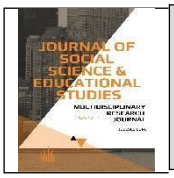

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Indigenous Knowledge and Community Ecological Governance: Lessons from Empirical Cases

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ABSTRACT

This paper uses theoretical and empirical experiences from different contexts to discuss the intrinsic value of indigenous and local ecological knowledge, and their implications for sustainable development and environmental justice. Specifically, the study deduces lessons on how indigenous local knowledge has been deployed by farmers and communities in Northern Guatemela, Papua New Guinea, Nepal and Ghana to protect critical ecosystems and enhance environmental integrity. This paper employs review writing investigation and evidence from existing theoretical and empirical examinations, to explore the relevance of indigenous and local knowledge in sustainable biodiversity management. The study concludes that indigenous and local knowledge is valuable and has proven to have supported farmers in sustainable farm practices, building resilience against climate change, and preventing anthropogenic forces which could have otherwise led to extinction of particular and significant biodiversity and local resources. From first-hand experience of its potency, some scholars have tended to equate indigenous knowledge to Western scientific knowledge. Rather than equating indigenous knowledge to Western scientific knowledge, we call for practical ways of enhancing complementarity and synergy between the two genres of knowledge.

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INTRODUCTION

The importance of indigenous and local knowledge (ILK or traditional knowledge) in sustainable development discourse cannot be overemphasized especially in relation to Sustainable Development Goals 2, 15, 13, 6, and 12, which seek to achieve food security, safeguard life on land, foster climate action, ensure clean water, and promote resource efficiency respectively (FAO, 2018; FAO et al., 2020; IPCC, 2019; UN, 2018). Many of the local resources highlighted in these themes have been properly managed and preserved by local people using indigenous knowledge handed down over millennia. This intergenerational transfer of knowledge has proven critical in enhancing sound ecological governance and fostering harmonious relations between all members of the Earth Community. Indeed, ILK has been the cornerstone of many local people and community's management and preservation of biodiversity before their encounter with modern scientific ecological knowledge. This intrusion presents a dilemma for local communities; an inability to fully tap into western notions of ecological governance, and an existential threat to ILK that has served several generations of local communities. Consequently, many researchers ((Löbmann et al., 2022; Ahsan et al., 2021; Moallemi et al., 2020) are of the view that the attainment of the globally agreed sustainable development goals (SDGs) hinges on proper management of natural resources and biodiversity, and ILK has a crucial role to play in that regard.

To ensure prudent and sound management of environmental resources, there has been a call to integrate ILK with modern scientific knowledge on resource management due to the increasingly complex threats to sustainability confronting contemporary societies. This, it is argued, will help tap into the strengths of various knowledge systems to foster collaboration and shared learning between multiple actors and to ensure mutual benefit across socio-ecological systems (SES) and the SDGs. Consequently, the value of indigenous knowledge has gained recognition by scientists, managers, and policy-makers, and has become an evolved component of national and international law (Anaya, 1996). In other words, ILK or traditional knowledge has become an important concept and practice generally advanced as the basis for conservation in contemporary ecological governance, land and resource usage, climate change adaptation and biodiversity protection.

A recognition of the value of indigenous and local knowledge and its relevance to sustainable environmental resources management began from the Brundtland Commission's Report on sustainable development in 1987. According to the Commission, indigenous and local knowledge embodies inherent traditional understanding, skills and practices essential for the prudent sustainable management of complex ecosystems (UNDRR, 2015). Indigenous and local knowledge has been conceptualized to denote an aggregate body of information, practice, and conviction that has evolved from versatile and adaptive cycles, passed down through the ages by means of socialization reflecting the connections between people, ecosystems, and general environment (Berkes, 2018). Despite its intrinsic value, indigenous and local knowledge appears to be put on the backburner of contemporary research and practice of sustainable development, presenting a lacuna in the process. Using practical examples and empirical cases, this study discusses the value of ILK in the governance and preservation of social-ecological systems. This paper uses theoretical and empirical experiences from different contexts to highlight the intrinsic value of ILK with the view to drawing their implications for sustainable development, especially, in relation to environment and biodiversity conservation. *How does traditional knowledge shape local people's actions and behaviour towards environmental resources? Have these practices yielded the necessary value or relevance for the people? How can indigenous knowledge be integrated with modern scientific knowledge to enhance prudent governance of environmental resources?* Deploying knowledge systems as the conceptual framework, this paper provides answers to these cross-cutting questions using empirical examples from across different contexts. The paper is in six sections: the first section provides a general introduction and framing to the study; the second section entails a conceptual overview of the key issues addressed in the study. The third section provides details of the methodology, whilst section four presents a thematic analysis of data. Section five is a detailed discussion of the data presented, whilst the final section draws conclusions and discusses policy implications.

CONCEPTUAL OVERVIEW

The section discusses the concept of traditional knowledge (ILK) and its relevance to biodiversity management and preservation. Berkes (2018) presents traditional knowledge or ILK as a cumulative body of information, practice, and conviction that has evolved over the ages in versatile and adaptive cycles by means of socialization indicating the interconnections between people, ecosystems and the general environment.

In other words, traditional knowledge or ILK refers to the aggregate body of knowledge formed long ago by past generations through their practices, thoughts and actions, and these knowledge systems are found within particular communities which have helped and continue to enhance sustainable socio-ecological practices (Kaniki & Mphahlele, 2002). Following this, it can be argued that ILK has proven to be resilient mainly relying on intergenerational transfer of knowledge.

Key features of ILK

The conceptualizations above and theoretical exposition on ILK and traditional knowledge suggests the following inherent characteristics.

