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The traditional ecological knowledge of the local people of Cijambu Village, Sumedang, Indonesia, on the diversity, utilization, management, and conservation of bamboo

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Abstract. *Ihsan M, Irawan B, Iskandar J. 2024. The traditional ecological knowledge of the local people of Cijambu Village, Sumedang, Indonesia, on the diversity, utilization, management, and conservation of bamboo. Biodiversitas 25: 1754-1770.* Bamboos have been known to play an important role in the socio-economic, cultural, and ecological benefits of rural people in West Java. However, many bamboo gardens have been converted to other land-use types, including commercial vegetable gardens. The study aimed to record local people's Traditional Ecological Knowledge (TEK) in Cijambu, Sumedang, West Java, Indonesia, regarding the diversity, utilization, management, and conservation of ethnobotany and bamboo. The mixed method, combining approaches with an ethnobotanical perspective, was employed in this study through semi-structured and structured interviews with informants. The study results showed a diversity of bamboo landraces with six types of bamboo identified by the community: *Awi Tali (Gigantochloa apus), Awi Gombong/Awi Surat (Gigantochloa verticillata), Awi Temen (Gigantochloa atter), Awi Bitung (Dendrocalamus asper), Haur Héjo (Bambusa vulgaris* var. *vulgaris),* and *Haur Koné*ng *(Bambusa vulgaris* var. *striata).* Bamboo has 41 uses: 3 ecological uses, 32 economic uses, and 6 socio-cultural uses. Bamboo management involves maintaining and transforming bamboo gardens into mixed gardens, combining vegetables and coffee plants to increase income. Community conservation efforts involve selective logging to ensure the sustainability and regeneration of bamboo. The conservation process is influenced by cultural beliefs and myths, such as refraining from cutting or taking bamboo on Fridays. Bamboo people believe in *Tolak Bala*, which uses *Haur Koné*ng bamboo.

Keywords: Bamboo diversity, bamboo garden conservation, bamboo utilization, traditional ecological knowledge

INTRODUCTION

Indonesia is widely known to possess for its rich biological and cultural diversity. Nowadays, many scholars have recognized a strong relationship between cultural and biological diversity, forming biocultural diversity systems. Therefore, there is a growing recognition that an emergent property of ecosystems that has experienced significant human presence and resource use over time is that they are biocultural systems. In other words, the system is jointly shaped by biological and cultural dynamics, and much of the biodiversity in village ecosystems is anthropogenic (Iskandar et al. 2023).

Regarding biological diversity, Indonesia is known as one of the tropical countries with a high diversity of bamboo (Widjaja 2019). Generally, bamboo is distributed in tropical and subtropical regions and temperate climates, often in rural and forest areas. A previous study has established that about 1,642 types of bamboo (Vorontsova et al. 2016), with 176 species found in Indonesia and 105 species endemic to the country (Widjaja 2019). This plant plays an important role in the community due to its relatively cheap and easy-to-obtain application in various fields. Bamboo is widely found around rural settlements as a versatile plant for the community. Ecologically, bamboo gardens prevent landslides, floods, and erosion, serving as the potential for developing human resources socially and culturally. Despite its modest price, bamboo has significant benefits, particularly when used sustainably to provide high economic value (Hanafi et al. 2017). Traditionally, it is used by rural communities based on local knowledge or Traditional Ecological Knowledge (TEK) and customs or beliefs (Iskandar and Iskandar 2017). However, today, due to the recent increase in population and the influence of the market economy system in rural areas, several bamboo gardens in villages are being converted into other forms, like commercial vegetable gardens (Iskandar et al. 2022).

Consequently, bamboo gardens are decreasing, along with species diversity, and there is a risk of losing ecological functions, such as carbon sequestration, maintaining the balance of hydrological systems, and controlling soil erosion. The low economic value of bamboo has resulted in the conversion of gardens into high-value plants. The demand for bamboo from the industrial sector is even higher. Although many countries have practiced bamboo cultivation, in Indonesia bamboo, bamboo tends to be allowed to grow naturally and still lacks treatment. The threat of unsustainable exploitation can cause a decrease in bamboo productivity and lead to its scarcity (Prasetyo et al. 2020). According to Hani et al. (2018), the bamboo population in several regions of Indonesia has decreased significantly, including in the

West Java area, due to the conversion of gardens into other commodities. Recognizing the potential and benefits bamboo possesses, urgent measures are required to ensure its sustainability and achieve sustainable development goals (Hanafi et al. 2017).

A study related to bamboo ethnobotany is a solution to understanding various bamboo ecosystems and changes in the social systems of rural areas. Consequently, several investigations have been carried out focusing on the use and management of bamboo gardens, specifically in the West Java area, by Hanafi et al. (2017), Partasasmita et al. (2017), Setiawati et al. (2017), Irawan et al. (2019), Irawan (2020), and Iskandar et al. (2022). The investigations examined various aspects, including using bamboo for building materials, medicines, consumption, and traditional musical instruments. One of the undocumented bamboo distribution areas in West Java province is Cijambu village, Sumedang District. Cijambu Village has a unique kite-making industry made from bamboo, which is the community's livelihood. Despite these numerous benefits, studies on using bamboo specifically for the kite industry have not been conducted. Therefore, to preserve this traditional knowledge, there is a need to investigate the knowledge, utilization, management, and conservation of community-based bamboo gardens in Cijambu Village. Therefore, this study aims to assess the TEK of the local people of Cijambu, Sumedang, West Java, Indonesia, on diversity, utilization, management, and conservation of ethnobotany and bamboo. The Cijambu village was chosen for this study because of the bamboo garden or bamboo mixed garden that has been traditionally maintained. However, the rapid development of the commercial monoculture garden may convert the bamboo gardens or mixed bamboo into commercial vegetable gardens.

MATERIALS AND METHODS

Study area

This study included data collection in bamboo forests and gardens conducted in Cijambu Village, Tanjungsari Sub-district, Sumedang District, West Java, Indonesia. Cijambu Village is located at a latitude of 6°49 47.0"S and a longitude of 107°47 31.7"E, as shown in Figure 1. Specifically, this study focused on bamboo-related aspects, emphasizing three hamlets: Jaganala, Gombong, and Pasanggrahan. The selection was purposively made based on the consideration that bamboo gardens are still dominant in these three hamlets.

Procedures

The mixed, qualitative, and quantitative methods with ethnobotanical approaches were employed in this study. This study uses a landrace as a local category for grouping the bamboo plants according to the characteristics of specific vernacular names. It is mainly based on morphological characteristics instead of genetic variations according to Western taxonomic sense or botanical taxonomy (Iskandar et al. 2023). The data collected in this study are included in many aspects, including agroecosystem, ethnobotanical, and conservation aspects of bamboo gardens. For various types and conditions of bamboo gardens, the data were collected by many means, including inventory, identification of the species diversity in the ecosystem, and health values based on interviews with informants. Data on ethnobotanical aspects, including knowledge of utilization and management related to bamboo, as well as ecological, economic, and socio-cultural use, were collected.

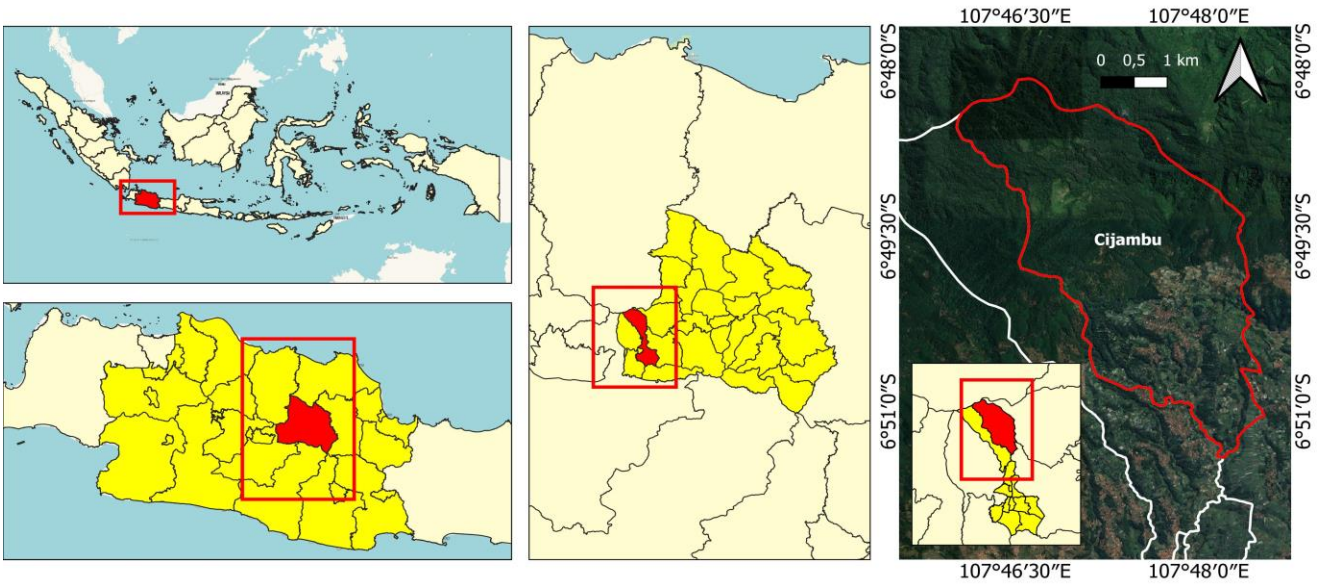

Figure 1. The location of the research site is Cijambu Village, Tanjungsari Sub-district, Sumedang District, West Java, Indonesia

