NARRATIVES IN THE ANTHROPOCENE ERA

Charles Travis, Vittorio Valentino (Editors)

Preface by Kirill O. Thompson

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Geographies of the Anthropocene

Narratives in the Anthropocene era

Charles Travis

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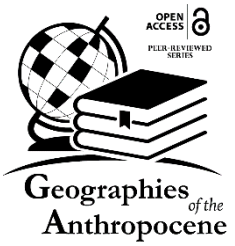

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The book series "Geographies of the Anthropocene" edited by Scientific International Publisher "Il Sileno Edizioni" will discuss the new processes of the Anthropocene epoch through the various worldviews of geoscientists and

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The volume proposals can be presented in English, Italian, French or Spanish.

The choice of digital Open Access format is coherent with the flexible structure of the series, in order to facilitate the direct accessibility and usability by both authors and readers.

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9. An Evaluation of a Shambaa Community's Tradition of Adaptation to Local and Global Forces to Maintain Socio-economic and Ecological Sustainability, and Plague Resilience in Lushoto, Tanzania

Raymond Ruhaak[1], Philemon Mtoi[2]

Abstract

Dramatic landscape change, as needed for cash-crop agriculture, promotes forest fragmentation and greater risk factors for zoonotic disease epidemics. The Lushoto District of Tanzania illustrates the cash-crop agriculture phenomenon that led to a plague epidemic, but a more traditional Shambaa community next to a Lutheran mission had been able to be remarkably resilient during plague outbreaks that swept through the district from the 1980s to 2004. This forested community of Mlalo has benefited from the connection to the mission to resume and adapt more traditional community and environmental practices than their neighbours, which resulted in their diminished risk for a zoonotic epidemic. Mlalo community member, Professor Kihiyo, gives insight of these community practices that this chapter puts in the larger Lushoto context and illustrates how Mlalo was able to largely avoid the plague.

Keywords: Plague; zoonosis; Lushoto, Tanzania; Shambaa; sustainability; resiliency

Introduction

The development of the COVID-19 pandemic has underlined the importance of understanding the activities, systems, and institutions that instigate vulnerability or create resilience for a zoonotic epidemic. Recent studies of human zoonotic (animal reservoir initiated) epidemics have identified risk factors for such epidemics that illustrate a strong connection to rapid ecological change. These ecological/biological risk factors and

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socio-economic factors of human activity that affect human zoonotic vulnerability are assessed in this investigation. This work assesses the resilience of a Shambaa community based within epidemic regions of a 1980-2004 plague epidemic in the highland Lushoto District of north-eastern Tanzania. This case study investigation, utilizing a local community narrative, analyses the reasons behind the greater resilience to the plague of this agriculture community based on Shambaa cultural knowledge compared to nearby two distinct large-scale cash-crop agricultural communities.

2. Lushoto/Usambara Region

The Lushoto District is located in Tanzania's Usambara Mountains at an altitude ranging from 1400-1600 meters above sea level. Lushoto is humid, with a daily air temperature ranging from 12−17°C and mean annual precipitation of 1000 mm.

Figure 1 - *Map of the Lushoto District with the physical position of the Shambaa communities of Mlalo and Mwangoi compared to the cash-crop agricultural areas of Shume. Source: Geographical Information Centre, University of Dar es Salaam. (Map constructed by: Olimpa Simon from University of Dar es Salaam, Geographical Information Centre.)*

The Usambara Mountains are bordered by the Umba Plains in the north, the Pare Mountains in the Northwest and the Maasai Steppe, which stretches westwards to the foothills of the Mbulu/Babati highlands, in the south. Situated between 4^0 30' and 5^0 15' south, the mountainous block is sub-divided by the Lwengera river valley into two massifs: the West and East Usambara (Mtoi, 2017, pp. 31-32). The West Usambara covers an area of 1,740km (Egger, 1980, p. 14), with their mountainous parts almost exactly delineating Lushoto District. The region's topography is characterized by hills, steep and mountainous slopes, dissected by narrow valley-bottoms, with undulating basin and range landscapes in Mlalo. The agricultural areas are mainly between 1,000 m and 2,000 m above sea level, located on the valley-bottoms and on slopes (Egger, 1980, p. 14). Due to its mountainous relief, the climate of the West Usambara is characterized by extremely high rainfall variability. The mean annual precipitation in the Usambaras varies from 2,000 mm/year in the southwest to 600 mm/year in the north. There are two main rainy seasons in the region, one from March to May and a shorter one from November to December. Most of the West Usambara typically has a dry spell from June to November, but the central area contains high altitude belts that have an intermediate rainy season (Egger, 1980, p. 14).

3. Methods

This research was conducted through Participatory Rural Appraisal (PRA) methods, with use of the *Table of Inquiries into risk of Human Zoonotic Epidemics* assessment tool (see Fig.1), which is based upon the *One Health* approach (One Health Commission, 2021), socio-ecological and zoonotic resilience research and transdisciplinary methodologies. The ultimate purpose of this assessment tool is to identify the factors which determine vulnerability or successful resilience to zoonoses, and to be able to predict areas of escalating or diminishing risk "based upon ecological change, human activity and the socio-economic institutions and systems that facilitate these risks" (Ruhaak, 2019, p. 8). Each inquiry on this table illustrates a spectrum of high vulnerability to high resilience to a human

zoonotic epidemic. This table begins with inquiry 1, which is based upon Laudisoit's (2017), Begon's (2013), and McMichael's (2004: 1054-1057) vulnerability factors of zoonotic disease (See Appendix), which are aptly summarized in Plowright *et al*'s (2021, 4) *The zoonoses spillover cascade: loss of landscape immunity as the pandemic trigger*.

