results illustrate that the basic encouragement, stimulation, influence, and stimulation of the community around the area to make use of the plants of the Groundcherry in Cibodas Resort are the same, namely religion, education, ecology, culture, recreation, and society. All medicinal plants, including *P. angulata*, are currently not available in sufficient quantities for global commercial use, as almost 100% of their supply comes from illegal harvesting (United State Forest service 2001).

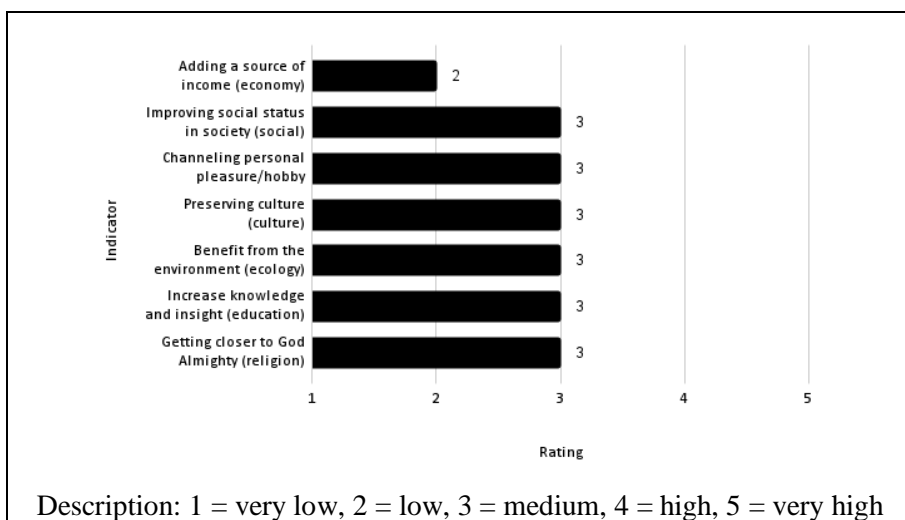


Figure 2 Graph of the motivation for using groundcherry by the local community

Based on the graph above, there are differences in the perceived value of the economic impact of using a groundcherry for the community around the area. The perception value of the form with the highest economic impact on the utilization of the groundcherry is at a score of 3 (doubtful) (Figure 3). This illustrates that the community is doubtful about whether the use of the groundcherry has an economic impact on the community according to the form of the impact.

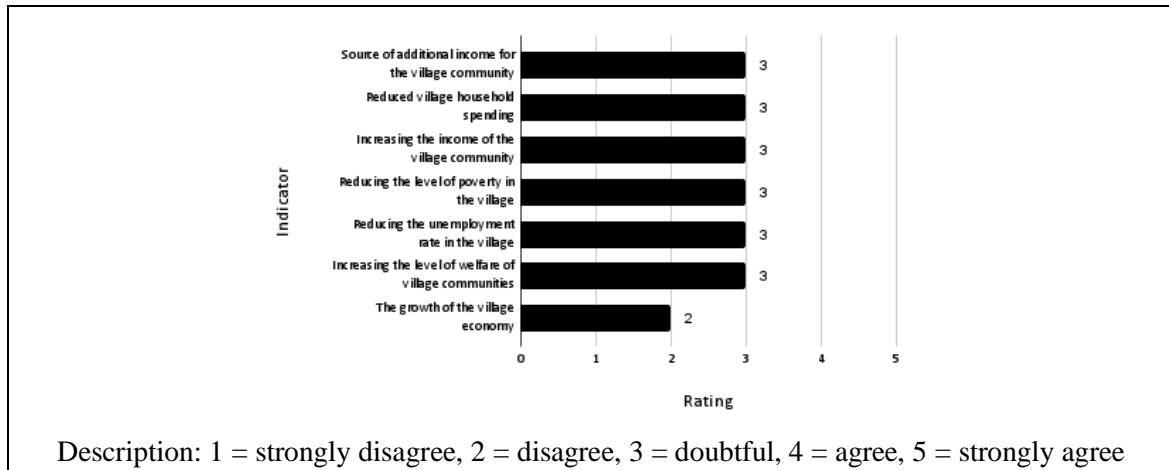


Figure 3 Graph of perceptions of the economic impact of using groundcherry by the community

The difference in results could be caused by differences in the form of utilization of the groundcherry by the community. Several forms of utilization can be considered for their impact on the community economy, such as direct sales, handicraft raw materials, food/beverage (consumption) raw materials, and recreational objects. The community does not feel that there is an economic impact, because it is not customary to sell or use conventionally. People are used to treating themselves/family/neighbors in return for food or kitchen ingredients (Eshete and Molla 2021). The graph above shows the differences in the perceived value of the social impact of using a groundcherry for the community around the area. The perception value of the highest form of social impact on the groundcherry was a score of 3 or doubtful (Figure 4). This illustrates that the community is doubtful about whether the use of the groundcherry has a social impact on society according to the form of the impact. Akhagba (2019) explains that people in Nigeria have not changed at all in the social aspect when using herbs, both in their natural form and those that have been packaged in the form of herbs.

