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Native Species Composition and Diversity of Valuable Woody Plants Regeneration during Fallow Period in Kamwatta, Moruca, Guyana

Shondell Rodrigues[1], Susy Lewis[1*], Colis Primo[2]

[1]Faculty of Agriculture and Forestry, University of Guyana, Georgetown, Guyana
[2]Environmental Protection Agency, Georgetown, Guyana
Email: katiajames24@gmail.com, *susy.lewis@uog.edu.gy, colisprimo@gmail.com

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Abstract

An intelligent method of shifting cultivation to regenerate vegetation after a long fallow period is critical information for restoration strategies. The literature review identified that the assessment of woody plant species on abandoned farmland has never been done before in Kamwatta, Moruca Region 1. In addition, more information should be available in indigenous communities and at the national level, including more documentation of the utilization of natural resources by the Warrau community. This study assessed the valuable woody plant species that grew during the fallow periods. Nine farmlands were randomly selected along a 100 m transect, each with varying fallow periods. In order to collect information on the age of farm abandonment, the researcher employed a mixed-methods approach. First, we found how long each farm had been fallow by administering a semi-structured questionnaire. Then, we conducted a flora survey to gain information on the variety and abundance of valuable plants using the age of farm abandonment as a dependent variable. The data analysis included the number of valuable woody trees with a diameter of >10 cm, seedlings and saplings with a diameter of <10 cm, the location of identified trees, and the uses of identified tree species. Microsoft Excel was used to code and analyze the questionnaire, while QGIS, Shannon's Index of Diversity, and Simple Linear Regression were used to analyze the inventory data. The results showed that the respondents listed 38 valuable woody species, and 79% occurred in the studied area. The field verification revealed that the dominant family in the area was Mimosaceae. Species abundance increased with fallow up to 10 years before declining in the latter years. Plant diversity and abundance had a weak relationship with the age of abandoned farmlands for woody trees, while the seedlings and saplings showed no relationship.

Keywords

Native Woody Plants, Fallow Time, Forest Regeneration, Species Diversity, Species Abundance

1. Introduction

Shifting agriculture is responsible for 90% of all farms worldwide, and throughout the regions, 60% of all arable lands are unevenly distributed (Chazdon, 2003). Various tropical countries still practice shifting cultivation, slash, and burn agriculture as a form of subsistence agriculture. This method is common practice in areas occupied by mixed-humid tropical forests. A shifting cultivation system results in land abandonment followed by secondary forest succession (Mertz, 2002). Small-scale abandoned farmlands were related to faster forest recovery of native ecosystems than other agricultural clearings (Chazdon, 2003; Queiroz et al., 2014). Slash and burn farming, for example, is practiced worldwide and has been the mainstay of subsistence for indigenous communities in Guyana. Shifting cultivation is a type of "non-sedentary" agriculture that involves removing and burning portions of forest for cultivation purposes (Persaud et al., 2020). Between 1831 and 1836, indigenous peoples in Guyana's interior started practicing subsistence agriculture (Laing, 2018). As a result, traditional shifting cultivation, fishing, and hunting were the primary activities undertaken by indigenous tribes. Currently, approximately 3206 hectares of forested lands are located in title Amerindian territory and are held and managed by them unless they wish to sell timber outside their community (GFC, 2021). Thus, lands abandoned due to shifting agricultural practices allow the initiation of secondary succession, and there are important woody plant species that colonize these abandoned farmlands. Therefore, from a global to a local perspective, secondary forest regrowth is crucial to preserve natural assets (Sears et al., 2021). Secondary forest, where access to the old-growth forest is limited, provides a diverse range of ecosystem services in abundance that is vital for life and the environment. Food, medicinal plants, fiber plants, and firewood are among the forest products available (Mertz et al., 2021). The regrowth of tropical secondary forests, also known as passive regeneration, has been shown in recent studies to sequester carbon and conserve biodiversity (Chazdon et al., 2016). Local farmers value secondary forests for their fallow and landscape services, such as soil fertility restoration, water, and climate management (Sears et al., 2021). In addition, secondary forest stands out for climate change mitigation because their potential is greater than old-growth forest. The conversation around forests is evolving to emphasize the importance of regenerating forests to restore degraded landscapes and improve livelihoods. As a result, secondary forests offer our stewards an opportunity and a reward (Sears et al., 2021; Queiroz et al., 2014). A scholarly article noted that secondary forest provides important socioeconomic plant uses, but it is unclear what tradeoff exists between human demand for forest products and the regenerating forest's biodiversity and regulating roles (Naime et al., 2020). Researchers have found that the traditional use of natural resources by indigenous communities is important in providing livelihood, food, and medicine for the local people (Cummings, 2013; Mistry et al., 2021).