Cheaper source of knowledge handed down by past generations

The definitions above bring to the fore the fact that ILK is a synthesized and cheaper body of knowledge, which has been practiced over a longer period of time and passed from previous generations to current generation through oral tradition and continuous practice. For example, in some developing African countries such as Tanzania, poor people tend to deploy ILK as ''social capital'' in their social strategies (see Kabudi, 2004). ILK forms the basis for their various spheres of endeavour including, inter alia, agriculture, indigenous health services, among others. ILK entails the enlightenment, advancements and the traditions of the local people acquired, nurtured, improved and relayed from past happenings, evolving with time. This also gets contextualized and adapted to complement the distinctive circumstances of the particular culture and environment (see Kamau & Winter, 2009). This synthesized knowledge has been relevant in diverse spheres of local people's lives with regards to how they organize and manage their environment and its resources in areas such as agriculture, environment, fisheries and forestry.

Influenced by socio-demographic features

Battiste (2002) explains that ILK is a ''living process to be absorbed and understood'' (p. 15). He contends that key demographic forces that influence this transfer and usability include age, gender, experience, political power and occupation. Even amongst a given setting or society, the demographic features outlined above would have implications on whether people resort to or place value on ILK or their exposure to quality and right amount of ILK (see Briggs, 2005).

Socialization and education for life

Indigenous and local people regard education as a process of acquiring know-how for the purpose of life (see Kanstrup-Jensen, 2006). In other words, life experience is the rationale for the social learning process such that conscious efforts are made to prepare the individual to fully become well-prepared members of the community via a hands-on approach to knowledge acquisition, entailing learning-by-doing (see Preston, 1982). This point is further reinforced by UNESCO (2009), which argues that such learning-by-doing techniques involve observations, activities, and engagements with all sections of the community and the environment. In other words, as people interact with elderly members of society and their environment, they get socialized into the whole process of the ILK system which prepares them for life. Pursuing similar arguments, Battiste (2002) contends that 'experiential learning' in the form of practical demonstrations, and oral approaches in the forms of storytelling, myth narration, or songs tend to be deployed for such social transmission purposes.

Immeasurable relevance across spheres

ILK remains a critical element in the preservation and conservation of natural resources because it controls and enhances sustainable practices. ILK has been deployed in numerous ways and endeavours, including those traditions relating to plants and animals, species variety, and ecosystem sustainability in numerous communities (Oguamanam, 2010). Many Indigenous Local Communities (ILCs) live in regions with critical degrees of biodiversity and, thus, have developed natural resources reasonably for ages, safeguarding and improving local biodiversity, keeping up with ecosystem system health and increasing the standards of sustainable development, far before their codification into law.

Indigenous knowledge is local

ILK is attached to a specific spot and set of encounters, and created by individuals residing in those spots. The implication of this is that moving the native knowledge to different spots risks disjoining it (Ellen & Harris, 2000). I argue that this localness offers significant opportunities for deeper learning and reflection, thereby contributing to the efficacy of ILK.

Indigenous knowledge is orally-transmitted

It is communicated through imitation and exhibition. The challenge then becomes attempts at codifying it which may alter part of the ultimate or intrinsic canons, albeit, codification makes it more manageable and enduring which reinforces the distortion if any (Ellen & Harris, 2000).

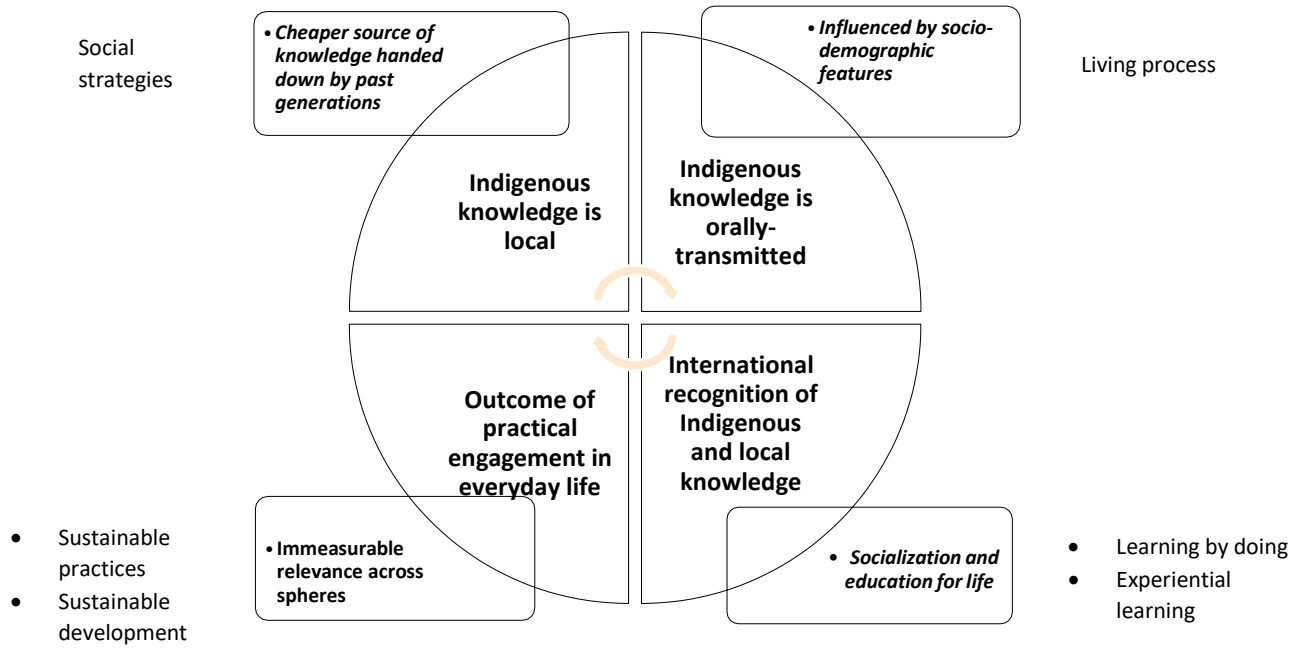
Outcome of practical engagement in everyday life

ILK is an outcome of day to day activities and practices of local people and communities. In other words, it is an aggregated knowledge based on people's experiences which have been tried and tested over time. This experience is distinctively the result of numerous ages of critical thinking, and since any disappointment has quick ramifications for the existence, and relevance of specialists, it is tried in the thorough research laboratory of endurance.

