



INDIGENOUS FARMING SYSTEMS AND CHALLENGES OF THE HIGAONON TRIBE IN ROGONGON, ILIGAN CITY: SOCIO-ECONOMIC AND AGRICULTURAL PERSPECTIVES

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ABSTRACT

Indigenous farming systems sustain food security, ecological stewardship, and cultural continuity, yet among the Higaonon of Rogongon, their continuity is threatened by land constraints, declining pest-control effectiveness, climate variability, low income, and security disruptions. Empirical documentation of these interconnected socio-economic and agroecological conditions remains limited. This study aimed to document and assess the indigenous farming systems of the Higaonon Tribe in Barangay Rogongon, Iligan City, Philippines. Specifically, it described socio-economic characteristics, farming systems and practices, pest and weed management, indigenous soil-quality indicators, and challenges affecting farming sustainability. Thirty key informants with farming experience and cultural knowledge were selected through purposive sampling. Data were gathered through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) and analysed using descriptive statistics. Results revealed that most respondents were female (60%) and mature adults aged 51 to 80 years (46.67%). In particular, farming was the primary livelihood of 56.67% of respondents, with an average monthly income of ₱2,800 (\$48.20). Although shifting cultivation remains culturally embedded, 40% practice semi-sedentary farming, while others have shifted to sedentary cultivation due to limited land, labour, and resources. Pest management relied on scarecrows, holed-land traps, and corn barriers, whereas soil fertility was assessed through soil colour, texture, plant vigour, and weed presence. Higaonon farming combines ancestral knowledge and adaptive strategies, though it remains vulnerable to pest outbreaks, shortened fallow periods, climate variability, labour limitations, and security concerns. Overall, the study highlights the need for culturally sensitive agricultural support, capacity-building programmes, and sustainable innovations that strengthen food security while preserving the Higaonon Tribe's indigenous ecological knowledge.

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Introduction

Indigenous Peoples (IPs) have long lived in harmony with nature across many regions of the world. They have made significant contributions to the maintenance of ecosystems through their traditional sustainable resource utilisation practices and cultural respect for ecological

balance (Nepal, 2024). Their knowledge systems, broadly defined as the cumulative body of wisdom, practices, and beliefs developed through generations of interaction with the environment, form the foundation of many local strategies for sustainability and resilience. In the

context of agriculture, indigenous knowledge encompasses farmers' adaptive strategies to the natural, physical, and socio-economic dynamics of their ecosystems. This, in turn, enables them to maintain productivity while conserving natural resources.

Several researchers emphasise that while indigenous knowledge is not a universal solution to sustainability challenges, it plays a crucial role in achieving sustainable development goals through its emphasis on diversity, community cooperation, and ecological stewardship (Agrawal, 1995; Brodnig & Mayer-Schönberger, 2000). Berkes (2012) and Altieri and Toledo (2011) further asserted that indigenous farmers' knowledge contributes significantly to the sustainable management of land, labour, and capital, fostering livelihood stability and environmental conservation.

However, in recent years, changes in agricultural systems driven by population growth, land scarcity, market expansion, technological innovation, and broader development pressures have increasingly disrupted traditional practices. These transformations pose serious challenges to sustainability, as they often undermine the ecological balance, social cohesion, and cultural values that indigenous farming systems have long upheld (Zandstra et al., 1981; Darnhofer et al., 2012; Tittonell, 2014; Pretty et al., 2018). Consequently, shorter fallow cycles, mechanisation, and market-driven monocropping, while economically attractive, frequently result in soil degradation, biodiversity loss, and cultural displacement. Hence, the challenge for agricultural research is to integrate the strengths of traditional knowledge with modern innovations to achieve sustainable outcomes. Following this, the principles of traditional agriculture, such as diversity, recycling of organic matter, and balance between production and regeneration, offer valuable insights for designing resilient and climate-adaptive farming systems (Altieri & Toledo, 2011; Kremen & Miles, 2012; Gliessman, 2014). Thus, documenting and analysing indigenous farming systems serves as

an effort to preserve cultural heritage and a vital contribution to sustainability science. Through such documentation, traditional ecological knowledge can be better understood as a foundation for sustainable land management, food security, and community-based adaptation to environmental change.

This relationship between indigenous knowledge and sustainability is particularly evident in the Philippine context, where traditional farming systems continue to shape rural livelihoods and ecological stewardship. According to the Philippine Statistics Authority (PSA, 2020), approximately 9.84 million IPs, belonging to 110 ethno-linguistic groups, are distributed mainly in Luzon (33%) and Mindanao (61%), with smaller populations in the Visayas. These communities continue to rely on indigenous agricultural systems that emphasise biodiversity conservation, soil regeneration, and reciprocal relationships with nature (Molintas, 2004). Among them are the Higaonons of Rogongon, Iligan City, one of the 18 Lumad groups of Mindanao, who sustain traditional farming practices deeply intertwined with their cultural beliefs, social structures, and spiritual relationship with the land.

Nonetheless, the effects of increasing population pressure on limited land resources have led to the cultivation of marginal and sloping lands and the intensification of existing agricultural areas (Lambin & Meyfroidt, 2011). These pressures have challenged the ability of indigenous communities to sustain traditional farming systems that depend on ecological balance, land rotation, and intergenerational knowledge transmission. Among the Higaonon of Rogongon, Iligan City, farming is not merely an economic activity. Instead, it is a culturally embedded system of land use, food production, ecological observation, and spiritual practice. Their indigenous farming system is traditionally associated with shifting cultivation, seasonal land preparation, the planting of rice, corn, root crops, banana, and abaca, and the observance of rituals that express respect for *Magbabaya*, the land, and the community's ancestral traditions.

Farm decisions are also influenced by practical ecological indicators, including soil colour, texture, plant vigour, weed growth, and the observed behaviour of pests and wildlife.

Relevant studies have demonstrated that indigenous farming systems remain important to food security, soil regeneration, biodiversity conservation, and community resilience. Dressler and Pulhin (2010), for example, documented the role of rotational fallowing in maintaining soil fertility among the Palawan people. On the other hand, Barrero *et al.* (2015) and Pandapatan *et al.* (2024) highlighted the continuing relevance of traditional cultivation among Higaonon communities. Broader agroecological studies likewise emphasise that traditional farming systems contribute to sustainability through crop diversity, nutrient recycling, organic matter management, and the balance between production and ecological regeneration (Altieri & Toledo, 2011; Kremen & Miles, 2012; Gliessman, 2014). However, these systems are increasingly affected by shortened fallow periods, land constraints, climate variability, pest pressure, and socio-economic vulnerability. Despite these concerns, empirical documentation of the Higaonon farming system in Rogongon remains limited. This is particularly true for studies that integrate socio-economic conditions, farming practices, pest and weed management, indigenous soil-quality assessment, and sustainability challenges.

