Short Note

The Role of Traditional Ecological Knowledge in Environmental Stewardship: Beyond Poverty and Necessity

Tej Kumar Nepal *

Posted Date: 26 June 2024

doi: 10.20944/preprints202406.1838.v1

Keywords: traditional ecological knowledge; conservation; ecological awareness; sustainable development

 doi:10.20944/preprints202406.1838.v1

Short Note

The Role of Traditional Ecological Knowledge in Environmental Stewardship: Beyond Poverty and Necessity

Tej Kumar Nepal

Freelance Researcher, Thimphu, Bhutan; tejkumarnepal97@gmail.com

Abstract: The persistence of Traditional Ecological Knowledge (TEK) among Indigenous and local communities is often associated with socio-economic constraints, poverty, and lack of choices. Such a perspective argues against underpinning profound environmental consciousness and sustainable practices that underlie TEK. The paper challenges reductionism—viewing TEK solely as a creation of necessity—and tries to argue that it entails a sophisticated understanding of ecological balance and conservation ethics. Through various examples, the paper exemplifies how TEK contributes to environmental sustainability for biodiversity conservation, management and use of natural resources, and the enhancement of resilience to climatic change—the same elements crucial for culture, tradition, and community living.

Keywords: traditional ecological knowledge; conservation; ecological awareness; sustainable development

Introduction

Traditional Ecological Knowledge (TEK) refers to the cumulated wisdom, practices, and beliefs concerning their natural environment developed over centuries by indigenous and local communities. This paper/debate argues against the postulate that "sometimes TEK (Traditional Ecological Knowledge) is maintained not because of positive values about the environment, but because of poverty and a lack of options" written by Hartel et al. (2023) and "Traditional ecological knowledge sustains due to poverty and lack of choices rather than thinking about the environment" written by Abdullah & Khan (2023), and in support of Albuquerque et al. (2024). Unlike the argument advanced by Abdullah & Khan (2023) and Hartel et al. (2023), who argue on the grounds of TEK persistence due to poverty or lack of choices. In most cases, TEK often reflects deep ecological awareness and purposeful environmental stewardship entwined with cultural and traditional practices (Robinson et al., 2021; Finn et al., 2017; Whyte, 2013). It has been shown that TEK is not just a stopgap in the absence of a modern alternative but recognizes deliberate choices sustained by cultural values and environmental ethics. For example, Berkes (2017) establishes that TEK integrates sophisticated ecological principles and practices that have evolved over generations to ensure sustainability in resource management. Similarly, some authors, like Davidson-Hunt and Berkes (2003), describe TEK as intrinsic to Indigenous people's cultural identity and social texture because it embodies a worldview that models humans as part of nature and not apropos of it.

Studies by Folke et al. (2003) have shown how TEK builds resilience in social-ecological systems by enabling a community to adapt to environmental change and uncertainty. This is a testament to the depth of ecological knowledge and the purposeful use of sustainable practices enshrined in TEK. Furthermore, complex spiritual and ethical dimensions are usually imbued in TEK, as documented by Turner and Berkes (2006). According to the authors, a profound respect for nature is institutionalized in many indigenous cultures, guided by spiritual and ethical precepts that embed sustainability imperatives and stewardship of natural resources within the general culture rubric. These cultural and ethical dimensions become part of TEK itself—holism writ large in environmental sustainability, transcending mere survival.

 doi:10.20944/preprints202406.1838.v1

The role of TEK in contemporary environmental management is increasingly recognized in the academic literature. Agrawal (1995) criticizes the artificial dichotomy between traditional and scientific knowledge and refers to TEK as not inferior to scientific knowledge but supplementary. The author claims that TEK offers insights into local ecosystems that can enhance conservation strategies. Jessen et al. (2022) also explain that Indigenous knowledge is dynamic and evolving; it can integrate new information and technologies without walking away from its core principles. Hence, it adapts to the present by remaining relevant and overturning solutions to modern environmental challenges like climate change and biodiversity loss. The significance of TEK is also supported by research on its practical application. Kimmerer (2013) explains how principles from TEK are applied not just in the sustainable harvesting of wild plants but also in restorative practices in degraded landscapes. These practices demonstrate a deep understanding of ecological processes and a commitment to maintaining ecological balance.

