CLIMATE-SMART FOR INDIGENOUS EDUCATION

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ABSTRACT

Indigenous peoples' have complex knowledge systems within current biodiversity trends and climate impacts. We aim to capture this knowledge through an IFAD funded project.

In this project we seek to combine storytelling, as real-life multi-species stories, with problem-based (active) learning where the listener can interact and shape the story. Psomos & Kordaki [23] found that such storytelling facilitates the convergence of student-centered learning.

Our conclusion seeks to expand indigenous knowledge for the design and implementation of best practices in complying with all interest groups for the furtherance of our target community.

KEYWORDS

Gaia, African Indigenous knowledge, Aichi Biodiversity Targets, Climate change, Conflict, Peace-building, Urbanisation, Adaptation, Traditional Knowledge, Sustainable Development

1. INTRODUCTION

We express our solidarity as Indigenous Peoples living in areas that are the most vulnerable to the impacts and root causes of climate change. We reaffirm the unbreakable and sacred connection between land, air, water, oceans, forests, sea ice, plants, animals and our human communities as the material and spiritual basis for our existence.

We are deeply alarmed by the accelerating climate devastation brought about by unsustainable development. We are experiencing profound and disproportionate adverse impacts on our cultures, human and environmental health, human rights, well-being, traditional livelihoods, food systems and food sovereignty, local infrastructure, economic viability, and our very survival as Indigenous Peoples. Mother Earth is no longer in a period of climate change, but in climate crisis. We therefore insist on an immediate end to the destruction and desecration of the elements of life.

Through our knowledge, spirituality, sciences, practices, experiences and relationships with our traditional lands, territories, waters, air, forests, oceans, sea ice, other natural resources and all life, Indigenous Peoples have a vital role in defending and healing Mother Earth. The future of Indigenous Peoples lies in the wisdom of our elders, the restoration of the sacred position of women, the youth of today and in the generations of tomorrow.
-- **"Report of the Indigenous Peoples' Global Summit on Climate Change"** -- 24 April 2009

In Greek mythology only Chaos precedes Gaia. Gaia was the Greek goddess of Earth, mother of all life [14], similar to the Roman *Terra Mater* (mother Earth) reclining with a cornucopia, or the

Andean *Pachamama*, the Hindu, *Prithvi*, "the Vast One," or the Hopi *Kokyangwuti*, Spider Grandmother, who with Sun god *Tawa* created Earth and its creatures.

In the 1970s, James Lovelock, published his book Gaia [30]. His hypothesis was that life in Earth's environment self-regulates to optimum conditions. While working with the US space program, Lovelock developed methods for determining whether a planet that supports life was for the additional purpose of advancing life? He focused on the living organism's natural tendency to change a planet's atmosphere. He described how life itself over time, changed Earth's atmosphere. Using the idea of the Earth's sulphur cycle, he showed how biological life created the conditions for more life. In the 1970s, the effects of climate change were generally unknown, but he demonstrated that humanity was changing Earth's atmosphere, with as he said—dangerous consequences. In the years since then, many parts of the world have suffered because of these effects now collectively known as climate change. In Kenya and Tanzania, the Maasai without knowledge of Lovelock, have their own long-held traditional way of celebrating Gaia with:

"**A maasai prayer**"
Father-mother-earth [29]

We pray thee at sunrise and sunset, that you may not abandon your sacred duty of sustaining our lives.

The water that quenches our thirst, the air that we breathe, the trees that provide shade, and the animals that give us company, all make life real and complete.

We the children of the earth pray for wisdom, that we may in turn be good custodians of these precious gifts to us and our unborn generations.

For if we fail nature, we shall have failed ourselves, and the generations that come after us.

Jørgensen & Boje (2020) [11] quotes scientists from around the world as calling the United Nations and governments to enact something other than "business-as-usual" policies and practices. Scientists sent a statement to UN member countries, "**World Scientists' Warning to Humanity: A Second Notice***"*—they said, *"[humans] have unleashed a mass extinction event, the sixth in roughly 540 million years in length, wherein many current life forms could be annihilated or at least committed to extinction by the end of this century."*

It is clear that biodiversity is facing a crisis, declining globally at rates unprecedented in human history, at a time when we need it most to help mitigate and adapt to climate change. Moreover, ecosystem-based approaches to climate change adaptation and disaster risk reduction, have the potential to increase the resilience of ecosystems. Nature-based solutions, have potential for human livelihoods in the face of climate change. In addition, ecosystem-based approaches can be cost-effective, and provide employment [4].