International recognition of Indigenous and local knowledge

The use and role of ILK has gained international recognition. The Convention on Biological Diversity (CBD) of 1993 marks a milestone in the recognition of local communities with their indigenous knowledge and their rights in indigenous knowledge and sustainable development. The preamble of CBD acknowledges the intricate and traditional reliance of local communities . . . on natural resources and the interest of involvement in the advantages obtained from the deployment of indigenous knowledge and practices. Article 8 of the Convention places obligations on states towards ILCs in conservation activities. Clause j of this particular article has dominated most discussions and treatise on the topic which contends that member-nations should regard, protect and maintain information, developments and practices of native and local communities epitomizing customary ways of life significant for the preservation and sustainability of biological resources (UNEP, 1992).

Figure 1: Conceptual framework of Indigenous Knowledge



Source: Author's construct

Knowledge types

There has been the recognition to promote integration and complementarity of diverse knowledge sources to sustainably manage natural resources. In other words, it is prudent to appreciate the various typologies of knowledge and devise mechanisms to complement them effectively. As a result, we discuss the following knowledge types:

Systems knowledge: This concerns methodical and logical comprehension or knowledge of complex interwoven contexts and situations.

Target knowledge: This concerns knowledge or comprehension of how people conceptualize and contextualize problems. In other words, the kind of interpretation communities put on prevailing situations and circumstances which also determines where the people want to get to with respect to that circumstance or problem.

Transformation knowledge: This concerns the most effective way to protect a system to make scientific revelations important for practical application and enforcement (Pohl et al., 2017; König et al., 2021; Hirsch-Hadorn et al., 2008).

From the foregoing, systems knowledge, transformation knowledge and target knowledge are all required in order to effectively understand a prevailing situation, how to conceptualize the issue and to determine where exactly one wants to go with respect to the reality. Understanding the present situation and determining which idealized situation one wants to find him or herself (target knowledge) requires additional knowledge 'the know-how' of 'how' to move from the prevalent situation to the idealized or conceptualized situation. Consequently, this calls for the need for integration or complementation of varying sources of knowledge so that the systems, target and transformation constructs will be done effectively. It drums home the need for interdisciplinary discourses requiring the need to integrate academic knowledge from diverse sources to conjointly create knowledge. More comprehensively, scholars have advanced for transdisciplinary

interaction which tends to incorporate academic and non-academic knowledge foundations to co-create knowledge (Engels, 2005; Gliessman, 2015).

The space and value of indigenous and local knowledge systems are complementary to scientific ecological knowledge with respect to how it facilitates the structuring of active and multifaceted social-ecological systems (Robinson & Wallington, 2012). Some thinkers have explained native and local individuals as scientists with their own evolved and improved worldviews and ontologies that have enabled safety of societies and their social-ecological systems over millennia. (Cockerill & Hagerman, 2020). Several studies and empirical data have pointed to the fact that indigenous and local people possess practical and traditional knowledge about the environment which helps contribute meaningfully to environmental resource sustainability (Thompson et al., 2020; Makondo & Thomas, 2018).

METHODOLOGY

The study employs the traditional (narrative) literature review approach, which collects and reviews published literature on a broad topic. The key source material for this study is existing hypothetical and empirical work, mostly drawn from journal articles and pertinent books to evaluate the relevance of ILK in sustainable biodiversity management. The writing search covered all phrasings and terminologies as approximately connected with native knowledge; “local knowledge’’, ‘’traditional knowledge’’ non-scientific knowledge’’, “ILK”, “people’s knowledge”, and “community knowledge”. In the process, we blended adjectives related to common benefits of ILK in sustainable development using specific indicators; these words included ‘relevance’ ‘importance’ ‘benefits’ , ‘roles’ and ‘advantages’. Lastly, we likewise joined adjectives connected with approaches to advancing the most common way of incorporating both ILK and scientific knowledge; the words included 'value' 'improving' 'promoting' 'effective' 'successful'. The various adjectives and the idea of indigenous and local knowledge (ILK) were joined in various ways to acquire a pool of more important literature on the review. The following three search spaces were principally embraced in view of their importance to the review and availability and accessibility to the specialists or researchers: *ScienceDirect, Tandfonline, and Google Scholar*. The enormous pool of articles from these sources were at first arranged for significance by skimming through their abstracts. After this heuristic process, all abstracts were thoroughly checked on by the writer. Towards the end of the process, copies were wiped out and a waitlist of abstract for précised and systematic review was set up. The individual themes brought up in each paper were then arranged and in different stages.

Additionally, the study came across an empirical study on a Ghanaian case by Yeboah-Assiamah et al (2017) which, although on collaborative governance, the ‘local institutional aspect’ has greater implications on indigenous knowledge. Consequently, the current study adapts the primary data or transcripts of recording from Yeboah-Assiamah et al. (2017) to demonstrate how traditional knowledge helps in natural resource preservation and management. Consequently, with the authors’ consent, the narratives or direct quotations from the study have been reproduced adapted in this work to throw emphasis on some of the points being made here.