These findings, in effect, mean that TEK is not an outcome of poverty and lack of choices but culturally set ways of living in harmony with the environment. The following sections will detail certain aspects and attributes of TEK to explain inherent ecological wisdom, cultural significance, and its potential operative value for solving modern environmental issues.

Ecological Consciousness in TEK

1. Sustainable Resource Management

Most of the existing TEK systems are founded on principles related to sustainability and conservation (Lemi, 2019; Kim et al., 2017). Characteristics of Indigenous practices are sophisticated resource management techniques, such as rotational farming, controlled burns, and sacred groves, aiming for long-term productivity and ecological balance (Hamadani et al., 2021; Gillies, 2019; Imoro et al., 2021; Charoenniyomphrai et al., 2006). These techniques are not solely for survival purposes but from years of knowledge of how ecosystems function and the expectation of which would take care of the environment for future generations.

2. Biodiversity Conservation

TEK plays a very crucial role in biodiversity conservation. Indigenous people generally maintain and protect various plant and animal species through traditional practices that enhance genetic diversity and increase ecosystem resilience (Salgotra & Chauhan, 2023; Jessen et al., 2022). For example, diverse crop varieties and agroforestry systems ensure ecological stability, reducing the risks associated with crop failures from pests or climate variability (Frison et al., 2011).

3. Climate Resilience

Indigenous knowledge systems have developed adaptive strategies to deal with climatic changes through drought-resistant crops, techniques of water conservation, and diversified livelihoods that reduce vulnerability to environmental stress (Grigorieva et al., 2023; Grey et al., 2020; Mugambiwa, 2018; Ajani et al., 2013). Thus, TEK is a beneficial resource in formulating effective policies and practices for adaptation to climate change.

TEK as Culture, Tradition, and Community Living

1. Cultural Practices and Traditions

TEK and indigenous cultural and spiritual values are entwined (Nepal, 2024). Most traditional practices are informed by ethics that aspire to respect nature and establish intergenerational responsibility (Allison, 2023; Taylor, 2017). Rituals, taboos, and customary laws often control the exploitation of natural resources to ensure that exploitation rates do not outstrip regeneration (Nepal, 2023; Yin, 2022; Tanyanyiwa & Chikwanha, 2011; Xiuping et al., 2010). These ethical frameworks demonstrate that TEK is animated by a willful attempt at environmental stewardship, not just necessity.

 doi:10.20944/preprints202406.1838.v1

2. Community and Social Structure

Passing on TEK is a social process consolidating the groups' cohesion and intergenerational relations (Tang & Gavin, 2016; Kirsten & Kathy, 2013; Berkes et al., 2000). It is passed on through storytelling, singing, rituals, and demonstration, thus rooting environmental stewardship in the social life of community members (Martinez, 2021; Rossano, 2020; Cajete, 2017). In such a communal approach, one ensures that TEK is constantly adjusted and added to in response to environmental changes.

3. Holistic Living

It is the holistic approach toward living in which the dimensions of environment, culture, and spirituality are integrated. By taking a holistic view comes belonging and responsibility toward the environment, fostering practices that bring well-being to the ecological and community levels. Accordingly, living in harmony with their environment enables communities that practice TEK to attain resilient livelihoods capable of overcoming external pressures (Meier, 2024; Hariram et al., 2023; Sponsel, 2020; Infield & Mugisha, 2010; Zapf, 2005).

Case Studies Illustrating TEK's Holistic Approach

1. The Kayapo People of the Amazon

The Kayapo people of the Brazilian Amazon do have their form of agroforestry, which can increase biodiversity and further maintain a forest ecosystem. In their practice, they create the so-called "apêtê" forest islands, which are highly rich in plant species used for food, medicine, and materials. This does not result in the mere conservation of the forest but the creation of microhabitats in which a variety of wildlife is sustained, reflecting the deep integration of ecological and cultural knowledge (Hecht et al., 2019; Ayestaran, 2011; Hecht, 2009; Posey, 1997).

