

Knowledge and Practices of the *Kankanaey* of Palina Kibungan, Benguet on Indigenous Knowledge Systems in Mitigating Climate Change

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Abstract

This study assessed the knowledge and practices of the *Kankanaey* residents of Palina, Kibungan, Benguet regarding Indigenous Knowledge Systems (IKS) in mitigating climate change. Anchored on environmental governance and the interrelationship between indigenous knowledge and climate action, the study focused on four domains: agriculture, environment, socio-cultural, and social. A quantitative descriptive survey design was used, supplemented by interviews, focus group discussions, and site observations. The respondents were 94 *Kankanaey* residents representing the youth, elders, barangay officials, teachers, farmers, and women. Data were gathered using a researcher-made questionnaire validated through pretesting, with a reliability result of .812. Statistical tools included frequency, proportion, weighted mean, ANOVA, paired sample t-test, and Pearson product-moment correlation. Findings revealed that respondents were moderately knowledgeable in agricultural, environmental, and socio-cultural IKS, and fully knowledgeable in the social IKS. In terms of practice, agricultural IKS was slightly practiced, environmental and socio-cultural IKS were moderately practiced, and social IKS was fully practiced. Significant differences were found in the level of knowledge across agriculture, environment, and socio-cultural domains, while no significant difference was found in the social domain. No significant differences were found in the extent of practice across all domains. A significant positive relationship was established between knowledge and practice, indicating that greater knowledge of IKS is associated with stronger application. The study supports SDG 13, SDG 15, SDG 11, SDG 4, and SDG 17 by promoting climate action, environmental protection, community resilience, education, and partnership-based governance. Its sustainability impact lies in strengthening cultural preservation, indigenous governance, environmental stewardship, and community-based climate resilience.

Keywords: Climate Action, Community Resilience, Environmental Governance, Indigenous Knowledge Systems, *Kankanaey*, Palina, Sustainable Agriculture, Traditional Practices, Indigenous Leadership

1. Introduction

This study examines the knowledge and practices of the *Kankanaey* residents of Palina, Kibungan, Benguet regarding Indigenous Knowledge Systems (IKS) in mitigating climate change. It situates climate change as a global, national, and local concern affecting environmental stability, agricultural productivity, cultural continuity, and community resilience. The study emphasizes that while scientific responses to climate change remain important, indigenous communities possess long-standing ecological knowledge, communal governance systems, and sustainable practices that can contribute to climate change mitigation and adaptation. In Palina, these practices are reflected in agriculture, environmental protection, socio-cultural traditions, and social cooperation, making the documentation and integration of IKS into local governance and climate planning both timely and necessary.

Climate change refers to long-term changes in temperature, rainfall, and other atmospheric conditions, driven by both natural processes and human activities. Since the Industrial Revolution, human-induced climate change has been strongly associated with fossil fuel burning, deforestation, and industrial activities that release greenhouse gases such as carbon dioxide and methane into the atmosphere, resulting in global warming and related environmental impacts (NASA, n.d.). The urgency of this issue is further emphasized by reports that human activities have already caused approximately 1.1°C of global temperature rise since pre-industrial times, leading to more frequent heatwaves, rising sea levels, ecosystem disruption, and biodiversity loss. If global temperatures exceed 3°C by the end of the century, the global economy may experience severe losses due to extreme weather events and their wider effects (WeForest, n.d.). Climate change is increasingly experienced through changing temperature, rainfall, wind patterns, and destructive natural hazards. The years 2010 to 2019 were identified as the warmest decade since record-keeping began, while 2019 recorded the highest ocean temperatures and became the second warmest year on record, contributing to disasters that kill approximately 60,000 people annually worldwide (NASA, n.d.). In developing countries such as the Philippines, the effects of greenhouse gas emissions are especially severe. The country has been identified as highly vulnerable to climate change, with impacts including losses

in GDP, rainfall changes, drought, biodiversity threats, food insecurity, sea level rise, public health risks, and risks to vulnerable groups such as women and indigenous peoples (National Integrated Climate Change Database and Information Exchange System, n.d.). According to the Division for Inclusive Social Development of the United Nations (n.d.), climate change poses a serious threat to Indigenous Communities because Indigenous Peoples depend heavily on resources from ancestral lands, territories, and immediate environments. Climate change may also contribute to the loss of traditional knowledge, weakening of traditional governance structures, and erosion of culture. Within this context, the study focuses on Indigenous Knowledge Systems as culturally grounded responses to climate change mitigation.

Climate change in the Philippine setting is already being experienced through recurring disasters and environmental disruption. A Social Weather Stations (2023) survey reported that nine out of ten Filipinos had directly felt the effects of climate change in the past three years, demonstrating the serious effect of unpredictable rainfall and rising temperatures on forest resources and the lives of Indigenous Peoples. The Philippine Government has also suffered trillions of pesos in damages since 2010 due to climate-related events (GMA News Online, n.d.). In the Cordillera region, Indigenous Cultural Communities (ICCs) have historically adapted to environmental conditions by using traditional knowledge and technologies. These communities respond creatively to climate variation and develop coping mechanisms suited to their local contexts. Studies emphasize that where indigenous communities remain strong, indigenous knowledge also remains strong (Saragpunta Fdn & PAFID, 2001; Medrana, 2002). Internationally, multilateral environmental agreements such as the Convention on Biological Diversity recognize the need for an integrated ecosystem approach to sustainable resource management (The Popular Coalition to Eradicate Hunger & Poverty, 2002). This supports the view that indigenous knowledge is closely connected to biological diversity, land rights, poverty reduction, conflict management, and sustainable resource use. Indigenous communities have also been recognized for conventional technology, local observation, and mitigation strategies that are environmentally beneficial in responding to climate variation. Leonard, Parsons, Olawsky, and Kofod (2013) agree with Colchester (1992) and Clay (2000) that Indigenous Peoples' knowledge and local observation can contribute to climate mitigation. However, their role is often underrecognized. Indigenous Peoples are rarely acknowledged in climate change mitigation and adaptation processes (Salick, J., and Byg, A., 2007), and they are often not consulted because their local observations differ from science-based interpretations used by media and government organizations (Igu, 2017). The Philippines is culturally diverse, with approximately 185 ethnolinguistic groups and 110 ICCs reported by the NCIP. Western ethnographers classified Cordillera highland peoples into seven or eight ethnolinguistic groups (Keesing, 1962; Worcester, n.d.). In Benguet, the *Kankanaeys* are found mainly in Kibungan, Buguias, Bakun, Kapangan, and Mankayan. Their customary environmental management practices, especially in forest resources, remain relevant to climate change mitigation and adaptation and may provide models for non-indigenous areas. Each indigenous community holds a distinct body of traditional knowledge and practices developed through centuries of experience and passed across generations, including knowledge related to indigenous governance and natural resource management (Flores, n.d.).

Barangay Palina, Kibungan, Benguet is one of the oldest and historically significant communities in the municipality. It is predominantly composed of *Kankanaey* residents and contains Indigenous Knowledge Systems related to ancestral domain management, social justice, human rights, disaster prevention, community resilience, and Indigenous Political Structure. Approximately 97 percent of Kibungan's population identifies as *Kankanaey*. However, the municipality has also become home to other ethnolinguistic groups, including the *Bisaya/Binisaya*, *Ilocano*, *Ibaloy*, *Bontoc*, *Pangasinense*, *Kalanguya*, *Ifugao*, *Cebuano*, and *Tagalog*, among others, reflecting a gradual diversification of its demographic composition (Varela, 2015). Palina has maintained values of consensus-building and collaborative decision-making despite modern pressures that may encourage resource-driven division and individualism. Palina is also an agricultural community where traditional farming and environmental management practices are being challenged by modernization, commercial vegetable farming, infrastructure development, and climate change. According to the Barangay Development Plan CY 2023–2026, Palina has a total population of 1,583 individuals, consisting of 754 females and 829 males, and a total of 338 households, with farming serving as the primary source of livelihood in the area. The area includes sitios such as Legleg, Pingew, Poen, Song, Batbato, Lingey, Purok 1, Purok 2, Mogao, Pangpang, Lamagan, and Tabbac. Labor is commonly family-based, although additional workers are hired during planting and harvesting, with wage differences between men and women based on expected physical tasks (PhilAtlas, n.d.). In Palina, natural resource management remains strongly tied to unity and collective action against threats such as logging and mining. The community has preserved practices such as controlled tree cutting, controlled *kaingin* or *uma*, communal forest and watershed protection, reserved pastureland, and traditional forest management and soil conservation. These practices reflect the sacred value of *dontog*, the *Kankanaey* term for forest, as a source of water, food, housing materials, firewood, and protection from erosion and other hazards (Studoco, n.d.). Cooperative practices such as *alluyon* and *baddang*, similar to *bayanihan*, continue to support planting and harvesting activities without monetary exchange. However, Palina has experienced a rapid shift from traditional organic farming to commercial vegetable farming, particularly with the improvement of road access, which has made the transport of produce to markets easier and faster. Land use data from 2010 to 2018 showed a major increase in vegetable farming and a decline in sweet potato or camote and rice production. Rice farming decreased sharply after the 1990 earthquake damaged rice terraces, encouraging a shift to vegetable farming. As of 2018, 273.7 hectares or 14.30% of

the total barangay area had been devoted to vegetable farming (OMAG, 2017), compared with 51.64 hectares in 2010 (Brgy. Palina Profile, 2010). While vegetable farming has provided economic opportunities and may have reduced some swidden-related deforestation in certain sitios, it has also introduced agrochemical inputs and increased pressure on water resources. Water scarcity during summer affects households, schools, churches, and farms. Community-based water management is practiced by limiting water use for vegetable gardens during dry periods and prioritizing rice farming. Barangay officials and community members monitor compliance, demonstrating how local governance practices regulate shared resources. The community also has a strong history of resisting extractive activities, including opposition to large-scale mining and logging, making Palina an important site for documenting indigenous environmental protection practices.