RESULTS: ILK and sustainable development

Sustainable development involves establishing a practical balance between socioeconomic development and ecological integrity. A cursory and analytical assessment reveals that ILK assumes an essential part in meeting those objectives connecting with sustainable development, in that those age old customary practices and knowledge frameworks created by native and local communities (ILCs) indirectly validate the art and praxis of environmental protection and sustainable utilization of biodiversity and natural resources.

From the review of theoretical and empirical literature, the following themes have been derived and discussed to demonstrate how ILK contributes to sustainable development.

Rational and reliable knowledge for sustainable development discourse and practice

ILK has increasingly become a form of rational and proven knowledge developed through generations of intricate connection with indigenous people/communities and their environment which has achieved similar status with scientific knowledge (UNEP, 1998). While local people, hitherto, had been regarded as destroyers of the environment and sources of degradation, these people in contemporary times (at least from the latter 20th Century) have usually sustained their lands and resources for centuries deploying ILK knowledge which makes them adapt to changing SES (Krech, 1999). In most instances, local people have improved native biodiversity via extensive "eco-cultural" sceneries, and have also developed the majority of the global diversity in domesticated flora and fauna (see Blackburn & Anderson, 1993; Nabhan, 1997) which have helped to preserve and sustainably manage these natural resources over time. Empirical examples are illustrated and discussed in the next sub-section.

ILK provides foundation for local decision making

Scholars have over time come to a realization that indigenous knowledge on environmental life, agriculture, forest and wildlife management remains very robust and solid than had been assumed (Posey, 1995). Additionally, ILK provides new frameworks for development which are regarded as both environmentally and socially thorough. Consequently, it is widely believed that development initiatives that embrace, seek to complement and work through indigenous knowledge do possess a greater array of benefits over their counterparts (those projects that function outside the spheres of ILK). A typical example has been the desire to revert to “non-scientific” mixed cropping practice from the “scientific” monoculture due to the catastrophic experiences with the latter. The features of customary polycultures that make them attractive were overlooked by agricultural analysts in less developed nations with the introduction of the idea of plantation revolution into those nations. However, recent research on polycultures has bloomed and a portion of their advantages are turning out to be clear. For instance, in Sri Lanka, mixed cropping had sustainable farming for more than 2500 years with its attendant benefits like diet diversity, income-diversification, production stability, and minimization of risk, reduction in the incidence of pests and diseases, and proficient utilization of labour. The native people have learnt these practices through centuries of collected insight and endurance, which is significant in planning current development endeavours for farming in Sri Lanka.

The local farmers through their informal gatherings persevere in a somewhat unorganized way and look for answers for their "localized" agricultural issues via native knowledge, usually undetectable to political actors. Such innovation is user-inferred then tried over some period. Then again, the basic stronghold of the traditional knowledge is its capacity to identify the correlation of disciplines, and afterward incorporate them meaningfully. This comprehensive and holistic perspective and the subsequent latent synergy show more elevated gap of formative effect, versatility and maintainability than the modernized Western knowledge. Consequently, it is a generally excellent source of readily accessible and already tried and tested suitable innovation for policy makers to use in their planning interaction and processes.

Indigenous and local knowledge for sustainable farming: The Nepal Case

In Nepal, the policy of community forestry and farmer managed irrigation system foster the recognition of rights and responsibilities of the locals in the country. In Lo Manthang, the locals designed an irrigation system which was sustained by traditional knowledge; without any downpour, normal repositories or reservoirs as profound snowpack and all year glacier empowered farming and agro-business in the area (Chhetri, 2008). The snow took more time to dissolve and give a more or less predictable stream during rainless seasons. In Dhakarjong and Phalyak custom, families sent agents to a neighbourhood irrigation board known as Mukhiya to arrange for where to direct the stream by the use wooden weirs. Through such self-association and with the customary information or knowledge, the local community was able to ensure that the lack of water did not prevent them from venturing into farming (ibid).

The Chhattis Mauja irrigation was also borne out of the traditional knowledge of the locals, the irrigation system diverts water from the Tinau River at Butwal. However, this system was later integrated with modern technology. This custom has brought forth Farmer Managed Irrigation Systems (FMISs). A significant part of the nation's irrigated region is under various FMISs dispersed over the country. Around nine hundred and fifty thousand hectares of land in the nation possess some type of irrigation system, with which six hundred and seventy five thousand hectares are within the authority of FMISs, and two hundred and seventy five thousand hectares are created and overseen by central organizations. FMISs represent more than seventy per cent of irrigation system development in the nation and add up to over forty per cent of the national cereal crop production (Poudel et al., 1997).

ILK for adaptive farming

The people in Manthang adopted a crop rotational system of farming as way of minimizing the wasting of water. With the idea of conserving water, the local people decided to grow crops and seeds that do not require much water for production. Therefore, they grew mustard, barley, wheat and potato. Buckwheat and peas are different crops which have been planted and harvested around this area for ages. (Chhetri, 2008).

The Tharu group has a customary local area leader called Badhghar. Before, he was exceptionally powerful in light of the fact that the Badhghar was tasked for the administration of justice and supervising the developmental activities in the community which involves the administration of the irrigation system. Chaukidar assisted the Badhghar in discharging his duties (watchman who used to function as a messenger and his assistant). The watchman (Chaukidar) was answerable to the Jamindar in the local area level developmental activities and in this way his role was to see the mobilization of the labour for the yearly, intermittent and occasional repair and innovation works of the dam system. The administration of dam-related works has gone on under the initiative of a group elected by the general members of the community who are also the water users (ibid).