Furthermore, Parrotta et al. (2016) emphasized that local and indigenous communities worldwide have been managing their forests to sustain their livelihoods and cultures by only extracting the needed products without negatively impacting the ecosystem that provides goods and services for future generations. Indigenous peoples have the traditional ecological knowledge and tree identification abilities to document the uses and importance of the species that have recolonized abandoned farmland. However, there is now insufficient focus on indigenous peoples' traditional knowledge to successfully contribute to the development of national environmental and conservation policy solutions (Mistry et al., 2021). Nonetheless, indigenous communities' knowledge of natural resource utilization is incompletely documented, and little information is accessible in indigenous communities or at the national level. Therefore, it is critical to capture this traditional knowledge since it will both enlighten indigenous people and add to a national database of indigenous knowledge. Understanding the scientific findings in this study will require recording and making documentation available in both English and indigenous languages (Warrau). In Guyana, two forms of shifting agriculture are 1) pioneer and 2) rotational cultivation (Persaud et al., 2020). Cutting the forest, cultivating the soil, and subsequently ending farming in that agricultural area are all examples of pioneer shifting agriculture. On the other hand, rotational cultivation is carried out on a rotational cycle using previously farmed land. The "fallow period" or "fallow age" refers to the interval between cultivations. Based on the review of relevant literature, no research has been done in Guyana to comprehend rotational cycles; however, some controversy has been reported (Mertz, 2002). The author emphasized that short fallows can have an influence on the forest's species diversity and plant composition, furthermore short fallows can help to enhance the number of pioneer species. Therefore, our understanding of the role of regenerating forests in providing ecosystem services and human well-being is urgently needed. According to Mertz et al. (2011), several shifting cultivation evaluations have addressed this issue, but they have primarily focused on the impact of changing shifting cultivation techniques on ecosystems and livelihoods. From this same perspective, Mertz et al. (2021) also stated that little attention has been paid to assessing the secondary forest's ecosystem services in the context of changing agricultural landscapes. The literature review identified that the assessment of woody plant species on abandoned farmland has never been done before in Kamwatta, Moruca Region 1. Greater quantity and diversity of woody plants in older abandoned farms due to the favorable soil conditions following the long fallow period result in the successful recolonization of native woody species. In order to test this hypothesis, we analyze the distribution, abundance, and diversity of native woody trees in the regeneration areas of abandoned farmlands. In this article, we present the results aimed at assessing valuable woody tree species colonizing abandoned farmlands in Kamwatta, Moruca. More specifically, we identify and quantify the important woody plant species that recolonize following slash-and-burn farms in Kamwatta and investigate the relationship between the abundance and diversity of these important plants about their age of abandonment.

2. Methods

This study used a mixed-methods approach to collect data, including qualitative data from semi-structured questionnaires and quantitative data from field inventory.

2.1. Location of the Study Site

The climate of Santa Rosa, Moruca, is tropical, with a monthly average temperature of 24˚C and an average maximum temperature of 31˚C. The total average precipitation is about 1,986 mm, with the driest month (March) having on average 90 mm of precipitation and the wettest month (June) having on average 309 mm of precipitation (Santa Rosa, Guyana: Weather and Climate, 2022). Kamwatta, Moruca of Region 1, including the mainland and surrounding islands. Within Santa Rosa title village, the largest indigenous settlement in Guyana, there are 11 satellite settlements, including Kamwatta. The location of Kamwatta is 21N 0281529 and UTM 0848738 in WGS84 (**Figure 1**). The study site on the

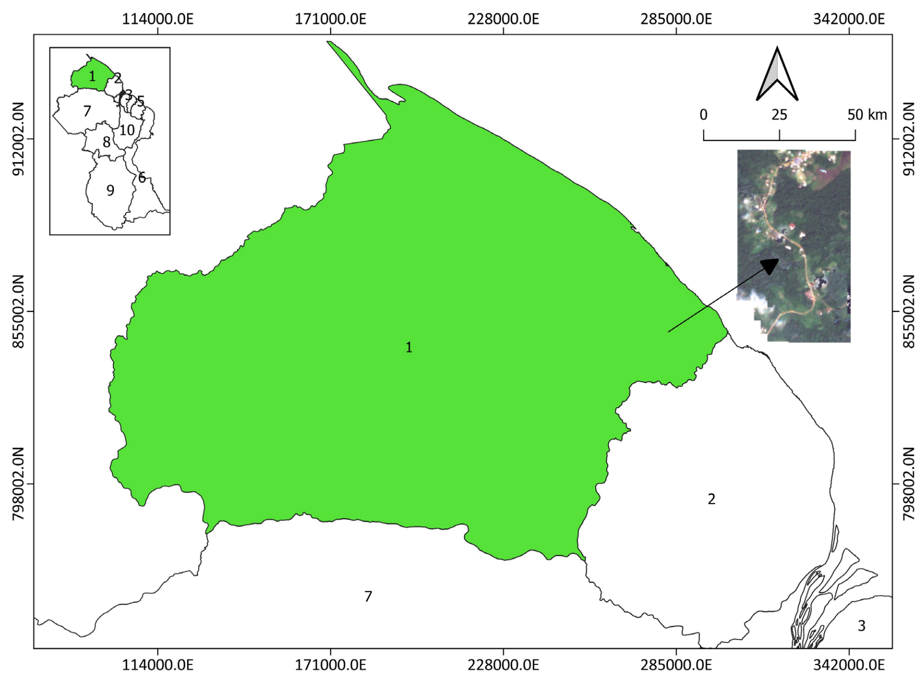


Figure 1. Location of the study site in Barima-Waini Administrative Region One of Guyana. On the right side, the Sentinel-2 image is associated with farmlands (May 2022). Source: Administrative map of Guyana (Diva-GIS) and Sentinel-2 (Google Earth Engine).

mainland has well-drained, brown loamy sands and red lateritic soils (Ferralsols or ferralic Arenosols) (van Andel, 2000).