2. The Maori of New Zealand

The Maori have long relied on TEK for fisheries management. Customary practices such as "rahui" allow for the temporary closure of fishing, which enables the fish to maintain ecological balance and replenish their populations. Now being integrated into modern New Zealand conservation plans, it attests to the persistence of TEK's validity in the contemporary management of the environment (Bambridge, 2016; Vierros et al., 2010; Kitson & Moller, 2008; Kitson, 2006).

3. The Inuit of the Arctic

The Inuit communities have profound knowledge about sea ice, including its patterns, the behavior of other animals, and traditional weather forecasting. Such knowledge allows traveling and survival under extreme Arctic conditions. Besides this, the relevance reaches much broader into the scientific knowledge base in general and climate monitoring in particular since TEK adds fine-scaled, long-term details of observation for enhanced understanding that scientific data cannot capture (Simonee et al., 2021; Panikkar et al., 2018; Pearce et al., 2015; Derry & Stallones, 2011; Weatherhead et al., 2010).

The Global Relevance of TEK

The principles and practices ingrained within TEK are not only locally rooted but remain pertinent globally (Mazzocchi, 2006). Regarding sustainable living, TEK has much to offer regarding global efforts against environmental deterioration and climatic change. Resilience and sustainability can be improved at larger scales by integrating TEK with current global environmental policies (Hosen et al., 2020; Gómez-Baggethun et al., 2013).

1. Contribution to International Conservation Efforts

 doi:10.20944/preprints202406.1838.v1

TEK is now more recognized by international agencies, such as the United Nations and the Convention on Biodiversity. These organizations now acknowledge that indigenous knowledge systems can contribute to achieving global biodiversity targets and formulating workable conservation strategies (Parks & Tsioumani, 2023; Reyes-García et al., 2021; Whyte, 2013; Twarog & Kapoor, 2004; Sillitoe, 2002).

2. Enhancing Scientific Research

Integrating TEK into scientific research might provide a more complete understanding of ecosystems. Such joint approaches for combining scientific and indigenous knowledge have already realized their potential in wildlife management, climate adaptation, and sustainable agriculture (Souther et al., 2023; Hoagland, 2017; Butler et al., 2012; Gagnon & Berteaux, 2009; Moller et al., 2004).

3. Policy Implications

TEK can be integrated into policy frameworks that bring about more inclusive and effective environmental governance (Henze & Santoro, 2024; Kant & Anjali, 2021; Ludwig & Macnaghten, 2020; Finn et al., 2017). Such policies would allow respect and integration of TEK, empowering Indigenous communities and including their knowledge and rights in efforts toward broader conservation and sustainability goals.

Challenges and Opportunities in Integrating TEK

1. Respecting Indigenous Rights

Integration of TEK into broader environmental management is challenging because of the need to safeguard indigenous rights in its protection- and respect-related processes. Indigenous communities have usually been marginalized and dispossessed of their lands, often undermining the traditional knowledge systems. It is not only about recognizing the value of TEK; effective integration also involves the associated empowerment of indigenous peoples as equal partners in conservation efforts (Ford et al., 2020; Shawoo & Thornton, 2019; Usher, 2000).

2. Collaborative Approaches

Successful integration of TEK into modern environmental management should be achieved by collaborating equally with recognized Indigenous knowledge holders and scientists. Such collaborative moves can bridge gaps between traditional and scientific knowledge, gaining innovative, culturally appropriate, and ecologically sound solutions. In many of these cases, the new solutions proved promising in programs that facilitated sharing knowledge and co-management of natural resources (Thornton & Scheer, 2012; Martin et al., 2010; Johnson, 1998).

3. Documentation and Preservation

While TEK is traditionally passed on orally, documenting this knowledge is a critical way of preserving and diffusing the knowledge further. In the process, however, documentation must be undertaken respecting cultural values and intellect. The community-driven approach will, therefore, ensure that the TEK recorded respects its origin and significance by raising Indigenous voices and perspectives (Oyelude, 2023; Kant & Anjali, 2021; Rose et al., 2016).