Farmers have additionally built Sanchhoes (proportion of weirs) which helped in dividing of water among and within the Maujas coming from the main source. These are by and large solid and strong concrete constructions. Previously, they were of transitory naturally made of locally accessible materials like shrubs, wood, sand, soil and stones. In view of their indigenous knowledge, the proportioning weirs operate with the end goal that, they are intended to share water, which is directly proportional to the land accessible in a specific Mauja (Uprety, 2020, p.94).

The irrigation system was regulated and governed by oral traditions, rules governing the usage of these irrigation were not codified into a single document but rather local leaders ensured such regulation. The Chhattis Mauja irrigation system had some tenets of democracy in its administration. At the Mauja level, everyone who uses the irrigation system possess the chance to give their opinion at the moment of general meeting. The people’s views and plights concerning the irrigation system were heard and taken at general gatherings with no respect to their position or status locally. (Uprety, 2020, p.98).

ILK for forest conservation in Northern Guatemala

The *Q’eqchi’e* who lived in the northern part of Guatemala used traditional knowledge in their agricultural processes (*Na’leb* which literally means advice or custom from an elderly). The leaders in the community are tasked to ensure the continued existence of na'leb' and to teach youths. The pasawink, one old couples who throughout the period have amassed value and authority via serving the local area as chinames. Chinames are chosen and sometimes appointed by the local area for a couple of years. The *Chinames* had two main duties in the community; I) they owed obligation to the Catholic Church by this, they take charge of cleaning the church, repairing faults in and around the church and also decorating it.) The other duty of the chinames is to sort out standard customs and ceremonies which are performed by the local area in general, for example, the feast of the patron saint and the mayejak ceremonies. The mayejak ceremonies are performed to initiate the beginning of the maize planting season in March or April not long prior to making the land ready when the pasawink in the community “speak” to the local mountain and a portion of the thirteen mountains that have a predominating position in the Q'eqchi' district. During this practice or ritual, members

of the community were not allowed to go haunting, harvest, grow or clear their farm. This allowed them to rest and also conserved the forest. (Siebers, 2004, p.38)

Also, through celebrating these rituals and customs for the sake of the community, these local leaders maintain great relations with the mountains and everything in the universe, like the luminous bodies (sun and the moon), the wind, the saints and the dead. These rituals additionally empower the people at the local level, particularly the youthful people, to regard and practice the different rules and prescription of how to manage every component in the natural environment like the land, flower, plants, seed, rivers and lakes. With this, these rules (awas) exemplify a significant bank of farming knowledge which the Q'eqchi'es are expected practice to keep up with and maintain great relations with the mountains on which, eventually, their food crops and the development of the creatures live on (ibid).

Local practices to reverse forest degradation in Northern Guatemala

The *Q'eqchi'es* were able to maintain and sustain their forests from indiscriminate cutting down of trees. Even if they are required for the construction of their homes, woods they use as building materials have grown on the mountain so they need to seek permission from the mountain and so they keep great relations with the mountain. The initiation of a newly built house is a special event for traditional rituals directing it to the spirit of the house and the Tzuultaq'a. This custom forestalled illegal activities in the forest and the mountains (Siebers, 2004, p.42).

Traditional practices for soil quality: Nepal

One other way the Napalese conserved the land was the Sakaluka Ritual, which depicts the opening of the "mouth" of the earth. The farm deity (natively called Lu - a snake god) is believed to become dynamic or active and should be appeased, subsequently during the festival all cultivating activities, for example, planting, hunting, irrigation systems are stopped, this custom is mostly to thank the god but paradoxically it was approach to conserving and allowing the lands to have some fallow period (Chhetri, 2008 p.146).

Forest Sustainability in Papua New Guinea

Oral tradition has been passed down from generations among the people of Papua New Guinea (*Malu). Malu* accounts of this kind also eminently lay out changes supposedly made from the early stages, in that the predecessors were mostly spirits and could take shapes of any animal, into the times of civilised as they developed preceding the colonial intervention from the 1930s forward. In recent times, there has been the resurgence of *Malu* narrative or knowledge about spirits being present in the earth crust and have become weaved with view of the site where developmental activities, particularly digging and mining for minerals, occur. For areas like Duna and its surrounding Paiela (Ipili speakers) and Huli these rumours and thoughts become the focused on the idea that a huge snake watches the gold and other minerals looked for some miners and this snake hates the exploitation of metal ore from the ground, this is way to prevent these miners from extracting the minerals and hence preserving the resources. (Ballard, 1998; Biersack, 1999).

Papua New Guinea on the Oil Reserve

There is an oral tradition among the natives of Wola of the Southern Highlands that says that the crude oil reserve [which have increased the presence of many drilling companies in the region] are the waste metabolism (urine and excreta) of a huge, serpent with seven heads which lives within soil. This saying was made so that the reserve or the oil resources remain unexploited and be well preserved. (Stewart & Strathern, 2004, p.55)

There is another idea or tradition that minerals (gold, diamonds and bauxite) are the possession of female evil spirit who visits the mineral mining sites in the community in human forms. Hence, mining in that area or mining for these minerals is like stealing from the spirits. This tradition has been handed down from generations to generations as a way discouraging or instilling fear in people to avoid exploiting the resources (ibid*).*

ILK in forest and wildlife management: The BFMS case of Ghana

A cursory assessment of the traditions of local communities shows the ways and avenues through which traditional knowledge (culture) and environmental balance is preserved. Culture is characterized by the environmental conditions and those traditional agencies that help in preserving and sustaining the resource in question and community (see Mishra, 1994). This creates a situation of "constructive dependence" rather than "destructive dependence" contrary to what some scholars perceive. The value of culture and relevance in ecological protection is denoted in different myths, rules, regulations and taboos that structure the native culture and ethos. Despite the relevance of local knowledge in helping biodiversity and resource sustainability, cultural and environmental changes have made most of these being distorted at an alarming rate (Haverkort & Millar, 1994). That notwithstanding, there are some of these cultural and traditional knowledge that have proven very formidable and robust in effectively helping in resource protection and sustainability.