The community, mostly comprised of indigenous Warraus, has a population of about 760 residents in 140 households. Three kilometers from Kumaka, it is accessible by land and water via the Kumaka/Kwebanna road and the Moruca River. Vegetation covers both sides of the road. The Kamwatta locals own these farmlands, including active and abandoned ones. The main economic activities in Kamwatta are subsistence activities such as fishing, hunting, agriculture, and obtaining non-timber forest products for household use. Most people are subsistence farmers who sell their produce in the community and village. In addition, wages from the mining and logging industries provide additional sources of income for the males in this community.

The majority of the farmers are women who use traditional agricultural methods such as slash and burn, which entails cutting down trees and burning them to make new fields. Residents used to grow coconut, coffee, citrus fruits, and peanuts, which they sold to people outside of the village. However, due to low prices and low yields for the former crops, residents now cultivate cassava, corn, yams, eddoes, plantains, bananas, and pepper. The crops are grown on the cultivated lands for two years, yielding less than the first harvest. This practice leads to the abandonment of the farmlands. After a period of time, the slash-and-burn method is repeated at one of the two locations, but not at the same time. Residents rely on various valuable woody plant species from the area to maintain their livelihood when farming has ceased on a plot of land. Farmland can recover to its natural state for a maximum of 36 - 60 years while providing various services to residents. The vegetation of Kamwatta varies from shrub to late secondary forest due to the expanding population and shifting cultivation. Mixed secondary forests comprised most of the plots studied (1, 3, 5, 8, 9, 10, 20, 35, and 60 years fallow). This study took place on nine abandoned farms in the area, on both the left and right sides of the road, at varying distances from one another.

2.2. Survey Data

Qualitative methods allowed for the collection of data on 1) the past history of land use, 2) the period of time since farms were abandoned, 3) the species that were recolonizing these farms, and 4) the uses of the identified species. Specifically, information about the year of abandonment of the farms was a prerequisite to designing the field methodology. In addition, semi-structured questionnaires allow respondents to provide additional responses to the questions posed. From 20 March to 3 April 2022, a semi-structured questionnaire was administered to the residents of Kamwatta. Respondents were chosen randomly from within the community after the Village Councilor conducted a community meeting, who presented the research topic and sought residents' approval to conduct the study in their community. The semi-structured questionnaires contained two sections: Section 1-Demographic Information, and Section 2-which focused on the quantitative perception of natural regeneration and fallow time. The second section consisted of the following items: 1) years since farm abandonment; 2) species recolonizing these farms; 3) the uses of the identified species, which involved traditional knowledge.

Traditional knowledge by the residents helps identify the species that occurred in abandoned farmlands and the use of various plants before the field assessment. According to one of the two categories adopted by Cummings (2013), such as 1) domestic logging: a plant used for commercial purposes in the village, and 2) traditional uses: species that provide the indigenous Warraus with food (fruits, beverages), medicine, crafting materials (strappings, paddles, paste, and tanning), building materials (for local construction, tool handles, and canoes), and firewood aid in the classification of plants (**Figure 2**). The enumeration of valuable woody plants used a list of the previously identified species with the aid of an indigenous tree spotter knowledgeable of native woody valuable plants.

2.3. Field Sampling Design and Data Collection

The survey yielded 13 different ages of abandoned farmlands from information provided by respondents before the field assessment. Based on this information, we identified three ages of farm abandonment: 1) 1 - 6 years (5 farms), 2) 7 - 10 years (4 farms), and 3) 20 - 60 years (4 farms). This data allowed for grouping the farms into three age classes. Farms were randomly selected based on abandonment age classes of 1 - 6, 7 - 10, and 20 - 60 years. Subsequently, three subsets of farms of varying ages were chosen randomly from each age class, resulting in nine farms for the study; 1, 3, 5, 8, 9, 10, 20, 35, and 60 years old, respectively. Two randomly selected transects of 100 m width of each selected farm at 120 m and a 30 m interval were established in the study site, resulting in eighteen (18) transects for the entire study area. Three 10 m × 10 m quadrats were randomly selected and established along each transect. We established one randomly selected subplot measured 1 m × 1 m size within each quadrat. Plant sampling was undertaken based on the species list developed during the semi-structured questionnaire. Trees with a diameter of >10 cm were identified and measured for height (m) and diameter at breast height (DBH) (cm). In