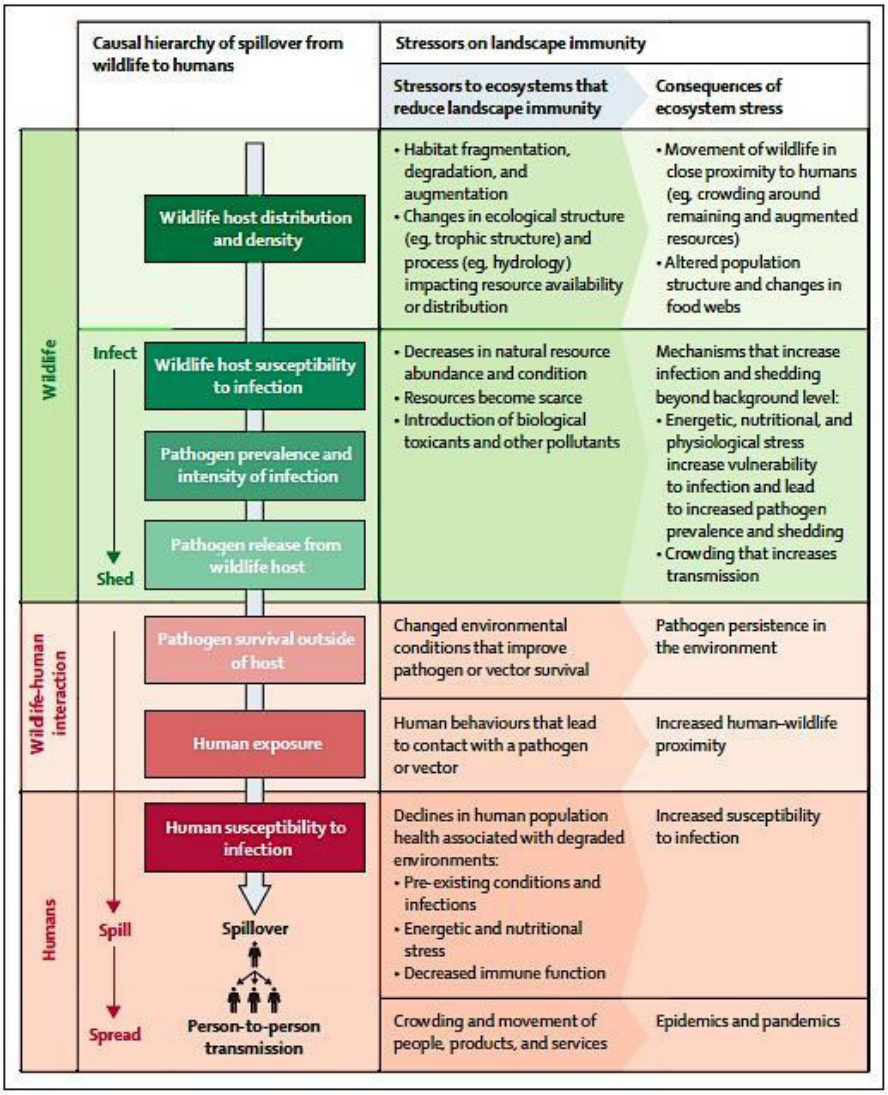

Figure 2. Plowright *et al*'s (2021, p. 4) *The zoonoses spillover cascade: loss of landscape immunity as the pandemic trigger,* begins with an increase in habitat fragmentation and degradation that diminishes resource availability and leads to smaller wildlife habitats, forcing some to leave the habitat or die off, while others experience a population boom, leading to altered population networks that may also include invasive species. These rapid changes bring stresses that threaten many wildlife species, increasing the vulnerability to infection and thus increasing pathogen prevalence. Changes to the soil, animal, and plant life improve vector

and/or pathogen survival, while human exposure is heightened. Human populations are under greater risk of infection with decreased immune system function, while transmission is intensified by higher population density.

Table 1 - *Inquiries into risk of human zoonotic epidemics (updated version of Ruhaak 2019, p. 3).*

Area of Inquiry:
Ecological and Biological Spheres
1) Based upon the vulnerability factors for a human zoonotic epidemic (as exemplified by McMichael 2004: 1054-7), is there evidence of change in the level of risk at the site?
2) Is there evidence of food insecurity and malnutrition/co-infections? OR A focus on locally sourced food, medicine, and health services sustainably meeting the needs of the population?
3) Is there evidence of deforestation, vegetative clearance, &/or erosion? OR Is there evidence of re-forestation that is increasing biodiversity with decreasing erosion rates?
Other Spheres: Socio-economic, language & education/enculturation, collective authority/spirituality & collective perception of past
4) Has there been an increasing emphasis upon language built for trade over ecological observation? OR Has there been greater emphasis upon learning language(s) or an older version of a trade-based language that was based in a certain cultural geography?
5) Is there evidence of trade/economic change leading to educational change in society? OR Is education/enculturation of sustainable socio-economic and ecological systems prioritized over short-term wealth growth through international trade?
6) Is there evidence of: Growth in social organizational size and complexity, which diminished the society's problem-solving efficiency? OR Is there a systematic focus on local control of problems with stakeholder

participation based on consensus?
7) Is there evidence of societal instigation of ecological crises through unsustainable socio-economic systems and institutions? OR Are there local organizations that are tied to the ecosystems that they depend upon and enforced rules are in place to sustainably maintain this connection?
8) Is there evidence of isolation in regard to a lack of network connections outside the community/society as well as to the knowledge and knowledge systems they use? OR Is there evidence for strategic alliances, networks, and knowledge that gives them valid and reliable assessments of human hazards that threaten them?

Inquiries 2 and 3 focus on the connection between healthy and dynamic ecological systems and the capacity of these systems to grow to a sufficient and sustainable number of environmental services upon which local people depend. These inquiries address major biological/ecological risk factors that will be assessed on a continuum of high risk (e.g., inquiry #2 - persistent food insecurity & malnutrition) to high resiliency (e.g., inquiry #2 - sustainable food and medicine for the local population).

If vulnerability to a zoonotic epidemic is largely determined by anthropogenic change to the ecological systems, then it is critical to uncover what systems and institutions instigate these activities that heighten such risk. Inquiries 4 -7 focus on these systems and institutions that spur human activity triggering changes that increase the risk of a zoonotic epidemic, as well as that which affect a population's connection to their local ecologies. These systematic and institutional changes may also affect peoples' capacity to observe their local ecologies, and to make any necessary responses to potential threats to their lives.