Providing an empirical case of how indigenous and local knowledge shape biodiversity management, this section adopts the exceptional case of the Monkey Sanctuary in Boabeng-Fiema (herein BFMS) in Ghana. The Monkey Sanctuary is a renowned tourist site located in Ghana, where there is co-existence between the black-and- white *colobus* and *Mona* monkeys and the human inhabitants in Boaben-Fiema villages without any intense confrontation. Primarily, the monkey species are protected and preserved by indigenous and local knowledge via traditional institutions. The monkeys are considered as "children of the gods", and are therefore safeguarded by customary laws. BFMS was accredited a sanctuary in 1975 in line with the implementation of formal regulations and plans to add up to the predominant informal courses of action for the sustainable administration of monkeys. The BFMS presents a feature of Ghana's Community Resource Management Areas (CREMA) scheme embraced by the Wildlife Division of Forestry Commission in Ghana. CREMA presents a local area range of natural resources management project whereby community agencies are urged to hold the administration of off-reserve lands which remain ungazetted. In this plan local towns are entrusted to wisely oversee resources and to upgrade township-wide advantages. Officially exuding from Ghana's 1994 Forest Policy, CREMA is a model through which the Wildlife Division delegate authority and management to the local areas to organize internally local arrangements and structure put in place for wildlife management. This is mainly underpinned by local knowledge enforced by informal institutions which in recent times have been complemented by scientific knowledge and formal institutions. For the purpose of this section, we have highlighted the indigenous and local knowledge as well as the corresponding traditional institutions for sustaining the wildlife species in the context of sustainable development. The section uses transcripts of recording from Yeboah-Assiamah et al. (2017) to demonstrate how traditional knowledge helps in preservation.

Traditional leaders as custodians of indigenous systems

Chiefs in the customary administration system assume a pivotal part in the protection of wildlife in BFMS. The communities which is the habitat of these monkeys have a vigorous kingship system presided over by a chief together with his Council of elders (Customary cabinet) who play important role in upholding and enforcing the traditional areas' bye-laws and rules towards the wellbeing of the monkeys. Locally, the leader (chief) is still considered fundamental implementer and enforcer of bye-laws and customary taboo that put a prohibition on physically harming the monkeys.

Anybody who flouts any of the bye-laws and the taboos protecting the monkeys is summoned before the central authority (chief) who pass judgement on the befitting punishment. In most instances, the accused individual is compelled to purchase things including a ram to be butchered to conciliate the divine beings (gods). A local priest recounted:

…so the individual who hurts the monkey should pacify the divine beings by bringing sheep and eggs for the ceremonies… anybody who even unintentionally kills the creature would purchase a coffin and convey

it. You will put together a memorial service for the monkey and everybody within the local area would realize that you killed the monkey. (Quoted in Yeboah-Assiamah et a, 2017)

Traditional Priest and resource preservation

Both communities (Boabeng and Fiema) possess customary priest responsible for the animals. These priest are accepted to receive divine directions from the divine beings (gods) and also direct traditional leaders on what to do. A priest contends:

….. We pay attention to the divine beings. Anything somebody does, the divine beings convey to us. So any hidden thing one does it is made known to us the priests… and in the event that one perishes a ceremony must be performed (ibid).

The priests in a joint effort with the rulers have the duty of implementing bye-laws in each of the two communities. Customarily, the monkeys are posterity of the deity and the priests of Boabeng and Fiema undertake customary ceremonies to pacify the deities at a time when there is a sad episode of a monkey being found dead. It involves burial customs for the animal and, past that, undertaking the rightful burial rituals.

Troublesome monkeys but remain protected: what explains this?

Ordinarily, issues caused by monkeys to members of the township in BFMS could have justified cruel retaliation as happens somewhere else, however the enforcement mechanisms assist with safeguarding them. Some of these Monkeys create problems in the community. A queen mother recounted the ordeal;

The monkeys are great however extremely awful, theft and annihilation. Simply look at the structure with red imprints (pointing a few messy imprints soiled on her fence by monkeys)…. I have replaced my roofing multiple times (monkeys hop on them to make small openings)… assuming food is even on fire, bread, kenkey (local ration prepared using maize dough) they will take and eat before you when they sit on the roofing or mango tree to spite you… .