Furthermore, data on bamboo garden management, including land ownership, seed selection, planting, care, and harvesting, were assembled. Some data, including local knowledge, perceptions, and strategies for bamboo garden conservation according to the community, were scrutinized in terms of conservation aspects. Recording the type of land use and diversity of bamboo species in the ecosystem was studied using the making plot method based on the plant ecological principles. The vegetation analysis method was applied to determine the structure of bamboo vegetation. In the bamboo vegetation structure study, a plot measuring 20 m × 20 m = 400 m^2 was employed as the maximum area for recording species and landraces of bamboo in the garden. In each village, 3 garden systems with a size: large, medium, and small size as representations were sampled, resulting in a total of 15 plots of 400 m^2. To comprehend the dominant species or landraces of bamboo in the garden plots, the dominance index was analyzed by calculating the dominance index using the Summed Dominance Ratio (SDR) value (Iskandar 2018).

Qualitative data, such as utilization, management, and conservation, were collected by semi-structured interviews with purposively selected competent informants. They were purposively selected from the local community of Cijambu village using criteria established by the researcher, who were local experts with a profound knowledge of various aspects of bamboo. This technique was used intentionally to select informants (Iskandar 2018). The competent informants were selected using snowball sampling by visiting and interviewing initial informants, including village heads and traditional leaders. Moreover, based on the information from the initial informants, some competent informants in the study area could be acknowledged. The total informants of this study were 12 people, consisting of village officials, traditional leaders, bamboo plantation owners, and village elders who know the utilization and management of bamboo. The informants were interviewed with semi-structured interviews; informants gave extensive responses to a series of general questions on bamboo, some of which had been prepared in advance and some of which arose naturally during the interview, for quantitative data were conducted by structured interviews with respondents using questionnaires. It was recorded that 42 families have their bamboo gardens in Cijambu village. Therefore, a total census of 42 household heads (*Kepala Keluarga*) was selected as respondents. The total respondents of this study were 42 people, and the total census was of all household heads of Cijambu village who have a bamboo garden. Each respondent was directly interviewed using the questionnaires, and all informants were asked the same questions.

Data analysis

Qualitative data from the field observations, semi-structured interviews with competent informants, and reports/village statistical data were analyzed by cross-checking, summarizing, synthesizing, and building a narrative account (Creswell 2014; Iskandar 2018). Cross-checking was carried out to validate data from one informant's information with another informant, as well as information from interviews with field observations and various reports. The validated data was then summarized and synthesized, and a descriptive-analytical narrative was made.

The quantitative data were analyzed by calculating the bamboo species diversity value, summed dominant ratio, and species used value. The species diversity index incorporates species richness and evenness into a single value. Therefore, the result of the high species diversity index means that the plot ecosystem has a high diversity of bamboo species or landraces, and those individual species were equally distributed in plots. In other words, ecosystem plots are considered a normal quality of environmental agroecological conditions or less disturbed agroecosystems. The bamboo species or landraces diversity index was calculated by the Shannon-Wiener as follows (Fath 2019):

$$H' = - \sum n_i/N \ln n_i/N$$

Where:
H' : the diversity index of Shannon-Wiener
n_i : the number of individuals of n_i species or landraces of bamboo in the community
N : the total number of individuals of bamboo in the community

To describe species distribution and species dominance of the bamboo garden was analyzed by using the SDR (*Summed Dominance Ratio*) value with the following formula as follows (Iskandar 2018):

$$SDR = \frac{FR + DR}{2}$$

Where:
SDR : Summed Dominant Ratio
FR : Relative frequency
DR : Relative dominance

To determine the use value of bamboo was calculated based on the use value of the community by using the use vale formula as follows (Iskandar 2018):

$$UV_{is} = \frac{\sum U_{is}}{n_{is}}$$

Where:
UV_{is} : Species use value
$\sum U_{is}$: Number of mentioned uses of one species or landrace of bamboo
n_{is} : Total number of respondents interviewed

RESULTS AND DISCUSSION

Bamboo and bamboo garden

Sundanese people of Cijambu village of West Java have a special term for bamboo species and their variations or landraces. The Sundanese term for bamboo generally is *awi*. Based on the Traditional Ecological Knowledge

(TEK), the various bamboo that grows in Cijambu Village can be classified (folk classification) into 2 categories, namely wild-growing (*Tuwuh Liar*) and cultivating in the mixed garden cultivation (*Kebon Campuran*) system. The wild growing category is usually found in a forest ecosystem without maintenance, while the cultivated category is often grown in agroecosystems of mixed gardens. Bamboo cultivated in the agroecosystem type may be divided into two categories: bamboo, which grows without mixing with other plant species called *Kebon Awi* (bamboo garden). The bamboos, planted with other plants, are called *Kebon Tatangkalan* (mixed-wood trees garden).

Based on the informants, the village agroecosystems consist of two main agroecosystem types: upland agriculture and wetland agriculture. The upland agriculture comprises home gardens (*Pekarangan*), gardens (*Kebun*), and mixed gardens (*Kebon Campuran*), while the wetland agriculture includes a wet rice-cultivation system (*Sawah*). The ecosystems are mainly forest ecosystems (*Leuweung* or *Rawa*). *Rawa* is specific to natural forest land unaffected by human activities such as hunting, logging, or land clearing. Generally, bamboo does not grow naturally in forests; it is planted by forest managers such as PT Perhutani officials on slopes and cliff edges to prevent forest landslides.

Dominant agroecosystem types in Cijambu village are recorded as wet-rice cultivation and garden or mixed-garden. The gardens are predominantly planted with various plants, including cabbage (*Brassica oleracea* L.), red chili pepper (*Capsicum annuum* L.), tomato (*Solanum lycopersicum* L.), leeks (*Allium fistulosum* L.), tobacco plants (*Nicotiana tabacum* L.). Various vegetable is mixed planted with perennial plants, including coffee (*Coffea arabica* L.), avocado (*Persea americana* Mill.), and pine (*Pinus merkusii* Jungh. & de Vriese); the local community plants coffee and pine in the production forest owned by Perhutani. Meanwhile, *Kebon Awi*, or bamboo gardens, are dispersed in Cijambu village. They are planted in specific special land privately owned by individual communities with various species and landraces of bamboo.

Bamboo gardens at the study location are privately owned by the people of Cijambu Village, covering areas ranging from an altitude of 1,000 to 1,300 m above sea level. Based on direct observations, bamboo is generally planted on higher land, cliffs, and the roadside of the village. Based on the structured interview with 42 respondents who own bamboo gardens showed that the total area of stands is 2,897 *Bata*, which *Bata*, *Tumbak*, or *Ru* units generally used by the community, equivalent to 1 *Bata* = 14 m^2 = 0.0014 Ha (Budiarto and Setianingsih 2019). When converted into hectares, the total area of bamboo gardens owned by the community is 4.06 Ha. This constitutes 0.30% of the total area of Cijambu village, which is 1,365.75 Ha, making privately owned bamboo gardens relatively small compared to other agroecosystem types such as rice fields at 73.12 Ha (5%) and settlements at 55.25 Ha (4%). The predominant bamboo land use type in the community is the *Kebon Awi* (bamboo gardens), evolving from the shifting cultivation (*Huma)* system to dry land (*Tegalan*), mixed-garden (*Kebon Campuran*), and bamboo gardens. The mixed-garden system can also be categorized as a permanent and non-permanent mixed garden. The permanent mixed garden (*Talun*) is rarely cultivated for planting annual crops, while the non-permanent mixed garden, the mixture mixed garden, typically lasts around 5 years followed, and can be converted to planted perennials such as bamboo and mango (Iskandar et al. 2023).