The last inquiry focuses on how well connected a community is to outside communities, and the knowledge and knowledge systems on which they base their assessments, decisions, and actions. Those who are well informed and connected to outsiders are better able to form strategic alliances and networks, while also taking preparation within the community/society to address any threat(s) they might experience from these groups (Friere, 1970; Goodyear-Ka'ōpua, 2009; Shiva, 2005). However, those that are quite isolated from knowledge and people from outside their communities may be especially at risk of violence,

advancement of outside exploitation and/or settlement onto their territory, and the ecological and zoonotic repercussions resulting from these changes (Shiva, 2005; Thomella *et al.,* 2006).

4. The History of Plague Epidemic in Lushoto, Tanzania

According to Kilonzo, Makundi, and Mbise (1992, p. 323), "plague has been endemic in Tanzania for more than a century" and was "introduced into the country through Uganda and Kenya" long before Europeans arrived. They also state that "most of the currently active and quiescent foci of the disease are found along these ancient routes" taken by the slave and ivory trade. Even though the bubonic plague was first recorded in the late nineteenth century, many communities had named the disease and put measures to limit its impact well before that time (Kilonzo, Makundi & Mbise, 1992, p. 323). Though the bacterium, *Yersinia pestis*, which is responsible for the high-mortality epidemic, was present before the European colonization of East Africa, it only reached epidemic proportions beginning in the late nineteenth century. The period between 1886 and 1969 marked the establishment of multiple epidemics in different parts of the country, from the tsetse fly boom and sleeping sickness, to the cattle epidemic, Rinderpest, and the start of the Plague (Kilonzo, Makundi & Mbise, 1992, p. 324).

The spread of *Y. pestis* and the subsequent geography of bubonic plague cases grew to encompass a large area in East Africa from the time of German and British colonialism up through the early post-colonial period. Upon independence, Tanzania had established British institutions and multinational corporate influences that were largely managed by the same professionals as the British colonial period. The Nyerere government also wanted to create a wealth surplus as the previous colonial administrations, but sought for it to be shared by all Tanzanians. Villagization along with the refugee camps of the 1980s and 1990s greatly impacted local resources. It was at this time that the first recorded instance of the bubonic plague appeared in the Lushoto district in the Usambara mountains. The first outbreak in 1980 affected two villages in the district, which resulted in 49 cases, 11 of which were fatal. Subsequently, until 2014 outbreaks occurred every year. In July 1990 there were 3,148 confirmed or suspected cases, with 311 fatalities from 45 villages (Kilonzo, Makundi & Mbise, 1992, p. 324). The expansion of the plague from 2 to 45 villages within a decade illustrates the inadequacy of the control mechanisms in place at the time.

Due to villagization, it is probable that many, if not most, people did not possess strong roots in the areas in which they were settled. Consequently, most probably had limited knowledge of their new area's ecology and potential vulnerabilities. Additionally, the lack of established community histories would have affected the migrants' potential to adapt, since they were only beginning to learn about local environments, customs, and how to effectively organize in order to address serious issues. Co-operation between native and newly established settlers was in its infancy. Subsequently, people were probably more dependent upon the Tanzania government – newly formed villages were typically not self-sufficient and relied on government handouts, though the government ran out of food support in the 1970s (Shao, 1986, pp. 219-239).

Another aspect of the villagization program was the Nyerere government's standardized approach to combat the bubonic plague through sanitary improvement, health education, and the use of chemicals to kill rodents and fleas (Kilonzo *et al.* 1992, p. 324). This included the indiscriminate spraying of 10% DDT in affected villages' homes from 1983 to 1987. Nevertheless, plague outbreaks continued every year. The standardization of these control measures without regards to local environments and risk factors may have heightened risks in some locations. For instance, houses that were sprayed with 10% DDT, a dangerous poison to humans, may have contributed to lowering people's immune system effectiveness (Corsini *et al.,* 2008, p. 673; Corsini *et al.,* 2013*;* Hermanowicz *et al.* 1982, p. 338). Additionally, deforestation may have lengthened the period of relative warmth above 16° C in highland Tanzania, which may be tied to the extended outbreak period (Kilonzo *et al.*, 1992: 324). Micro-climates may have played a role in expanding animal reservoirs, as these cleared areas have a significant warming effect on shallow ground water and ground temperature (Bense & Beltrami, 2007, p. 9; Ellison *et al.,* 2017; Hesslerová *et al.,* 2013). This is especially true for the surface soil temperature, which is an important factor in escalating population density in rodent burrows, leading to increased risks for human populations (Ari *et al.,* 2011, p. 4; Meliyo *et al.,* 2014, p. 6; Stenseth, 2006, p. 13112). Additionally, clearing fields have long been known to increase wind and water erosion, as well as evaporation, all of which often leads to soil salinisation (Hassani et al., 2020; Singh, 2015). *Yersinia pestis* has been shown to thrive in saline soils (Barbieri *et al.*, 2020) while deforestation and vegetative clearance disperses hosts and vectors of zoonotic pathogens that leads to greater contact with humans (Friggens & Beier, 2010; Ziwa *et al.*, 2013, p. 5).