4. Education and Advocacy

There must be heightened awareness about the value of TEK and its contribution to sustainable development. Educational programs on indigenous knowledge inputs towards biodiversity conservation will enhance support and appreciation for TEK. Such advocacy efforts will, likewise, help influence policy and ensure needed resourcing is in place on a priority basis for TEK-based initiatives (McElwee et al., 2020; Harvey, 2009; Oviedo & Maffi, 2000).

 doi:10.20944/preprints202406.1838.v1

Conclusion

Traditional ecological knowledge is important in environmental stewardship at the locality level and in global sustainability efforts. It uniquely and significantly informs empirical natural resource management, climate adaptation, and biodiversity conservation. Linked with scientific research, TEK can enhance our understanding of ecosystems by adding fine-scaled and long-term observations that complement scientific data. TEK is not resorted to because of poverty or the lack of alternatives, but rather it represents a rich cultural heritage and an effective system of knowledge whose efficiency and effectiveness have enabled communities to survive generation after generation. It contains sustainable practices and ethical and spiritual principles toward the land and environment. The pertinence of TEK cannot be reduced to its socio-economic context; it hints at insights and strategies of universal significance, no matter the wealth or technological advance of a society. International organizations now recognize the potential of TEK in attaining global conservation goals, as it is encapsulated with sustainable practices honed over generations of people. To that end, such integration can help engender larger-scale resilience and sustainability by merging TEK with contemporary environment-focused policies. Embracing TEK is thus not catering to tradition but a strategic move towards a more sustainable and ecologically balanced future. Furthermore, this values the marriage between knowledge systems in solving real problems created by complex environmental challenges today.

Funding: There is no funding for the paper.

Conflict of Interest: The author declares no conflict of interest.

References

1. Abdullah, A., & Khan, S. M. (2023). Traditional ecological knowledge sustains due to poverty and lack of choices rather than thinking about the environment. *Journal of Ethnobiology and Ethnomedicine*, *19*(1), 65. https://doi.org/10.1186/s13002-023-00640-1
2. 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
3. Ajani, E. N., Mgbenka, R. N., & Okeke, M. N. (2013). Use of indigenous knowledge as a strategy for climate change adaptation among farmers in sub-Saharan Africa: implications for policy. *Asian Journal of Agricultural Extension, Economics & Sociology*, *2*(1), 23-40. https://doi.org/10.9734/AJAEES/2013/1856
4. Albuquerque, U. P., Cantalice, A. S., Oliveira, D. V., Oliveira, E. S., dos Santos, E. B., dos Santos, F. I. R., ... & Brito-Junior, V. M. (2024). Why is traditional ecological knowledge (TEK) maintained? An answer to Hartel et al.(2023). *Biodiversity and Conservation*, 1-8. https://doi.org/10.1007/s10531-024-02794-0
5. Allison, E. (2023). Collective Responsibility and Environmental Caretaking: Toward an Ecological Care Ethic with Evidence from Bhutan. *Ecology and Society*, *28*(1), 10. https://doi.org/10.5751/ES-13776-280110
6. Ayestaran, I. (2011). *Sustainable Development-Relationships to Culture, Knowledge and Ethics* (Vol. 3). KIT Scientific Publishing. https://doi.org/10.25969/mediarep/3018
7. Bambridge, T. (2016). The Rahui: Legal pluralism in Polynesian traditional management of resources and territories. Anu Press. https://doi.org/10.26530/OAPEN_607554
8. Berkes, F. (2017). *Sacred ecology*. Routledge.
9. Butler, J. R., Tawake, A., Skewes, T., Tawake, L., & McGrath, V. (2012). Integrating traditional ecological knowledge and fisheries management in the Torres Strait, Australia: the catalytic role of turtles and dugong as cultural keystone species. *Ecology and Society*, *17*(4). https://doi.org/10.5751/ES-05165-170434
10. Cajete, G. A. (2017). Children, myth and storytelling: An Indigenous perspective. *Global Studies of Childhood*, *7*(2), 113-130. https://doi.org/10.1177/2043610617703832
11. Charoenniyomphrai, U., Phichetkulsamphan, C., & Tharawodome, W. (2006). Indigenous knowledge, customary use of natural resources and sustainable biodiversity management: case study of Hmong and Karen communities in Thailand. *Chiang Mai: Inter Mountain Peoples Education*.
12. Davidson-Hunt, I. J., & Berkes, F. (2003). Nature and society through the lens of resilience: toward a human-in-ecosystem perspective. *Navigating social-ecological systems: Building resilience for complexity and change*, *53*, 82. https://doi.org/10.1017/CBO9780511541957.006
13. Derry, K. W., & Stallones, L. (2011). *New Risks, New strategies: Greenlandic Inuit responses to climate change*. Colorado State University. https://doi.org/10.1093/ije/dyv096.173