The study is anchored on the interrelationship between Indigenous Knowledge Systems and climate change. It examines how these two variables operate in agriculture, environmental management, socio-cultural practices, and social systems. This aligns with environmental governance, which has developed as a distinct field of study and policy (Batterbury & Fernando, 2006). Environmental governance emphasizes participatory arrangements, prudent natural resource use, and the well-being of resource users. It also recognizes that local or Indigenous Peoples' knowledge may be superior to external expert knowledge in certain resource management contexts, especially when traditional practices are supported by community-based monitoring and enforcement (Redclift 1996; Ostrom 1990; Chambers 1983). Indigenous knowledge systems and practices are defined as local knowledge developed over centuries of experimentation by ancestors and passed orally from one generation to another (Kinomis, 2016). Climate change refers to changes in the Earth's climate at local, regional, and global scales and is commonly used to describe anthropogenic or human-caused climate change (Ramkumar, n.d.). Indigenous Knowledge Systems and Practices have been viewed as a framework for sustainable development because they connect the past, present, and future (Kinomis, 2016). The *Kankanaey* people possess a holistic relationship with the environment, rooted in cultural beliefs, practices, and traditions. Their worldview emphasizes harmonious coexistence with nature, which is viewed not only as a resource but also as a sacred space connected to ancestors and deities (Lakay, 2024). This is reflected in rice terrace construction, stonewalling practices, rituals, agricultural systems, and community interactions that emphasize sustainability and respect for natural cycles (Yodisphere, 2022). Their Indigenous Knowledge Systems also support environmental preservation and sustainable land management (Flores, n.d.). *Kankanaey* practices such as rice terrace maintenance, communal forest management, sacred groves, sustainable harvesting, crop rotation, organic farming, irrigation canals, and rainwater harvesting contribute to ecological balance and climate resilience (Lakay, 2024). Community-based resource management is especially important because collective action is central to climate change adaptation, and such practices may help build climate-resilient agricultural systems in the Cordillera region (Mountain Journal of Science and Interdisciplinary Research, n.d.). However, modernization, mining, deforestation, and other external pressures threaten the continuity of these practices. The conceptual basis also recognizes indigenous leadership and governance. According to Hart (2010), Indigenous Peoples' worldview on environmental governance is based on the principle that all things have a role in ensuring balance and harmony. In the Cordillera, environmentalism is guided by traditional beliefs, customary laws, and traditional governments. Domingo (2004) explained that effective Indigenous Peoples' leadership depends on approaches suited to the community, including trait, behavioral, contingency or situational, group and exchange, and charismatic or transformational approaches. In Palina, indigenous leadership is represented by elders or *nankakakay / a-am-a* and by ritual specialists / priests or *mambunong*. Nationally, the Climate Change Commission (CCC) (n.d.) recognized the need to strengthen climate action in the Philippine Development Plan 2023–2028 through the engagement of local and indigenous communities. The study also recognizes Indigenous Peoples' governance based on power and control, leadership, accountability, equality, and fairness (Buendia and Brillantes, 2003). Comparable indigenous conservation systems, such as *muyong* among the *Ifugao*, show how traditional practices preserve woodlots and watersheds for sustainable use (Camacho et.al, 2016). The conceptual framework is further informed by the view that indigenous values such as respect for elders, nature, children, family, language, wisdom, and spirituality remain relevant across time (Barnhardt, 2007).

Although Palina has a rich body of Indigenous Knowledge Systems, there is limited official documentation of how these practices are contextually applied in climate change mitigation. The Local Climate Change Action Plan of Kibungan has not incorporated IKS on climate action with scientific concepts. This gap is significant because traditional knowledge holders, particularly elders, are aging, while younger generations are increasingly influenced by modern practices. As a result, indigenous knowledge related to *dontog*, organic farming, communal labor, water regulation, forest protection, and traditional governance may gradually disappear if not documented, preserved, practiced, and transferred. The study responds to this gap by assessing the level of knowledge and extent of practice of *Kankanaey* residents regarding IKS in climate change mitigation. It focuses on agriculture, environment, socio-cultural, and social dimensions. The study also seeks to establish whether there is a significant relationship between knowledge and practice, and whether perceptions differ across these dimensions. Its rationale is grounded in the need to integrate IKS into local governance systems, climate mitigation planning, and community education without detaching these practices from their cultural foundations. The study further aims to empower the residents of Palina by identifying awareness gaps, strengthening cultural identity, encouraging intergenerational knowledge transfer, and providing insights for sustainable agriculture, water management, disaster

resilience, policy advocacy, and community collaboration. It supports the government's policy of self-determination for Indigenous Peoples and recognizes IKS as a meaningful and effective community-based system.

The study aligns most directly with SDG 13 – Climate Action because it focuses on Indigenous Knowledge Systems in mitigating climate change through agriculture, environmental protection, social cooperation, and local governance. It also connects with SDG 15 – Life on Land because it discusses forest protection, watershed management, biodiversity conservation, sustainable resource use, and resistance to environmentally destructive activities such as logging and mining. The study is also relevant to SDG 2 – Zero Hunger because Palina is an agricultural community where climate change affects farming, food production, water availability, and sustainable agricultural practices. Its attention to organic farming, rain-fed farming, crop rotation, soil conservation, and water management supports climate-resilient food systems. It may also relate to SDG 4 – Quality Education because the study highlights awareness, education, and intergenerational transfer of indigenous knowledge. In addition, the study supports SDG 11 – Sustainable Cities and Communities by emphasizing community resilience, cultural heritage preservation, and local adaptation practices. It is connected to SDG 16 – Peace, Justice, and Strong Institutions because it recognizes indigenous governance, Indigenous Political Structure, consensus-building, and community-based decision-making. Finally, it contributes to SDG 17 – Partnerships for the Goals because it encourages the integration of indigenous knowledge into local climate action planning and broader governance systems involving the barangay, municipality, indigenous sectors, and policy institutions.

This study contributes to environmental sustainability by documenting *Kankanaey* traditional practices that protect forests, watersheds, soil, water sources, and agricultural lands. It highlights how local knowledge can complement scientific approaches to climate mitigation and adaptation while preserving the ecological balance of ancestral domains. It also contributes to socio-economic sustainability by examining how farming practices, labor cooperation, crop choices, water management, and resource protection affect livelihood resilience in an agricultural community. Since climate change directly influences farming productivity and household stability, understanding IKS-based practices can support more sustainable local economic planning. The study strengthens cultural sustainability by emphasizing the preservation and transmission of *Kankanaey* knowledge, beliefs, values, rituals, environmental ethics, and communal traditions. It recognizes that climate action is not only a technical matter but also a cultural and intergenerational responsibility. Finally, the study supports policy and governance sustainability by providing a basis for integrating IKS into local climate change action plans, barangay governance, and community-based resource management. By recognizing indigenous leadership, customary laws, and collective decision-making, the study promotes a multidisciplinary approach where environmental science, public administration, agriculture, culture, and governance work together toward sustainable and climate-resilient communities.

2. Material and methods

2.1 Research Design

The study employed the quantitative descriptive survey method to describe the current conditions of the sample population in relation to the specific problems investigated. This design was appropriate because the study aimed to present existing phenomena in terms of conditions, beliefs, relationships, and trends. To supplement the quantitative data, interviews and focus group discussions were conducted before and after the distribution of the questionnaire. Site observations were also undertaken to support and validate the data gathered. Secondary sources such as books, manuals, online journals, publications, and other print and internet materials related to the study were also used.