Our goal is to capture the capacity of indigenous peoples' complex knowledge systems within biodiversity trends and climate impacts. This knowledge particularly as it relates to changing climatic conditions for the Maasai community must be captured. To achieve this, a project proposal was developed for the UN agency IFAD, [8] aimed to understand the motivating factors in non-indigenous communities over the indigenous Maasai knowledge and practices particularly with reference to state (government) and other non-state actors in the Ngorongoro district.

Therefore, through a series of direct interventions and research, we aim to document with evidence-based information the efficiency in indigenous peoples' identity, culture, knowledge, and experiences. Their practices have been firmly placed within biodiversity conservation, climate change adaptation resilience and disaster risk reduction in mind. It should be captured for both Maasai survival; and for the establishment of Maasai Indigenous Knowledge (IK) documentation.

Anthropologists and conservation groups in Tanzania, have pointed to "consumption" as the main causes of resource depletion and degradation [21]. They point to poor rural producers for what is perceived to be unsound practices, including "slash and burn" cultivation (Jhum cultivation), overgrazing, and deforestation for fuel wood. They propose strategies they believe will reduce human population pressure on wildlife and other forms of biodiversity, such as removing indigenous peoples from endangered habitats through the creation of national parks and reserves [6]. However, the science supporting such strategies are based on incorrect assumptions incorporated in a notion called *The Tragedy of the Commons* [25] and have been shown to be faulty.

All groups are concerned with their own perception of the world, without realising that the other groups have rights or freedoms. The fundamental concern in this paper is for indigenous education. To be educated means to be able to defend one's right to exist.

2. CLIMATE CHANGE MITIGATION

For Africa, the Sub-Saharan area is characterised by recurrent droughts, the magnitude and intensity of which have been on the increase for over 100 years and has caused massive destruction [18]. Records show that most regions of Africa have experienced marked rainfall declines and droughts that exceeded all predictions from science. The communities in the region of Tanzania have survived until today even with fast population growth rates, despite these droughts. They have developed indigenous mechanisms and strategies to cope with droughts—some of these actions combine elements of mitigation and adaptation. Clearly, traditional knowledge about how local populations have coped with previous droughts can guide current and future climatic events.

Although, IK has been recognised in the design and implementation of sustainable development projects, little has been done to incorporate it into formal climate change mitigation and adaptation strategies—Agenda 2030. [20] Climate change cannot be divorced from sustainable development as it is a crucial dimension of climate change adaptation and impacts [18]. Incorporating IK into climate change initiatives can lead to mitigation and adaptation strategies that are cost-effective, participatory, and sustainable for both the national Tanzanian and international levels. However, we acknowledge that incorporating IK into climate change should not be done at the expense of modern / western scientific knowledge. IK should complement, rather than compete with local and global knowledge systems.

3. SUSTAINABLE STORYTELLING

The modern age, began with a secularization of knowledge and with it, a turning away from a god who was the Father of men in heaven. With such repudiation, we saw the earth as an extension of our own desires, rather than the mother of all living creatures—Gaia [30]. Such a condition of being is "fake" and results in what Jørgensen calls, "fake" storytelling [11]. In this sense, "Fake" describes climate denial, first as a condition of thought, and then with inherent belief in Capitalism. This, "Fake" is also described as the evil condition of unoriginality. Of not

thinking, it is therefore not being responsible for our actions. On the other hand, "true" storytelling and with it, action, implies responsibility. However, Socially Responsible Investing (ESG), the circular economy [22] and other parts of the sustainability discourse, are rarely live up to in this criterium.

Indeed, storytelling is "fake", as long as it is severed from multi-species storytelling. Haraway in Jørgensen, suggests that the challenge today is to find ways of living with, and in companionship with the multiple species of earth [11]. That is, despite all our technological advances and innovations, Mother Earth is the condition of our own becoming as well as the condition of all life on earth [11].