14. Finn, S., Herne, M., & Castille, D. (2017). The value of traditional ecological knowledge for the environmental health sciences and biomedical research. *Environmental Health Perspectives*, *125*(8), 085006. https://doi.org/10.1289/EHP858
15. Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: building resilience and adaptive capacity in social-ecological systems. *Navigating social-ecological systems: Building resilience for complexity and change*, *9*(1), 352-387. https://doi.org/10.1017/CBO9780511541957.020
16. Ford, J. D., King, N., Galappaththi, E. K., Pearce, T., McDowell, G., & Harper, S. L. (2020). The resilience of indigenous peoples to environmental change. *One Earth*, *2*(6), 532-543. https://doi.org/10.1016/j.oneear.2020.05.014
17. Frison, E. A., Cherfas, J., & Hodgkin, T. (2011). Agricultural biodiversity is essential for a sustainable improvement in food and nutrition security. *Sustainability*, *3*(1), 238-253. https://doi.org/10.3390/su3010238
18. Gagnon, C. A., & Berteaux, D. (2009). Integrating traditional ecological knowledge and ecological science: a question of scale. *Ecology and Society*, *14*(2). https://doi.org/10.5751/ES-02923-140219
19. Gillies, C. (2019). Traditional Aboriginal burning in modern day land management. *Landcare Australia. Accessed*, *13*.
20. Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology and society: a journal of integrative science for resilience and sustainability*, *18*(4). https://doi.org/10.5751/ES-06288-180472
21. Grey, M. S., Masunungure, C., & Manyani, A. (2020). Integrating local indigenous knowledge to enhance risk reduction and adaptation strategies to drought and climate variability: The plight of smallholder farmers in Chirumhanzu district, Zimbabwe. *Jàmbá: Journal of Disaster Risk Studies*, *12*(1). https://doi.org/10.4102/jamba.v12i1.924
22. Grigorieva, E., Livenets, A., & Stelmakh, E. (2023). Adaptation of agriculture to climate change: A scoping review. *Climate*, *11*(10), 202. https://doi.org/10.3390/cli11100202
23. Hamadani, H., Rashid, S. M., Parrah, J. D., Khan, A. A., Dar, K. A., Ganie, A. A., ... & Ali, A. (2021). Traditional farming practices and its consequences. *Microbiota and Biofertilizers, Vol 2: Ecofriendly Tools for Reclamation of Degraded Soil Environs*, 119-128. https://doi.org/10.1007/978-3-030-61010-4_6
24. Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability. *Sustainability*, *15*(13), 10682. https://doi.org/10.3390/su151310682
25. Hartel, T., Fischer, J., Shumi, G., & Apollinaire, W. (2023). The traditional ecological knowledge conundrum. *Trends in Ecology & Evolution*, *38*(3), 211-214. https://doi.org/10.1016/j.tree.2022.12.004
26. Harvey, B. (2009). Indigenous knowledges, sustainable development and the environment: implications for research, education and capacity building. In *Indigenous knowledges, development and education* (pp. 57-71). Brill. https://doi.org/10.1163/9789087906993_005
27. Hecht, S. B. (2009). Kayapó savanna management: fire, soils, and forest islands in a threatened biome. In *Amazonian dark earths: Wim Sombroek's vision* (pp. 143-162). Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-9031-8_7
28. Hecht, S. B., Morrison, K. D., & Padoch, C. (Eds.). (2019). *The social lives of forests: past, present, and future of woodland resurgence*. University of Chicago Press. https://doi.org/10.7208/chicago/9780226024134.001.0001
29. Henze, J., & Santoro, A. (2024). *Including traditional ecological knowledge (TEK) in agriculture research: Guidelines and lessons learned*. FOSC – ERA-Net on Food Systems and Climate Knowledge Hub. https://doi.org/10.5281/zenodo.10964254
30. Hoagland, S. J. (2017). Integrating traditional ecological knowledge with western science for optimal natural resource management. *IK: Other Ways of Knowing*, 1-15.
31. Hosen, N., Nakamura, H., & Hamzah, A. (2020). Adaptation to climate change: Does traditional ecological knowledge hold the key?. *Sustainability*, *12*(2), 676. https://doi.org/10.3390/su12020676
32. Imoro, Z. A., Imoro, A. Z., Duwiejuah, A. B., & Abukari, A. (2021). Harnessing indigenous technologies for sustainable management of land, water, and food resources amidst climate change. *Frontiers in Sustainable Food Systems*, *5*, 691603. https://doi.org/10.3389/fsufs.2021.691603
33. Infield, M., & Mugisha, A. (2010). Integrating cultural, spiritual and ethical dimensions into conservation practice in a rapidly changing world. *Prepared for the John D. and Catherine T. MacArthur Foundation*.
34. 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
35. Johnson, M. (Ed.). (1998). Lore: Capturing traditional environmental knowledge. Diane Publishing.
36. Kant, N., & Anjali, K. (2021). Traditional Ecological Knowledge (TEK): A Strategic Resource for Tribal Communities. In *Peace, Justice and Strong Institutions* (pp. 915-928). Cham: Springer International Publishing. https://10.1007/978-3-319-71066-2_130-1