2.2 Locale of the Study

The study was conducted in Barangay Palina, Kibungan, Benguet, a self-sustaining and predominantly agricultural community recognized as the seat of indigenous governance in Kibungan. Palina is located in the northern part of the municipality and is the fifth largest among its seven barangays. Farming remains the major source of livelihood in the area, and climate change directly affects crop production. About 90% of households are engaged in farming, while 8% are involved in small-scale business and 2% are employed in government and private institutions (Barangay Palina Profile, 2010). The study area also includes portions of the Ancestral Domain of Kibungan, particularly traditionally managed Pine and Mossy Forest ecosystems of the ICCs/IPs of Kibungan.

2.3 Respondents of the Study

The respondents were 94 *Kankanaey* residents of Palina, Kibungan, Benguet. They came from six community sectors: youth, elders, barangay officials, teachers, farmers, and women. The respondents were residents aged 18 years old and above who were considered capable of providing information about Indigenous Knowledge Systems and their application in mitigating climate change. Women formed the largest respondent group, followed by the youth.

2.4 Sample and Sampling Procedure

The researcher used snowball sampling (Havelin, 1996), with respondents purposively chosen from among qualified constituents who had lived in Palina and represented the identified community sectors. The selection included elders,

farmers, women, youth, barangay officials, and teachers to ensure that the study captured perspectives from different groups involved in community life, indigenous practices, agriculture, and local governance.

2.5 Research Instrument

The main data-gathering tool was a researcher-made questionnaire checklist. Its contents were adapted from the Barangay Development Plan of Palina for CY 2023–2026 and the Ancestral Domain Sustainable Protection Plan 2024 of Kibungan, Benguet. The first part gathered the profile of respondents, limited to length of residency in Palina and sectoral affiliation. The second part measured the respondents' level of knowledge on IKS in mitigating climate change along agriculture, social conditions, environmental conditions, and socio-cultural conditions. The third part measured the extent of practice of IKS in mitigating climate change. The questionnaire was pretested among Palina residents who were not included as actual respondents. Cronbach's alpha was used to measure internal consistency, and the result of .812 indicated that the instrument was reliable. Interviews, focused group discussions, and site visits were also conducted to validate the questionnaire results and gather more in-depth data.

2.6 Data Gathering Procedure

Before the conduct of the study, the research was submitted to the Cordillera Career Development College Research Ethics Committee (CCDC REC) for ethics review. After ethics clearance was issued, the researcher secured permission from the National Commission on Indigenous Peoples (NCIP) - Benguet, Municipal Government of Kibungan, and the Barangay Government of Palina. Consent to administer the questionnaire among the six sectors was also sought from the *Punong* Barangay. The researcher coordinated with the *Sangguniang* Barangay and schools in Palina, personally administered the questionnaire to the respondents, and retrieved the completed questionnaires immediately to ensure full retrieval. Online surveys were conducted for youth respondents studying outside the barangay. Each survey took approximately 5–10 minutes to complete. Initial interviews were conducted before administering the questionnaire to gather information on the current situation in Barangay Palina. Follow-up interviews and focus group discussions were conducted after the survey to validate the responses, and field visits were undertaken to verify information provided by respondents.

2.7 Data Analysis Techniques

The gathered data were cleaned and coded using Microsoft Excel and then subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS). Frequency and proportion were used to analyze the respondents' profile, including sectoral affiliation and length of residency. Weighted arithmetic mean was used to determine the respondents' level of knowledge and extent of practice regarding IKS in mitigating climate change. A 4-point Likert scale was used to interpret the findings, ranging from least knowledgeable or least practiced to fully knowledgeable or fully practiced. Inferential statistics were also employed, specifically one-way ANOVA and paired sample t-test, to determine significant differences between the level of knowledge and extent of practice among the six respondent sectors. Pearson product-moment correlation was used to determine the relationship between the level of knowledge and extent of practice of IKS in mitigating climate change (Newcastle University, n.d.).

2.8 Ethical Considerations

The study underwent ethics review through the Cordillera Career Development College Research Ethics Committee (CCDC REC). Respondents were informed about the nature of the study before answering the questionnaire. They were advised that their participation was voluntary and that they could withdraw from the study or decline to answer the questionnaire. They were also informed that the risks of participation were minimal, their answers would not be publicly disclosed, their names were optional and would not be recorded, and all information gathered would be kept confidential. The researcher also explained that the results would be shared with the respondents and the Barangay Government of Palina for utilization. Individuals below 18 years old, non-residents of Palina, those unable or unwilling to give informed consent, unavailable residents, those who refused to complete the survey, and those outside the specified sectoral groups were excluded from the study.

3. Results and Discussion

3.1 Level of Knowledge on Indigenous Knowledge Systems in Mitigating Climate Change

3.1.1 Agriculture Domain

The respondents were moderately knowledgeable about agricultural IKS, with an overall mean of 2.67. Organic fertilizer had the highest mean of 3.16, followed by rain-fed farming at 3.06, both interpreted as moderately knowledgeable. Natural or plant-based pest control, swidden farming, shifting cultivation, crop rotation, multi-cropping, and mulching were also moderately known. However, soil-moisture trapping obtained a lower mean of 2.41, while fog collecting had the lowest mean of 1.80, both interpreted as slightly knowledgeable. This indicates that respondents were more familiar with common and practical farming practices than with less commonly used water conservation techniques. The moderate knowledge of organic fertilizer may be linked to continuing awareness of sustainable farming and government-supported organic agriculture programs. Recidoro (2012) noted that organic agriculture programs have been promoted since the enactment of

Republic Act 10068 or the Philippine Organic Agriculture Act of 2010. However, some farmers engaged in fast-cash cropping tend to rely more on commercial fertilizers. This finding is supported by Verma et al. (2019), who emphasized that organic fertilizers help sustain biodiversity, reduce soil degradation, and improve soil fertility, while Tiwari (2023) underscored the importance of organic farming in maintaining ecological balance amid climate change. The moderate knowledge of rain-fed farming corresponds with Reyes et al. (2017), Abbas et al. (2022), and Yeleliere et al. (2023), who emphasized its relevance in upland and climate-vulnerable agricultural areas. In contrast, the limited knowledge of soil-moisture trapping and fog collection reflects low exposure, unsuitable local conditions, and lack of tools or formal training, consistent with Asad et al. (2019), Diop et al. (2018), Chuma et al. (2014), Qadir et al. (2018), and Oktor et al. (2024).

3.1.2 Environment Domain

The respondents were moderately knowledgeable about environmental IKS, with an overall mean of 3.23. Proper waste management had the highest mean of 3.66, followed by indigenous preservation methods such as smoking, sun-drying, earth caching, fermenting using boiled camote water, and root crop storage, with a mean of 3.49. *Salipangan* and *tipla*, controlled burning, *depdep* technique, use of indigenous materials, stonewalling, designated communal forest and watershed, herbal or medicinal plants, and designated pastureland and animal shelters were also known to varying degrees. The lowest means were observed in herbal or medicinal plants at 2.83 and designated communal pastureland and *kamarin / balawwa* at 2.77. The high knowledge of proper waste management is associated with visible community practices, barangay initiatives, school activities, clean-up drives, waste segregation campaigns, and local enforcement of environmental policies. These efforts are supported by provincial environmental programs and awareness activities (Sunstar, 2021; DENR, 2024). The high knowledge of indigenous preservation methods shows that oral tradition remains relevant, especially through elders and practical household use. Knorr and Augustin (2023) and Mbhenyane and Tambe (2024) support the value of indigenous preservation methods in sustaining food availability and reducing waste. However, knowledge of herbal medicine and communal pasture systems is declining due to modernization, reduced reliance on traditional healing, changing land use, and fewer knowledge holders, which aligns with Yineger and Yewhalaw (2007), Arquion et al. (2015), Abe & Ohtani (2012), Hviid et al. (2008), Pugra (2025), Cohen (2021), Arjona-García et al. (2021), Leal Filho et al. (2024), and Rangel (2024).

3.1.3 Socio-Cultural Domain

The respondents were moderately knowledgeable about socio-cultural IKS, with an overall mean of 2.97. Marriage tree planting obtained the highest mean of 3.36 and was interpreted as fully knowledgeable. *Tongtongan* or tribunal of elders followed with a mean of 3.21, while Environment Month or Environment Day activities obtained a mean of 3.16. Indigenous calendar, traditional weather interpretation, and early warning signs were moderately known with a mean of 2.64. *Pakde*, *pudong*, *daw-es*, and other rituals related to disaster risk reduction and crop management had the lowest mean of 2.47 and were interpreted as slightly knowledgeable. The high knowledge of marriage tree planting may be attributed to its formal institutionalization in the municipal and barangay governments. This supports the view that cultural practices become more widely known when integrated into formal governance. Camacho (2012) and Polonio (2015) emphasized that marriage tree planting links cultural practice with environmental responsibility, land stewardship, biodiversity, and climate resilience. The moderate knowledge of *tongtongan* reflects the continuing role of elders in consensus-based decision-making and community dispute resolution, consistent with Balatong et al. (2022) and Olaya (2022). However, the low knowledge of *pakde*, *pudong*, *daw-es*, and similar rituals reflects the decline of ritual practitioners, the influence of Christianity, and limited intergenerational transfer. Tabuzo (2024) and Luz et al. (2019) explain that indigenous rituals support ecological balance, environmental responsibility, and climate adaptation, but these practices are weakening as religious and modern systems become more dominant.