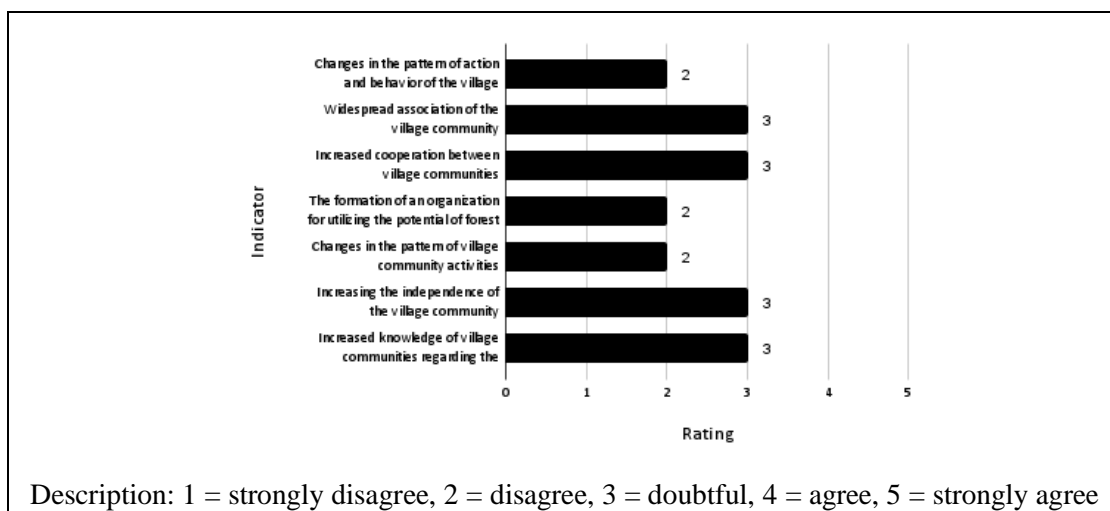


Figure 4 Graph of perceptions of the social impact of using groundcherry by the community



In the graph above, there are differences in the perceived value of the cultural impact of using a groundcherry for the community around the area. The highest cultural impact perception value was 3 or doubtful (Figure 5). This illustrates that the community is doubtful about whether the use of the groundcherry has a cultural impact on the community according to the form of the impact. Akhagba (2019) explains that people in Nigeria have not changed at all in terms of culture when using herbs, both in their natural form and those that have been packaged in the form of herbs.

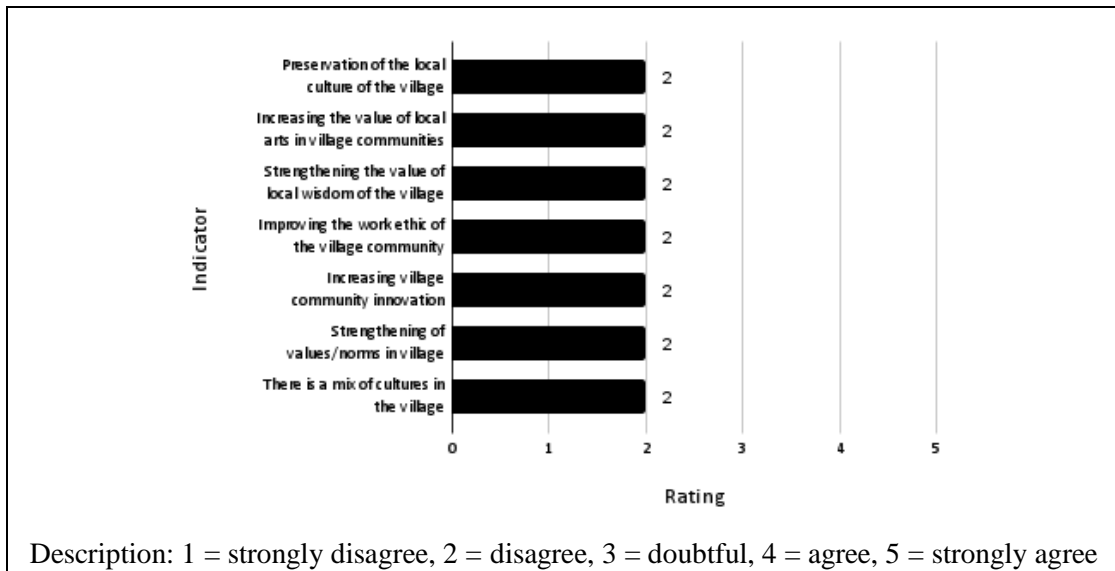


Figure 5 Graph of perceptions of the cultural impact of using groundcherry by the community