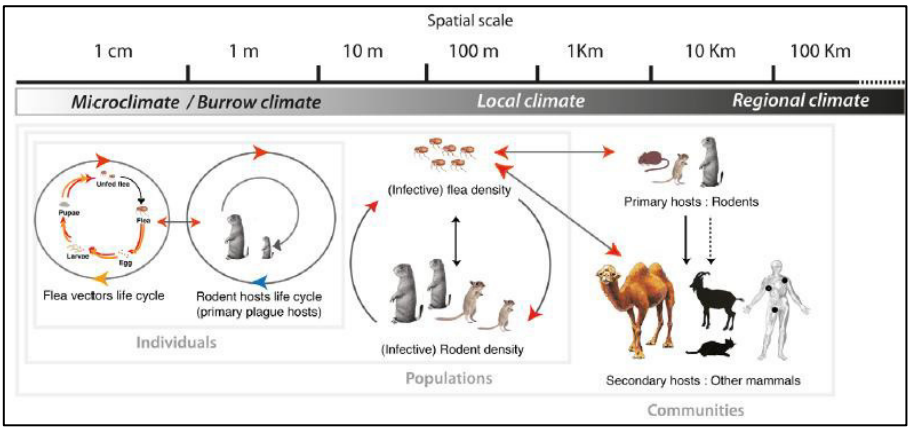

Figure 3 - *Ari et al. (2011, p. 4) illustrate the impact climate has "on the plague cycle as a function of spatial scale", with the arrows representing the "connections affected by climate".*

5. Land use and microclimate-plague relationship

Hall *et al.* (2009) note that the West Usambara Mountain region in Tanzania lost 0.82% per year of forest between 1955 and 2000 (most intensively before 1975), -the highest percentage in the Eastern Arc Mountains, which span across 14 districts of Tanzania and Kenya. In addition, a relationship between the plague disease and the activity of firewood collection in this region (see Fig. 3) was observed by Hubeau *et al.* (2014).

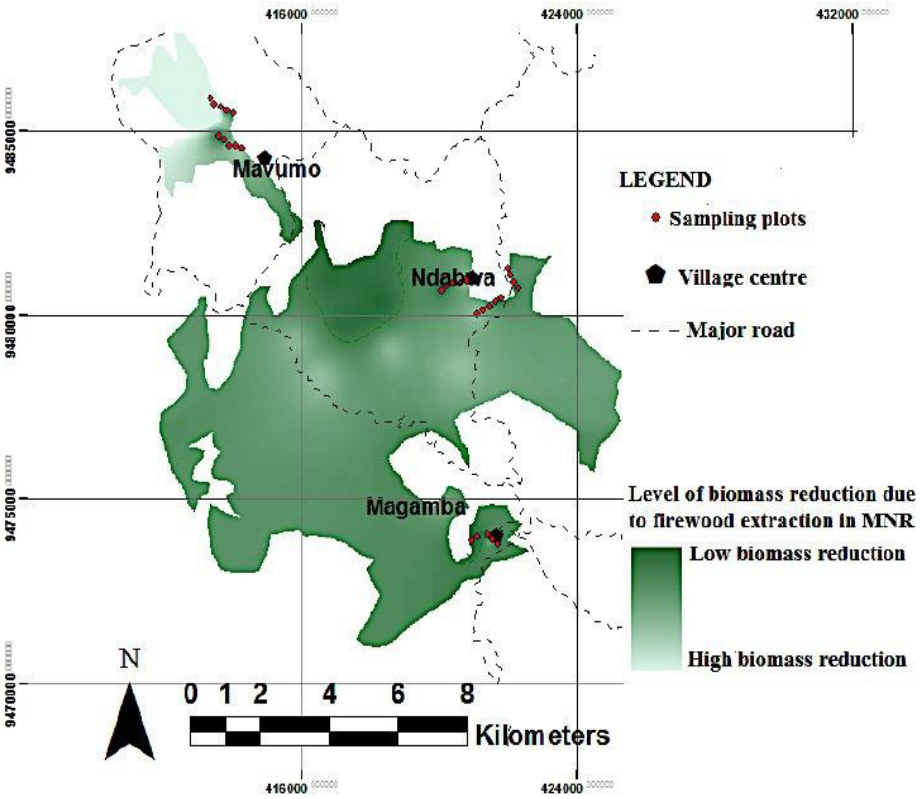

Figure 4 - *Spatial distribution of biomass changes due to firewood collection in the Magamba Nature Reserve, Lushoto, Tanzania (2009-2013). Mwabumba (2015, 28) demonstrates example that the small, fractured forest by Mavumo is frequently being sourced for firewood, as is the forest by Nbabwa. The percentage of human activities that included firewood collection in Mavumo was 22% versus 27% in Nubawa (Mwabumba, 2015: 22). However, the plague frequency observed by Hubeau et al. (2014) was 0.611 for Mavumo and 0.278 in Nbadwa, which may in part be due to the fractured size of the forest Mayumo and the lack of continuous forest.*

Clearance of vegetation is also seen as a risk factor as land use changes and conversion of the land to agricultural production leads to different vegetation and thus, niches being created (Ceradini & Chalfoun, 2017, p. 1823). Wood and Singleton (1994, p. 45) note, "in higher lands of eastern Africa, the dominant cash and food crop is maize, which is subject to heavy rodent attack." They also explain "other cereals, legumes, tomatoes, root crops and cash-crops like cotton and sugarcane also can be damaged" (Wood & Singleton, 1994, p. 45). Consequently, the introduction of crops develops a new niche that some rodent species take advantage of, in turn creating disturbances of interactions between species that often include

domesticated animals (Morand *et al.,* 2019). Additionally, as settled agriculturalists become more prevalent, friction grows with herders that need to find new grazing areas (Conte, 1999). This escalation of land cultivation and animal use also leads to greater contact between domestic animals and humans. Intensified cultivation is not unique in fostering rodent population growth as many studies have shown a tie between intensification of livestock grazing and feeding areas with the augmentation of some small mammal populations (Bueno *et al.*, 2012, p. 22; Davidson *et al.,* 2010, p. 3189; Duplantier & Rakotondravony, 1999, p. 452; Jones & Longland, 1999, p. 1; Ronkin, Savchenko & Tokarsky, 2009, pp. 282-4; Shi, 1983, pp. 181–187).