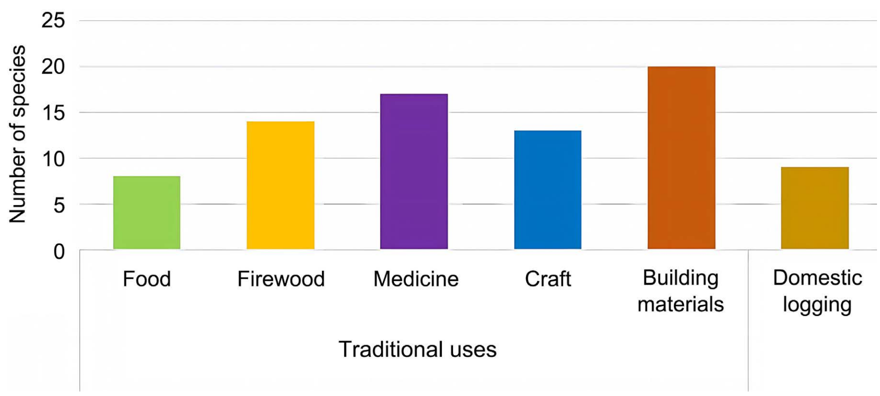


Figure 2. Woody plant species and their uses.

addition, the records contain the geographical locations and photographs of the species identified. In the one 1 m × 1 m sub-plots, seedlings and saplings with a diameter of <10 cm were identified and counted. Consultation with the local people and relevant literature (van Andel, 2000) aided in verifying plant use.

2.4. Data Analysis

Microsoft Excel was the software used to develop descriptive statistics. The abundance and the diversity were calculated for each fallow (since farming ceased). The Shannon Index of Diversity was used to separately calculate the species diversity of woody tree species based on the data from the quadrats and subplots, respectively, according to the age of the fallows. The following formulae calculated the Shannon index of diversity:

$$H = \sum_{i=1}^{s-} p_i \ln\left(p_i\right) \tag{1}$$

where:

H = Shannon Index of Diversity

P_i = the proportion of individuals found in the ith species

ln = the natural logarithm

s = the number of species in the community

Using Statistix 10 software, we verified the normality distribution of the data collected in all cases before estimating the linear regression analysis. Then, we used linear regression to find out if there was a relationship between fallow age and the abundance and diversity of useful woody plant species. As a categorical variable by assigning all fallow to an age class (Delang et al., 2016). Because of the response from residents about the fallow time, the age classes ranged from 1 - 6 years which was the youngest fallow time. The sample size of the youngest age class determined the distribution of the subsequent age classes: 1 - 6, 7 - 10, and 20 - 60 years. In each fallow class, the number of fallow fields was; 1, 3, 5, 8, 9, 10, 20, 35, and 60 years old, respectively. Finally, spatial distribution maps of the native woody plants identified during the study were overlaid into an NDVI image using QGIS version 3.18.1 software.

3. Results

3.1. Farmers' Information on Fallow Cycles

Forty-two farmers from Kamwatta, Moruca, provided 57 responses; this resulted from some farmers owning many holdings or acres of land. Twenty-two farms were abandoned for a period of 1 - 6 years, 16 for a period of 7 - 10 years, six for a period of 11 - 20 years, and thirteen for 21 - 60 years. Farmers reportedly allow farms to go fallow based on crop production, soil fertility, and weed invasion into the fields (Figure 3).

3.2. Valuable Woody Plant Species Identified

We sampled nine locations, including areas of varying successional stages. Four hundred twenty-six plants, comprising 22 species from 21 families, were recorded (Figure 4; Table 1). The most abundant family was Mimosaceae, consisting of four species; Guttiferae, Chrysobalanaceae, Anacardiaceae, Annonacea, Caesalpiniaceae, and Palmae. All of the species found were native to the study area.

3.3. Valuable Woody Plant Species and Their Uses

The abandoned farmlands had thirty species. These species offer six useful purposes (Figure 2; Table 1). Traditional use and domestic logging in the community were assigned two categories associated with one or more plants sampled in this study. Traditional uses included food, firewood, medicine, crafts (strappings,

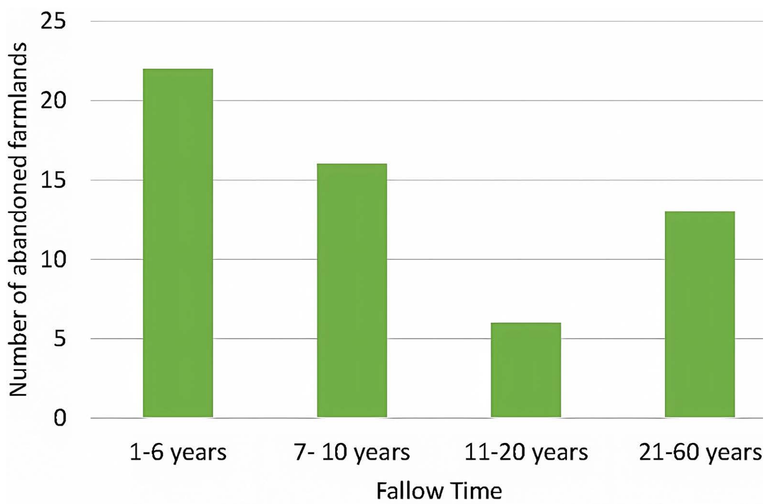


Figure 3. Age of abandoned farmlands in Kamwatta, Moruca.