Accordingly, this study aimed to document and assess the indigenous farming systems and practices of the Higaonon Tribe in Barangay Rogongon, Iligan City. Specifically, it sought to: (1) describe the socio-economic characteristics of the Higaonon farmers; (2) characterise their indigenous farming system and current farming practices; (3) document their pest and weed management strategies; (4) identify indigenous soil-quality indicators used in assessing soil fertility and degradation; and (5) determine the major environmental, economic, and socio-political issues and challenges affecting the sustainability of their farming system.

Materials and Methods

Description of the Study Area

Barangay Rogongon is located in the corner of the north-western part of Iligan City, whose geographical location lies between 8°12'00" and 8°17'00" latitude and 124°22'20" to 124°33'30" longitude (Figure 1). It is bounded on the north by a portion of the Province of Misamis Oriental and Cagayan de Oro City; on the east by the Province of Bukidnon; on the south by Barangay Kalilangan and Panorogan; on the southwest by Barangay Dulag; on the west by Barangay Digkila-an; and on the northwest by Barangay Mainit.

The barangay has a total area of 35,555 hectares, representing about 44% of the total land area of Iligan City. The Comprehensive Land Use Plan 2013-2022 of Iligan City identified the majority of the land of Barangay Rogongon as forestland and a few patches as agricultural land. An area of approximately 33,000 hectares within the forestland is likewise claimed by the Higaonon Tribe as their ancestral domain area, of which application is in process at the National Commission on Indigenous Peoples (NCIP).

Barangay Rogongon is classified as a rural area with a total population of 5,786, whose ethnicity is dominated by Bisaya, Cebuano, and Higaonon (PSA, 2015). Approximately 2.2% (7,122) of the total population of 322,821 in Iligan City are Higaonons, with areas of concentration not indicated.

Sampling Method

Purposive sampling was utilised to select 30 respondents, ensuring the intentional inclusion of Higaonon farmers regardless of their clan affiliation, tribal status, gender, or age. This sampling approach was deemed appropriate since the study sought information-rich participants who possessed firsthand farming experience and deep cultural knowledge of indigenous agricultural practices. By focusing on individuals actively engaged in traditional farming, the method ensured that the collected

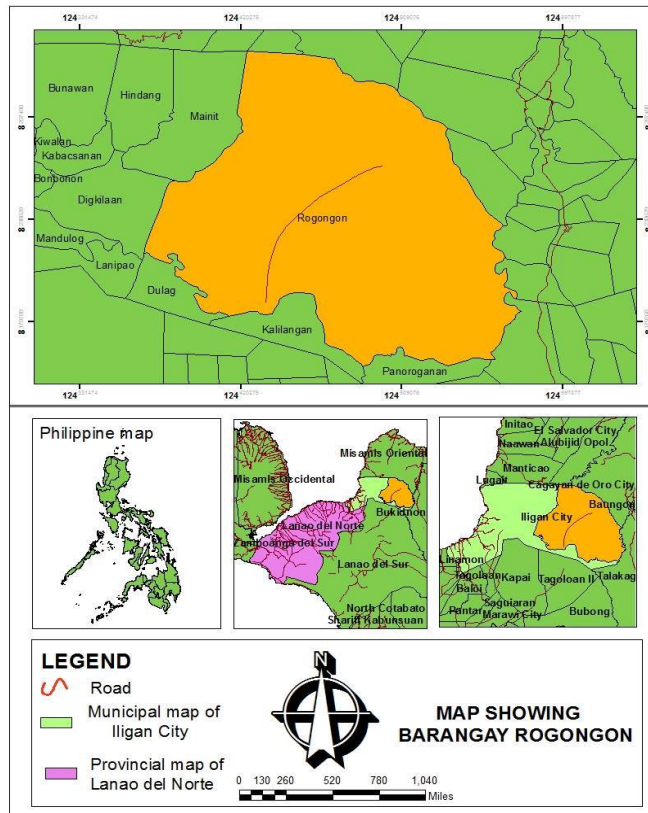


Figure 1: Location map of Barangay Rogongon, Iligan City, Philippines

data were authentic and representative of the tribe's indigenous farming systems. Furthermore, purposive sampling allowed the researcher to capture diverse perspectives within the community, providing a comprehensive understanding of their farming practices and the socio-cultural contexts in which they are embedded.

Data Gathering

Data were gathered using a semi-structured interview guide administered through Key Informant Interviews (KII) with selected Higaonon farmers in Barangay Rogongon, Iligan City. Notably, the use of a semi-structured guide allowed the researchers to collect comparable information across respondents while also allowing participants to explain their farming

experiences, indigenous practices, and perceived challenges in their own words. Following this, interviews were conducted at the respondents' residences to provide a familiar, comfortable setting for open discussion.

The interview guide was organised according to the major objectives of the study. The questions were categorised into five sections: (1) Socio-economic characteristics, including age, sex, civil status, household size, educational attainment, income, livelihood sources, and farming experience; (2) indigenous farming systems and agricultural practices, including landholding, cultivated area, cropping system, crop types, farming calendar, land preparation, planting, harvesting, fallow practices, and rituals associated with farming; (3) pest and weed management practices,

including common pests and weeds, traditional control methods, perceived effectiveness of pest management, and treatment of uprooted weeds; (4) indigenous soil-quality assessment, including local indicators of soil fertility and degradation such as soil colour, texture, plant vigor, and weed growth; and (5) issues and challenges affecting farming sustainability, including climate variability, pest outbreaks, labour constraints, land limitations, and security concerns.

To validate and enrich the information obtained from the KIIs, a Focus Group Discussion (FGD) was conducted with selected tribal members and *Datus*. The FGD served to confirm the accuracy of responses, clarify culturally specific interpretations, and ensure that the findings reflected the collective knowledge and experience of the community. All interviews and discussions were conducted in Cebuano, with translations verified by local interpreters to maintain cultural and linguistic accuracy.

Data Analysis

The study employed a descriptive analytical approach involving both quantitative data and categorised qualitative interview responses. In particular, quantitative data, such as age group, sex, civil status, household income, educational attainment, livelihood sources, landholding size, and farming experience, were summarised using frequencies, percentages, and means. These were subsequently encoded and analysed using Microsoft Excel.

Interview responses from the semi-structured KII and FGD were analysed through thematic content analysis. Responses were first reviewed and organised according to the major categories of the interview guide: Socio-economic characteristics, indigenous farming systems and practices, pest and weed management, soil-quality assessment, and farming-related challenges. Recurring responses within each category were then coded into specific themes or response classes. For example, farming systems were classified as shifting,

semi-sedentary, or sedentary; pest management practices were coded according to the methods used, such as scarecrows, holed-land traps, corn barriers, and manual pest removal; and soil-quality indicators were grouped according to soil colour, texture, plant vigour, weed growth, and plant types present.