The account from the queen mother is authenticated by observation made by team of researchers around the area, as the animals were found in the homes of individuals in the mornings and nights, which exhibits a relatively normalized human-wildlife relation. At the time of the focus group meetings, members concurred that while both local and foreign members of the township did not physical abuse the monkeys, purposes behind their activity might contrast. For example, one migrant explain:

> *…. despite the fact that I might feel a little uncertain about these myths, I don't want to have any issue with the government so i submit to the guidelines… regardless of whether officials are nowhere to be found, individuals themselves will report you if knowingly or unknowingly trespass… government regulations will deal with anybody who affronts.* (ibid)

An alternate explanation was given by a native member who submitted:

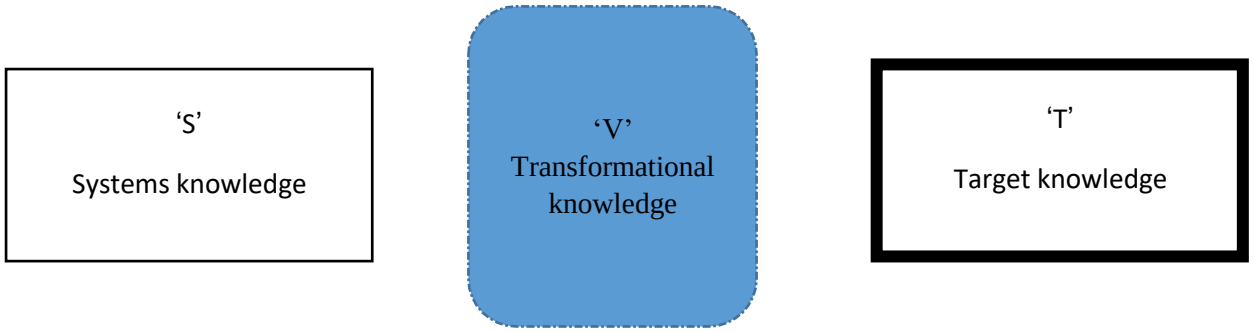
> *monkeys are offspring of the deities, this is everything that our elderly in the community have said to us and we hold in high esteem, the improvement of Boabeng-Fiema is an outcome of the funds generated by eco-tourism as result of the monkeys… we cherish the custom and we don't hurt the monkeys and will not permit anybody to do as such* (ibid)

DISCUSSION

The foregoing data and accounts highlight the role of indigenous knowledge in ecological governance and biodiversity conservation. The observations from the data add credence to an argument by Segger and Phillips (2015) that '' Sustainable development requires more than essentially adjusting financial and environmental drivers… fruitful or successful practices are informed through commitment and strengthening ILCs to give contextual knowledge and insight based on centuries of experiences " (p 436).

From the data one clearly comes to terms that indigenous and local people possess knowledge about ecological resources and depending on what they want to see an idealized situation look like, indigenous measures and mechanisms are always put in place. Envisioning the future and how they want these to be effectively protected. Consequently, by juxtaposing the data with the concepts deployed for the study, this framework summarizes ILK in sustainable development.

Figure 2: Knowledge types and ILK



By Systems knowledge, we are concerned with the methodical understanding or knowledge of complex interwoven contexts and situations. From the data one observes that all the indigenous and local communities highlighted have practical understanding of the complex contexts in terms of their agricultural practices and biodiversity protection (see also Löbmann et al., 2022 on systems knowledge for soil management and farming practices). In the case of Nepal, they do understand the current situation of how inadequate supply of rainwater hinders farming and year-long farming. In Northern Guatemela, the indigenous people have local knowledge about the relationship between continuous farming and implications on soil quality, and wildlife sustainability among others. In Papua New Guinea, the indigenous people appreciate the nexus between incessant mining and depletion of the resources. Similarly, in the Ghanaian case, the local people possess knowledge about human-wildlife relationship. In all these circumstances, the local people clearly understand the relationship between human practices and natural resource protection (systems knowledge which has been denoted as 'S').

Target knowledge: Target knowledge concerns knowledge about how communities envision the future of the resource in question and their general wellbeing. In the context of this discussion (denoted as 'T'), the ultimate target or vision of the indigenous people is to sustainably manage and preserve the sanctity of the resources in question such that activities of people do not unduly degrade the resources. For example, in the case of Northern Guatemela, the target knowledge was how to increase or maintain yield even in the dry season when there was no natural rainfall and also to maintain soil quality. In the case of Papua New Guinea, the target knowledge was to prevent illegal small-scale mining whilst in the case of Ghana, the target was to prevent the depletion of the monkey species and to ensure maximum protection of the wildlife and its habitat. From the data and each of the indigenous communities discussed, each of them had target knowledge or an envisioned idea about the resource in question and they perfectly executed such target using traditional knowledge or ILK to ensure people willingly complied. This communicates the relevance of local knowledge on sustainable management of environmental resources that has helped many local communities for years in managing unique and important resources.

Transformation knowledge: This concerns with the most effective way to direct a system to make scientific proof significant for practical application and implementation (Pohl et al., 2017; König et al., 2021; Hirsch-Hadorn et al., 2008). From the cases discussed, the indigenous people had a systems knowledge about the connection between poor anthropogenic activities and natural resource sustainability. They had a target knowledge of an envisioned future where the resources should not be left at the mercy of human activities. The biggest question would be: *how will this envisioned 'ideal' future be accomplished or realized?* This

makes the role of transformational knowledge (denoted as 'V') which seeks to deal with the useful elements that will necessarily help achieve the target of effectively protecting and sustaining the environmental resources in question. In other words, that kind of knowledge serves as the vehicle upon which society will move or transit into the idealized future. In all the cases, highlighted, respective local people or communities had some traditional narratives they had put on the resources in question to ensure that people do not unduly degrade the resources. In the case of Northern Guatemela, the local people had envisioned a year-long agriculture and how to achieve this target was through the use of tradition knowledge and their unique style of tapping water in the form of local irrigation to help realize this target. This observation finds support in the literature where statistics show that about half of the population of the world relies on traditional knowledge for crops and food produce (see Hart & Vorster, 2006). For example, in Tanzania, the local sector powered by ILK accounts for approximately ninety-nine per cent of the nation's cattle and eighty-five per cent of the poultry (Hill, 2003), and not less that ninety per cent of the seeds planted (Mushi, 2008). In all these instances, traditional knowledge has been able to keep the said resources intact, albeit, in some cases traditional knowledge systems and institutions have been augmented with modern scientific knowledge and modern institutions to ensure synergies and robustness of the transformational knowledge.