Diversity of bamboo species and landraces

Based on the folk classification, the local people of Cijambu village have recognized 4-5 levels of bamboo (Table 1). At level 0, local people can recognize various wild or non-cultivated plants (*Tutuwuhan*) and cultivated plants (*Pepelakan*). At level 1, life form, local people can distinguish the life forming of plants, namely trees (*Kakayon*), herbs (*Rungkun*), lianas (*Areuy*), and grass (*Jukut*). At level 2, folk genus/generic, various types of bamboo (*Awi*) and non-bamboo, such as various types of wood *(Kai*), tubers (*Beubeutian*), and others. Local people know various bamboo landraces at the specific/species level, including *Awi Haur*. In addition, the local people distinguish bamboo at the varietal level, such as *Awi Haur Héjo* and *Awi Haur Konéng* (Table 1).

Table 1 shows that the local people of Cijambu village, Sumedang, like the rural Sundanese people, generally have very rich knowledge about plant classification, including bamboo, at 4-5 levels (Iskandar 2018). Thus, based on local people knowledge shows five distinct landraces, namely species as identified *Awi Tali*, *Awi Bitung*, *Awi Surat* or *Gombong Héjo*, *Awi Temen*, *Haur Héjo*, and *Awi Haur* or *Haur Konéng* (Table 2).

Table 1. Folk classification of bamboo based on the Cijambu village community, Cijambu Village, Tanjungsari Sub-district, Sumedang District, West Java, Indonesia

Level	Class	Local term of Cijambu people/Sundanese	Rank*)
0	Plant/Crop	*Tutuwuhan/Pepelakan*	Unique beginner
1	Tree	*Tatangkalan*	Life form
2	Kind of bamboo and non-bamboo tress	*Tangkal Awi* and *Tatangkalan*	Generic
	Bamboo	*Awi*	
3	Bamboo	*Awi Tali* *Awi Haur* *Awi Temen* *Awi Bitung*	Species
4	Bamboo	*Haur Héjo* *Haur Konén*	Specific/varietal

Note: *Adapted from Berlin et al. (1973) and Iskandar (2018)

Table 2. Bamboo is based on emic and ethics, and the scientific name

Vernacular name	Meaning*	Signs according to local community (emic)	Signs according to scientific (etic) **	Scientific name
Awi tali	*Awi*: bamboo; *tali*: rope (tool for tying)	Green culm color Height 10-25 m Medium to large culm size Culm straight Shoots are not eaten	Green culm with a height of 22 m and straight. Trunk diameter 5-10 cm The midrib of the culm does not shed easily and is covered with black or brown feathers Green shoots covered with brown and black feathers	*Gigantochloa apus* (Schult.f.) Kurz
Awi Surat/ Gombong	*Gombong*: This type of bamboo is large, as big as a thigh; *surat*: large-diameter bamboo	The color of the culm is green, and there is a yellow stripe Height 10-20 m Large culm size Hard and rigid culm Edible bamboo shoots	The culm reaches 22 m in height and is erect with a green color of yellow stripes. Trunk diameter 5-13 cm The culm midrib is covered with white feathers and sheds easily; the ears of the culm midrib are frame-like, with a height of 2.5 mm. Green shoots, covered with brown and black	*Gigantochloa verticillata* (Willd.) Munro
Awi Temen	*Temen*: really/absolutely	Culm color is green with black patches Height 10-15 m Medium to large culm size Edible bamboo shoots	The culm reaches 22 m in height and is erect. The color of the culm is light green with black plumage. Trunk diameter 5-10 cm The culm midrib is covered with white feathers and sheds easily; the ears of the culm midrib are frame-like, with a height of 2.5 mm. Green shoots, covered with brown and black	*Gigantochloa atter* (Hassk.) Kurz
Awi Bitung	*Bitung*: large-diameter bamboo with thick culm	Culm color is dark green Height 15-25 m Medium to large culm size with thick culm Edible bamboo shoots	Culm reaches 20-30 m in height, upright and curved. Culm color is dark green or purplish green or whitish-green. The diameter of the stem is 12-18 cm, with a thickness of 30 mm. Solid roots surround the books. The bottom of the young culm is covered like velvet. The midrib of young culms sheds, covered with black to dark brown feathers. The shoots are purplish black, covered with brown to blackish velvety fur.	*Dendrocalamus asper* (Schult. f.) Backer ex K. Heyne
Haur Héjo	*Haur*: bamboo with thick and bent culm; *héjo*: green	Green culm color Height 5-15 m Medium culm size Thick, rigid culm with a slippery surface Edible bamboo shoots	Culm reaches 20 m in height, erect or slightly bicurious The diameter of the culm is 5-10 cm with a thickness of 7-15 mm. Glossy green light/dark culm color The midrib of young culms sheds, covered with black to dark brown feathers. The ears of the culm midrib are rounded with the tip curved outward, with a height between 1-1.5 cm Culm midrib leaves erect, triangular with a widened base Green or yellow shoots covered by brown to black culms	*Bambusa vulgaris* Schard. ex J.C. Wendl. var. *Vulgari*
Haur Konéng	*Konéng*: yellow	Culm color yellow with a green stripe Height 5-15 m Medium culm size Thick, rigid culm with a slippery surface Edible bamboo shoots	Culm reaches 20 m in height, erect or slightly bicurious The diameter of the culm is 5-10 cm with a thickness of 7-15 mm. The color of the culm is yellow striped with green. The midrib of young culms sheds, covered with black to dark brown feathers. The ears of the culm midrib are rounded with the tip curved outward, with a height between 1-1.5 cm Culm midrib leaves erect, triangular with a widened base Green or yellow shoots covered by brown to black culms	*Bambusa vulgaris* Schard. ex J.C. Wendl. *var. striata* (Lodd. ex Lindl.) Gamble

Note: *:Hendrayana and Ismail (2019), **: Damayanti et al. (2019)

Moreover, based on the local people's classification of folk classification, various bamboo landraces can be divided into various characteristics, including stem color, diameter, thickness, presence of edible bamboo shoots, and the type of use or functions. For example, the color of culms is distinguished as *Awi Gombong Héjo* (*Gigantochloa verticillata* (Willd.) Munro) from green culm (*Héjo*). At the same time, *Haur Koněng* is recognized by the yellow color of the stem (*Koněng*). Regarding the thickness of bamboo sticks, *Awi Gombong Héjo* (*G. verticillata*) and *Awi Tali* (*Gigantochloa apus* (Schult.f.) Kurz) have thick and thin stems, respectively. In addition, bamboo shoots of *Awi Tali* (*G. apus*) are usually not consumed. In contrast, those from *Awi Haur Koněng* (*Bambusa vulgaris*), *Awi Bitung* (*Dendrocalamus asper* (Schult.f.) Backer), and *Awi Temen* (*Gigantochloa atter* (Hassk.) Kurz ex Munro) are edible based on local knowledge (Irawan 2020; Ihsan et al. 2023).

Table 2 shows that indigenous classification has similarities with scientific botanical classification; for example, bamboo is classified based on the culm's morphology, such as color, surface texture, and diameter size. However, there are differences; for example, the resident classification is differentiated based on its benefits, uses, and whether bamboo shoots can be eaten. Meanwhile, botanical classification is primarily based on morphology but can also be based on anatomy, biochemistry, and genetics. Morphologically, each bamboo species has distinctive features such as density, surface, and wall thickness differences. Therefore, bamboo species morphological characterization is based on stem base and stem-node internode characters (rhizome type, branching, growth habit, primary bud per mid-stem, and nodal line position). Identification parameters on growth habits, culm internodes, nodal structure, young shoots, and flowering events described the distinctiveness of bamboo species. Several types of bamboo contain coumarins, saponins, steroids, terpenoids, and quinones (Opeña et al. 2023). Species characterization through DNA barcoding is a more appropriate method for identifying and certifying bamboo species. Genetic characterization assesses the genetic diversity among identified bamboo species based on DNA fingerprint profiles and morphological traits (Yeasmin et al. 2015; Elejoste et al. 2021).