After coding, the categorised responses were tabulated and converted into frequencies and percentages to describe the distribution of responses among the 30 key informants. Building on this, qualitative statements from the interviews and FGD were used to support, explain, and contextualise the numerical results. Thus, the main analysis of the study was descriptive, with quantitative summaries used to present socio-economic and categorised interview data. At the same time, qualitative data were used to interpret the cultural meanings and practical significance of Higaonon farming practices.

Results and Discussion

Socio-economic Profile of the Respondents

Gender

A total of 30 respondents were interviewed in this study, with females constituting 60% and males 40% (Table 1). In Higaonon communities, farming activities are shared by both men and women, though gender roles influence specific responsibilities within the household and on the field. Women, in particular, play a central role in agricultural production, as they are actively involved in cultivating all crops grown in their farms, including rice (*Oryza sativa*), corn (*Zea mays*), root crops, and vegetables. This broad participation underscores their vital contribution to food security and household sustenance. Recent studies affirm this significant role of indigenous women in agriculture. For instance, Duong (2024) emphasised that women are instrumental in addressing agricultural challenges through conservation practices and the adoption of innovative farming methods. Similarly, Lu (2010) observed that women in Philippine highland communities are deeply

Table 1: Socio-economic profile of the respondents

Socio-economic Profile		Frequency	Percentage (%)
Gender	Male	12	40
	Female	18	60
Age group	Early adult	6	20
	Middle age	10	33.33
	Mature adult	14	46.67
Civil status	Married	26	86.67
	Widowed	3	10
	Separated	1	3.33
Income classes	Low (Less than 7,000)	28	93.33
	Middle (7,000–20,000)	2	6.67
	High (21,000 and above)	-	-
Secondary source of income	None	17	56.67
	Private employment	3	10
	Government employment	4	13.33
	Micro-retail enterprise	4	13.33
	Fishing	1	3.33
	Driving motorcycle taxis	1	3.33
Educational attainment	None	3	10
	Elementary level	15	50
	Elementary graduate	8	26.67
	High school level	2	6.67
	High school graduate	2	6.67

engaged in the production of staple and cash crops, reflecting their agency in sustaining local agricultural systems. Despite historical influences that introduced patriarchal values, Higaonon women continue to demonstrate resilience and cultural integrity through their enduring involvement in farming. This remains an essential expression of their indigenous identity and ecological stewardship.

Age Group

The majority of respondents in this study were mature adults aged 51 to 80 years, while only 20% were early adults (21 to 35 years old). This demographic pattern reflects a broader global trend of an ageing farming population. In the United States (US), the average age of farm producers was 58.1 years in 2022, continuing

a long-term ageing trend (US Department of Agriculture-National Agricultural Statistics Service [USDA-NASS], 2024). Likewise, in the European Union, only 11.9% of farm managers were under the age of 40 in 2020 (Eurostat, 2024).

This phenomenon is also evident in the Philippines, where the average age of farmers is estimated at 55 to 59 years, raising concerns of a future shortage in the agricultural workforce as fewer youth enter the sector (PSA, 2021; Southeast Asian Regional Centre for Graduate Study and Research in Agriculture [SEARCA], 2023). One major reason behind this demographic shift is the migration of younger generations from rural to urban areas in search of better economic opportunities, higher education, and improved living conditions.

Moreover, agriculture is often associated with lower wages and limited economic incentives, leading many farmers to encourage their children to pursue non-agricultural livelihoods. The Food and Agriculture Organisation (FAO) of the United Nations (2015) has observed that agriculture in many developing countries, including the Philippines, offers fewer attractive opportunities for youth compared to urban-based employment.

Within this study's sample, the proportion of middle-aged respondents (36 to 50 years old) was slightly lower than that of mature adults, with a difference of about 13.34%. This may reflect that individuals in this age group are in their prime working years, often engaged in both farm and off-farm labour, while older adults remain the most active in sustaining household-level agricultural production.

Civil Status

Civil status strongly influences livelihood choices, household roles, and long-term engagement in agriculture. In many rural and indigenous settings, marriage signifies stability and shared responsibility, fostering cooperation in farming and household subsistence. In line with this, married individuals often remain in farming as it sustains their family's food and economic needs through collective labour and intergenerational knowledge transfer (Landale, 1989; Anderson *et al.*, 2017).

In this study, the majority of respondents were married (86.67%), while 10% were widowed and 3.33% were separated. Most of them relied on farming as their primary livelihood, with an average of 28.53 years of farming experience. The predominance of married respondents underscores the close intertwining of family life and agricultural work. Marriage establishes a labour-sharing system in which spouses and children contribute to farm activities such as planting, harvesting, and crop maintenance. Among the Higaonon, farming is traditionally viewed as a source of income and a collective duty that sustains the family and community. Furthermore, married couples

collaborate in farm decision-making, from land preparation to post-harvest storage, while widowed members often depend on extended kinship networks for farm labour support. This shared labour tradition reflects the Higaonon's cultural emphasis on *bayanihan* (communal cooperation) and *panaghiusa* (unity), values that strengthen resilience in agricultural livelihoods (National Commission for Culture and the Arts [NCCA], 2020; Tangian, 2011).

In contrast, unmarried or single individuals are more likely to explore opportunities outside agriculture, often seeking urban employment or higher education. Similar patterns have been observed across rural areas in the Philippines and Asia, where family formation is linked to continued engagement in farming, while single youth demonstrate higher mobility and occupational diversification (FAO, 2017; International Fund for Agricultural Development [IFAD], 2019).

Income Classes

Income level is a fundamental determinant of household well-being, shaping access to essential needs such as food, education, and health services (World Bank, 2020). In rural and indigenous communities, limited cash income often coexists with strong reliance on subsistence production, kinship labour, and shared resource systems, which enable families to meet basic needs despite low monetary earnings (FAO, 2019). In essence, these traditional livelihood systems, grounded in self-sufficiency and community reciprocity, serve as social safety nets that buffer indigenous households from extreme poverty and market dependency (United Nations Development Programme [UNDP], 2021).

Field data revealed that the 30 participating households supported an average of five members, with a reported monthly income of approximately ₱2,800 (\$48.28). This figure was derived from respondents' self-reported earnings during the KIIs, where participants were requested to estimate their average monthly income from all livelihood sources, including

crop sales, minor livestock production, and small-scale trading activities. Subsequently, the reported amounts were summed and averaged across all respondents to obtain the mean household income, providing an indicative measure of the tribe's economic condition. This modest income, coupled with a relatively large household size, indicates a pronounced level of economic vulnerability among the respondents. Based on the PSA (2023), a family of five requires at least ₱13,873 (\$236.38) per month to meet basic food and non-food needs, indicating that the respondents' income is well below the national poverty threshold. Despite this disparity, many families can subsist through direct reliance on their own farm produce, including rice (*O. sativa*), corn (*Z. mays*), cassava (*Manihot esculenta*), and bananas (*Musa* spp.). These provide daily nourishment and reduce dependence on purchased goods. This form of subsistence farming, characterised by diversified cropping and the use of traditional seeds, serves as both a livelihood and a coping strategy against poverty (FAO, 2019). Additionally, the ability to draw sustenance from locally cultivated resources demonstrates how indigenous farming systems sustain household food security even when cash income remains critically low.