4. BIODIVERSITY 2021-2030

The concept and aim of *'living in harmony with nature'* is the vision of the new 2021-2030 Strategic Plan [26] and it's central purpose—a new relationship of society to the natural environment. The concept of central importance in the design of a plan, is the link between the status of biodiversity and human well-being with development. For achieving sustainable development there needs to be a sustainable supply of ecosystem services that not only meets the needs of all sectors of society— without biodiversity loss. Determining the needs and demand for ecosystem services of different sectors of society, becomes a goal, that may mean reducing demand in some circumstances [21].

Figure 1: The Maasai living in harmony with nature [27]

In 2010, the parties to the Conservation Based Development (CBD), adopted the Strategic Plan for Biodiversity 2015-2020 (and now 2021-2030, in draft) and its 20 Aichi Biodiversity Targets [12]. It has since been endorsed by Multilateral Environmental Agreements [16] as a global framework for biodiversity. In 2015, the members of the United Nations adopted the 2030 Agenda for Sustainable Development and its SDGs. These constitute two of the most important environment and sustainable development commitments ever made by governments for international flora, and fauna and recognizes the important role of protected areas as a key strategy for biodiversity conservation. For example, Aichi Biodiversity Target 11, and SDG goals 14 and 15, [12] cover the land/sea for global protected areas. It's an important contribution to achieving SDG commitments for Tanzania as a country. The country, signed up for these commitments, as did the other 197 countries of the United Nations.

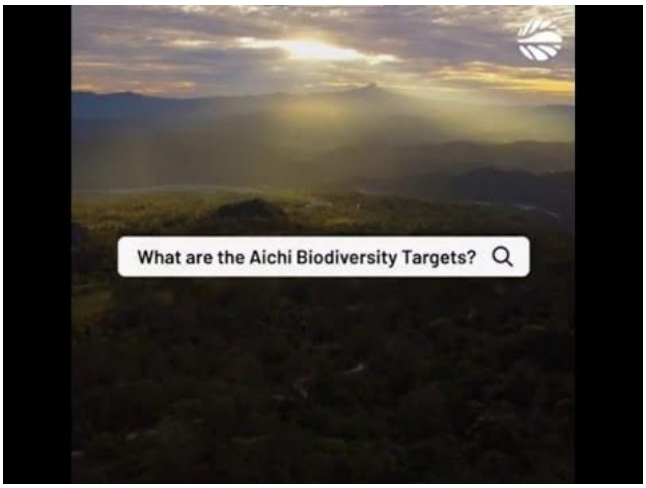

Figure 2: YouTube: Aichi Biodiversity Targets [7]

The Protected Planet Report 2016 [10] assesses how protected areas contribute to achieving the Aichi Biodiversity Targets and relevant targets of the SDGs, and highlights current research and case studies. An example for Tanzania is Ficus natalensis [5] a tree in the family Moraceae, and commonly known as the natal fig. It can be harvested for the bark of the tree without harming the tree. Skilled artisans incorporate this unique fabric into many modern uses to make barkcloth. an environmentally-friendly, renewable material. Creating a global demand for barkcloth, is the vision for sustainable jobs in East Africa.

5. THE MAASAI OF TANZANIA

The ways of life of the Maasai people, [17] nomadic pastoralists, who graze huge herds of cattle and other animals in northern Tanzania has long been a hot-spot of political pressures from the outside. Their ability to roam was restricted by arbitrarily imposed colonial borders, and modern governments have not helped them. The security given these indigenous people threatens their very survival. Failing rainfall and land insecurity have become a trigger for conflict between the Maasai and their neighbours. Government officials have deemed their land as unoccupied, and caused long-running conflicts over land rights. In line with models of climate change in Sub-Saharan Africa, droughts are becoming longer and more frequent. However, the Maasai are used to dealing with drought and food shortages. They have lived on this land since time began. Now, the droughts are becoming more frequent and more prolonged. They have less opportunity to recover from poor rainy seasons. The predictability of rain is uncertain. In the longest drought, rains come at odd times. The Maasai can tell, from natural signs, when and where rains would come and fall. However, rain when it does come, may be sudden, violent and unpredictable.