 doi:10.20944/preprints202406.1838.v1

37. Kim, E. J. A., Asghar, A., & Jordan, S. (2017). A critical review of traditional ecological knowledge (TEK) in science education. *Canadian Journal of Science, Mathematics and Technology Education*, *17*(4), 258-270. https://10.1080/14926156.2017.1380866
38. Kimmerer, R. (2013). Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants. Milkweed Editions.
39. Kirsten, V., & Kathy, L. (2013). Exploring the Role of Traditional Ecological Knowledge in Climate Change Initiatives. *US Department of Agriculture, Forest Service, Pacific Northwest Research Station*.
40. Kitson, J. C. (2006). Traditional ecological knowledge and harvest management of Titi (Puffinus griseus) by Rakiura Māori (Doctoral dissertation, University of Otago).
41. Kitson, J. C. & Moller, H. (2008). Looking after your ground: resource management practice by Rakiura Titi harvesters. *Papers and Proceedings of the Royal Society of Tasmania*, *142*, 161-176. https://10.26749/rstpp.142.1.161
42. Lemi, T. (2019). The role of traditional ecological knowledge (TEK) for climate change adaptation. *International Journal of Environmental Sciences and Natural Resources*, *18*(1), 28-31.
43. Ludwig, D., & Macnaghten, P. (2020). Traditional ecological knowledge in innovation governance: a framework for responsible and just innovation. *Journal of Responsible Innovation*, *7*(1), 26-44. https://10.1080/23299460.2019.1676686
44. Martin, J. F., Roy, E. D., Diemont, S. A., & Ferguson, B. G. (2010). Traditional Ecological Knowledge (TEK): Ideas, inspiration, and designs for ecological engineering. *Ecological Engineering*, *36*(7), 839-849. https://10.1016/j.ecoleng.2010.04.001
45. Martinez, D. E. (2021). Storying traditions, lessons and lives: Responsible and grounded Indigenous storying ethics and methods. *Genealogy*, *5*(4), 84. https://10.3390/genealogy5040084
46. Mazzocchi, F. (2006). Western science and traditional knowledge: Despite their variations, different forms of knowledge can learn from each other. *EMBO Reports*, *7*(5), 463-466. https://10.1038/sj.embor.7400693
47. McElwee, P., Fernández-Llamazares, Á., Aumeeruddy-Thomas, Y., Babai, D., Bates, P., Galvin, K., ... & Brondízio, E. S. (2020). Working with Indigenous and local knowledge (ILK) in large-scale ecological assessments: Reviewing the experience of the IPBES Global Assessment. *Journal of Applied Ecology*, *57*(9), 1666-1676. https://10.1111/1365-2664.13705
48. Meier, C. (2024). Integral Ecology as a Holistic Worldview and New Paradigm Towards Destination Conscience. Fostering a More Respectful Interaction of Human and Non-Human Creatures. In *Destination Conscience: Seeking Meaning and Purpose in the Travel Experience* (pp. 111-126). Emerald Publishing Limited. https://10.1108/978-1-80455-960-420241011