Socio-economic studies consistently suggest that large household size amplifies the risk of poverty, as the financial burden increases while income sources remain limited. In the Philippine context, Orbeta (2005) established that families with more children are more likely to experience economic hardship due to higher consumption needs and constrained financial capacity. This observation aligns with reports from United Nations Children's Fund (UNICEF) Philippines (2023) and Duncan *et al.* (2017), which emphasised that children from low-income families face barriers to education, proper nutrition, and long-term social mobility, factors that reinforce intergenerational poverty. The respondents' circumstances reflect this cycle. With five household members on average and a cash income far below the poverty

threshold, most families depend heavily on subsistence farming and occasional informal labour to survive. Such economic conditions limit their capacity for savings, farm investment, or educational support for their children, thereby perpetuating vulnerability across generations. Nevertheless, the persistence of indigenous farming practices and communal support networks provides a modest yet resilient safety net that helps sustain these households amid economic adversity.

Analysis of income distribution highlights that the majority of respondents live below the national poverty threshold, while only two households fall within the middle-income category. What distinguishes these relatively better-off families is their engagement in multiple livelihood sources, such as small-scale trading or wage labour in nearby areas. This pattern supports broader evidence that diversified income strategies enhance household resilience, allowing families to offset seasonal or market-related risks in farming (Ellis, 2000). Among indigenous farmers, this diversification is an economic adaptation and a cultural expression of self-reliance and reciprocity. Moreover, secondary livelihood activities often involve kinship-based cooperation, borrowing tools, exchanging labour, or bartering farm products, which reinforces social cohesion within the community (Ortiz, 1998; Torres, 2003). Thus, while financial poverty remains pervasive, the Higaonon farmers' ability to draw from both traditional knowledge and flexible livelihood practices demonstrates a form of resilient adaptation that sustains their households despite persistent economic constraints.

Secondary Source of Income

Livelihood diversification is a key survival strategy among rural and indigenous populations, providing financial stability when agricultural income is uncertain. Secondary occupations supplement farm-based livelihoods and help households meet basic needs during off-harvest periods (Ellis, 2000). Among the Higaonon, this practice reflects both economic pragmatism and

social adaptability, where individuals combine traditional farming with modern forms of employment.

Survey data indicate that more than half of the respondents (56.67%) rely exclusively on farming as their primary source of income. However, several respondents pursue secondary occupations that complement their agricultural work. About 13.33% are employed in government positions, including barangay officials and members of the Barangay Lupon, the local mediation council responsible for resolving community disputes. Meanwhile, 10% work in private institutions, and another 10% operate small *sari-sari* stores (village convenience shops). A religious organisation in Barangay Rogongon also employs some tribe members as farm labourers in its church-managed coffee plantation. Following this, a few respondents engage in other informal livelihood activities, such as selling tobacco, fishing, and driving a *habal-habal* (motorcycle taxi).

This variety of economic activities illustrates the Higaonon's adaptive capacity to balance cultural tradition with modern livelihood options. The coexistence of traditional farming roles and contemporary occupations demonstrates the tribe's ability to function within both customary and mainstream political systems, where members may hold elective or appointed positions in local government. Such economic and institutional flexibility exemplifies the Higaonon's resilience, their capacity to harmonise indigenous values with emerging opportunities while maintaining social cohesion and cultural continuity (Tangian, 2011; NCCA, 2020).

Educational Attainment

Education is widely recognised as a key instrument for poverty alleviation and social mobility. It enhances human capital, expands employment opportunities, and strengthens a community's adaptive capacity to economic and environmental changes. According to the World Bank (2023), each additional year of schooling can increase an individual's earnings by

approximately 9%. This emphasises education's central role in improving long-term economic stability and resilience.

Survey results indicate that 90% of the respondents have attended formal education, yet there is a notable decline in participation at higher education levels (Table 1). This pattern reflects persistent barriers faced by the Higaonon community, particularly financial limitations and the geographical distance of educational institutions from their remote settlements. Such constraints mirror global and national trends in rural education. For example, Frenette (2002) and the USDA Economic Research Service (2023) reported that adults residing in rural areas often have lower educational attainment compared to urban populations. This is primarily due to limited access to schools, inadequate infrastructure, and opportunity costs associated with schooling.

Globally, United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2022) warned that individuals with only primary education remain among the most vulnerable to poverty and economic shocks. This finding underscores the importance of ensuring equitable access to secondary and higher education for indigenous communities. For the Higaonon, improving access to quality education, through scholarships, mobile learning programmes, and community-based schools, could significantly reduce vulnerability. Such initiatives further empower future generations to participate more fully in local governance, sustainable livelihood, and cultural preservation.

Indigenous Farming System of the Higaonon Tribe

Farming is the cornerstone of the Higaonon tribe's livelihood and cultural identity in Rogongon, Iligan City. Similar to many indigenous groups in the Philippines, the Higaonon practice shifting cultivation as their main agricultural system. According to Lanly (1985), shifting cultivation is characterised by brief cultivation periods followed by longer fallow intervals that allow the soil and vegetation to regenerate. Several

studies affirm that this traditional system remains central to the food security and ecological balance of IP. For instance, Dressler and Pulhin (2010) documented that the Palawan people in Southern Palawan sustain soil fertility through rotational fallowing. Meanwhile, Pandapatan *et al.* (2024) and Barrero *et al.* (2015) highlighted its continuing role in the Higaonon communities of Rogongon and Claveria.

Within this system, the Higaonon follow an annual agricultural cycle known as *Panuig*, which reflects how traditional ecological knowledge governs land use through seasonal patterns and spiritual observance. As summarised in Table 2, their farming cycle centres on the cultivation of rice (*O. sativa*) as the primary crop, along with corn (*Z. mays*), banana (*Musa* spp.), abaca (*Musa textilis*), and other secondary crops. The *Panuig* cycle encapsulates both agricultural management and spiritual reverence, demonstrating that, for the Higaonon, farming is as much a cultural ritual as it is an economic activity.

The cycle begins with *Pagtakda*, conducted between December and January, when designated clans observe star constellations (*Pagtala*) to determine the appropriate time and location for cultivation. This is followed by *Pagbabasok* (land preparation) between January and February, which starts with a ritual led by the *Baylan* (tribal priest). Offerings of native chicken, rice, betel leaves, and nuts are presented before *Magbabaya* (God), with the *Datus* (tribal leaders) and the landowner

participating to seek divine permission and blessing. Similar pre-cultivation ceremonies are observed among other indigenous groups, such as the Maguindanaon, who honour spiritual entities before beginning agricultural activities (Saavedra & Abas, 2015).