Based on an analysis of the species/landraces diversity index of bamboo by Shannon-Weiner in the mixed-garden plots, it was recorded at 2.945. This diversity index value is considered moderate according to the criteria for elaborating values by Odum (1996) cited by Fath (2019). This means that the species richness and bamboo distributed in the plots/mixed garden are considered moderate or tend to be lower. Regarding diversity richness, for example, the diversity of bamboo species in Cijambu Village, with 5 species, is relatively lower compared to other areas in West Java; in Karangwangi Village, Cianjur District, Kampung Naga, Tasikmalaya District, and Sukamenak, Sumedang District, recorded 13, 7, and 9 bamboo species, respectively (Partasasmita et al. 2017; Irawan et al. 2019; Iskandar et al. 2022). The bamboo diversity in Cijambu Village is considered low due to various factors, including many bamboo gardens that have been converted to commercial monoculture vegetable gardens. In addition, due to the intensive monoculture of commercial vegetables, some forest areas in the village have been replaced with commercial vegetables. Commercial vegetables have rapidly developed in the Cijambu village due to many factors, including the village area being a highland with cold weather and fertile soil that is considered suitable for planting various vegetables. In addition, the Cijambu village is not too far from town and has relatively good transportation access. As a result, the products of the monocultural vegetable farming system are easily traded to the urban markets. In addition to planting vegetables, the local community predominantly cultivates bamboo due to its numerous benefits for daily life regarding socio-economic and ecological functions.

Moreover, regarding the bamboo vegetation composition, as shown in Table 3, the three species/landraces of bamboo with high SDR values are *Awi Tali*, *Awi Surat/Gombong*, and *Awi Haur/Haur Koneng*. The landrace of bamboo with the highest SDR value is *Awi Tali* (*G. apus*) (57.58%), with many individuals and a wide distribution. *Awi Tali* is a bamboo type widely used by people in various regions of West Java, including Karangwangi Village, Cianjur, and Kampung Naga, Tasikmalaya, respectively (Partasasmita et al. 2017; Irawan et al. 2019). The *G. apus* is one of three bamboo species Indonesians often use; others are *G. atroviolacea* and *G. Verticillata* (Widjaja 2019). According to Borowski et al. (2022), bamboo species is often used as raw material throughout economic activities, especially in the construction, textile, and alternative food ingredients.

Socio-economic utilization

People in rural areas use bamboo by trading stems or processing special bamboo for revenue. In recent years, bamboo has become increasingly recognized as a valuable resource for economic development, particularly cultivation and processing activities. The bamboo's major economic benefit is the potential for job creation for several community members (Isukuru et al. 2023), such as selling directly and processing per culm or processing into finished products obtained through purchases from community-owned gardens or purchased from outside the village. Based on interviews with bamboo garden owners, several utilizations have been carried out and processed for various purposes, as shown in Table 4.

Table 3. SDR value of bamboo species in Cijambu Village, Sumedang District, West Java, Indonesia

Types of bamboo		SDR value (%)
Vernacular name	**Scientific name**	
Awi Tali	*Gigantochloa apus*	57.58
Awi Surat (*Gombong Héjo*)	*Gigantochloa verticillata*	14.36
Awi Temen	*Gigantochloa atter*	2.94
Awi Bitung	*Dendrocalamus asper*	6.76
Haur Héjo	*Bambusa vulgaris* var. *vulgaris*	6.41
Awi Haur (*Haur Koněng*)	*Bambusa vulgaris* var. *striata*	11.95

Table 4. Various types of economic utilization of bamboo

Types of utilization	Types of bamboo	Utilization description	Parts used
Utilization of bamboo as raw material for making kites			
Rarancang	*Awi Tali*	Kite frame	*Leunjeur*/culm
Utilization of bamboo as woven and household appliances			
Aseupan	*Awi Tali*	Rice cooker/rice steamer container	*Leunjeur*/culm
Giribig	*Awi Tali*	Rice drying mat	*Leunjeur*/culm
Boboko	*Awi Tali*	Rice storage container/rice basket	*Leunjeur*/culm
Tampir	*Awi Tali*	Drying container for raw food	*Leunjeur*/culm
Hihid	*Awi Tali*	Rice fan/grilling fan	*Leunjeur*/culm
Nyiru	*Awi Tali*	Rice fire container/tray	*Leunjeur*/culm
Dingkul	*Awi Tali*	Vegetable container basket	*Leunjeur*/culm
Cécémpéh	*Awi Tali*	Small container/tray for condiments or cakes	*Leunjeur*/culm
Songsong	*Awi Tali*	Blower pipe to raise fire	*Leunjeur*/culm
Utilization of bamboo as a construction and building material			
Pager	*Awi Tali*	Fence at the boundary of the land/house	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Fence at the boundary of the land/house	*Leunjeur*/culm
	Awi Temen	Fence at the boundary of the land/house	*Leunjeur*/culm
Pager Kebon	*Haur Konéng*	Fencing in the garden	*Leunjeur*/culm
	Haur Héjo	Fencing in the garden	*Leunjeur*/culm
Usuk Bumi	*Awi Tali*	Supports the roof structure of the house	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Supports the roof structure of the house	*Leunjeur*/culm
Eréng	*Awi Gombong/Awi Surat*	Roof support	*Leunjeur*/culm
	Awi Temen	Roof support	*Leunjeur*/culm
Tihang	*Awi Gombong/Awi Surat*	Stage support pole and flagpole	*Leunjeur*/culm
	Awi Temen	Stage support pole and flagpole	*Leunjeur*/culm
Sasak/Bilik	*Awi Tali*	Woven walls of the house	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Woven walls of the house	*Leunjeur*/culm
Palupuh	*Awi Gombong/Awi Surat*	The floor of the house on stilts	*Leunjeur*/culm
	Awi Bitung	The floor of the house on stilts	*Leunjeur*/culm
Darurung	*Awi Gombong/Awi Surat*	Stilt house floor support	*Leunjeur*/culm
Utilization of bamboo in supporting agricultural activities			
Tuturus	*Awi Tali*	Propagating vegetables and supporting structures	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Propagating vegetables and supporting structures	*Leunjeur*/culm
	Awi Bitung	Propagating vegetables and supporting structures	*Leunjeur*/culm
Pancuran	*Awi Gombong/Awi Surat*	Water pipes	*Leunjeur*/culm
Sundung/Pikulan	*Awi Tali*	Containers for lifting or carrying grass and foliage	*Leunjeur*/culm
Kompos/Pupuk	All types of bamboo	Used as a natural fertilizer for plants	Leaf litter
Utilization of bamboo in supporting farming activities			
Paranjé/Kandang Hayam	*Awi Tali*	Chicken coop	*Leunjeur*/culm
Kurungan Hayam	*Awi Tali*	Hood for confining chickens	*Leunjeur*/culm
Kandang Sapi	*Awi Tali*	Cowshed Structure	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Cowshed Structure	*Leunjeur*/culm
Paranjé/Kandang Domba	*Awi Tali*	Sheepfold Structure	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Sheepfold Structure	*Leunjeur*/culm
Kandang Manuk	*Awi Tali*	Bird cage	*Leunjeur*/culm
Species of bamboo used as food ingredients			
Iwung/Boros	*Haur Konéng*	Bamboo shoots for vegetable cooking ingredients	Shoots
	Haur Héjo	Bamboo shoots for vegetable cooking ingredients	Shoots
	Awi Bitung	Bamboo shoots for vegetable cooking ingredients	Shoots
	Awi Temen	Bamboo shoots for vegetable cooking ingredients	Shoots
	Awi Gombong/Awi Surat	Bamboo shoots for vegetable cooking ingredients	Shoots
Economic utilization of bamboo for other purposes			
Suluh	All types of bamboo	Materials for firewood	*Leunjeur*/culm and branch
Sampayan/Jemuran	*Awi Tali*	Clothesline support	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Clothesline support	*Leunjeur*/culm
Tarajé	*Awi Tali*	Multipurpose staircase	*Leunjeur*/culm
Tihang Antene	*Awi Tali*	Antenna mast Television	*Leunjeur*/culm

Interviews with bamboo garden owners also showed a range of bamboo prices for each type. Generally, the community sells three species of bamboo categories: *Awi Tali*, *Awi Gombong/Surat*, and *Awi Bitung*. *Awi Tali* has the most varied prices, from IDR 5,000 to IDR 8,000, and is predominantly used by the community. Based on the information obtained, bamboo's price range is related to the stem diameter size. The next category is the price range for *Awi Gombong/Surat* and *Awi Bitung*, which have large stem diameters. For *Awi Gombong*/culm, the price is IDR 20,000 to IDR 30,000, while *Awi Bitung* is around IDR 20,000 to IDR 25,000. Some owners keep *Awi Bitung* in their gardens due to personal use and not intent to sell, and other bamboo that is not sold are *Awi Temen*, *Haur Konéng*, and *Haur Héjo*. Based on the information obtained, *Awi Temen* is not sold due to limited availability in community-owned gardens. At the same time, *Haur Konéng* and *Haur Héjo* are used for soil reinforcement and for constructing garden barriers.