Duplantier and Rakotondravony (1999, p. 452) observed that during the plague season in Madagascar, the rodent and flea populations were abundant around cattle pens and it was "where the highest antibody seroprevalence against *Y. pestis* was noted among rats". Specific herding practices have also been linked to higher infection rates of the zoonosis, *Peste des petits ruminants* virus (PPRV), in goat, sheep, and cattle livestock in northern Tanzania, including: "goat or sheep introduction or seasonal grazing camp attendance, cattle or goat death or sales, and goat given away in the past twelve months" (Herzog *et al.,* 2020, p. 930). The frequency of such practices may be correlated with the demand for animal commodities. Economic and political environments that emphasize the commodities trade have been found to drive ecological risks, as overgrazing (Darkoh & Mbaiwa, 2002; Kreike, 2009; Jimoh, *et al.,* 2020) that have been tied to small mammal population spikes (Fan *et al*., 1999; Gao & Li, 2016: 804; Harris, 2010; Nikol'skii & Ulak, 2005, p. 50, Ronkin & Savchenko, 2004; Savchenko & Ronkin, 2018; Wilson & Smith, 2015). These mammals are often commensal, and their population booms have been shown to increase risk for human plague outbreaks (Li *et al.*, 2005; Meliyo, 2014, p. 6; Suntsov, 2012; Suntosov & Suntsova, 2000).

Intensified cultivation and animal husbandry should not be seen as mutually exclusive, but as the demand for land grows, so does the contact between these domesticated and commensal animals that live off this intense, large-scale agricultural production. Even though Kaoneka and Solberg (1994, p. 209) observe that it was agricultural settlements and the introduction of cash-crops that "resulted in the removal or modifications of the forest," overgrazing from intensive herding has also been a serious contributor to land degradation (Kaoneka & Solberg, 1994, pp. 208, 212) contributing to circumstances leading to forest fragmentation. The movement towards settled agriculture also stimulates population growth, as

labour is in greater demand during harvesting. This fosters habitat changes advantageous to opportunistic commensal species expansions, and subsequently increases in the risks of contact between people and vectors of zoonotic disease.

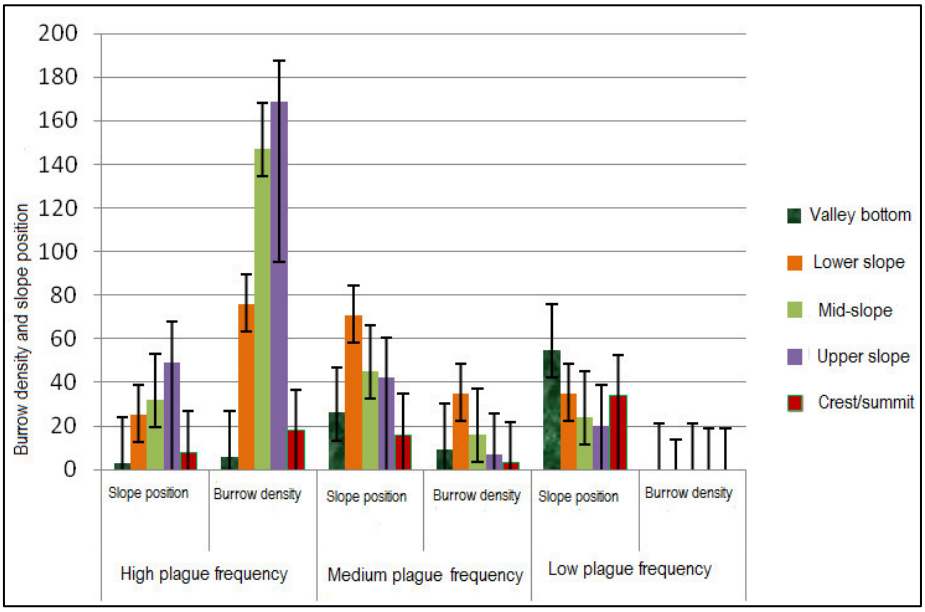

Figure 5 - *West Usambara Mountains, Tanzania- Burrow Sampling & Presence of Bubonic Plague. Meliyo's chart (2014:6) illustrating the correlation of plague frequency with rodent burrow density and the altitude position of the burrows on the slopes. As noted previously, deforestation and clearance create relatively warmer areas (0.5-2 degrees Celsius) (Parker, Atinmo & Titanji, 2007: 5) which have been known to attract greater rodent populations and greater burrow densities. However, anthropogenic activity that diminishes vegetation diversity has also been seen to decrease the diversity of small mammals (Ralaizafisoloarivony et al., 2014: 9). Looser, formally ploughed soils are thought to be easier habitats for rodents, and fallow land has led to greater population densities of some rodent species (Makundi, Kilonzo & Massawe, 2003, 20-24; Meliyo et al, 2015: 105-119). Additionally, high altitudes have been cited as a significant factor for bubonic plague outbreaks in sub-Saharan Africa (Laudisoit et al., 2007: 687), which may be due to the more temperate climate that favoured large-scale agricultural practices started by European colonisation.*

6. Plague resilience through the deeply rooted cultural geography of a Shambaa community

Figure 6 - *Mlalo Site of Late Nineteenth Century German Missionary and Regional Home of the Shambaa People. Photo taken in the Mlalo area of the Lushoto District, Tanzania during an excursion of the LEPUS Conference Soils, Land Use and Plague.*

This Mlalo site is atop a forested hill that has been established by a German Lutheran missionary that came from Tanga in 1891 during German colonization. Professor Kimaro, who led the LEPUS (Landscape-ecological clarification of bubonic plague distribution and outbreaks in the West-Usambara Mountains, Tanzania) conference excursion, stated the Shambaa people have settled in the area since 1500 and are the most traditional people of the region. According to the LEPUS Conference Excursion Guide,

> "The Mlalo basin in source of water for a number of settlements. The area is remarkable by its lush vegetation, and for a number of horticultural products [...] The Shambaa people have lived in this region from around 1500" (LEPUS, 2013, p. 25).