Figure 3: TEST Operational area in Tanzania [27]

These unpredictable rains bring tensions between groups for access to water and pasture. But escalating tensions in recent times have increased as water sources dried up and pastures are lost. Because, the water table is not being recharged, the forests and wetland areas that the Maasai could traditionally fall back on, have dwindled. Territorial disputes have become common as lakes recede, taking with it the features of the landscape. Many disputes are settled peacefully, but when one party or the other is perceived to have broken agreements, the willingness to trust becomes strained. Consequently, respect of borders, becomes eroded. In addition to droughts and growing insecurity over land rights, the Maasai have moved from a state in which they are able to cope most of the time, to one of destitution [17] and vulnerability to famine—a constant companion to their existence.

6. INDIGENOUS KNOWLEDGE IN MITIGATION AND ADAPTATIONS

IK has been defined by Nyong, and Osman, [18] as institutionalized local knowledge that has been built upon and passed on from one generation to others, by word of mouth [18]. It is the basis for local-level decision-making in many rural communities. IK has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities. This knowledge-set is influenced by the previous generations' observations and experiment and provides an inherent connection to the people's surroundings and environment. Therefore, IK is not transferable but provides relationships that connect people directly to their environments and the changes that occur within it—including climate change.

Figure 4: Maasai indigenous habitation in Tanzania [27]

IK has potential and can be directly applied in Ngorongoro district for climate change mitigation through emission reduction, [18] "Carbon" sequestration and carbon substitution being a leading contender in this process. In adaptation, IK systems have been applied in weather forecasting,

vulnerability assessment and adaptation strategies. Considering that agriculture and land-use changes are identified as the two main sources of Green House Gases (GHG) in Africa. A review of IK systems becomes important to the application of mitigation and adaptation. First for all to Tanzania, and then through the lens of farmers and pastoralists to the Ngorongoro district. These local communities have been known to conserve "Carbon" in soils through the use of zero tilling practices in cultivation, mulching and other soil management techniques. Natural mulches moderate soil temperatures and extremes, suppress diseases and harmful pests, and conserve soil moisture. Before the advent of chemical fertilizers, local farmers largely depended on organic farming, which is capable of reducing GHG emissions—in stark contrast, to modern fertilizer methods.

The forests of Tanzania, have been recognised as playing an important role in the global carbon cycle by sequestering and storing Carbon. Local farmers are known to have practiced the fallow system of cultivation, which encourages the development of forests. It may be argued that with the growth in population, lengths of fallow have been reduced to the extent that this practice no longer exists in certain areas of Africa. However, forests play an important role for traditional owners. The extent of communal forest reserves is very common in traditional societies. Besides the fact that they are well managed, forests providing food and timber resources to the community. The recognition of the role of forests in climate change has influenced participants of the Kyoto Protocol to allow countries to include carbon sequestered in forests in a country's emission requirements [18].

Adaptation strategies that are applied among the pastoralists include the use of emergency fodder in times of droughts, multi-species composition of herds to survive climate extremes, and culling of weak livestock for food during periods of drought.

7. PLANNING CITIES IN AFRICA

Ma & Jiang (2022) report that China's built-up area has increased extensively from 13,000 square kilometres in 1990, to 56,000 square kilometres in 2017 [13b]. The urban environment, including natural resources, has also been degrading in the same period, as reflected by habitat loss, heat island creation, and water and air pollution. They went on to raise serious concerns about liveability and sustainability for future urban development across the country.

Likewise, Tanzania, and all of southern Africa is experiencing a rapid rate of urbanisation. This exacerbates the impacts of climate change on surrounding cities. The recent droughts and water stress in cities in South Africa, including the impacts of cyclones such as Jobo, which made landfall near Dar es Salaam [19] in April 2021, and the recurrent heatwaves are evidence of the impacts of climate change on cities in the entire region. For design, city planners are responsible for the spatial configuration of spaces and places that make cities safe, resilient, sustainable, and inclusive.