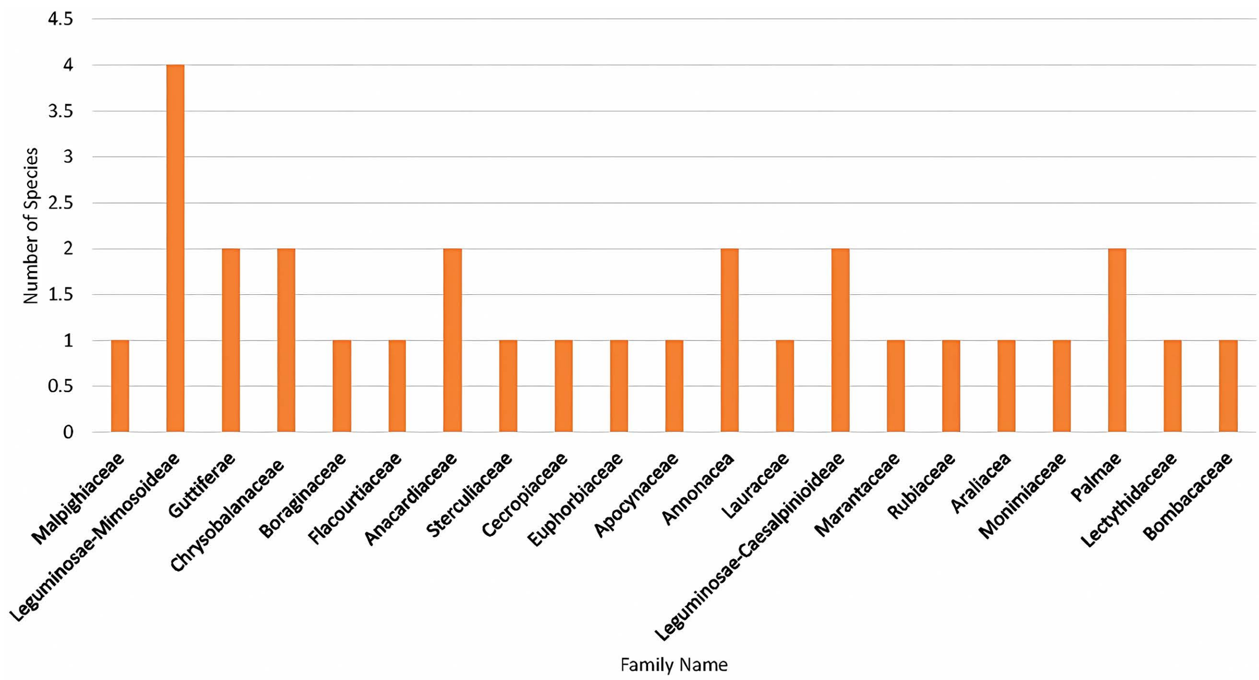


Figure 4. Families of woody plants were identified in the study area.

Table 1. Valuable woody plant species of native trees and their uses were identified in the study area.

Vernacular Name	Warrau Name	Scientific name	Family	Uses
Hicha	Hitia	*Byrsonima spicata* (Cav) DC.	Malpighiaceae	Food, Firewood, Medicine, Building material
Wity	Doho	*Inga marginata* Willd.	Leguminosae-Mimos	Food, Firewood, Building material
Fine leaf bloodwood	Dau hotu	*Vismia guianensis* (Aubl.) Choisy	Guttiferae	Firewood, Medicine, Building material
Broadleaf bloodwood	Dau aijamu hotu	*Vismia macrophylla* Kunth	Guttiferae	Firewood, Medicine, Building material
Burada		*Parinari rodolphii* Huber	Chrysobalanaceae	Building material
Gramma Cherry		*Cordia sericicalyx* A. DC	Boraginaceae	Craft
Heroko	Heroku	*Laetia procera* (Poeppig) Eichler	Flacourtiaceae	Firewood, Building material, Domestic logging
Waramia		*Tapirira guianensis* Aubl	Anacardiaceae	Food, Firewood, Medicine, Building material, Domestic logging
Sherada	Doho arau	*Inga lateriflora* Miq	Leguminosae-Mimosoideae	Food, Firewood, Medicine, Craft, Building material
Acquero	Akorlorlo arau	*Astrocaryum aculeatum* G. Mey	Palmae	Food, Craft
Maho		*Sterculia pruriens* (Aublet) Schumann	Sterculiaceae	Medicine, Craft
Congo pump	Waro	*Cecropia sciadophylla* Mart	Cecropiaceae	Medicine
Suradani	Duru	*Hyeronima alchorneoides* Allemão	Euphorbiaceae	Firewood, Craft, Building material, Domestic logging
Moporokon	Maborokoni	*Inga alba* (Sw.)	Leguminosae-Mimosoideae	Food, Firewood, Medicine, Craft, Building material, Domestic logging
Duka		*Tapirira marchandii* Engl	Anacardiaceae	Building material, Domestic logging
Yarola	Yaruru	*Aspidosperma excelsum* Benth.	Apocynaceae	Firewood, Medicine, Craft.
Trysil	Bihibihidu	*Pentaclethra macroloba* (Willd.) Kuntze	Leguminosae-Mimosoideae	Firewood, Medicine, Building material
Black Yariyari	Dau horo ana	*Unonopsis glaucopetala* R.E. Fries	Annonacea	Medicine, Craft, Building material
White Yariyari	Hoiju, Zarazara	*Duguetia pycnastera* Sandw.	Annonacea	Medicine. Craft, Building material
Kereti		*Aniba jenmanii* Mez	Lauraceae	Building material, Domestic logging
Rose of the Mountain	Hotoquai aha	*Brownea latifolia* Jacq	Leguminosae-Caesalpinioideae	Firewood, Medicine, Building material
Mokru	Sehuru	*Ischnosiphon arouma* (Aubl) Koern	Marantaceae	Craft
Soldier's cap	Soldier's cap	*Psychotria poeppigiana* Müll	Rubiaceae	Medicine
Counter	Kwamara anahoro arau	*Licania alba* (Bernoulli) Cuatrec.	Chrysobalanceae	Firewood
Marimari	Marimari	*Senna multijuga* (Rich)	Leguminosae-Caesalpinioideae	Building material