3.1.4 Social Domain

The respondents were fully knowledgeable in the social domain, with an overall mean of 3.59. The *alluyon*, *baddang*, and *timpuoyog* systems obtained the highest mean of 3.88, while communal values and taboos such as *inayan* (moral code), *paniyew*, and *lawa* obtained a mean of 3.30. This shows that respondents had a strong understanding of volunteerism, mutual help and support, solidarity, social harmony, trust, spiritual balance, and collective responsibility. The strong knowledge of social IKS reflects the continued relevance of cooperation and solidarity in Palina's everyday life, especially during planting, harvesting, building houses, weddings, wakes, burial activities, disasters, and other community events. Baldago et al. (2023) and Ramazanu et al. (2023) emphasized that collective action, volunteerism, and cooperativism help communities respond to environmental challenges and climate change. Adabanya (2023) also emphasized the role of social cooperation in managing common-pool resources. Likewise, Bernados and Ocampo (2023), Fu and Zhang (2024), and Carmen et al. (2022) support the finding that strong communal values strengthen resource management, equitable adaptation, sustainable practices, and community resilience.

3.2 Differences in Respondents' Level of Knowledge Across Domains

The comparison of respondent groups showed significant differences in the level of knowledge in agriculture, environment, and socio-cultural domains, with p-values below 0.05. Specifically, agriculture had a p-value of 0.007, environment had a

p-value of 0.000, and socio-cultural had a p-value of 0.001. The social domain showed no significant difference, with a p-value of 0.393. Elders generally had the highest knowledge, particularly in socio-cultural aspects, while farmers, youth, and women showed lower knowledge in agriculture. These differences suggest that knowledge of IKS is unevenly distributed across sectors because each group has different roles, exposures, and experiences. Elders remain important custodians of socio-cultural and social IKS, while farmers, women, youth, teachers, and barangay officials showed their strongest knowledge in the social domain and weaker knowledge in agriculture. This reflects the influence of modernization and the declining transmission of agricultural IKS. Mercado & Osbahr (2023) emphasized the role of Filipino youth in learning traditional agriculture for climate change mitigation, while Lugtu (2022) highlighted the need for older farmers to transfer knowledge to younger generations. Alrhoun et al. (2025), Nitah (2021), Bullough et al. (2021), Martinez (2023), Shapland (2023), and Alampay (2024) further support the importance of cultural context, elders, women, communities, and family-based transmission in preserving ecological and socio-cultural knowledge.

3.3 Extent of Practice of Indigenous Knowledge Systems in Mitigating Climate Change

3.3.1 Agriculture Domain

The respondents slightly practiced agricultural IKS, with an overall mean of 2.40. Mulching had the highest mean of 2.82, followed by organic fertilizer at 2.71 and swidden farming, shifting cultivation, crop rotation, or multi-cropping at 2.65, all interpreted as moderately practiced. Natural or plant-based pest control, soil-moisture trapping, and rain-fed farming or fog collecting were slightly practiced. The lowest mean was recorded for rain-fed farming and fog collection at 1.63, indicating that these practices are rarely implemented. The low practice of agricultural IKS indicates increasing reliance on modern farming approaches, commercial fertilizers, pest control products, and supplier-financed agricultural inputs. Mulching remains moderately practiced because of its benefits for moisture retention, weed control, soil protection, and crop quality, consistent with Basquial et al. (2021) and Osting (2011). Organic fertilizer is also moderately practiced due to government support, farmer preferences, and organic agriculture policies, as noted by Recidoro (2013) and Hent (2021). However, rain-fed farming and fog collection remain less practiced because of erratic rainfall, climate variability, limited infrastructure, geographical constraints, and unreliable fog conditions, which aligns with Tan et al. (2019) and Agoot (2024).

3.3.2 Environment Domain

The respondents moderately practiced environmental IKS, with an overall mean of 2.97. Proper waste management had the highest mean of 3.44 and was interpreted as fully practiced. Indigenous preservation methods followed with a mean of 3.21, while designated communal forest and watershed, *salipangan* and *tipla*, controlled burning and *depdep*, stonewalling, indigenous materials, herbal or medicinal plants, and designated communal pastureland and animal shelters were moderately practiced. The lowest means were observed in designated communal pastureland and *kamarin / balawwa* at 2.50 and herbal or medicinal plants at 2.74. The full practice of proper waste management suggests that environmental behaviors are strongest when they are visible, simple to perform, and supported by ordinances and community norms. Anokye and Mohammed (2024) linked traditional waste disposal to ancestral respect for nature, while the current practice in Palina is also reinforced by modern environmental regulations. Indigenous preservation methods remain moderately practiced because smoking, sun-drying, earth burying and other methods still serve food security and cultural functions, consistent with Bersamin et al. (2020) and Molintas (2017). However, herbal medicine and communal pasture practices are declining due to modern healthcare access, reduced number of herbalists, land-use changes, limited pastureland, and reduced livestock raising. This supports the observations of Wrobel et al. (2023), Bersamin et al. (2020), and Rondilla et al. (2021).

3.3.3 Socio-Cultural Domain

The respondents moderately practiced socio-cultural IKS, with an overall mean of 2.69. Marriage tree planting had the highest mean of 3.11, followed by Environment Month or Environment Day activities at 3.10, both interpreted as moderately practiced. *Tongtongan* or tribunal of elders also remained moderately practiced with a mean of 2.93. However, indigenous calendar and traditional weather interpretation had a mean of 2.18, while *pakde*, *pudong*, *daw-es*, and other rituals for disaster risk reduction and crop management had the lowest mean of 2.16, both interpreted as slightly practiced. The moderate practice of marriage tree planting and environmental celebrations suggests that IKS-related practices are sustained when supported by local ordinances and barangay-led programs. Community tree planting and environmental activities remain active because they are accessible and linked to formal civic responsibilities, consistent with the environmental awareness activities reported by the Benguet Provincial Government (2022). In contrast, the low practice of *pakde*, *pudong*, *daw-es*, and related rituals reflects the decreasing number of ritual specialists, the influence of Christianity, the adoption of modern farming techniques, and the limited interest of younger generations. Gonzales (2024) and Aguilar et al. (2020) similarly observed that indigenous agricultural rituals are gradually disappearing due to modernization, commercial agriculture, and changing rural social structures.

3.3.4 Social Domain

The respondents fully practiced social IKS, with an overall mean of 3.55. *Alluyon*, *baddang*, and *timpuyog* obtained the highest mean of 3.80, while communal values and taboos such as *inayan*, *paniyew*, and *lawa* obtained a mean of 3.30. This indicates that volunteerism, mutual help, solidarity, cooperation, mutual trust, mutual respect, social harmony, and spiritual balance remain strongly practiced in the community. The strong practice of social IKS shows that collective values remain deeply rooted in Palina's cultural life. These values guide residents in helping one another during disasters, gatherings, community activities, and other shared responsibilities. Owen's (2020) emphasized that unity and cooperation strengthen sustainable environmental practices, especially when community-based solutions are needed for climate change adaptation. Carmen et al. (2022), Nath (2024), and Costa et al. (2022) also support the finding that communal values, cooperation, and strong local relationships improve resilience, resource mobilization, environmental sustainability, and adaptive capacity.

3.4 Differences in Respondents' Extent of Practice Across Domains

The comparison of respondents' extent of practice showed no significant difference across all four domains. The p-values were 0.204 for agriculture, 0.092 for environment, 0.097 for socio-cultural, and 0.259 for social, all greater than 0.05. This means that respondents from different sectors had generally consistent levels of practice in agriculture, environment, socio-cultural, and social domains. The social domain showed the strongest and most balanced practice, while agriculture remained the weakest across sectors. This consistency suggests that community sectors share similar exposure to IKS practices, especially those embedded in collective life. However, all sectors face difficulty sustaining agri-based IKS due to commercial farming, modern agricultural technologies, government-led modernization, education systems focused on technological advancement, and the appeal of fast-growing cash crops. Palis (2019) and Alcantara et al. (2022) support the finding that farmers in the same locality tend to adopt similar cultivation practices because of shared geography and environmental conditions. Reyes (2019) also noted that environmental-indigenous practices tend to be consistent when community values and routines are shared. In the socio-cultural and social domains, the findings align with Mayo's (2023), Zabala (2021), Ariaso (2020), and Grey's (2019), who emphasized that cultural pride, social norms, and community cohesion help sustain socio-cultural and social practices despite modernization.