This site had much deeper ancestral roots than others of the area, which had all been post-eighteenth-century settlements. This site is also significant as the outbreaks on the eastern side of this region, closer to this missionary site, did not have the large outbreaks that were seen in the western part of the region. The mission is of German Lutheran origin as part of the Bethel missions, *Evangelische Mission nach Deutsch Ostafrika* (EMDOA), in the North-Eastern diocese of Tanzania. German missions attempted to establish themselves in Tanzania for about a decade before gaining footholds (Snyder 2013, p. 182). Synder (2013, p. 152) notes that these missions were not in accordance with colonial policy and would have provided some protection against colonial over-exploitation of local resources. This was evident in the late 1890s, when, as Synder (2013, pp. 182-183) explained, "the collective impact of a series of ecological disasters resulted in a destructive famine," which resulted in many deaths and the EADOA missionaries becoming safe havens with food security, as the German government was doing little at the time to assist them. This famine was triggered by a zoonotic disease, Rinderpest, which devastated the cattle population (Synder, 2013, p. 183), thereby greatly diminishing the availability of fertilizer.

The missions were still faced with widespread suspicion and according to founding missionary Earnest Johanssen, its members needed to "learn about local cultural practices if they hoped to see their philosophy take root" (Johanssen, 1917, p. 69 translated by Snyder, 2013, p. 183). Missionary efforts bore fruit and continued to expand under British occupation, with Christian converts reaching 10% of the population in 1938 (Mesaki, 2011, p. 252), compared to only 2% in 1914. In addition to the missions being relative safe havens in the midst of colonial agendas, they also became perceived as important education centres. As Mesaki (2011, p. 252) notes, "Christianity was seen as a literary movement, and the Christians were called *wasomaji* ("those who can read")." Lemmi Tamilwai Baruti recently focused on the missions and practices of ancestor veneration, which had been commonplace from the time the religious institution was initially established. Baruti (2011, p. 13) notes how profound the reverence to ancestors is, noting:

> "They [ancestors] know the needs of men, they have recently been here with men, and at the same time they have full access to the channels of communicating with God directly or, according to some societies, indirectly through their own forebears. They are guardians of family affairs and may even warn of impending danger or rebuke those who have failed to

> follow their special instruction [...] This is to say that in African life the ancestors are very important since the surviving of the living depends much on the dead".

The importance of the Mlalo community giving respect to their ancestors was highlighted during Philemon's interview with community member, Professor Vicent Benard Kihiyo. This deep-rooted connection to the community's predecessors is evident in Professor Kihiyo's discussion of his ancestors being in the area for more than 200 million years and his description of what is necessary for *Kuzifya shi*, (healing the land). He explains to heal the land it is first necessary to seek, 'forgiveness from ancestors' in part through sacrifices being done in their honour. He continues on to describe the causes of *Kubana shi,* (harming the land) to be 'going against the directions of the elders and sin against God,' which would lead to 'very clear and vivid' consequences, as drought, erosion, lack of water etc. Accordingly, the Shambaa Mlalo community has understood that their lives have depended upon the strong, continuous connection to their local environments that gave them the necessities of life. Thus, it is also recognised that diminishing this connection threatens the community as a whole, which is reflected in how deeply serious the education of their children is taken.

Professor Kihiyo, focusing on boys' education, stated that if a teenage boy is not keeping up with the tutelage he is receiving, then, tradition advocates his expulsion from the community. Kihiyo explains that this education is elder led and informal, concentrating on assimilating needed practical knowledge. This guidance is often through Shambaa proverbs on their local environment as well as preparation for issues the boys will likely have to face. Kihiyo states these issues include learning how to survive in the forest, feeding and protecting their future families, how to treat their future wives and help them through pregnancy, as well as how to get along with their neighbours.

The Mlalo community lessons and cultural practices in developing a sustainable, healthy environment have been linked to food and water security, zoonotic disease resilience, and the social functioning of the community. Trees and forests have been seen to play an especially critical role in the health of the environment, ecosystem services (as food and water), and the well-being of the community. Professor Kihiyo explains that it is taboo to cut certain species of trees and planting trees and bushes, which are key to control slope erosion. Additionally, he states that preserving the forests has been critical to limit rodent populations and

zoonotic disease, while forest clearance and population have been the primary causes of the water problem.

Agricultural practices are also important parts of maintaining environmental sustainability that leads to food and water security. According to Professor Kihiyo, slash and burn agriculture has been used to fertilise the soil on virgin land, while crop rotation, mixed cropping, and traditional irrigation systems have also been used to cultivate healthy, sustainable crops production. Additionally, the hand hoe has been the main tool of cultivation, which has allowed for greater environmental observation and care with the agricultural labour being done. Cassava, maize and the diversification of food crops, especially drought-resilient crops, have also been seen as keys for food security.

Food and water insecurity have been tied to fostering malnutrition, immune-system weakness and subsequently leading to a greater risk of disease (Katona & Katona-Apte, 2008, pp. 1582-1588; Rosinger & Young, 2020, pp. 1-22). Accordingly, the community's focus on environmental sustainability and food security help limit the chances for a zoonotic epidemic to develop in the first place. Additionally, the Shambaa Mlalo community has instituted quarantines for infectious disease outbreaks and the community's high altitude limits their exposure to tropical diseases.

Kihiyo illustrates the success the Shambaa's community has had in its growing population and their long roots to the region. Accordingly, the respect for the accumulated knowledge of their local ecologies, human health, and disease prevention as well as family and community relationships have been thought to be critical for the community's present and future well-being. Families have been expected to store food for difficult times, and family networks have taken the primary responsibility for food distribution as well as other primary issues they may have faced. However, the whole community must work together to heal the land as well as deal with other issues at the communal level or to assist family networks when they have needed support. Additionally, the community has had a clear structure in place for community decision-making and information sharing from the family level to the community. Recently, the involvement of community members in decision-making has fallen dramatically while the mode of communication has increasingly been through electronic means – mobile phones. Nevertheless, the reasons behind most decisions made are self-apparent, as the need for the community to clear roads, cleaning wells, etc. Thus, everyone feels responsible to comply. However, compliance for decisions made is also backed by penalties supported by the community.