However, in an education case study, which investigated climate change impacts on cities, [15] researchers recognised that cities are increasingly become hotspots for different climate-induced hazards and disasters. In 2019, Cyclone Idai [15] was associated with heavy rains, flooding and landslides that caused immense damage to property, livelihoods and human life across cities in Malawi, Mozambique and Zimbabwe. In Mozambique, 90% of the city of Beira was destroyed, [15] which amounted to millions of dollars lost in infrastructure and services. In other cities, heatwaves have become the norm and are considered "a potential silent killer of citizens in African cities" [15]. New diseases and plagues have destroyed farmlands, jeopardising food security, [15] as has recently been experienced in East Africa.

Therefore, increasing the resilience, sustainability and safety to climate change where most of the population will be residing soon, requires extraordinary skills. Adaption has long been acknowledged as a "*super wicked problem*". We are exploring how education within communities can spread awareness of pressing climate change issues. However, situation analysis and needs assessment of the existing skills, knowledge and capabilities in education about climate change and their mainstreaming into communities is an urgent need. There are still many unknowns that must be explored to give even a broad picture of the wicked problems that are facing the community. Such transformations of Tanzanian society, can take advantage of traditional knowledge that has served indigenous people very well in the past.

We ask the question: *"How is education equipped to train in response to climate change adaptation?"*

Urbanisation is happening at breakneck speed. Half of the world's population now call a city their home. Urbanisation pressures have implication on personal, social, economic and environmental well-being of its citizens. With so much of humanity concentrating in urban areas, building and managing housing within cities and communities to be inclusive, healthy, resilient, and sustainable becomes increasingly difficult.

However, the macro issues are not enough, for the micro involve the educators in their day-to-day activities, as an essential ingredient of building a future. We must change the way we learn to make it as efficient as possible if, in this rapidly changing environment, we are to slow climate change.

8. STORYTELLING / PROBLEM BASED LEARNING

Education is an essential component in response to the climate crisis. Through formal education and informal, or lifelong learning; people are able to make more sustainable decisions and work towards systems change and social transformation. Climate education cuts across traditional subjects and disciplines; it encompasses climate science, human and social sciences and factors that drive greenhouse gas emissions, in technical and political solutions. To mitigate climate change, strategies for individual and community adaptation require ecological restoration.

Ecological restoration must not be done in classroom led teaching/learning. But, in problem-based learning (PBL). In Jørgensen&Boje (2020) stories are described as enabling collaboration between stakeholders. This helps to confront all the problems in practice [11]. They describe, pulling the strings and changing the whole network of relations requires: storytelling conversations, dialogues, coaching, negotiation, experiments, human resource management tools and concepts as all parts of the toolbox. Then, keeping the process going over time, and adjusting it when sustainability projects face problems. PBL must show the way forward, rather than just saying it, or writing it.

PBL is a pedagogical strategy which employs contextualized real-world situations, unlike classroom learning which is confined to classroom scenarios. In addition, PBL educators have recognised that the use of a "storyline" form of storytelling [23] in training, particularly regarding Technical Vocational Education & Training (TVET) environments, enhances learning.

Storytelling is undoubtedly a cultural achievement of the human race. The Iliad and the Odyssey by Homer are great examples of the power of storytelling on human cultural development [23]. Homer was one of the first storytellers of mankind. Thought these epics, we understand the result of generations of storytellers, and what their material means for us today. Storytelling is regarded

as the original form of teaching. Every culture has its foundations in unique stories. The very culture of modern society depends on these stories. They form our collective history—our knowledge of who we are. A collective history with many different representations. African storytellers, have passed on their oral traditions through stories through countless generations. They have been ingrained into IK. In that sense, the modern storytelling follows the same well-known strategy. For example, the Maasai creation legend [3]

According to Maasai legend, Enkai, (the creator of the Earth), used to live on the planet together with human beings, until the day he chose to rise to the sky bringing all the cattle with him. This originated a problem in the long run, as animals needed to graze grass to get their nutrients.