Subsequent stages, *Paglampas* (clearing), *Pagpugas* (sowing), *Pagguna* (weeding), *Pagtanum* (planting of additional crops), and *Pagkayug/Pag-ani* (harvesting), trace the continuous interaction between people, land, and the divine. During *Pagpugas*, men and women work cooperatively: Men use sticks (*Iduk*) to make holes in the soil while women drop rice and corn seeds. The seeds used are heirloom varieties preserved by the tribe, symbolising seed sovereignty and intergenerational stewardship. In *Pagguna* (June-July), the tribe removes weeds from their fields, which also serves as preparation for planting additional crops. Between June and August, they engage in *Pagtanum*, the planting of secondary crops such as sweet potato, cassava, banana, abaca, sugar cane, and corn. The harvest period, known as *Pagkayug/Pag-ani*, occurs from September to November, when the tribe harvests rice using a *kayug*, a hand tool fashioned from scrap metal. The harvest begins and ends with a thanksgiving rite led by the *Baylan*, joined by the farm owner and *Datus*, offering harvested rice and corn, a live chicken, and betel leaves and nuts to express gratitude. Post-harvest, the land is left to fallow while the tribe transitions to new areas to begin another farming cycle, allowing previously cultivated plots to regenerate naturally.

Table 2: The shifting cultivation cycle of Higaonons

Farming Activities (Higaonon)	Common Term (English)	Rituals	Month
<i>Pagtakda</i>	Land marking/field designation	None	December–January
<i>Pagbabasok</i>	Land preparation	Permission and guidance	January–February
<i>Pagpugas</i>	Sowing/planting	Notification and supplication	April–May
<i>Pagguna</i>	Weeding	None	June–July
<i>Pagtanum</i>	Planting other crops	None	June–August
<i>Pagkayug/Pag-ani</i>	Harvesting	Thanksgiving	September–November

The agricultural year culminates with the *Kaamulan* Festival, an 18-day communal thanksgiving held in November. Derived from the *Binukid* term *amul*, translating to “to gather,” *Kaamulan* unites Higaonon clans and other indigenous groups in a shared expression of gratitude and unity (Cajetas-Saranza, 2016; NCCA, 2022). Through this integrated system of cultivation and ritual, the Higaonon uphold a sustainable relationship with the land, blending ecological wisdom, spirituality, and social harmony into one enduring cycle. Furthermore, their observance of fallow periods and rotational cultivation ensures that soil fertility and forest vegetation are naturally restored, minimising degradation and maintaining biodiversity. This cycle of use, rest, and renewal exemplifies traditional ecological stewardship, where sustainability extends beyond mere practice. Rather, it is a way of life rooted in ancestral values. Such enduring harmony between people and nature demonstrates how indigenous knowledge systems, such as those of the Higaonon, can inform modern approaches to sustainable land management and climate resilience.

Status of Higaonons’ Farming System and Practices

The integration of tribal governance into the mainstream political system has profoundly reshaped many indigenous communities in the Philippines. While this integration aimed to strengthen participation in formal governance, it has also facilitated processes that compromise ancestral domain integrity. As Wilkins and Heidi (2024) noted, the redefinition of territorial boundaries through political declarations has often resulted in the loss of ancestral lands. These are subsequently declared public property or allocated for corporate use and resource extraction, including mining concessions (United Nations, 2023). Correspondingly, these developments have disrupted the mobility of IP, reduced the size of cultivable land, and weakened traditional shifting cultivation systems that depend on expansive forest areas and long fallow cycles (World Bank, 2023).

Among the Higaonons of Rogongon, Iligan City, these external pressures have compelled the community to modify its traditional farming system. What was once a fully rotational and extensive form of shifting cultivation has evolved into a blend of semi-sedentary and sedentary farming practices, reflecting both adaptation and constraint. Following this, semi-sedentary farming incorporates elements of the traditional system, such as rotational cropping and temporary fallows, within increasingly limited landholdings. Due to land tenure insecurity and restrictions on forest access, traditional shifting cultivation has become increasingly difficult to sustain (Mukul & Herbohn, 2016).

Empirical data from this study indicate that the average individual landholding among the 30 respondents is seven hectares, though only a small portion of these areas is cultivated annually. About 40% of the respondents continue to practice semi-sedentary farming, cultivating one to two hectares of land following the shifting cultivation cycle. After a year of farming, the owner moves to another portion of their land to begin a new cycle, leaving the previously used area to fallow for only one to two years before cultivation resumes (Mukul & Herbohn, 2016). The remaining 60% of respondents have transitioned fully to sedentary farming, cultivating the same plots year after year. However, these farmers are unable to utilise their entire landholdings due to limited manpower and financial resources. Traditionally, household members contributed labour for land preparation and cultivation. Today, some members pursue other income-generating activities, leaving an average of only 2.58 hectares under active cultivation.

To maximise land productivity, several farmers have diversified into agroforestry-based systems, planting timber and fruit-bearing trees such as *Falcataria moluccana* (Falcata), *Lansium domesticum* (Lansones), *Durio zibethinus* (Durian), *Annona muricata* (Guyabano), and *Persea americana* (Avocado). This shift represents a strategic adaptation toward long-term economic stability, as tree

crops provide sustained market value while supporting soil retention and microclimate regulation. Nevertheless, this transition also signifies a decline in staple crop production, potentially affecting household food security. The reduced fallow periods associated with both semi-sedentary and sedentary systems have further implications for soil fertility, biodiversity, and yield sustainability.

The transition of the Higaonon tribe from a foraging to semi-sedentary and sedentary farming systems reflects an adaptive response to environmental degradation, land scarcity, and socio-economic pressures. Accordingly, semi-sedentary farming offers flexibility but risks soil depletion due to shortened fallow cycles, while sedentary farming provides stability but requires sustained capital and labour inputs. In essence, the emerging agroforestry trend illustrates the tribe's resilience and ingenuity, integrating traditional knowledge with market-oriented practices to enhance livelihood sustainability.

Pests and Weeds Management of the Higaonon Tribe

The Higaonon people have long approached farming with deep ecological respect, guided by

traditional beliefs that emphasise harmony with all living beings, including pests. Traditionally, they refrained from intervening when pests infested their crops, believing that killing even a single pest would provoke population growth and greater crop damage. This non-intervention practice reflected an ecological ethic rooted in balance rather than domination. Nonetheless, many respondents noted that pest populations have increased in both number and diversity despite maintaining these customs. As illustrated in Figure 2, approximately 70% of farmers reported that their current pest management practices are less effective, 20% deemed them completely ineffective, and only 10% considered them still effective. These assessments were based on farmers' observations of harvest yields and visible crop damage at the end of each cropping cycle, serving as practical indicators of pest control success.