3.5 Relationship Between Level of Knowledge and Extent of Practice

The study found a statistically significant positive relationship between the level of knowledge and extent of practice of IKS in mitigating climate change. The Pearson correlation coefficient was 0.636, with a p-value of 0.001. This indicates a moderate to strong positive relationship, meaning that as knowledge increases, the extent of practice also tends to increase. Among the sectors, elders had the highest knowledge level at 3.6 but a lower practice level at 3.0. Farmers showed relatively balanced knowledge and practice, with means of 3.05 and 2.95. Teachers had a high knowledge level of 3.3 but a lower practice level of 2.9. Barangay officials showed close alignment between knowledge and practice, with means of 3.25 and 3.2. Youth had moderate knowledge and lower practice, while women had the lowest overall knowledge and practice scores, at 2.85 and 2.7. The significant relationship confirms that knowledge is an important predictor of practice. Elders remain key holders of IKS but need stronger platforms for active knowledge transfer, consistent with Battiste (2002). Farmers retain practical experience but increasingly rely on modern farming, showing the need to integrate traditional ecological knowledge with sustainable agriculture, as suggested by Berkes et al. (2000). Teachers possess strong theoretical understanding but need more opportunities to apply IKS beyond classroom contexts, making curriculum integration important under the Philippine Indigenous Peoples Education Policy Framework (2011). Barangay officials are effective intermediaries because they translate knowledge into policies and community programs, consistent with participatory governance principles (cf. Chambers 1994 on participatory rural appraisal). Youth require stronger engagement because modernization and digital distractions limit their active practice, while Semali and Kincheloe (1999) emphasized curriculum integration and digital storytelling as ways to bridge intergenerational gaps. Women need more inclusive participation in IKS roles, as Agrawal (1995) stressed that gender-sensitive approaches are essential in IKS preservation. Overall, the findings are supported by Jessen et al. (2022), Makondo and Thomas (2018), and Gordon et al. (2023), who found that stronger understanding of traditional or indigenous knowledge systems leads to more effective environmental and climate-related practices.

3.6 Summary of Findings

The study found that the respondents were moderately knowledgeable about IKS in agriculture, environment, and socio-cultural domains, and fully knowledgeable in the social domain. Significant differences in knowledge were observed in agriculture, environment, and socio-cultural domains, while no significant difference was found in the social domain. In terms of practice, respondents slightly practiced agricultural IKS, moderately practiced environmental and socio-cultural IKS, and fully practiced social IKS. No significant differences were found in the extent of practice across the four domains. Finally, a significant moderate positive relationship was found between knowledge and practice, indicating that higher knowledge of IKS is associated with greater application of IKS in climate change mitigation.

4. Conclusion & Recommendations

The study concludes that the *Kankanaey* of Palina, Kibungan, Benguet possess knowledge of Indigenous Knowledge

Systems (IKS) for climate change mitigation across agriculture, environment, socio-cultural, and social domains. However, perceptions on knowledge differ significantly in the agriculture, environment, and socio-cultural domains, while no significant difference was found in the social domain. In terms of practice, the respondents share similar perceptions: they minimally practice agricultural IKS, satisfactorily practice environmental and socio-cultural IKS, and strongly practice social IKS. The study further concludes that there is a statistically significant relationship between the level of knowledge and the extent of practice of IKS, indicating that knowledge predicts practice and practice may also reinforce knowledge.

The study recommends that the Barangay Government of Palina collaborate with local elders, indigenous leaders, the Barangay Indigenous Peoples Mandatory Representative, and IKS advocates to conduct regular knowledge-sharing sessions, workshops, mentoring programs, and community-based training, particularly in agricultural and environmental IKS. The *Sangguniang* Barangay - Committee on Agriculture and Food may coordinate with traditional knowledge holders and modern agricultural experts to integrate IKS into daily farming practices and support farmers who apply sustainable indigenous practices. The Barangay Committee on Education may also issue a resolution integrating local IKS into the school curriculum in collaboration with elders and knowledge holders. The Barangay Government of Palina, in partnership with the Municipal Government of Kibungan, may further promote IKS through information campaigns, symposiums, forums, systematic documentation, intergenerational transmission, curriculum integration through the Department of Education's formal basic education and its Alternative Learning System, capacity-building for women and youth, and community-led projects that connect traditional knowledge with scientific approaches to climate resilience. Future researchers are encouraged to examine how indigenous leadership adapts to modern challenges while maintaining its foundational principles.

Compliance with ethical standards

This study complied with institutional ethical standards and was reviewed by the Cordillera Career Development College Research Ethics Committee (CCDC REC) before data gathering. Permission was secured from NCIP - Benguet, Municipal Government of Kibungan, and the Barangay Government of Palina. Participation was voluntary, informed consent was obtained, and respondents were assured of confidentiality, anonymity, and the right to withdraw from the study. The researcher acknowledges the support of the concerned offices, community leaders, and respondents, declares no conflict of interest, and affirms responsibility for the accuracy, integrity, and copyright ownership of the research.

REFERENCES

- Abbas, Q., Han, J., Bakhsh, K., Ullah, R., Kousar, R., Adeel, A., & Akhtar, A. (2022). Adaptation to climate change risks among dairy farmers in Punjab, Pakistan. *Land Use Policy*, 119, 106184. <https://doi.org/10.1016/j.landusepol.2022.106184>
- Abubakar, I. R., Maniruzzaman, K. M., Dano, U. L., AlShihri, F. S., AlShammari, M. S., Ahmed, S. M. S., & Alrawaf, T. I. (2022). Environmental sustainability impacts of solid waste management practices in the global South. *International Journal of Environmental Research and Public Health*, 19(19), 12717. <https://doi.org/10.3390/ijerph191912717>
- Adabanya, U., Awosika, A., Moon, J. H., Reddy, Y. U., & Ugwuja, F. (2023). Changing a community: A holistic view of the fundamental human needs and their public health impacts. *Cureus*, 15(8), e44023. <https://doi.org/10.7759/cureus.44023>
- Adekunle, I. A. (2021). On the search for environmental sustainability in Africa: The role of governance. *Environmental Science and Pollution Research*, 28, 14607–14620. <https://doi.org/10.1007/s11356-020-11432-5>
- Adger, W. N. (2010). Social capital, collective action, and adaptation to climate change. In M. Voss (Ed.), *Der Klimawandel* (pp. 327–345). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-92258-4_19
- African Union. (2022). *Linking Agenda 2063 and the SDGs*. <https://au.int/agenda2063/sdgs>
- Age, J., Lugangwa, E., Obua, J., & Kambugu, R. (2008). Role of indigenous knowledge in enhancing household food security: A case study of Mukungwe, Masaka District, Central Uganda. *Indilinga: African Journal of Indigenous Knowledge Systems*, 7(1). <https://doi.org/10.4314/indilinga.v7i1.26394>
- Agoot, L. (2018, June 26). *1,226 couples in Baguio plant trees before tying knots*. Philippine News Agency. <https://www.pna.gov.ph/articles/1039402>
- Agoot, L. (2024, April 12). *Startup Benguet firm catches mist to help solve water shortage*. Philippine News Agency. <https://www.pna.gov.ph/articles/1222490>
- Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, 26(3), 413–439. <https://doi.org/10.1111/j.1467-7660.1995.tb00560.x>
- Aguilar, C. H. M., Altoveros, N. C., Borromeo, T. H., Dayo, M. H. F., & Koohafkan, P. (2020). Traditional rice-based agroecosystem in Kiangnan, Ifugao, Philippines: Drivers of change, resilience, and potential trajectories. *Agroecology and Sustainable Food Systems*, 45(1), 296–316. <https://doi.org/10.1080/21683565.2020.1813861>