One unique knowledge of the people in Cijambu Village is how to make kites. The kite-making industry in Cijambu Village provides several socio-economic benefits for industrial owners and workers. The village kite industry provides revenue for plantation owners who supply bamboo for kite production and villager kite workers. Some workers in the village rely on the kite industry as their main income source, while others are alternatively (Ihsan et al. 2023). Moreover, men in the village work as vegetable farmers and cultivate rice fields, while women stay at home. However, many wives are also kite-making laborers, vegetable farmers, and bamboo harvesters during their spare time. Additionally, the harvested bamboo is transported to production sites, sold by plantation owners, or purchased by village kite industry traders, as shown in Figure 2.

Based on interviews with informants in several locations with various types of use, the Cijambu Village people use bamboo as woven, and household appliances are still found. Although some people already use modern household appliances made of plastic and aluminum, some still use bamboo. Bamboo is a versatile and sustainable building material; however, like any other building material, it comes with its own set of challenges. One of the main challenges is its susceptibility to pests and moisture damage. This can be overcome with proper care and processing techniques, such as boiling or pressurizing the bamboo to make it more resistant to pests and decay.

Several types of woven bamboo and household utensils were found at the research site, such as *Giribig* (rice drying mat), *Tampir* (raw food drying container), *Boboko* (rice basket), and *Dingkul* (vegetable container) (Figure 3). Although utilizing several types of woven and household utensils from bamboo, none of the people in Cijambu Village specifically produce woven and household products from bamboo. Based on interviews with informants, most woven products and household appliances are purchased from outside villages such as Nagarawangi Rancakalong Village and Kadakajaya Village, which specialize in producing wicker that only blowing pipes are made by the community.

Figure 2. A. The process of cutting bamboo, B. The process of bringing bamboo from the garden to the production site, C. The process of knitting bamboo, D. the process of tying the kite frame

Figure 3. Some woven bamboo used by the community for household appliances: A. *Giribig*, B. *Tampir*, C. *Boboko*, D. *Dingkul*

Other West Java communities, especially the people of Kampung Naga Tasikmalaya (Irawan et al. 2019), the people of Karangwangi Cianjur Village (Partasasmita et al. 2017), the people of Putrajawa Selaawi Garut Village, the people of Nagarawangi Village Rancakalong Sumedang (Irawan 2020), and the people of Sukamenak Sumedang Village (Irawan 2020; Iskandar et al. 2022) are also used bamboo as woven and household appliances. If the people of Cijambu Village have no woven craftsmen, then some of these communities' artisans specialize in woven bamboo making. Bamboo is also used as the main material for constructing buildings in rural communities due to its cheaper price and lighter weight. According to

Phimmachanh et al. (2015), it has a similar role to wood, almost serving as a substitute for the main material used in building construction. The people of Cijambu Village know how to use bamboo in building construction. Bamboo also has good potential for environmentally friendly development; according to Yasin and Priyanto (2019), bamboo has become one of the ecological materials in fulfilling green building; on the contrary, the existence of bamboo as an architectural material began to be eroded by the development of modern technology. Despite the erosion of bamboo as the main architectural material due to modern technology, using bamboo as one of the main materials in buildings is still carried out by some people in Cijambu Village, such as fences, poles, and a house floor.

The bamboo used as agricultural equipment by the community is mostly used as *Tuturus* or propagation media for vegetable crops such as tomatoes, chili, cucumbers, and pumpkins. Besides its use as a propagation medium, bamboo is also used as a water channel for irrigation in the garden; bamboo is also used to make it into a container to carry grass or leaves. Lastly, the bamboo stem is also used as plant compost. People in Cijambu Village use three types of bamboo as *Tuturus*: *Awi Tali*, *Awi Gombong /Awi Surat*, and *Awi Bitung*. Based on information from the community, *Tuturus* from *Awi Tali* is usually used for tomatoes and chili.

In comparison, *Tuturus* from *Awi Gombong/Awi Surat* and *Awi Bitung* are used on cucumber and chayote plants, but some people use *Awi Tali* as tomato *Tuturus*. According to the community, *Awi Tali* has more strength and durability as a *Tuturus* than others. The *Tuturus* length differs according to the plant types: Tomatoes measure 180 cm long, chickpeas 200 cm, chili 120 cm, and eggplant 150 cm. *Tuturus* in pea plants generally has a longer size of up to 300 cm, longer than in other vegetable plants. The *Tuturus*-making method is by cleaning the bamboo stems first, then the bamboo is mashed, split in four, and cut according to the required size. Finally, one bamboo end is pointed to plug into the ground easily (Figure 4), and each stalk of *Tuturus is* valued at around IDR 2,000-4,000 to be sold to farmers around the village.

The community has long used bamboo shoots as a traditional food ingredient. In West Java, bamboo shoots are known as *Iwung* but are recognized as useful materials in Cijambu Village. Generally, people search for bamboo shoots in gardens and forest areas for vegetable side dishes. Based on observation, out of the 6 types of bamboo in Cijambu Village, only 5 are used by the community, namely *Haur Konéng*, *Haur Héjo*, *Awi Bitung*, *Awi Temen*, and *Awi Gombong/Awi Surat*. The people in Cijambu Village know how to process bamboo shoots, which have been passed on for generations, specifically to teenage girls, when cooking with their mothers. This inheritance was comprehensive because fathers handled the harvesting and cleaning stages while mothers cooked.

Figure 4. Utilization of bamboo in agricultural activities: A. bamboo sticks to make *Tuturus*, B. ready-made *Tuturus*, C. tomato *Tuturus*, D. cucumber *Tuturus*, E. pumpkin *Tuturus*

The community does not consume bamboo shoots Awi Tali because they have a bitter taste and are not convenient for consumption, so from all respondents, no one consumes them. The cause of the bitter taste in bamboo shoots is that there is cyanide acid (HCN) content, which is a dangerous ingredient both for humans and animals; it is reported that fresh bamboo shoots contain cyanide as high as 25 mg kg^{-1}, while cyanide content in dried, canned or boiled bamboo shoots is about 5.3 mg kg^{-1}. The presence of cyanide acid produces bitterness in bamboo shoots, limiting its edible value. The acute lethal dose for humans is 0.5-3.5 mg kg^{-1}. Therefore, approximately 25-175 mg of free cyanide from bamboo shoots is the lethal dose for an adult man. Hence, cyanide in edible bamboo shoots must be confirmed at low concentrations according to its severe toxicity before consumption (Ding and Wang 2018). According to the community, the best bamboo shoots taste is the *Haur Koneng* and *Haur Héjo* type because of its sweet taste. Darmawan and Sutiyono (2021) explain that bamboo shoots in *Bambusa vulgaris* Schrad. ex J.C.Wendl. have a slightly bitter taste with a rough texture. The community is usually harvested at bamboo shoots at 3 months from the first growth. Bamboo shoots can be harvested and consumed only with a maximum size of 50 cm; this is related to the community's belief that they should not take something excessively from nature to determine the limitations of using natural resources, one of which is bamboo shoots.

Moreover, most people in Cijambu Village know how the bamboo shoot process is. Knowledge about bamboo shoot processing is passed from parent to child, especially teenage girls, while cooking with their mothers. The fathers carry out the harvesting stage, cleaning until ready to cook, while the mothers cook until ready to eat. The bamboo shoot processing starts with cutting bamboo shoots from bamboo clumps, then cleaning of adhering dirt, tidying up, brought to the house, and then pouring with hot water, after soaking with cold water that has been boiled for 4-5 hours, then flooded again with hot water and transferred to another container, then washed with boiled water and let stand overnight; after that, the bamboo shoots are ready for consumption either cooked or fried. The soaking and washing process with hot water aims to reduce cyanide acid levels contained in bamboo shoots; this is in line with Ding and Wang (2018), that boiling bamboo shoots proved to be effectively correlated in reducing cyanide levels after treatment for safer consumption.