49. Moller, H., Berkes, F., Lyver, P. O. B., & Kislalioglu, M. (2004). Combining science and traditional ecological knowledge: monitoring populations for co-management. *Ecology and Society*, *9*(3). https://10.5751/ES-00675-090302
50. Mugambiwa, S. S. (2018). Adaptation measures to sustain indigenous practices and the use of indigenous knowledge systems to adapt to climate change in Mutoko rural district of Zimbabwe. *Jàmbá: Journal of Disaster Risk Studies*, *10*(1), 1-9. https://10.4102/jamba.v10i1.388
51. Nepal, T. K. (2023). Traditional ecological knowledge (TEK) and its importance in the Himalayan Kingdom of Bhutan. In *Traditional Ecological Knowledge of Resource Management in Asia* (pp. 317-332). Cham: Springer International Publishing. https://10.1007/978-3-031-16840-6_19
52. Nepal, T. K. (2024). The Place of Spirituality in Traditional & Scientific Ecological Knowledge. *Asian Journal of Language, Literature and Culture Studies*, *7*(1), 183-187.
53. Oviedo, G., & Maffi, L. (2000). Indigenous and Traditional Peoples of the World and Ecoregion Conservation: An Integrated Approach to Conserving the World's Biological and Cultural Diversity. World Wide Fund for Nature.
54. Oyelude, A. A. (2023). Indigenous knowledge preservation as a sign of respect for culture: concerns of libraries, archives and museums. *Insights*, *36*(1). https://10.1629/uksg.628
55. Panikkar, B., Lemmond, B., Else, B., & Murray, M. (2018). Ice over troubled waters: Navigating the Northwest Passage using Inuit knowledge and scientific information. *Climate Research*, *75*(1), 81-94. https://10.31230/osf.io/bzywv
56. Parks, L., & Tsioumani, E. (2023). Transforming biodiversity governance? Indigenous peoples' contributions to the Convention on Biological Diversity. *Biological Conservation*, *280*, 109933. https://doi.org/10.1016/j.biocon.2023.109933
57. Pearce, T., Ford, J., Willox, A. C., & Smit, B. (2015). Inuit traditional ecological knowledge (TEK), subsistence hunting and adaptation to climate change in the Canadian Arctic. *Arctic*, 233-245. https://doi.org/10.14430/arctic4475
58. Posey, D. A. (1997). Indigenous knowledge, biodiversity, and international rights: learning about forests from the Kayapo Indians of the Brazilian Amazon. *The Commonwealth Forestry Review*, 53-60.
59. Reyes-García, V., Fernández-Llamazares, Á., Aumeeruddy-Thomas, Y., Benyei, P., Bussmann, R. W., Diamond, S. K., ... & Brondizio, E. S. (2021). Recognizing Indigenous peoples' and local communities' rights

and agency in the post-2020 Biodiversity Agenda. *Ambio*, *51*(1), 84-92. https://doi.org/10.1007/s13280-021-01561-7