Continued

Matchwood	Omu	*Schefflera morototoni* (Aublet) Maguire, Steyerm. & Frodin	Araliacea	Firewood, Medicine, Craft, Building material, Domestic logging
Munuridan	Hiyo arau	*Siparuna guianensis* Aublet	Monimiaceae	Medicine, Building material
Kokerite	Doi arau	*Maximiliana maripa* (Corrêa) Drude	Palmae	Food, Medicine, Craft
Kakaralli	Kakarari	*Eschweilera sagotiana* Miers	Lectythidaceae	Craft, Building material, Domestic logging
Common Baromalli	Dauhoroija	*Catostemma commune* Sandw.	Bombacaceae	Building material, Domestic logging

paste, bows, fans, and tan), and building materials (local construction, tool handles, paddles, and canoes). Twenty plant species have building material utility, compared to 17 plant species identified for medicinal purposes.

3.4. Abundance and Diversity of the Valuable Species

The results showed that for woody plants greater than 10 cm dbh, species abundance increased from over one to five years of fallow time. The 10-year plot displayed the highest species abundance, while the one-year plot showed the lowest number. Likewise, in years 1 and 3, species abundance for plants below 10 cm dbh also increases during the fallow time. The year with the highest species abundance was 10, while the year with the lowest was 1. On the other hand, for 1 - 8-year plots, species diversity for plants greater than ten cm dbh decreased with fallow time. The older fallow time recorded an increase and a decline. The 1-year-old plot had the highest diversity, while the 35-year-old plot had the lowest. Similarly, plants < 10 cm dbh recorded a decrease in species diversity for the 1 - 8-year plot. The eight and 35-year-old plots reported the lowest species diversity, whereas plot 9 recorded the highest (**Figure 5**).

3.5. Relationship between the Abundance and Diversity of Valuable Woody Species

The simple linear regression showed the relationship between the age of farm abandonment and the abundance and diversity of valuable woody species > 10 cm. The results showed a weak relationship for abundance ($R^2 = 0.018$). Similarly, diversity to age also showed a weak relationship (**Figure 6**).

The regression analysis showed no relationship between the age of farm abandonment and the abundance and diversity of woody species < 10 cm dbh (**Figure 7**).

3.6. Spatial Distribution of the Identified Valuable Woody Plant Species

The distribution of woody plant species showed a clumped distribution for each plot assessed. The Normalized Difference Vegetation Index (NDVI), which ranges from −1 to +1, displays vegetation health. Bright red indicates healthy vegetation