Cijambu Village people still use traditional cooking methods with wood and bamboo, as well as LPG gas cylinders. *Suluh* is the remaining bamboo pieces from stems and branches that are generally used for cooking to start fires. The community also uses bamboo as an alternative fuel when LPG gas runs out; all bamboo reeds or sticks can be used as firewood and do not require special processes (Liana et al. 2017). The use of bamboo by the community in their daily life is not limited to the categories mentioned above; its utilization in other aspects is also done, such as firewood, clothes clotheslines, ladders, and television antenna masts.

Socio-cultural utilization

The types of bamboo that grow in the community's environment not only bring ecological and economic benefits but also benefit the community's socio-cultural interests. The ecological history of bamboo cannot be separated from cultural activities such as traditional ceremonies or myths owned by villagers (Iskandar et al. 2023). Table 5 shows that People in Cijambu Village use bamboo socio-culturally for cultural rituals.

The community's use of bamboo for cultural ritual activities does not distinguish it from other regions, especially in West Java. It is used as a flagpole, pennant pole, and competition pole when commemorating the Independence Day of the Republic of Indonesia (Figure 5).

Figure 5. A. Bamboo is used for *Janur* wedding events, B. Bamboo is used as a torch handle and flag on torch parades in commemoration of the Islamic New Year

Table 5. Various types of socio-cultural use of bamboo

Types of utilization	Types of bamboo	Utilization description	Parts used
Flagpole	*Awi tali*	Used during national holiday celebrations	*Leunjeur*/culm
August race pole	*Awi tali*	Used during the celebration of Indonesia's Independence Day	*Leunjeur*/culm
	Awi Gombong/Awi Surat	Used during the celebration of Indonesia's Independence Day	*Leunjeur*/culm
Pennant pole	*Awi tali*	Used during the celebration of Indonesia's Independence Day	*Leunjeur*/culm
Pole	*Awi tali*	*Janur* pole during a wedding	*Leunjeur*/culm
Torch handle	*Awi tali*	Used during celebrations of Holidays such as Islamic New Year Commemoration	*Leunjeur*/culm
Tolak Bala	*Haur Konéng*	Planted in front of the house to avoid bad things	All

Figure 6. A. A child helps his mother make *Rarancang*, B. The direct practice of making *Rarancang* by a teenager accompanied by his parents, C. Children and teenagers are playing with kites

The Cijambu Villagers believe in using bamboo as a protector from bad things, known as *Tolak Bala*. People harvest and take any part of bamboo by praying for permission from the creator and nature itself. People also believe in not cutting or taking bamboo on Fridays. In addition, people use *Haur Konéng* bamboo to believe in *Tolak Bala*. People believe planting *Haur Konéng* around the residence will avoid bad things or *Bala*. Ecologically, planting *Haur Konéng* bamboo around residences, especially in settlements on the slopes or cliffs, has a positive impact. The *Bambusa* mat-like roots are tightly woven with underground roots and rhizomes, effectively maintaining the soil structure. Higher coarse root intensity in *B. vulgaris*, *Bambusa bambos* (L.) Voss and *Bambusa balcooa* Roxb. indicate their usefulness in supporting the plant and providing slope stability more efficiently.

Further, *B. bambos* can be suitably planted in areas prone to biotic disturbances and soil erosion (Kaushal et al. 2020). The Baduy community of Kanekes Village, Leuwidamar Sub-district, also uses bamboo as a belief to *Tolak Bala*, known as *Jukut Sadané* (Irawan 2020). This belief in bamboo as an antidote to bad things also exists in communities outside West Java, such as the people of Mobui Village, Sanggau District, who make *Entongap* (a kind of talisman) from *B. vulgaris* bamboo as a repellent of all dangers (Riswan et al. 2022).

The people of Cijambu Village run a kite frame business (*Rarancang*) from bamboo, forming a biocultural system characterized by strong relationships between biology (bamboo), culture, and linguistics. The same concept is also found in the community of Karangwangi Cianjur Village, where bamboo is one of the species that impacts the socio-cultural and serves as a cultural buffer (Partasasmita et al. 2017). The bamboo used is *Awi Tali* (*G. apus*), one of the species components in bamboo gardens, culturally used by the community to make kite skeletons based on local know-how transmitted orally with the linguistics around the Sundanese regional language users. Therefore, a close relationship exists between cultural, linguistic, and biodiversity in rural ecosystems (Maffi and Dilts 2014). Regarding the social system, community knowledge in managing and using bamboo as a material for making kites is passed down from parent to child. This was the local knowledge method transfer to Cijambu Village culture (Figure 6). In the kite industry, it is important to ensure that labor exploitation and gender inequality do not exist in the division of labor. This can be achieved through fair labor practices, such as paying fair wages, providing safe working conditions, and promoting gender equality in the workplace. In addition, supporting organizations that promote social and environmental sustainability in the kite industry can help ensure that the industry is beneficial to people and the planet.

Ecological functions

People in Cijambu Village use bamboo gardens to manage various damages due to existing environmental conditions. According to informants, knowledge of bamboo's ecological benefits was obtained through parents' use and management experience. The community recognizes three types of ecological benefits of bamboo: soil structure reinforcement (pamageuh), hydrological or water cycle maintenance (*Ngajaga Cai*), and cooling the environment (*Niis Lembur*) (Table 6).

The community uses bamboo *Haur Konéng* (*Bambusa vulgaris* var. *striata* (Lodd. ex Lindl.) Gamble) and *Haur Héjo* (*Bambusa vulgaris* var. *vulgaris*) for soil structure reinforcement. *Haur* bamboo is generally planted in steep soil conditions, such as on the cliff side around the house or bamboo garden, to minimize soil shift due to landslides. In other areas in West Java, the people of Kanekes Village, Nagarawangi Village, and Putrajawa Village also use *Haur* bamboo for ecological functions to strengthen soil structure using the term *Ngarucuk* (Irawan 2020). The people of Gununglurah Village, Banyumas, Central Java, also know about managing landslide disasters using *Haur* or *Bambusa* by the principles of marking (*Niteni*), imitating (*Nirokke*), and adding (*Nambahake*); they applied several simple applications for landslide management by making concrete and planting bamboo (Suwarno et al. 2022). Generally, bamboo was found in watersheds (DAS) characterized by strong and dense root systems. This phenomenon facilitates water absorption and binding soil structures due to bamboo's sympodial root system (Mentari et al. 2018); the bamboo types used are *Haur Konéng* and *Haur Héjo*.

This significant application is attributed to their fibrous root, interconnected rhizome, and relatively dense foliage that protects from heavy rainfall and produces new stems from underground. Bamboo species impact soil by reducing runoff, controlling soil erosion, and improving the groundwater recharge of an area with similar soil and climatic conditions (Patra et al. 2022). Ramadhan and Mukhsin (2017) reported that a dense underground bamboo root system at the slope location will improve soil stability. Bamboo roots' tensile strength leads to greater cohesion to the soil shear value, which impacts slope stability.

Ecologically, bamboo gardens also benefit from maintaining the hydrological soil water cycle, locally recognized as *Ngajaga Cai* (maintaining water) in Cijambu Village. The community grows bamboo to maintain water conditions and availability. Bamboo plants are fiber-rooted and capable of binding groundwater and absorbing carbon dioxide for environmental preservation and restoration. Furthermore, bamboo clumps can hold up to 25% of rainwater falling to the ground; this percentage is far greater than conifers and pine (Yasin and Priyanto 2019). Maintaining water with bamboo is also known in Kanekes Village, Nagarawangi Village, and Putrajawa Village as spare (absorbing) for rainwater. The bamboo roots have hairs that can expand and store enough water for the future (Irawan 2020). The people of Cijambu Village plant bamboo around their homes to provide a sense of coolness (*Niis Lembur*). This cooling effect is facilitated by its rapid growth, a cycle from 120 to 150 days, attributed to the release of oxygen (O_2) and carbon dioxide (CO_2) withdrawal. Due to the rapid accumulation of biomass and effective CO_2 fixation, bamboo has a high carbon sequestration capacity. Consequently, its natural recommendation for reducing the negative impacts of climate change and a large carbon sink is important in improving human ecosystem services (Nath et al. 2015; Emamverdian et al. 2020; Aarthi et al. 2021).