- Akpodiogaga, P. (2010). General overview of climate change impacts in Nigeria. *Journal of Human Ecology*, 29(1), 47–55. <https://doi.org/10.1080/09709274.2010.11906248>
- Alampay, L. P. (2024). Cultural values, parenting and child adjustment in the Philippines. *International Journal of Psychology*, 59(4), 568–577. <https://doi.org/10.1002/ijop.13117>
- Alrhoun, M., Sulaiman, N., & Pieroni, A. (2025). Shifting herbal knowledge: The ecological and cultural dynamics behind plant use changes in the southern Occitan Alps. *Plants*, 14(3), 367. <https://doi.org/10.3390/plants14030367>
- Amnesty International. (2024). *Indigenous peoples*. <https://www.amnesty.org/en/what-we-do/indigenous-peoples/>
- Anokye, K., & Mohammed, A. S. (2024). Indigenous traditional knowledge for cleaner waste systems and sustainable waste management systems in Ghana. *Cleaner Waste Systems*, 9, 100165. <https://doi.org/10.1016/j.clwas.2024.100165>
- Arioso, R. (2020). Social gathering: A reflection and examination of the Philippine culture. *ResearchGate*. https://www.researchgate.net/publication/355162358_SOCIAL_GATHERING_A_REFLECTION_AND_EXAMINATION_OF_THE_PHILIPPINE_CULTURE
- Arjona-García, C., Blancas, J., Beltrán-Rodríguez, L., López Binnquist, C., Colín Bahena, H., Moreno-Calles, A. I., Sierra-Huelsz, J. A., & López-Medellín, X. (2021). How does urbanization affect perceptions and traditional knowledge of medicinal plants? *Journal of Ethnobiology and Ethnomedicine*, 17, Article 48. <https://doi.org/10.1186/s13002-021-00472-0>
- Balatong, L. S., Banglig, V. P., Dato, R. G., & Laltoog, B. (2022). Tongtong practices of Bakun, Benguet: Its historical and political relevance. *European Online Journal of Natural and Social Sciences*, 11(4), 270–276. https://www.researchgate.net/publication/380972169_Tongtong_Practices_of_Bakun_Benguet_Its_Historical_and_Political_Relevance
- Baldago, J. M., Olayan, T. J. A., Segundo, J. C., & Toldague, J. G. C. (2023). Binnadang: A cultural practice amidst the COVID-19 pandemic among local government workers in Poblacion, Tuba, Benguet. *University Research Journal*, 5(1). <https://rdc.ubaguio.edu/binnadang-a-cultural-practice-amidst-covid-19-pandemic-among-local-government-workers-in-poblacion-tuba-benguet/>
- Barnhardt, R. (2007). Creating a place for indigenous knowledge in education: The Alaska Native Knowledge Network. In D. A. Gruenewald & G. A. Smith (Eds.), *Place-based education in the global age: Local diversity* (pp. 113–133). Lawrence Erlbaum Associates.
- Basquial, D. A., De Guzman, C. C., Aspuria, E. T., Sta. Cruz, P. C., & Cuevas, V. C. (2021). Protected cultivation improves the growth of Lollo Rossa lettuce under chilling conditions in Benguet, Philippines. *Journal of Agricultural Science and Technology*. <http://issaasphil.org/wp-content/uploads/2021/12/12.-Basquial-et-al-2021-Lettuce-protected-cultivation-FINAL.pdf>
- Benguet Provincial Government. (2021, June 19). *Kapangan observes Arbor Day with tree planting activity*. <https://benguet.gov.ph/2021/06/19/>
- Benguet Provincial Government. (2022, June). *SPES beneficiaries plant seedlings in celebration of Environment Month*. <https://benguet.gov.ph/provincial-spes-beneficiaries-plant-seedlings-in-celebration-of-environment-month/>
- Berhanu, A. A., Ayele, Z. B., Dagnew, D. C., Fenta, A. B., & Kassie, K. E. (2024). Smallholder farmers' coping strategies to climate change and variability: Evidence from Ethiopia. *Climate Services*, 35, 100509. <https://doi.org/10.1016/j.cliser.2024.100509>
- Bernados, S., & Ocampo, L. (2023). Exploring the role of social capital in advancing climate change mitigation and disaster risk reduction. *Community Development*, 55(4), 470–490. <https://doi.org/10.1080/15575330.2023.2253316>
- Bersamin, A. T., Tayaben, J. L., Balangcod, K. D., Balangcod, A. K., Cendana, A. C., Dom-Ogen, E. T., Licnahan, L. O., Siadto, B., Wong, F. M., & Balangcod, T. D. (2020). Utilization of plant resources among the Kankanaeys in Kibungan, Benguet Province, Philippines. *Biodiversitas Journal of Biological Diversity*, 22(1). <https://doi.org/10.13057/biodiv/d220144>
- Bucha, I. E. (1987–2025). *One-way analysis of variance*. StatsDirect. https://www.statsdirect.com/help/analysis_of_variance/one_way.htm
- Buendia, R. G., & Brillantes, A. B. (2003). *Mapping and analysis of indigenous governance practices in the Philippines and proposal for establishing an indicative framework for indigenous peoples' governance*.
- Bullough, A., Guelich, U., Manolova, T. S., & Schjoedt, L. (2021). Women's entrepreneurship and culture: Gender role expectations and identities, societal culture, and the entrepreneurial environment. *Small Business Economics*, 58(2), 985–996. <https://doi.org/10.1007/s11187-020-00429-6>
- Buyao, S. (2024, February 13). *An indigenous communication practice of conflict resolution*. Herald Express. <https://baguioheraldexpressonline.com/an-indigenous-communication-practice-of-conflict-resolution/>
- BYJU'S. (2015). *Weighted mean formula*. <https://byjus.com/weighted-mean-formula/>
- Camacho, L. D., Combalicer, M., Yeo-Chang, Y., Combalicer, E. A., Carandang, A. P., Camacho, S. C., de Luna, C., & Rebugio, L. L. (2012). Traditional forest conservation knowledge/technologies in the Cordillera, Northern Philippines. *Forest Policy and Economics*, 22, 3–8. <https://doi.org/10.1016/j.forpol.2010.06.001>
- Camacho, L. D., Gevaña, D. T., Carandang, A. P., Camacho, S. C., Combalicer, E. A., Rebugio, L. L., & Youn, Y.-C. (2016). Indigenous knowledge and practices for the sustainable management of Ifugao forests in Cordillera,

- Philippines. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 12(1–2), 5–13. <https://doi.org/10.1080/21513732.2015.1124453>
- CAR-EMB. (2016). *Benguet to manage waste and maximize MRF*. <https://car.emb.gov.ph/benguet-to-manage-waste-maximize-mrf/>
- Carmen, E., Fazey, I., Ross, H., Bedinger, M., Smith, F. M., Prager, K., McClymont, K., & Morrison, D. (2022). Building community resilience in a context of climate change: The role of social capital. *Ambio*, 51, 1371–1387. <https://doi.org/10.1007/s13280-021-01678-9>
- Cheserek, G. (2015). *Indigenous knowledge in water and watershed management: “Marakwet” conservation strategies and techniques*.
- Chikaire, J., Osuagwu, C., Ihenacho, R., Oguegbuchulam, M., Ejiogu-Okere, N., & Obi, K. (2012). Indigenous knowledge system: The need for reform and the way forward. *Global Advanced Research Journal*.
- Chisanga, A., Saul, S. T., Daka, S., Masebe, E., Mulenga, R., Banda, D., & Mwansa, P. (2024). Community engagement in solid waste management: An in-depth analysis of household participation and practices in Chelstone Township in Lusaka, Zambia. *International Journal of Research and Innovation in Social Science*, 8(4), 2168–2194.
- Chuma, G. B., Mondo, J. M., Ndeko, A. B., Bagula, E. M., Lucungu, P. B., Bora, F. S., Karume, K., Mushagalusa, G. N., Schmitz, S., & Biolders, C. L. (2022). Farmers’ knowledge and practices of soil conservation techniques in smallholder farming systems of Northern Kabare, east of DR Congo. *Environmental Challenges*, 7, 100516. <https://doi.org/10.1016/j.envc.2022.100516>
- Cohen, K. A., Stiles-Shields, C., Winkist, N., & Lattie, E. G. (2021). Traditional and nontraditional mental healthcare services: Usage and preferences among adolescents and younger adults. *The Journal of Behavioral Health Services & Research*, 48, 537–553. <https://doi.org/10.1007/s11414-020-09746-w>
- Cordillera Peoples Alliance. (2011, April 24). *Cordillera Day 2011 central statement: Biagen ti nadeggang a pakasaritaan iti pannakidangadang! Ilaban ti daga, biag ken dayaw!* <https://cpaphils.org/cd2011-central-statement.html>
- Costa, M. J. S., Leitão, A., Silva, R., Monteiro, V., & Melo, P. (2022). Climate change prevention through community actions and empowerment: A scoping review. *International Journal of Environmental Research and Public Health*, 19(22), 14645. <https://doi.org/10.3390/ijerph192214645>
- CUEMATH. (n.d.). *ANOVA test*. <https://www.cuemath.com/anova-formula/>
- Diop, M., Chirinda, N., Beniaich, A., El Gharous, M., & El Mujahid, K. (2022). Soil and water conservation in Africa: State of play and potential role in tackling soil degradation and building soil health in agricultural lands. *Sustainability*, 14(20), 13425. <https://doi.org/10.3390/su142013425>
- Doctolero, D. R. (2021). Kankanaey ethnolinguistic group. *MS Review*, 23(1), 2. https://mstreview.com/wp-content/uploads/2021/06/Doctolero_Vol-23-no-1-2021-2.pdf
- Domingo, M. O. (2024). Indigenous leadership and governance. *Philippine Journal of Public Administration*, 48(1–2).
- Environmental Management Bureau–CAR. (2021, June 27). *Padyak para sa kalikasan held in Baguio City*. <https://car.emb.gov.ph/padyak-para-sa-kalikasan-held-in-baguio-city/>
- Fiveable. (2022). *Focused study guides for every class*. <https://library.fiveable.me/>
- Flores, S. (n.d.). *The indigenous communities of Benguet Province*. <https://www.scribd.com/presentation/727590766/The-Indigenous-Communities-of-Benguet-Province>
- Food and Agriculture Organization of the United Nations. (2017, February 27). *A study on Philippine mountain peoples*. <https://www.fao.org/mountain-partnership/news/newsroom/news-detail/A-study-on-Philippine-mountain-peoples/en>
- Fu, Q., & Zhang, X. (2024). Promoting community resilience through disaster education: Review of community-based interventions with a focus on teacher resilience and well-being. *PLOS ONE*, 19(1), e0296393. <https://doi.org/10.1371/journal.pone.0296393>
- Gonzales, N. A. P. (2024). Safeguarding indigenous practices in the family, education, agriculture, and forest conservation among the Ifugaos in the Philippines. *Suranaree Journal of Social Science*, 18(2). <https://doi.org/10.55766/sjss-2-2024-272439>
- Gordon, H. S. J., Ross, J. A., Bauer-Armstrong, C., Moreno, M., Byington, R., & Bowman, N. (2023). Integrating indigenous traditional ecological knowledge of land into land management through Indigenous-academic partnerships. *Land Use Policy*, 125, 106469. <https://doi.org/10.1016/j.landusepol.2022.106469>
- Gota de Leche. (2019). *The seeds, beads, and meals for moms program was launched in Kibungan, Benguet*. <https://www.gotadeleche.ph/kibungan-benguet-welcomes-seeds-beads-and-meals-for-moms-program/>
- Grey, E. J. (2019). Cultural beliefs and practices of ethnic Filipinos: An ethnographic study. *IRA-International Journal of Management & Social Sciences*, 3(3). <https://doi.org/10.21013/jmss.v3.n3.p30>
- Hamadani, H., Rashid, S. M., Parrah, J. D., Khan, A. A., Dar, K. A., Ganie, A. A., Gazal, A., Dar, R. A., & Ali, A. (2021). Traditional farming practices and their consequences. In *Innovative approaches for sustainable development* (pp. 119–128). Springer. https://doi.org/10.1007/978-3-030-61010-4_6
- Hauser, S., & Norgrove, L. (2013). Slash-and-burn agriculture, effects of. In *Encyclopedia of biodiversity* (2nd ed.). Elsevier. <https://www.sciencedirect.com/science/article/abs/pii/B9780123847195001258>