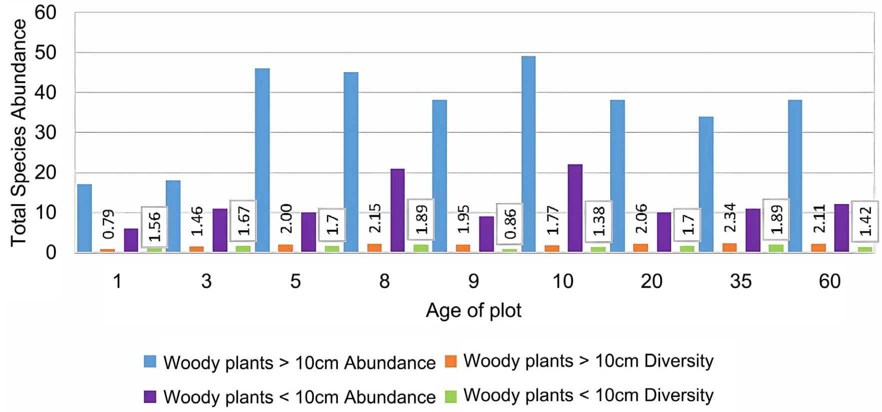
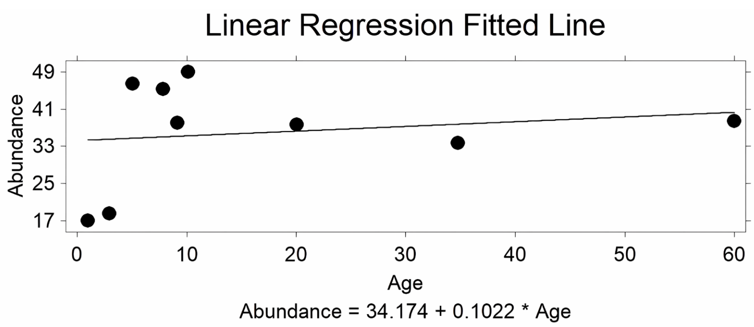
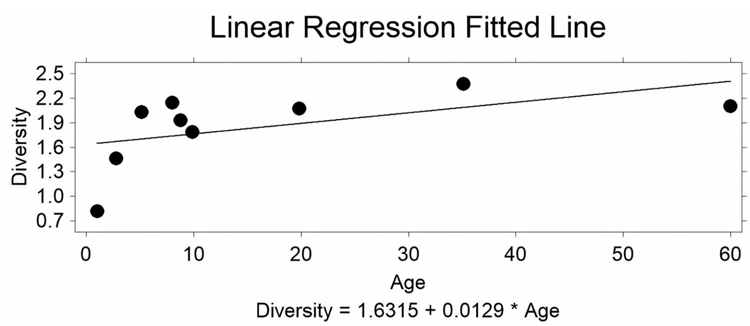


Figure 5. The abundance and diversity of valuable woody plant species growing on the abandoned farmlands.

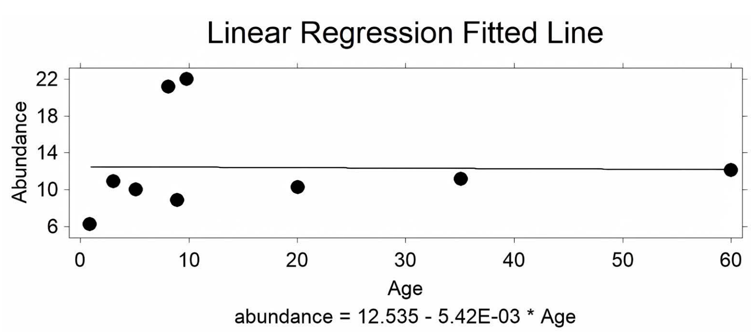


(a)



(b)

Figure 6. Relationship between age of farm abandonment and the abundance and diversity of valuable woody species > 10 cm dbh colonizing abandoned farmlands.



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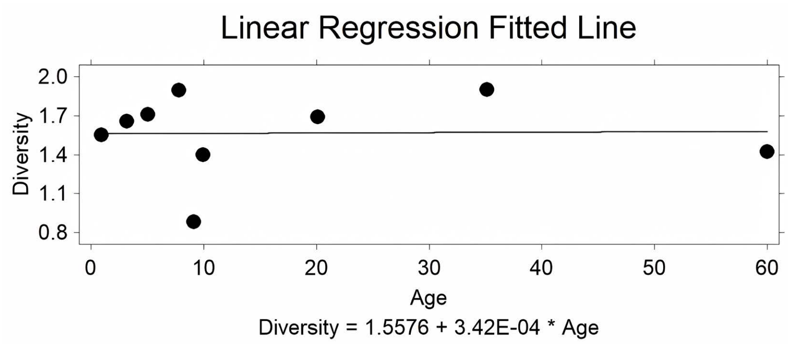

(b)

Figure 7. Relationship between age of farm abandonment and the abundance and diversity of valuable woody species < 10 cm dbh colonizing abandoned farmlands.