African indigenous communities particularly in Mlalo employed myth to ensure that the environment was well conserved. Forestry was disallowed in the forest beyond mid-day. After mid-day, the gods and spirits were actively in charge of protecting the forest. The violation of this prohibition would result in the heavy punishment of the entire community for interfering with the realm of gods and spirits through natural disasters like heavy storms, floods, severe drought, epidemics disease, and the like. The Shambaa on the slopes of mounts Usambara, which are known for its waterfalls and as a source for water, had a myth called, "Kandee Kamp'aa." People were disallowed to farm or pasture around this area as it was believed that such places were getaways of spirit and ancestors. Anyone who disobeyed this myth was swallowed by 'Kandee Kamp'aa' and taken into the underworld where he/she could be enslaved or killed. The 'Kandee Kamp'aa' myth was however enforcing the community decisions that aimed at protecting source of water and environment at large. Punishments were also common mechanisms for enforcing law and order in the communities. For example, among the Shambala, whoever was found cutting or clearing the forest, was to undergo torture, or pay a fine of cows.

Professor Kihiyo's insights sheds light as to why the Mlalo community has been able to continue to be a forested area in the Lushoto District marked by deforestation and clearance for Western style cultivation. This may indeed signal the importance of interconnected biodiversity/complexity in deciphering the different degrees of vulnerability to bubonic plague. The importance of this biodiversity is bolstered by the Mwangoi site, which had a greater degree of biodiversity than the Shume agricultural sites, and thereby less vulnerability to the devastating impact of pests and plant diseases, that would appear to lead to greater food security. The Mwangoi site also had significantly fewer plague outbreaks than the Shume sites. The use of the land in these two areas were quite similar except for the development of a *Pinus sp*. plantation forest in Shume, an indicator of its diminished biodiversity due to the area's more intensive human activity (LUPUS, 3013, pp. 19, 23).

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8

Figures 7-8 - *The two photos are of cash-crop areas in the Lokome-Shume area, Lushoto, Tanzania that were epicentres of bubonic plague. The deforested areas around fields had the greatest prevalence of overpopulated rodent burrows that are believed to spread Y.pestis. Note the limited potential & adaptability of this western-style agricultural system to deal with a change in climate/precipitation, insects/pests, crop disease in order to be able to meet the high demanded output needed by the population. Photos taken during an excursion of the LEPUS Conference.*

Figure 9 - *A moderately affected plague area of mixed vegetation in Mwangoi-Mao area. This scene shows greater variety of vegetation than seen in the cash-cropping areas using western agriculture, while have much smaller outbreak of the Plague. Photo taken in the Mwangoi-Mao area of the Lushoto District, Tanzania during an excursion of the LEPUS Conference Soils, Land Use and Plague.*

Conclusion

The highest incidents of the plague in the Lushoto district were areas especially dependent upon cash-crops in the most deforested regions and thus required people to chop firewood from nearby forested areas. These cash-crop areas were intensely cultivated which led to a decrease in biodiversity, diminishing competition and predators for opportunistic rodent species. These adaptable animals that could live in different ecological niches increased in population and burrow density, leading to greater infection rates. Additionally, over-cultivation reduced soil fertility and undermined the climate stability on which agriculturists depended for sufficient harvests to pay debts and to buy what they needed. Many of the economic and environmental decisions in the cash-crop areas largely lacked local control, but rather depended upon the federal government, international markets, and other international players. The information used to make decisions was typically through using language and knowledge developed outside of the local cultural geography of the Lushoto District, instead of incorporating local knowledge and ecological considerations.

The Mlalo area of the Shambaa people contrasted with the cash-crop areas of Shume in that it was the least affected by plague outbreak and was also exceptional in its forested topography. Agriculture was interwoven in the forested environment, while soil fertility was maintained by traditional practices of inter-cropping, controlled weeding, and forest plant-life decay, while different crops would thrive in different climatic circumstances. All of this led to greater biodiversity, diminished risk for large-scale pest and plant disease, greater food security and therefore less vulnerability for malnutrition among the community.

The Mlalo Shambaa community benefited from having the longest history of settlement in the region and therefore has been familiar with how to sustainably survive off the land, knowledge that many recent migrant families did not have. The community has been able to accomplish this by maintaining their native Shambaa tongue, which is still tied to the ecological systems within which the language developed. This helped safeguard the environmental knowledge and practices passed down through the generations and contributed to maintaining their human-environmental connection. Intrinsic cultural ties and local environmental health have been interwoven with the functioning of the local community practices of *kuzifya shi* and avoiding *kubana shi*.

Furthermore, the Shambaa people in keeping up with much of their traditional knowledge were able to adapt and apply it to changing

circumstances. They were not isolated as the nearby Lutheran mission offered education that helped predict, prepare, and adapt to forces of globalisation as well as offering important networks that provided gave the opportunity for greater legal protection, political influence, and an outlet for financial support.

The resilience of this Shambaa community and their narratives of how this came into being is a consequence of their ability to adapt to the increased impact of human activity on the environment and the spread of disease during the Anthropocene. This ability has not required greater technology, or wealth, but networking and learning from outside groups while adapting the local knowledge and customs to the changes or potential changes outside forces may bring. These threats by outside forces have been commonplace as colonisation and globalisation have encouraged military and economic expansions into indigenous people's territory around the world, and too much isolation brings vulnerability to these pressures. The Mlalo community's relationship with the local mission serves as an example of the need for indigenous communities to have personal networks to tap into influential institutions that respect them and could advocate on their behalf. Additionally, these institutions could also be an important outlet for the community members to gain some understanding of colonial/globalised knowledge and language(s). This knowledge of the encroaching foreigners and the education that they base their decisions upon gives indigenous communities the ability to predict changes and how to successfully adapt to them. However, those communities that abandon the knowledge and customs of their cultural geography due to these threats are also open to the same ecological and zoonotic risks as the rest of the globalised world. Thus, those that maintain the connection to their local ecologies, language and knowledge while having networks of people familiar with threatening outside forces and their knowledge and language have the means to be sufficiently adaptable and flexible to adjust to the threats they are faced with.