The bamboo processing based on community knowledge has been around for generations in various regions, including Cijambu Village. Almost all parts of bamboo, ranging from leaves and culm to bamboo shoots obtained from community-owned gardens, are processed and used in their daily life. The dominant bamboo parts commonly used by the community are the reed or stem, followed by shoots of leaves and roots. Furthermore, the community recognizes bamboo morphological characters to distinguish various types based on the reed characters (Irawan 2020). Using leaves and shoots is relatively significant, as is composting on agricultural plants and in the house's yard. According to Irawan et al. (2021), the compost from bamboo leaves contains Nitrogen (N), Phosphate (P), and Carbon (C) elements, serving as essential components to improve soil structure and plant growth. Bamboo leaves have a slow decomposition time due to the high carbohydrates they contain; therefore, they are composted. Compost is fermented organic materials such as leaf litter or grass that accumulate and are continuously buried in the top of soil, forming a layer of humus.

Bamboo shoots are also processed into vegetable side dishes, except for *Awi Tali* (*G. apus*), which has a bitter taste due to the cyanide acid content, a dangerous compound in humans and animals. The people of Cijambu Village, specifically the bamboo garden owners, do not know how to use rhizome roots. Additionally, bamboo rhizome roots have not been used due to the difficulty of accessing them, causing damage to the clumps after being dismantled. The rhizome is an organ of vegetative growth that grew by multiplication; therefore, its wide application can interfere with regenerating bamboo clumps. According to Patra et al. (2022), bamboo has rhizome roots systematically interconnected in clumps, indicating that exploiting a stem in the rhizome part would interfere with producing new stems and soil structure stability.

Table 6. Various types of ecological functions of bamboo

Types of utilization	Types of bamboo	Utilization description
Pamageuh	*Haur Konéng*	Prevent landslides and maintain soil structure
	Haur Héjo	Prevent landslides and maintain soil structure
Ngajaga cai	All types of bamboo	Absorbs and stores water
Niis lembur	All types of bamboo	Provides air coolness

Use value index

The use value index is analyzed to determine which species or landraces of bamboo are mainly used by the people of Cijambu village. The use value index shows that *awi tali*, *Awi Gombong*, *Awi Temen*, and *Awi Haur* have high used value indexes (Table 7). Table 7 revealed that the high-value index is the *Awi Tali, with 0.786; this number indicates that Awi Tali is a bamboo species that has* great benefits for the community in Cijambu Village. According to Hoffman and Gallaher (2007) in Gaoue et al. (2017), the index value of 0.5-1 is categorized as "*major*" indicates that a species has many benefits in society, while the value of 0-0.5 is categorized as "*minor*" indicating a species has an insignificant benefit. Major and minor categories refer to the number of use categories of a species (Gaoue et al. 2017). The type of bamboo *Awi Tali* is the species with the most utilization and the largest usability index value in Cijambu Village. Additionally, research conducted by Irawan (2020) in 5 villages in West Java and 1 village in Banten shows that *Awi Tali* has the highest usage index value. These results show that *Awi Tali* (*G. apus*) is a type of bamboo widely used by people in various regions, especially in West Java. The *G. apus* is one of the three types of bamboo besides *G. atroviolacea* and *G. verticillata* that are mostly used (Widjaja 2019).

Management of bamboo garden based on TEK

The management of the community in Cijambu village bamboo gardens is based on traditional knowledge (TEK) passed down from parents to children. Generally, people plant bamboo in privately owned gardens and around their homes. The bamboo garden ownership category in Cijambu village is 100% private property; no one rents bamboo gardens. Meanwhile, according to the origin of ownership, almost all bamboo gardens are obtained from their parents' inheritance, as much as 98%. The remaining 2% buy bamboo gardens from others, and no community gets gardens from grants or gifts. The garden plot measurement unit is *Tumbak/Bata* (equivalent to 14 m^2), and the number of bamboo individuals in each bamboo garden is around 2-4 bamboo clumps, depending on the clump size. Traditionally, *Haur Konéng* and *Haur Héjo* bamboo landraces can be used as guardrails for their garden to other people's land. Like the Cijambu people, the traditional Baduy community of Kanekes village, the ownership of bamboo gardens is also marked by bamboo clumps.

Similarly, the Nagarawangi village community also plants bamboo, which is usually used as a garden barrier (Irawan 2020). Cijambu Village people who do not have bamboo gardens will use bamboo from privately owned bamboo gardens; people who want to take bamboo have to ask permission from the garden owner. The ownership status affects the land cultivated by the community; they inherit bamboo plantations from parents to children, mostly not accompanied by certificates or official documents. According to Iskandar et al. (2023), in addition to legal land ownership, residents also have land ownership that is probably legally invalid because they do not have land certificates. The term illegal ownership in Sundanese society is referred to as *Taneuh Bodas* or *Taneuh Pangangonan*, which used to be land cultivated for generations by its owner. In managing bamboo gardens, people who also work as farmers use existing land to plant other crops: coffee, tobacco, bananas, and vegetables such as chili and cabbage. Therefore, the negative impacts of the intercropping system arise, such as pesticides and chemical fertilizers used continuously that can damage the composition of soil compositions, kill pest predators and pollinating insects such as bees (Iskandar et al. 2017).

To maintain the existence of bamboo gardens and be economically sustainable, the community manages them by selecting bamboo seeds to be planted, providing bamboo pest care and control, and harvesting bamboo. Therefore, before planting bamboo in the garden, they prepare the bamboo type and organic fertilizer, clear the land of shrubs, and mark the garden's boundaries for planting. Bamboo seedlings are usually obtained from privately owned gardens; as shown in interviews with bamboo garden owners, 95% of bamboo seedlings are obtained from their gardens, while the remaining 5% are obtained from other gardens, but no people buy bamboo seeds. Most people use the propagation method by vegetative planting/reed cuttings/stems as much as 93%, while the rest use planting rhizomes. Propagation by stem cuttings starts by selecting seedlings from bamboo clumps with young stems. Bamboo seedlings are cut with a size of about 50 cm, plugged into the ground upright, and planting distance from 3 to 5 meters between seedlings. People usually do this by dismantling clumps with rhizomes in the planting method and then burying the rhizome with roots in the planting holes.

After planting, bamboo seedlings are fertilized with organic, such as animal manure, and inorganic, such as urea, at 50-50 to boost seedlings' growth. Fertilizer application is carried out for 3 to 6 months after planting. Bamboo planting by the community is generally carried out in December every year. This is in line with what Akinlabi et al. (2017) explained that bamboo planting should be considered the ideal time, and planting of new seedlings should be done at the beginning of the rainy season to enhance the survival rate, planting from September to December. People grow almost all types of bamboo using the stem cuttings method, but in general, stem cuttings are widely used in planting *Haur*-type bamboo on the edge of the cliff. According to Irawan (2020), the method of planting with stem cuttings (*Melak Watang*) is based on bamboo types with thick reeds, such as *Haur Hejo* (*B. vulgaris*). The community managing bamboo gardens does not have special treatment in caring for and controlling pests. Based on interviews with bamboo garden owners, most (52%) care for their bamboo gardens, while others (48%) do not do maintenance and are naturally growing. The bamboo garden care is done by cleaning weeds that grow on the road to the garden and making it easier to access the bamboo garden. Weeds do not grow much in bamboo gardens because not much sunlight reaches the ground; the presence of allelopathic properties in bamboo reduces other native vegetation by their allelopathic and phytotoxic effect, and a large amount of bamboo leaf litter also suppresses weed growth (Buziquia et al. 2019).

Table 7. The use value index of various bamboo species or landraces

Local classification (*Landrace*)	Botanical name	Use Value Index
Awi Tali	*Gigantochloa apus* (Schult.f.) Kurz	0.786
Awi Gombong Héjo, also called *Awi Surat*	*Gigantochloa verticillata* (Willd.) Munro	0.405
Awi Temen	*Gigantochloa atter* (Hassk.) Kurz	0.190
Awi Haur also called *Haur Konéng*	*Bambusa vulgaris* Schard. ex J.C. Wendl. var. *striata* (Lodd.ex Lindl.) Gamble	0.190
Awi Bitung	*Dendrocalamus asper* (Schult. f.) Backer ex K. Heyne	0.167
Haur Héjo	*Bambusa vulgaris* Schard. ex J.C. Wendl. var. *vulgaris*	0.167

Figure 7. A. Part *Doyong Awi*, B. Part *Lundung Awi*

Bamboo is harvested by the community from its bamboo gardens and mixed gardens. The harvesting time is usually carried out according to their needs. The Cijambu Villagers harvest 5 years after planting, and the next harvest is generally carried out 9-12 months later. The best time to harvest bamboo is at the end of the rainy season, between March and June; according to the community, at this time, bamboo can be harvested with stems that are hard and flexible enough to be used on matting materials. According to the community, bamboo should be cut at noon because the moisture content composition on bamboo stems has decreased, indicated by withered bamboo leaves. Logging with a low moisture composition is easier to cut because bamboo stems are hard.