60. Ross, A., Sherman, K. P., Snodgrass, J. G., Delcore, H. D., & Sherman, R. (2016). Indigenous peoples and the collaborative stewardship of nature: knowledge binds and institutional conflicts. Routledge.
61. Rossano, M. J. (2020). Ritual as resource management. *Philosophical Transactions of the Royal Society B*, *375*(1805), 20190429. https://doi.org/10.1098/rstb.2019.0429
62. Shawoo, Z., & Thornton, T. F. (2019). The UN local communities and Indigenous peoples' platform: A traditional ecological knowledge-based evaluation. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(3), e575. https://doi.org/10.1002/wcc.575
63. Sillitoe, P. (2002). Globalizing indigenous knowledge. *Participating in development: Approaches to indigenous knowledge*, 108-138.
64. Simonee, N., Alooloo, J., Carter, N. A., Ljubicic, G., & Dawson, J. (2021). Sila Qanuippa?(How's the weather?): Integrating inuit qaujimajatuqangit and environmental forecasting products to support travel safety around Pond Inlet, Nunavut, in a changing climate. *Weather, Climate, and Society*, *13*(4), 933-962. https://doi.org/10.1175/WCAS-D-20-0174.1
65. Souther, S., Colombo, S., & Lyndon, N. N. (2023). Integrating traditional ecological knowledge into US public land management: Knowledge gaps and research priorities. *Frontiers in Ecology and Evolution*, *11*, 988126. https://doi.org/10.3389/fevo.2023.988126
66. Sponsel, L. E. (2020). Spiritual ecology. In *Encyclopedia of psychology and religion* (pp. 2262-2267). Cham: Springer International Publishing.
67. Tang, R., & Gavin, M. C. (2016). A classification of threats to traditional ecological knowledge and conservation responses. *Conservation and Society*, *14*(1), 57-70. https://doi.org/10.4103/0972-4923.182799
68. Tanyanyiwa, V. I., & Chikwanha, M. (2011). The role of indigenous knowledge systems in the management of forest resources in Mugabe area, Masvingo, Zimbabwe. *Journal of Sustainable Development in Africa*, *13*(3), 132-149.
69. Taylor, P. W. (2017). The ethics of respect for nature. In *The Ethics of the Environment* (pp. 249-270). Routledge.
70. Thornton, T. F., & Scheer, A. M. (2012). Collaborative engagement of local and traditional knowledge and science in marine environments: a review. *Ecology and Society*, *17*(3). https://doi.org/10.5751/ES-04714-170308
71. Turner, N. J., & Berkes, F. (2006). Coming to understanding: developing conservation through incremental learning in the Pacific Northwest. *Human ecology*, *34*, 495-513. https://doi.org/10.1007/s10745-006-9042-0
72. Twarog, S., & Kapoor, P. (2004). Protecting and promoting traditional knowledge: systems, national experiences and international dimensions (p. 418). United Nations.
73. Usher, P. J. (2000). Traditional ecological knowledge in environmental assessment and management. *Arctic*, 183-193. https://doi.org/10.14430/arctic849
74. Vierros, M., Tawake, A., Hickey, F., Tiraa, A., & Noa, R. (2010). Traditional marine management areas of the Pacific in the context of national and international law and policy. *Darwin, Australia: United Nations University—Traditional Knowledge Initiative*.
75. Weatherhead, E., Gearheard, S., & Barry, R. G. (2010). Changes in weather persistence: Insight from Inuit knowledge. *Global Environmental Change*, *20*(3), 523-528. https://doi.org/10.1016/j.gloenvcha.2010.02.002
76. Whyte, K. P. (2013). On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecological Processes*, *2*, 1-12. https://doi.org/10.1186/2192-1709-2-7
77. Xiuping, H. H. M., Kissya, E., & Yanes. (2010). Indigenous Knowledge and Customary Law in Natural Resource Management: Experiences in Yunnan, China and Haruku, Indonesia. Asia Indigenous Peoples Pact (AIPP) Foundation.
78. Yin, L. (2022). Traditional Ecological Customary Law for Conservation and Sustainability in Biodiversity. In *Floristic Diversity-Biology and Conservation*. IntechOpen. https://doi.org/10.5772/intechopen.105918
79. Zapf, M. K. (2005). The spiritual dimension of person and environment: Perspectives from social work and traditional knowledge. *International Social Work*, *48*(5), 633-642. https://doi.org/10.1177/0020872805055328