From the foregoing, systems knowledge, target knowledge and transformation knowledge are all required in order to effectively understand a prevailing situation, how to conceptualize the issue and to determine where exactly one wants to go with respect to the reality. Understanding the present situation and determining which idealized situation one wants to find him or herself (target knowledge) requires additional knowledge 'the know-how' of 'how' to move from the prevalent situation to the idealized or conceptualized situation. This finding corroborates a similar observation by Löbmann et al. (2022) whose study assessed systems knowledge about soil and its implications on local people's management approaches. Indigenous communities have demonstrated that customary knowledge or indigenous and local knowledge has greater implications on resource sustainability. It is within this context that the Food and Agricultural Organization draws attention that some thirty per cent of animal genetic resources stand a high risk of extinction as a result of people disregarding traditional knowledge or ILK and tilting more towards conventional scientific knowledge (Muyungi & Tillya, 2003). Aluma (2004) contends that many farmers, for example those in Tanzania and many parts of the world are becoming more incensed of the deleterious consequences of chemical fertilizers and other chemicals for crops hence reverting to the use of traditional practices and inputs for sustainability (p.25). It has been observed in south-east Asia that traditional knowledge or ILK has helped immensely in enhancing forest management and in stimulating the conservation of biodiversity through the constant adaptation to and the prudent management of those challenges that come with the imperatives of forestry and cropping practices (see Rerkasem et al., 2009). It is therefore prudent to constantly recognize, identify, approve, preserve, and spread native abilities and practices in agriculture and other extractive endeavour to maintain harmony with nature and enhance sustainability.

CONCLUSIONS AND POLICY IMPLICATIONS

The study has brought to the fore, the relevance and deployment of traditional knowledge or ILK in sustainable administration of ecological resources. The study concludes that there is value in ILK which has proven to be efficient in helping farmers adopt sustainable farm practices as well as make contributions to prevent anthropogenic forces which could have otherwise led to extinction of particular local resources.

Due to its potency and the experiences, many scholars have made attempts to regard indigenous knowledge as having the same status as scientific knowledge in the spheres of range management (Homann *et al.*, 2008), ethnobotany (Blanckaert et al., 2007); coastal systems management (Foale, 2006); water and climate (Liwenga, 2008; Marin, 2010; Weatherhead et al., 2010). I argue that rather than attempt to find equivalence in relation to the two genres of knowledge, a lot more good will ensue by stressing complementarity. Observing the reality of the potency of ILK in resolving real world problems, this study contends that addressing the relevant sustainable development goals

(SDGs) requires a critical attention to indigenous knowledge. This policy recommendation adds credence to a recent call by Moallemi et al. (2020) that achieving the Sustainable Development Goals requires transdisciplinary innovation at the local level because 'local actors tend to have an understanding of the knowledge requirements necessary to make the right decision at the right time and then for carefully monitoring and responding to the changing environment on the ground' (p. 308). Consequently, stakeholder engagement, guided by adequate analytical calculations has the potential of effectively contributing to sustainable resource governance. It is therefore, quintessential to ensure active participation of local champions and societal actors as this is required to optimize the institutional capacity to adjust to changing social ecological systems. This is highly imperative in the context of the sustainable development goals, which among other things calls for varying and integrated 'institutional capacities' and 'governance approaches' at diverse scales of society to push the transformative agenda.

An important admonition in the research agenda over a period of time has been efforts on the best approaches with which indigenous knowledge could effectively be interspersed with recognised scientific knowledge to yield sets of synthesized and emergent knowledge for farmers and other people to utilize (Briggs et al., 2007). Despite the practical challenges that may be associated with this complementation (Liwenga, 2008; Mercer et al., 2009), it is nevertheless viewed to be a meaningful encounter. Corroborating this call, scholars make a case for efforts at entwining scientific with indigenous knowledge in order to generate a more realistic and profound comprehension and governance of biodiversity for sustainable development (Lado, 2004, p.281). A prototype template for the breakthrough has been proposed by Mercer et al. (2010) who discuss that if one wants to come up with a model to help reduce community susceptibility to the vicissitudes of the environment in Papua New Guinea, one may want to follow a four-point method which entails: (1) engagement with societal members; (2) efforts to identify and detect risk factors and vulnerability forces; (3) efforts at identifying indigenous as well as scientific approaches; and (4) the application of these (see also Reed et al., 2007). The latter also a four-point model which entails an initial scoping in the literature; engagement with relevant people via interviews and focus group discussions on both the observations in the literature and the indigenous knowledge. The final stage involves the fabrication of useful manuals to make available context specific and relevant alternatives. Realizing this meaningful pathway requires building of trust and social capital so that local people will have confidence in the process (see Ahsan et al., 2021).

There has been exaggerated emphasis on what can be described as ecological modernisation as a panacea to fixing environmental challenges. For policy players, practitioners and scholars in the natural resources and environmental governance space, there is a call to reflect on whether scientific knowledge is universal, all-embracing, and applicable everywhere. In this paper, I have demonstrated through some empirical cases that local knowledge is essential in protecting critical environmental ecosystems and promoting sustainable development. Though indigenous knowledge may not have all the answers to present day challenges, it has served local people very well over the years by enabling them to make decisions based on their own culture, values, lived experience, and belief systems. This makes a case for scientific plurivesality, diversity and transdisciplinarity, and invites policy makers to consider complementarity between the two genres of knowledge when designing programmes and policies.

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