The interviews with respondents who own bamboo plantations show that the harvesting technique of the Cijambu Village community uses a 100% selective logging method; no community clears their bamboo plantations except for land conversion. According to Terefe et al. (2019), harvesting by selective cutting on bamboo is a way to make bamboo sustainable for a long time so that it will continuously provide resources. The Baduy community of Kanekes Village Banten and the people of Putrajawa Garut Village determine the best time to harvest is during the dry season (Irawan 2020); they will cut bamboo starting from the first process using machetes on *Doyong Awi* and *Lundung Awi*. The terms *Doyong Awi* and *Lundung Awi* refer to the side of the stem at the bottom of the bamboo stem slope; *Doyong Awi* is the side of the stem facing the ground, while *Lundung Awi* is the side of the stem that has its back to the ground (Figure 7). Bamboo is towed with machetes alternately in the *Doyong* and *Lundung* parts, generally repeated 2-3 times until the bamboo stems collapse. Once on the thigh height, the bamboo is cleaned and cut using a saw. *Doyong* and *Lundung Awi* are generally located on the stem part close to the root. Bamboo is harvested as *Leunjeuran* (bars) by removing the top of the bamboo parts or stem shoots with many leaves and twigs. The community cut down about 80% of the bamboo, leaving 20% of the remaining reed to regenerate. This is in line with when harvesting bamboo that is more than 3 years old; only 70-80% of the stem should be harvested, leaving the rest of the stem to maintain seedlings and regenerate.

Traditional conservation of bamboo

The community in Cijambu Village conserves bamboo gardens by passing on the knowledge of management and ownership of their gardens to the next generation, in this case, their children; this inheritance has been going on for generations. According to Abdoellah et al. (2015). The tradition of maintaining bamboo tree gardens as important family assets offers opportunities to preserve biodiversity and maintain the socio-economic role of land use in local production systems. The bamboo knowledge and ownership inheritance is also found in the Baduy community of Kanekes Village to maintain the natural resources and environment to support their needs (Irawan 2020; Iskandar and Iskandar 2017). In addition, the inheritance of the bamboo gardens as family assets for generations is also found in the Upper Citarum watershed community of West Java (Abdoellah et al. 2015).

In general, the conservation of bamboo gardens by the community is influenced by beliefs and myths in the local community's culture. People in Cijambu Village harvest and take any part of bamboo by praying to the creator and nature itself for permission; the community also believes in not cutting or taking bamboo on Fridays. In addition, people who use bamboo believe in *Tolak Bala; the* bamboo used is *Haur Konéng*. People are confident that planting *Haur Konéng* around their residences will avoid bad things. From an ecological perspective, planting *Haur Konéng* bamboo around residences, especially in settlements on the side of slopes or cliffs, has a positive impact. Belief in *Tolak Bala* with bamboo planting is also found in several areas, such as the community of Nagarawangi Village, Rancakalong Sumedang District, which also plants *Haur Konéng* concerning *Tolak Bala*. The people of Karangwangi Cianjur Village also believe that *Haur Konéng* can expel black magic, so it is used as an antidote (*Tolak Bala*) (Partasasmita et al. 2017). The Baduy

community of Kanekes Village, Leuwidamar Sub-district, also uses bamboo with the belief in *Tolak Bala*, known as *jukut sadané* (Irawan 2020).

One strategy for conserving bamboo gardens is sustainable use and management. The community cutting bamboo applies a selective logging system; the selective cutting method is used as one of the strategies to maintain the sustainability and regeneration of bamboo. This is in line with Terefe et al.'s (2019) statement that the bamboo cutting method by selective logging is a strategy for maintaining bamboo regeneration. Another strategy for maintaining bamboo gardens is to modify them into mixed gardens; the Cijambu Village area, which partly covers the Perhutani (State Forestry Public Company) area, modified its bamboo gardens by planting coffee; the Perhutani Forest management supports this. According to the community, modifying the land use of bamboo gardens into mixed gardens with vegetables and coffee plants will increase revenue and an annual piggy bank (savings). This concept is in line with the statement of Irawan (2020) that there is land use with type multistoried inter-culture of perennial and annual/biennial crops (predominantly vegetable type) combined with bamboo tree gardens (dominated by types of wood) is considered to have higher advantages than only bamboo gardens.

In conserving bamboo gardens, it is necessary to involve related parties responsible for resource management with local communities to use the bamboo species sustainably with traditional knowledge of the community (Honfo et al. 2015). The economic benefits of bamboo cultivation must not come at the expense of the environment. It is important to practice sustainable farming techniques that minimize environmental impact, such as avoiding monoculture planting practices and preserving natural habitats. Sustainable bamboo plantation management should consider environmentally sound, economically feasible, and sustainable aspects that can be applied to community life (Iskandar 2018). Bamboo is adaptable to extreme environmental conditions such as low nutrient availability, high temperature, soil acidity, poor drainage, and low humidity. The roots' characteristics allow bamboo to maintain the hydrological system that can be utilized in conservation (Aswandi and Kholibrina 2021). With various benefits for the community, bamboo gardens are still maintained as a sustainable resource for the people of Cijambu Village. People in Cijambu Village, especially in Jaganala, Pasanggrahan, and Gombong Villages, maintain bamboo gardens because of the need for the kite design industry. This makes bamboo gardens more maintainable because they are managed for utilization in industry (Ihsan et al. 2023).

Based on interviews conducted with bamboo garden owners, most people have a high tendency to conserve bamboo gardens as one of the sustainable resources with various benefits; it shows 93% of people agree to make conservation efforts for bamboo gardens, while the remaining 7% answered neutrally. The conservation concept in society is commonly known as preservation; community preservation is related to traditional beliefs and socio-cultural systems. In conserving bamboo gardens, it is necessary to involve related parties responsible for resource management with local communities to use the conservation of bamboo species sustainably with traditional community knowledge (Honfo et al. 2015). Sustainable bamboo plantation management should consider environmentally sound, economically feasible, and sustainable aspects that can be applied to community life (Iskandar 2018). By conserving bamboo and bamboo gardens, various socio-economic-cultural, and ecological benefits, including producing various subsistence and commercial economic functions, hydrologic and erosion control, gene bank, animal habitats, maintaining micro-climate conditions, and CO_2 sequestration may be obtained by the village community (Iskandar et al. 2023).

In conclusion, it revealed that Cijambu people documented 6 landraces based on TEK: *Awi Tali (G. apus), Awi Surat* or *Gombong Héjo (G. verticillata), Awi Temen (G. atter*), *Awi Bitung (D. asper), Haur Héjo (B. vulgaris* var. *vulgaris),* and *Awi Haur* or also called *Haur Konéng (B. vulgaris* var. *striata);* Unlike classification by TEK, the scientific biological classification found 5 species were recorded due to *Haur Héjo* and *Haur Konéng* being considered the same species, only differed by variety. Various bamboo landraces are traditionally utilized for socio-economic, cultural, and ecological functions. In terms of the socio-economic functions, it was documented that based on 6 bamboo landraces were utilized 32 various that were documented 32 types of traditionally utilized bamboo are documented in 32 distinctive uses. The ecological functions of bamboo have 3 main function categories, namely *Pamageuh* (maintaining soil structure), *Ngajaga Cai* (absorbing and storing water), and *Niis Lembur* (providing air coolness). The bamboo in the bamboo gardens of Cijambu village has been managed based on TEK and cosmology, including selecting bamboo seeds and planting, bamboo pest care and control, and sustainable bamboo harvesting. The Cjiambu community conserves bamboo, which is traditionally based on TEK and has been passed down through generations. Therefore, bamboo cutting cannot be randomly undertaken in everyday belief or cosmos. The community also inherit the garden to their children and grandchildren as a conservation effort. The community's strategy for conserving bamboo gardens is to harvest using selective cutting methods. In addition, to conserve bamboo gardens and obtain household income, the Cijambu village communities have practiced agroforestry in a mixed garden system, planting coffee and other annual and perennial crops. Therefore, the bamboo and mixed gardens have provided socio-economic and ecological functions for the village people.

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