The rise in pest occurrence among the Higaonon community mirrors trends observed in other indigenous farming systems across the Philippines. For example, the Ifugao rice farmers of Northern Luzon have reported escalating pest infestations, attributing them to climate variability that disrupts traditional cropping cycles and ecological balance. Joshi

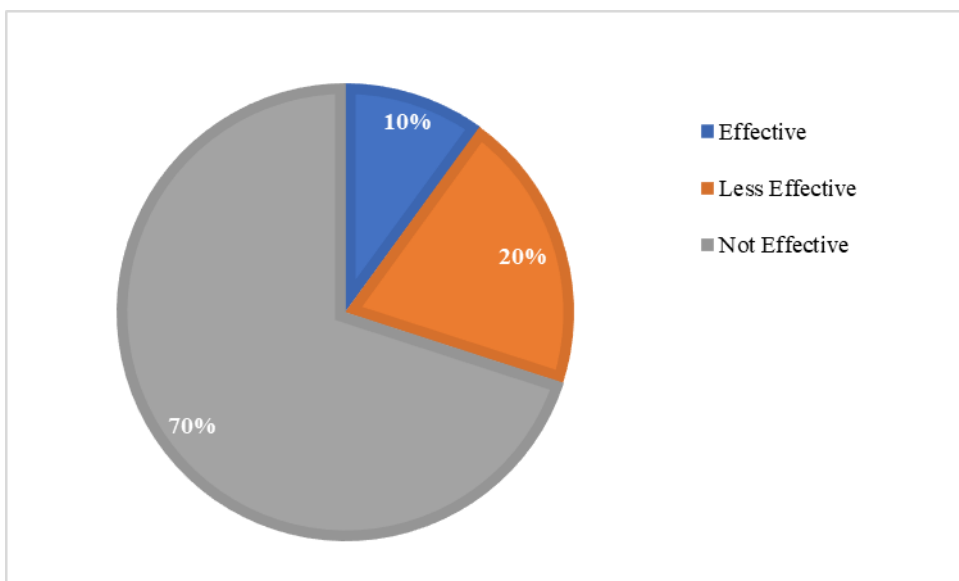


Figure 2: Effectiveness of the tribe's pest management

et al. (2000) reported that the emergence of new pest species and intensified infestations have undermined traditional, low-input pest management practices in Ifugao. Similarly, Meranao farmers in Southern Mindanao have experienced declining reliability of traditional pest control techniques as pest diversity and resilience increased under shifting climatic conditions (Valdez, 2023). Collectively, these observations indicate that climate-induced environmental changes are challenging the effectiveness of traditional pest management systems, necessitating adaptive approaches that combine indigenous wisdom with ecological science.

Among the Higaonon farmers, several pests are recognised as major threats, including wild boars, birds, rodents, monkeys, crawling insects, and a pest locally referred to as the “Japanese seal”. To mitigate these threats, farmers employ a variety of low-cost, traditional methods. Accordingly, scarecrows are placed throughout fields to deter birds, while maize is planted along the periphery of rice plots to draw wild boars toward the edges, minimising crop damage. In addition, rodents are controlled through hole traps, an indigenous trapping method that reduces field losses without chemicals. The “Japanese seal” was identified as the golden apple snail (*Pomacea canaliculata*), an invasive species introduced to the Philippines in the 1980s (Joshi *et al.*, 2017). Farmers remove these snails manually and crush them to prevent reproduction, an approach that reflects labour-intensive yet environmentally safe pest control.

Despite the widespread use of pesticides in commercial agriculture, the Higaonon community has not adopted chemical pest control methods. Their reluctance stems primarily from financial limitations, as purchasing synthetic pesticides is economically unfeasible. Equally important, many farmers believe that chemical inputs degrade soil fertility, a belief consistent with findings that indigenous farmers elsewhere avoid chemical use due to its potential to disrupt soil health and ecosystem balance (Maghirang *et al.*, 2021). In general, the Higaonon’s

persistence in organic, non-chemical approaches demonstrates an environmental ethic aligned with agroecological principles.

The challenges now confronting Higaonon pest management underscore the need for integrated and adaptive strategies. Traditional practices, while historically effective, must evolve to address new pest dynamics driven by environmental change. Blending indigenous ecological knowledge with modern, ecologically based pest control methods, such as biological control, crop diversification, and habitat management, could strengthen agricultural resilience and preserve cultural integrity.

The Higaonon people’s philosophy of coexistence extends beyond pests to all elements of their agroecosystem. Their approach to farm management is guided by a worldview that recognises both harmful and beneficial roles of living organisms in maintaining ecological balance. Just as they practice restraint in managing pests, the tribe applies a similar principle of ecological tolerance and respect toward weeds. To the Higaonon, these plants are not merely intruders in their fields. They also contribute to soil health and fertility, embodying the community’s deep understanding of the interconnectedness of all forms of life in sustaining productive landscapes.

Weeds, commonly defined as unwanted plants growing among cultivated crops, are viewed by the Higaonon both as nuisances and contributors to soil fertility and ecological balance. As displayed in Figure 3, about 60% of farmers do not remove weeds, adhering to the belief that these plants enrich the soil and protect it from erosion. The remaining 40% of farmers perform hand weeding to manage competition between weeds and crops. In this sense, farmers who allow weeds to remain in their fields do so selectively, tolerating moderate weed growth that does not significantly hinder crop development. They note that while some competition occurs, the benefits to soil fertility and moisture retention often offset minor yield losses. When weed growth becomes excessive or visibly affects plant vigour, farmers conduct

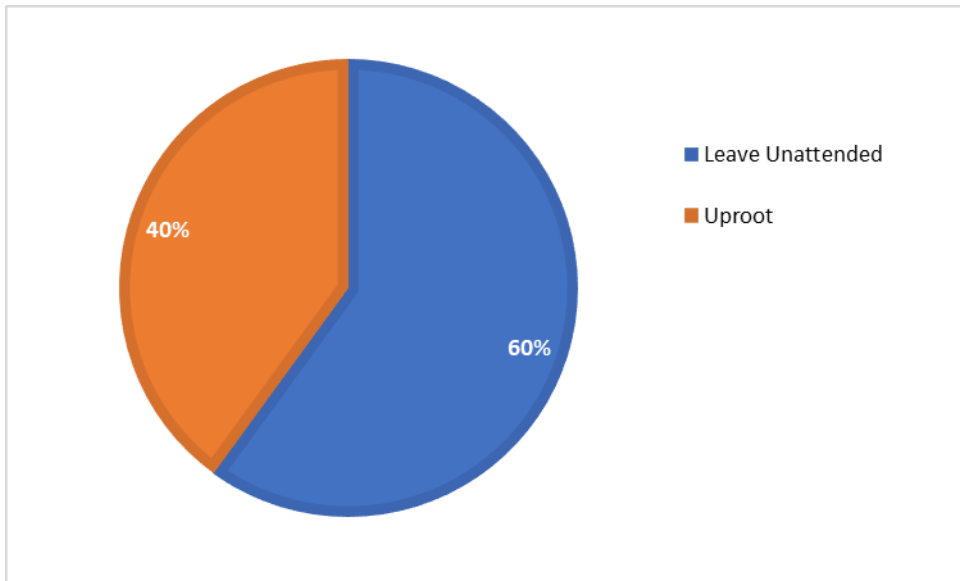


Figure 3: Distribution of respondents based on weed management

partial hand weeding to ensure adequate harvest. Correspondingly, this adaptive approach allows them to maintain acceptable yields while preserving soil health and minimising labour costs.