Enkai then decided to send the animals back to Earth, and he did so by making bovines and ovines slide along the branches of some trees ending up on Earth. The animals were entrusted to the care of the Maasai, who have taken care of the cattle for Enkai since then. The tree used by Enkai to make the animals come down on Earth is the Ficus Natalensis locally known as Mutuba. This tree is sacred to the Maasai for this reason. [3]

Such ideas and theories of narratives are divided in the four phases: exposition, ascension, climax and conclusion. These stories capture the imagination of both students and teachers and the act of crafting meaningful stories elevates their experience.

Compared to conventional storytelling, digital storytelling is viewed by listeners/viewers not only as stories, but also as active learning where the viewer can interact and shape the story. Psomos&Kordaki [23] found that digital storytelling facilitates the convergence of four student-centered learning strategies: student engagement, reflection for deep learning, project-based learning, and the integration of technology into instruction.

In PBL environments, storytelling is further enhanced by being engaged in a collaboration process of research, reflect on the information, and sharing in a group. As a technique, meaning making in learning is a way to capture the active elements as well as the uniqueness of each learner's prior experience. According to Vygotsky [28], meaning has two components: meaning proper and personal sense [2]. Meaning proper, means repeatable, and "public" literal or primary meaning of a word, gesture, action or event.

Most researchers focus their studies on meaning proper when they are doing research in education. In this approach, meaning inspires researchers to examine whether the learners have obtained the right concept that is, whether the meaning can be shared or testable [13].

However, this is only one of the aspects of meaning as defined by Vygotsky [28]. Activity theorists, believe that there is a more primary aspect of meaning making. The second aspect, is the 'personal sense'. As shown by Ali [2] the construct of personal sense attempts to capture the very personal, biographical, embodied, situated connotations of words, gestures, actions and events. This is, what things mean for us, as part of our personal story. Our experiences, our sense of place, or even sense of ourselves. It's about how they resonate with our values, beliefs, judgments and knowledge.

As educators, we often discount or ignore this hugely important aspect of meaning making. Effective teaching, therefore, takes place when students experience successful learning while affective teaching occurs and when the practitioners manage to empathize with the students' experience. They then use it to further enhance their learning. [2]

These learning processes must be employed for wicked problems. Ones that require a detailed learning process to be employed in first-time activities; particularly those that are meant to be implemented in developing countries. Many projects in developing countries struggle with insufficient background knowledge of the country, the community, or the underlying issues, together with top-down control where collaboration is non-existent.

It is not our intention to replicate a developed country education system; rather to leverage the skill-set of existing people who are familiar with their local environment and are open to laser focused tasks that they know how to perform—a marked departure to traditional international development which fails to contextualized real-world tasks/situations.

9. CONCLUSION

This paper is in sync. with solution-oriented papers we proposed to the African Development Fund [1]. It's strongly focused on the Ngorongoro district, for local farmers and local pastoralists, suggesting the inclusion of innovative mechanisms designed to fit the existing financial resources, physical infrastructure, in a project led adaption to climate risk.

We seek support based on a Multiple Evidence Based (MEB) framework [24], as adopted by the United Nation's Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [9] to help weave together indigenous, local, and scientific knowledge for enhanced resilience and sustainability, while respecting the integrity of every knowledge system and the people.

We realise that researchers might come up with ideas. But companies implement those ideas. What are some of the challenges we face in translating great ideas into tangible, world-changing solutions? Perhaps a combination of community involvement, a solution-oriented approach, and a willing third-party funding agency, may make huge impacts on the local community.

The first requirement for any society to thrive is that there be peace. In that sense, the SDG's were not selected without this in mind—because, we believe in building today, a better Tanzania tomorrow.

ACKNOWLEDGEMENTS

The author acknowledgements the invaluable help and support from Yannick Ndoinyo Executive Director, and his team at Traditional Ecosystems Survival Tanzania (TEST) [27]!

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Building partnerships is necessary to combine knowledge, resources, skills with mandates in achieving vision, Sustainable Development, and the Aichi targets that enhance the inclusion of all people particularly indigenous people in the greatest challenge of all time—to slow climate change. All ensure support for livelihoods, ecosystem resilience, inline, with Climate Mitigation and Adaption.