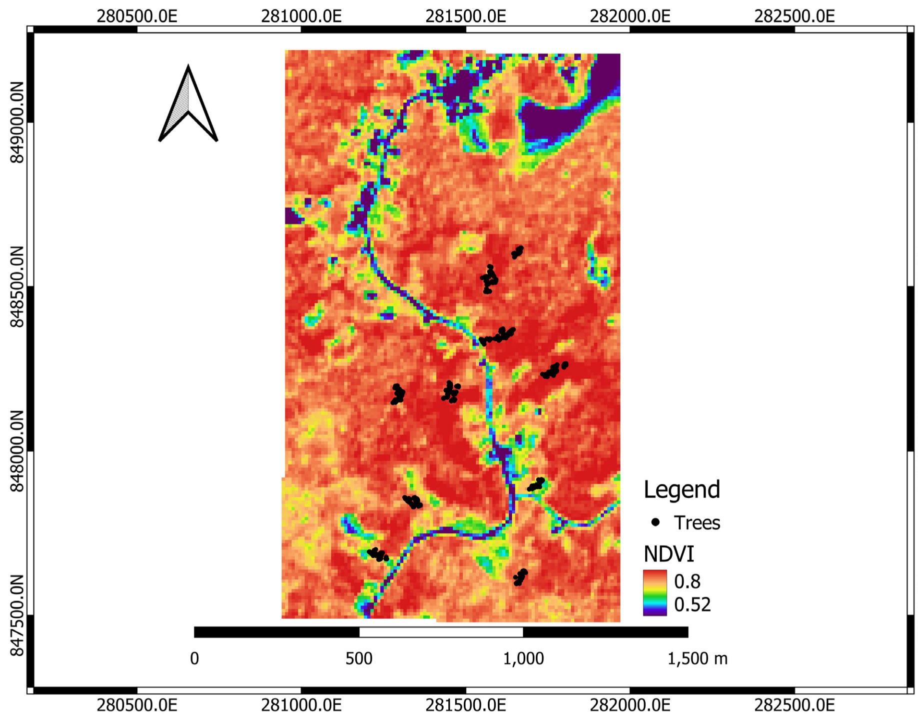

Figure 8. Spatial distribution of valuable woody plant species growing in Kamwatta's abandoned farmlands overlay on Normalized Difference Vegetation Index.

with an NDVI of (0.80), while purple indicates areas cleared for farming in May 2022, with an NDVI value below 0.52 (Figure 8).

4. Discussion

The study highlighted two main findings regarding the distribution of plants with higher traditional value. Firstly, all plants in the plots surveyed have traditional purposes associated with medicinal plants and building materials. The plant had a clump distribution pattern with farms located along the Kamwatta road. Secondly, the Warrau people have traditionally used a variety of woody plants, some of which also have favorable characteristics that might help in the regeneration of secondary forests. For example, *Inga marginata* from the Mimosaceae family was the key dominant species found in the abandoned farmland, suggesting the species can adapt well to the environmental conditions in the study area. Woody plants such as *Inga marginata* are important for forest regeneration as they are pioneers or early successional species (Aidar et al., 2003). In addition, its roots have more carbon, which could indicate a larger carbon storage capacity that gives seedlings the ability to endure in environments with low light conditions and adapt when light availability is limited (Dos Santos Pereira et al., 2019). Besides the ecological characteristics of the colonizers, Sivasailam & Cummings (2017) suggest that the proximity of valuable plants enables indigenous peoples to invest less effort in accessing plants that support their livelihood.

The results showed that traditional use and domestic logging were the two main uses of valuable woody plant species. According to Cummings and Read (2016), mismanaging these species will affect indigenous populations and forest ecosystems' sustainability in the long term. Particularly, the diversity of species and the abundance of woody plants fluctuated, as shown in **Figure 5**. Based on the results, most species have building materials purposes. Hence, the extraction of forest products and associated disturbances could be the underlying force with decreased diversity in woody species. Extensive utilization of species can lead to a decline in species abundance and diversity. Less abundant species can aid in replacing declining major but functionally similar species (Berhane et al., 2015). Other scholars report that the significant invasion of shrubs into open fallows is one potential barrier to the growth of tree seedlings and saplings (Klanderud et al., 2009).

Plant diversity and abundance had a weak relationship with the age of fallow in the main plots. However, in the subplots, no relationship with the age of fallow was found. Fallow periods as short as 1 - 3 years in Kamwatta increased species diversity while dropping in later stages. In early successional plots, species diversity tends to be high because various species compete for limited resources. In contrast, species abundance was low during early fallows before increasing during the 8 - 10-year fallow period. One potential explanation of these findings is that pioneer woody species succeeded weedy species. Over time, the soil seed bank contained seeds of pioneer tree species. *Inga* was the dominant species in fallows as old as 8 - 35 years in the area. However, early colonizers such as *Inga*, with relatively faster growth rates than other woody tree species, may have facilitated soil-nutrient recovery and provided microhabitats to regenerate shade-tolerant species (Aidar et al., 2003). Based on research by Delang & Li (2013), species diversity increases when fallow age. Other results showed an increase at the beginning but then a drop in levels in later stages of succession, and a few studies concluded that there was no difference among age classes.

5. Conclusion

Mimosaceae was the dominant family found in abandoned farmlands from the

38 valuable woody species identified by the respondents. Field verification yielded 79% of these species occur in the sample area. Species abundance increased with fallow up at ten (10) years before declining in the latter years. Plant diversity and abundance had a weak relationship with the age of abandoned farmlands in the main plots, while the subplots showed no relationship. Based on the results, further studies to explore how other groups of indigenous people utilize woody plant species that are colonizing abandoned farmlands in their communities are of key importance; to investigate the connection between indigenous people and fallow succession; to improve documentation on the silvicultural characteristics of the *Inga* genus, since few species of *Inga* occur in the study area with related characteristics.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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List of Abbreviations

DBH—Diameter at Breast Height;

SC—Shifting Cultivation;

ES—Ecosystem Services;

REDD+—Reducing Emission from Deforestation and Forest Degradation.