- Helzner, C., & Jackson, C. (2023). *The correlation coefficient: Definition, formula, and example*. Study.com. <https://study.com/academy/lesson/the-correlation-coefficient-definition-formula-example.html>
- Hent. (2021, October 26). *Benguet institutionalizes organic agriculture*. Baguio Herald Express. <https://baguioheraldexpressonline.com/benguet-institutionalizes-organic-agriculture/>
- Intergovernmental Panel on Climate Change. (2021, August 9). *IPCC AR6 WG1 report on a physical science basis*. <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/>
- Ismail, Z., & Go, Y. I. (2021). Fog-to-water for water scarcity in climate-change hazards hotspots: Pilot study in Southeast Asia. *Global Challenges*, 5(5), 2000036. <https://doi.org/10.1002/gch2.202000036>
- Jessen, T. D., Ban, N. C., Claxton, N. X., & Darimont, C. T. (2022). Contributions of indigenous knowledge to ecological and evolutionary understanding. *Frontiers in Ecology and the Environment*, 20(2), 93–101. <https://doi.org/10.1002/fee.2435>
- Karri, V., & Nalluri, N. (2024). Enhancing resilience to climate change through prospective strategies for climate-resilient agriculture to improve crop yield and food security. *Plant Science Today*, 11(1), 21–33.
- Kansas State University Research and Extension. (n.d.). *Environment*. <https://www.ksre.k-state.edu/program-areas/natural-resources/environment/index.html>
- Kihila, J. M., Wernsted, K., & Kaseva, M. (2021). Waste segregation and potential for a recycling case study in Dar es Salaam City, Tanzania. *Sustainable Environment*, 7(1), 1935532. <https://doi.org/10.1080/27658511.2021.1935532>
- Kinomis, X. G. (2016). *Indigenous knowledge systems and practices (IKSPs) in the teaching of science*. Philippine Statistics Authority. <https://psa.gov.ph/sites/default/files/ncs-manuscripts-powerpoint/Session%25202-Lakay>
- Lakay. (2024, February 27). *The Kankana-ey people of the Cordilleras*. Igorotage. <https://www.igorotage.com/blog/kankana-ey-people>
- Leal Filho, W., Lütz, J. M., Totin, E., Ayal, D., & Mendy, E. (2025). Obstacles to implementing indigenous knowledge in climate change adaptation in Africa. *Journal of Environmental Management*, 373, 123678.
- Leonard, S., Parsons, M., Olawsky, K., & Kofod, F. (2013). The role of culture and traditional knowledge in climate change adaptation: Insights from East Kimberley, Australia. *Global Environmental Change*, 23(3), 623–632. <https://doi.org/10.1016/j.gloenvcha.2013.02.012>
- Lintang, R. B. (2020). The Kankanaey people: A cultural and linguistic perspective. *Benguet Review Journal*. <http://journals.bsu.edu.ph/index.php/BRJ/article/view/423>
- Lugtu, K. C. (2022, April 21). For young Filipinos, #Futureofwork is farming. *The Manila Times*. <https://www.manilatimes.net/2022/04/21/business/top-business/foryoung-Filipinos-future-of-work-is-farming/1840643>
- Makondo, C. C., & Thomas, D. S. G. (2018). Climate change adaptation: Linking indigenous knowledge with Western science for effective adaptation. *Environmental Science & Policy*, 88, 83–91. <https://doi.org/10.1016/j.envsci.2018.06.014>
- Martinez, A. (2023). A paper about the influence of the Philippines' unique social culture on business. *ASEAN Journal of CI-EL and Applied Philosophy*. <https://jurnal.ugm.ac.id/v3/arcelap/article/view/9732>
- Mayo, R. E. (2023). Preserving socio-cultural practices: Exploring resilience and the impact of government initiatives among the Manobo in the Philippines. *Open Journal of Social Sciences*, 11(9), 601–616. <https://doi.org/10.4236/jss.2023.119037>
- Mbhenyane, X. G., & Tambe, A. B. (2024). The influence of household and community food environments on food insecurity in Limpopo Province, South Africa. *International Journal of Environmental Research and Public Health*, 21(2), 125. <https://doi.org/10.3390/ijerph21020125>
- Mercado, K. M., & Osbahr, H. (2023). Feeding the future: Knowledge and perceptions of the Filipino youth toward agriculture. *Asian Journal of Agriculture and Development*, 20(2), 31–50. <https://doi.org/10.37801/ajad2023.20.2.3>
- Molintas, E. (2017). Design and fabrication of a passive solar dryer for meat preservation in the Cordillera region of northern Philippines. *CLSU International Journal of Science & Technology*, 2(1). <https://doi.org/10.22137/ijst.2017.v2n1.01>
- MSN. (2023, April 6). *Global warming of more than 3°C this century may wipe 40% off the world's economy, a new analysis reveals*. <https://www.msn.com/en-au/news/other/global-warming-of-more-than-3-c-this-century-may-wipe-40-off-the-world-s-economy-new-analysis-reveals/ar-AA1C3ePg>
- Narvaez, L. M. (2019). Climate change responsive indigenous knowledge systems in crop farming in Albay Province, Philippines. *Bicol University R&D Journal*, 22(2), 12–20. <https://doi.org/10.47789/burdj.mbtcbbs.20192202.7>
- NASA. (2025, April 16). *Global temperature*. NASA Climate Change and Global Warming. <https://climate.nasa.gov/vital-signs/global-temperature/>
- NASA. (n.d.). *What is climate change?* <https://science.nasa.gov/climate-change/what-is-climate-change/>
- Nath, S. (2024). Mobilizing transformative community-based climate change adaptation. *Urban Transformations*, 6, Article 1. <https://doi.org/10.1186/s42854-023-00059-7>