Based on the results of the graph, there was a similarity in the perceived value of the ecological impact of the use of the groundcherry by the local community at each point. The highest value for the perceived form of ecological impact was 2 (disagree) (Figure 6). This shows that the community disagrees with the ecological impact of using the groundcherry according to the form of the impact. Eshete and Molla (2021) stated that almost all medicinal plants are obtained from nature and can adapt well and do not affect the habitat. However, habitat is decreasing because of the increase in human and livestock populations.

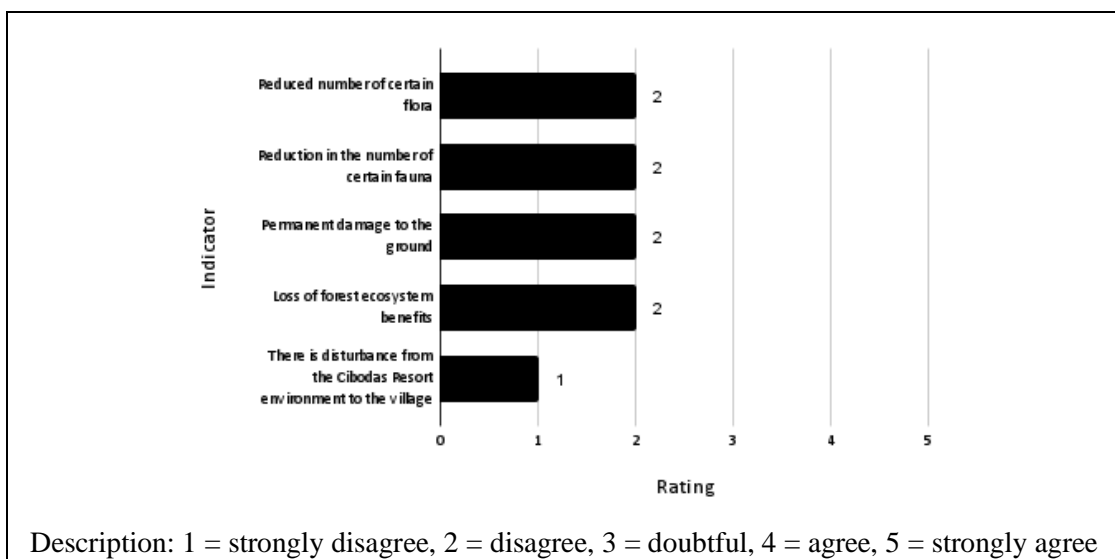


Figure 6 Graph of perceptions of the ecological impact of groundcherry utilization by local communities

Drug harvesting or healing plants, invasive species competition, habitat loss, deforestation, and climate change can affect rainfall patterns, overpopulation, global warming, and cause biodiversity loss in rural populations (IUCN 2007). In this case, the use of a groundcherry is considered to have no impact on ecology and may prevent its spread as a potentially invasive plant in the Cibodas Resort area.

## CONCLUSION

The density of the species obtained was 74/14 ha of the 148 individuals recorded during the study. The HPWRA value of short plants as an indicator of the potential for invasive plants in a location is 20, which means that there is a high risk of invasion. Currently, MGPNP is not registered as an invasive plant because its distribution has not been identified in all resorts. The people of Cimacan Village still use the groundcherry for medicine or eat it directly as a fruit. The plant parts used were the roots and leaves. It is used by first washing it and then boiling it to drink water. The other part of the plant that is used is the fruit; usually, people wash and clean it first, peel the skin, and then consume it directly. The highest intensity of use of the groundcherry by the community was as a food or beverage ingredient with a value of 4 or more.

Community motivation to utilize the groundcherry gets a score of 3 or moderate on the social, recreation, cultural, ecological, educational, and religious aspects and a score of 2 or lower on the economic aspect. The perception of the economic impact of using a groundcherry in almost all aspects was scored 3 or doubtful. The perception of the social impact of using the groundcherry has disagreed, or in numbers, was 2. The perception of the cultural impact of using a groundcherry was 2 or disagree. Perceptions of the ecological impact of using the groundcherry received a score of 2 (disagree) and 1 (strongly disagree). These results can be the basis for inviting the community to make optimal use of cultivation, such as ornamental plants and vegetables that have been cultivated by the community. However, the development of cultivation also requires management of the Cibodas Resort and Gunung Gede Pangrango National Park.

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