Among those who remove weeds, 94% leave the uprooted plants on the field to decompose naturally, allowing organic matter to return to the soil. Only 6% of farmers burn the collected weeds near their fields, a method that may help reduce pests and disease, though it can also deplete nutrients and contribute to air pollution. The Higaonon's approach to weed management demonstrates a deep-rooted ecological awareness consistent with sustainable agriculture. Their belief that weeds enhance soil fertility aligns with agroecological principles emphasising nutrient cycling and biodiversity. Notably, allowing weeds to decompose in situ adds organic matter, improves soil structure, and promotes microbial activity, essential processes for maintaining productivity without chemical fertilisers. However, while the small-scale burning of weeds may offer short-term pest control benefits, it can also lead to nutrient loss and soil degradation if practised frequently. In general, these contrasting approaches illustrate

the balance between traditional reasoning and practical adaptation, highlighting both the wisdom and the limitations of indigenous ecological practices.

The pest and weed management practices of the Higaonon people collectively embody a low-input, ecosystem-based agricultural philosophy rooted in respect for the natural world. Their reliance on manual, organic methods and avoidance of synthetic chemicals reflects a form of indigenous sustainability that prioritises soil health, biodiversity, and ecological harmony. Nonetheless, as climate variability intensifies and pest populations evolve, these traditional methods face increasing limitations.

Soil Quality Assessment of the Higaonon Tribe

The transition of the Higaonon tribe from shifting to semi-sedentary and sedentary farming has prompted the development of indigenous soil assessment practices. In earlier times, celestial observation guided cultivation schedules. However, as farming became more site-specific, soil conditions emerged as the main basis for land selection. Farmers now evaluate soil fertility through practical observation, examining crop

vigour, yield, and tactile soil properties. This reflects a system of knowledge refined through generations of shifting-cultivation experience.

As illustrated in Figure 4, Higaonon farmers identified three primary indicators of fertile soil: Plant growth, plant types present, and soil colour. About 3.33% assess fertility based on weed density and greenness, interpreting lush weed growth and deep-green leaves as signs of high fertility. This observation aligns with studies highlighting that certain weed species dominate nutrient-rich soils due to their allelopathic interactions and adaptive competitiveness (Callaway & Ridenour, 2004; Tran Dang *et al.*, 2007; Dawoe *et al.*, 2012). Another 3.33% rely on the presence of specific indicator plants, believing that particular species grow only on fertile ground, a concept consistent with ecological bio-indicators recognised in soil science.

The majority (93.33%) use soil colour and texture as their main indicators of fertility. Dark-coloured, soft, and friable soil is perceived as fertile, while hard, reddish soil signals compaction and nutrient exhaustion. This perception accords with findings that darker soils generally contain more organic matter and better moisture-holding capacity, whereas reddish soils often reflect oxidation and reduced fertility (Barrera-Bassols & Zinck, 2003; Dawoe *et al.*, 2012; Sirisathitkul & Sirisathitkul, 2025). Table 3 summarises these classifications, indicating that black, loose soils denote good quality and hard, red soils represent degradation. Such indigenous classification provides a cost-efficient and context-specific alternative to formal soil surveys, offering valuable insights for sustainable land use.

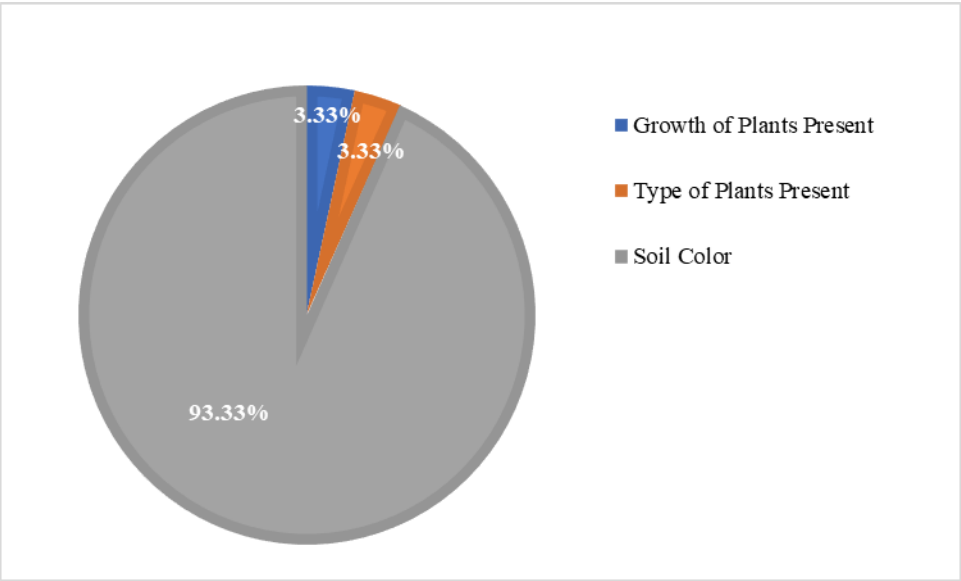


Figure 4: Distribution of respondents by their soil fertility assessment

Table 3: Characteristics and quality of soil based on the assessment of Higaonons

Soil Colour	Texture	Quality
Black	Soft, moist	Fertile
Red	Hard, dry	Degraded

Higaonon farmers also apply similar sensory cues to identify soil degradation. As depicted in Figure 5, most respondents again cited soil colour as the key indicator of declining fertility, confirming that visual and tactile properties remain central diagnostic tools. Approximately 13.33% associated the proliferation of weeds with soil infertility, a perception possibly shaped by weed species that aggressively compete with crops rather than enrich the soil. Another 10% evaluated degradation through plant characteristics, such as yellowing leaves and thin stems, interpreting these as signs of nutrient deficiency and soil fatigue. Together, these qualitative observations parallel agronomic findings that chlorosis and stunted growth correlate with nitrogen or micronutrient depletion (Cordeau *et al.*, 2021).