- Neal, T. (2025, April 2). *Global warming of more than 3°C this century may wipe 40% off the world's economy, a new analysis reveals*. Green Central Banking. <https://greencentralbanking.com/2025/04/02/global-warming-of-more-than-3c-this-century-may-wipe-40-off-the-worlds-economy-new-analysis-reveals/>
- Nelson, G. L. M., Zamora, O. B., de Guzman, L. E. P., Tatlonghari, R. V., Espaldon, M. V. O., & Brillon, J. A. (2019). The indigenous practices and climate change responses of Ati and Suludnon farmers in Iloilo, Philippines. *Journal of Environmental Science and Management*, 22(1), 87–98. https://doi.org/10.47125/jesam/2019_1/06
- Newcastle University. (n.d.). *Pearson product-moment correlation coefficient r*. <https://www.ncl.ac.uk/webtemplate/ask-assets/external/maths-resources/statistics/regression-and-correlation/strength-of-correlation.html>
- Nitah, S. (2021). Indigenous peoples proven to sustain biodiversity and address climate change: Now it is time to recognize and support this leadership. *One Earth*, 4(7), 907–909. <https://doi.org/10.1016/j.oneear.2021.06.015>
- Nygaard, E., Hussain, A., Siqueland, J., & Heir, T. (n.d.). General self-efficacy and posttraumatic stress after a natural disaster: A longitudinal study.
- Oktor, K., Dhuol, M. G. R., & Ercan Kalkan, M. (2024). Fog harvesting: An effective solution to the water scarcity problem. *Sakarya University Journal of Science*, 28(4), 899–911. <https://doi.org/10.16984/soaufenbilder.1480488>
- Olaya, G. M. (2022). *Co-production in forest protection: The Ikalahan/Kalanguya ancestral domain*.
- Osting, J. B. (2011). *Preferences on the different mulching materials of strawberry farmers in the swamp area, La Trinidad, Benguet* [Bachelor's thesis, Benguet State University]. <http://portal.bsu.edu.ph:8081/greenstone/collect/undergra/index/assoc/HASHb48c.dir/doc.pdf>
- Owen, G. (2020). What makes climate change adaptation effective? A systematic review of the literature. *Global Environmental Change*, 62, 102071. <https://doi.org/10.1016/j.gloenvcha.2020.102071>
- PhilAtlas. (n.d.). *Kibungan, Province of Benguet*. <https://www.philAtlas.com/luzon/car/benguet/kibungan.html>
- Philippine Statistics Authority. (2020, August 28). *Farm workers are paid an average daily wage of PhP 331.10 in 2019; CALABARZON farm workers are the highest paid, while Central Visayas farm workers are the lowest paid*. <https://www.psa.gov.ph/content/farm-workers-are-paid-average-daily-wage-php-33110-2019-calabarzon-farm-workers-are-highest>
- Philippines Today. (2023, August 5). *Tree planting: A pre-requisite before getting married in Itogon, Benguet*. <https://philippinestoday.net/archives/23451>
- Polonio, J. M. N. (2015, August 23). 'Marriage trees' are getting popular in Benguet towns. *Rappler*. <https://www.rappler.com/philippines/103363-marriage-trees-reforestation-benguet-towns/>
- Pugra, I. W., Kencanawati, A. A. A. M., & Kurniawan, I. G. W. A. (2025). The cultural significance of traditional foods in shaping Indonesian social identity: Challenges and preservation strategies. *Journal of Language, Literature, Social and Cultural Studies*, 3(1), 21–31.
- Qadir, M., Jiménez, G. C., Farnum, R. L., Dodson, L. L., & Smakhtin, V. (2018). Fog water collection: Challenges beyond technology. *Water*, 10(4), 372. <https://doi.org/10.3390/w10040372>
- Ramazan, S., Wiyono, L., Abu-Odah, H., Comabig, R. G., Musa, S. S., Mahmood, J., & Miranda, A. V. (2023). Current landscape of climate change adaptation and health preparedness among indigenous populations in Southeast Asia. *Public Health Challenges*, 2(4), e129.
- Ramkumar, S. (n.d.). *Climate change*. Student Energy. <https://studentenergy.org/influencer/climate-change/>
- Rangel, J. M. L., do Nascimento, A. L. B., & Ramos, M. A. (2024). The influence of urbanization on local ecological knowledge: A systematic review. *Journal of Ethnobiology and Ethnomedicine*, 20(1), 106.
- Recidoro, V. D. (2013). *Farmer-users' preferences for organic fertilizers, Buguias, Benguet* [Bachelor's thesis, Benguet State University]. <http://portal.bsu.edu.ph:8081/greenstone/collect/undergra/index/assoc/HASHb48c.dir/doc.pdf>
- Reyes, C. M., Domingo, S. N., Agbon, A. D., & Olaguera, M. D. C. (2017). *Climate-sensitive decisions and use of climate information: Insights from selected La Trinidad and Atok, Benguet agricultural producers* (PIDS Discussion Paper Series No. 2017-47). Philippine Institute for Development Studies.
- Salungayan, C. L., Hupayan, K. D. S., Alima, A. G. T., & Diez, K. P. O. (2024). Menuvu tribe's knowledge, belief systems and practices (KSP): A study of cultural heritage variability.
- Shapland, P., van Paassen, A., Almekinders, C. J., & Leeuwis, C. (2023). Women's resistance: An alternative perspective to women's participation in community-driven development. *The Journal of Development Studies*, 60(2), 179–195. <https://doi.org/10.1080/00220388.2023.2279483>
- Studocu. (n.d.). *Kankanaey ethnolinguistic group*. <https://www.studocu.com/ph/document/benguet-state-university/cordillera-socio-cultural-heritage/the-kankanaey-ethnolinguistic-group/118887760>
- Sunstar. (2021). *Waste reduction along Benguet roads noted*. <https://www.sunstar.com.ph/more-articles/waste-reduction-along-benguet-roads-noted>
- Tabuzo, M. O. (2024). Understanding the environmental roles of mining beliefs and practices in Sitio Midas, Itogon. *Mountain Journal of Science and Interdisciplinary Research*, 84(2), 88–102. <https://doi.org/10.70884/mjsir.v84i2.426>
- Tan, F. J., Estanislao, M. A. P., Gregorio, A. M. A., & Navea, I. D. (2019). The potential of fog harvesting in tropical highlands as an alternative water resource: The case of Atok, Benguet, Philippines. *E3S Web of Conferences*, 117, 00007. <https://doi.org/10.1051/e3sconf/201911700007>

- Tiwari, A. K. (2023). The role of organic farming in achieving agricultural sustainability: Environmental and socio-economic impacts. *Acta Biology Forum*, 2(2), 29–32.
- University of Cebu. (2022). *Agriculture*. <https://www.studocu.com/ph/document/university-of-cebu/bs-accountancy/16-agriculture/30914187>
- UNESCO. (2010). *Reaching the marginalized: EFA Global Monitoring Report 2010*. UNESCO.
- United Nations. (2023). *Climate change*. <https://www.un.org/sustainabledevelopment/climate-change/>
- United States Environmental Protection Agency. (2025, January 17). *Causes of climate change*. <https://www.epa.gov/climatechange-science/causes-climate-change>
- Varela, R. (2015, July 9). *History*. Kibungan. <https://kibunganph.wordpress.com/2015/07/09/history/>
- Verma, B. C., Pramanik, P., & Bhaduri, D. (2019). Organic fertilizers for sustainable soil and environmental management. In *Nutrient dynamics for sustainable crop production* (pp. 289–313). Springer. https://doi.org/10.1007/978-981-13-8660-2_10
- WeForest. (n.d.). *IPCC Special Report: Global warming of 1.5°C*. [https://www.weforest.org/blog/opinion/ipcc-global-](https://www.weforest.org/blog/opinion/ipcc-global-WorldResourcesInstitute.2023IPCCAR6synthesisreport:Climatechangefindings.https://www.wri.org/insights/2023-ipcc-ar6-synthesis-report-climate-change-findings)
- World Resources Institute. (2023). *2023 IPCC AR6 synthesis report: Climate change findings*. <https://www.wri.org/insights/2023-ipcc-ar6-synthesis-report-climate-change-findings>
- Wróbel, B., Zielewicz, W., & Staniak, M. (2023). Challenges of pasture feeding systems—Opportunities and constraints. *Agriculture*, 13(5), 974. <https://doi.org/10.3390/agriculture13050974>
- Yee, T. X., Wei, C. C., & Ojo, A. O. (2021). Green volunteerism: A new approach to achieve the United Nations' sustainable development goals. *Tourism and Sustainable Development Review*, 2(1), 19–31.
- Yeleliere, E., Antwi-Agyei, P., & Guodaar, L. (2023). Farmers' response to climate variability and change in rainfed farming systems: Insight from lived experiences of farmers. *Heliyon*, 9(9), e19656. <https://doi.org/10.1016/j.heliyon.2023.e19656>
- Yodisphere. (2022, September). *Kankanaey tribe culture*. <https://www.yodisphere.com/2022/09/Kankanaey-Tribe-Culture.html>
- Zabala, P. S. (2021). The manifestation of sociocultural factors among administrators at local universities and colleges. *International Review of Social Sciences Research*, 1(1), 1–17. <https://doi.org/10.53378/346496>