The Higaonons' soil-quality assessment system reveals a practical synthesis of observation, experience, and ecological understanding. Their reliance on colour, texture, and vegetation indicators demonstrates the precision of indigenous environmental knowledge, which allows rapid field assessment without external inputs.

Other Issues and Challenges of the Higaonons' Farming System and Practices

The issues and challenges presented in this section were primarily derived from the KIIs with Higaonon farmers and were further validated through the FGD with selected tribal members and *Datus*. During the interviews and discussions, respondents identified changing weather patterns, stronger typhoons, pest-related losses, labour limitations, land constraints, and security concerns as major factors affecting the sustainability of their farming system.

Despite their enduring resilience and ecological wisdom, the Higaonon farmers continue to face growing environmental and socio-political challenges that threaten the sustainability of their traditional farming systems. The most pressing of these include changing weather patterns, intensifying typhoons, and persistent security concerns that disrupt cultivation cycles and endanger livelihoods.

Climate variability has become one of the most critical threats to indigenous agriculture worldwide. Correspondingly, changing weather

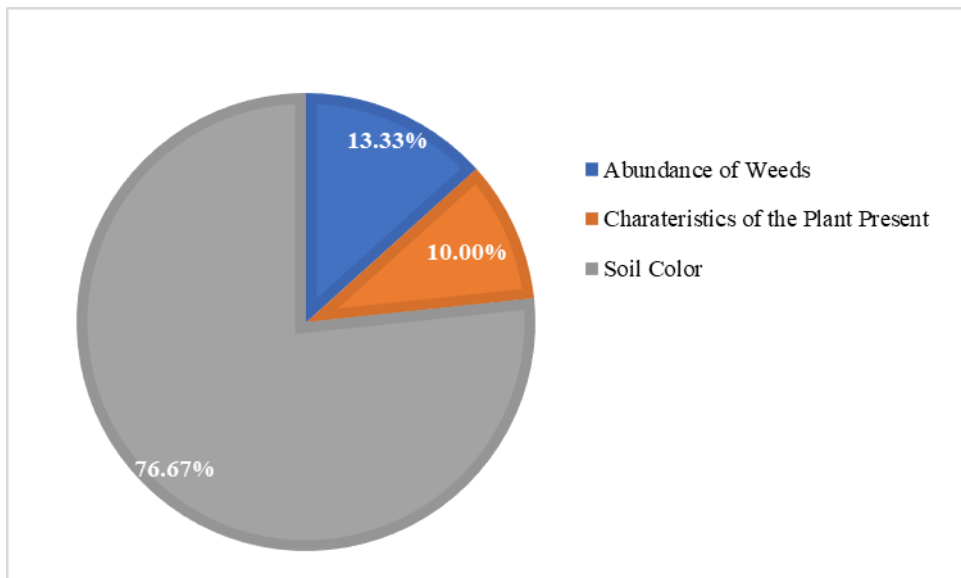


Figure 5: Distribution of respondents by soil degradation assessment

patterns alter rainfall distribution, temperature, and seasonal timing, factors that are vital for food production and ecosystem stability (Mirzabaev *et al.*, 2022). Locally, the Higaonons have observed erratic rainfall patterns and prolonged dry periods that disrupt their farming calendar. These changes are particularly evident from February to May, when consistent sunlight is needed to dry slashed vegetation for burning, a crucial step in land preparation and soil fertility maintenance. On the other hand, unpredictable rainfall during this stage delays cultivation, shortens planting windows, and reduces overall crop yields.

Moreover, global warming has intensified the frequency and severity of typhoons, posing significant threats to human lives, ecosystems, and food security (Ortiz *et al.*, 2023). The Philippines, situated along the Pacific typhoon belt, ranks among the world's most vulnerable countries to climate-related disasters. In December 2011, Typhoon Sendong (Washi) devastated the northern part of Mindanao, including Barangay Rogongon, a site historically considered low-risk under the Comprehensive Land Use Plan (2013–2022) of Iligan City. The typhoon left large tracts of tribal farmland eroded, destroyed stored seeds, and caused total crop loss. Interestingly, these experiences align with findings that IPs are disproportionately affected by environmental hazards due to their dependence on local ecosystems for subsistence and their socio-political marginalisation (Ford *et al.*, 2020; Cuaton & Su, 2020).

Beyond climate-related challenges, the presence of armed groups in the surrounding uplands has further endangered the community's stability. The ongoing conflict forces farmers to temporarily abandon their fields during periods of tension, leaving crops untended and disrupting seasonal rituals such as *Pagtakda* and *Pagbabasok*, marking the start of land preparation. In addition, repeated displacement reduces fallow periods and accelerates soil degradation, compounding the effects of environmental stress. This reflects the interlinked nature of ecological and security

risks, where instability limits production and erodes the social cohesion and knowledge transmission that sustain indigenous farming traditions (Chandra *et al.*, 2017).

These interwoven climatic and socio-political pressures reveal the vulnerability of the Higaonon farming system to rapid environmental change and insecurity. While traditional ecological knowledge has long enabled adaptation, the magnitude of present challenges demands broader institutional and policy support. Thus, strengthening local disaster preparedness, promoting community-based resource management, and integrating indigenous practices into climate-resilient agriculture frameworks are essential to safeguard both the Higaonon's livelihoods and their cultural heritage.

Conclusions

This study underscores the importance of indigenous knowledge in sustainable agriculture, as demonstrated by the Higaonon Tribe's adaptive farming systems and ecological practices in Barangay Rogongon, Iligan City. While the tribe has successfully integrated semi-sedentary farming and traditional pest management strategies, challenges such as climate variability, pest infestations, labour shortages, and security concerns threaten their agricultural sustainability. These challenges reflect broader issues faced by indigenous communities worldwide, particularly in securing land rights, preserving traditional knowledge, and adapting to environmental and socio-economic changes. In line with this, the study highlights the need for policy interventions and support to empower the Higaonon farmers through capacity-building programmes and sustainable agricultural innovations. Given their reliance on traditional farming practices, introducing organic fertilisers and sustainable pest management strategies could enhance productivity while respecting their cultural and environmental values. In response, future research could explore long-term impacts of

climate change on indigenous farming systems, effective strategies for integrating traditional and modern agricultural practices, and policy frameworks that strengthen indigenous land tenure security. At the same time, addressing these areas can contribute to the broader discourse on sustainable agriculture, food security, and indigenous rights. This ultimately ensures that traditional ecological knowledge remains a cornerstone of environmental sustainability.

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Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

Author Contributions Statement

Psyche Karren Ann Jondonero contributed to the conceptualisation and design of the research, prepared the proposal, collected and analysed the data, and led the writing and revision of the manuscript. Manuel Anthony Jondonero assisted in data analysis and provided valuable insights in the development of the full manuscript. Frandel Louis Dagoc led the conceptualisation of the research and supervised its overall progress. All authors reviewed and approved the final version of the manuscript.

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