The Anthropocene may be viewed as an era of upheaval in human-environmental relationships, where short-term threats to survival through daunting owner-debtor relationships or armed force has led communities and societies to disconnect themselves from the local environments upon which they ultimately depend. However, this example of the Mlalo Shambaa community illustrates another way for both short and long-term security, through networking and incorporating different knowledge systems, as they continue their own indigenous knowledge practices based in their local cultural geography. This has shown success because in our globalized

world the demand to re-connect with local environments is intensifying and the greater recognition that environmental disconnection has enormous consequences.

Recent ecological crises and zoonotic epidemics/pandemics, as COVID-19, have heightened the awareness of interconnections between environment and disease in the world, as well as understandings of the interdependent nature of solutions. The uncertainty of our modern world implores the need to tap into different ways to be sustainable and resilient and its basic principles that these are built upon. The Mlalo example can be part of such a model of communities adapting to environmental and socio-economic changes that have increased their resilience to zoonotic disease and food insecurity.

The key aspects of a local community's connection with their own environment and to international institutions is certainly a topic that deserves more attention. Certainly not all connections to international institutions would be equally beneficial, as some would not sufficiently respect or advocate for the community. Effective community networks with international institutions could work together to influence and develop national and international law, law-enforcement focused on environmental sustainability; as well as protecting local cultural geographies and the local language and knowledge that sustain them. These and other measures that can help strengthen each community's tie to its cultural geography could also foster these communities as centres of learning for the outside world, in order repair the human-environmental ties that have frayed. Re-connection of communities around the globe to their local ecosystems to promote their sustainability and resilience would diminish the risk factors for zoonotic epidemics, but they would need protection from the continued global economic exploitation of their local ecosystems for this to be realised.

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Appendix

A. Risk Factors for a Human Zoonotic Disease Epidemic

McMichael's Six Vulnerability Factors for a Human Epidemic of a Zoonotic Disease:

a) Altered habitat, with proliferation of reservoir or vector populations: (i.e. increasingly wet areas, dramatically increasing rodent populations' ideal habitat).

b) Biodiversity change and habitat fragmentation (e.g. deforestation)

c) Ecosystem changes, loss of predators and host species imbalance (e.g. Forest fragmentation).

d) Intensified farming and animal husbandry (e.g. closer interaction with animals lead to new strains of virus or bacteria being created, making it better adapted to avoid immune defences).

e) Niche invasion (e.g. the emergence of some infectious disease results from a pathogen invading a new or recently vacated niche.")

f) Human-induced climate change (e.g. land cover change has been tied to regional climate change.) (McMichael 2004: 1054-57).

Begon's Vulnerability Factors for a Human Epidemic of a Zoonotic Disease:

1) The increased presence of emerging infectious disease (EID) in area wildlife.

2) The increased interaction of area wildlife with humans.

3) The increase vulnerability of human populations to infectious disease.

4) The increase potential for human to human transmission through greater population densities and increased movement both within and among different populations (Begon 2013, personal communication).

Laudisoit's factors of risk for a zoonotic epidemic (adapted for assessment of diverse geographies)

A) High population fertility and the population growth next to hotspots is higher than in non-forest areas (urban bloom is mainly due to immigration – rural exodus).

B) Encroachment in pristine forests.

C) Bushmeat consumption.

D) Land-use changes and conversion of land in agricultural surface.

E) Disturbance of interactions between species causing species range shifts and increased contacts with domestic animals and humans (one health).

F) Trade of forest products and bushmeat and the illegal or uncontrolled nature of the trade.

G) Increase in edges of the forest as these regions are broken down into smaller fragments, leading to greater human (anthropic) disturbed surface and a greater interface between humans and fauna and the zoonotic pathogens they carry (Laudisoit, 2017, personal communication).

(See also Jones,K.E. *et al.* 21/02/2008. Global Trends in Emerging Infectious Diseases. Nature. 451:990-993; Wolfe,N.D. *et al.* 17/05/2007. Origins of Major Human Infectious Diseases. 447:279-283; Wolfe,N.D. *et al.* Bushmeat Hunting, Deforestation, and Prediction of Zoonotic Disease. Perspective.11.12:1822-1827).

B. Interview of Professor Vicent Benard Kihiyo of the Mlalo Shambaa community

1) What is your name and the name of your community?
"Prof. Vicent Benard Kihiyo"

2) How long is your ancestry been in the area?
"For more than 200 million years".

3) Describe how children are taught within the community.
"Before the coming of European[s], African[s] particularly [the] Shambaa community had their own way of educating their children. They did not have [a] formal [education] system, but it was the best way which moulded children to be the better citizen in the community." He continues saying that, "Children when [they] reach the [age] of adolescence he is [they are] taken to the special place normally in the forest and stayed there for more than three months. During this time, they are taught, to handle their wives, to feed, protect family. How should you behave when your wife she in pregnant? Furthermore, do not fight with wife, how to live with your neighbours. He must know how to defend his community. If a boy failed to catch up the instruction he is eliminated. They were taught by very experienced elders and through actual environment".

4) Describe the Shambaa language in the community and what knowledge it is based in.
"Most people in my community speak Shambaa as the major way of communication. And its [a] very rich language items of knowledge, skills and experiences through proverbs. Example;

Ukiita kweombeza kabogha uituke na kako kashashizeko"

Translation

"When you go to bring vegetables to your neighbour make sure you have yours that is about to go waste".

The above proverb entails that, before you request for help make sure you have something in your possession because when you don't get you can still have something. This reveal[s] that the Shambaa language has a lot of wisdom within".

5) How does your community's knowledge of the local ecology differ from that of neighbouring communities?

"The ecological knowledge of Shambaa and their neighbours like Pare and Chaga are the same, this is because when you visit the burial place of these communities you find that there is tendency of planting of trees. And also, there is taboo which prohibited to cut certain species of trees in these communities. The only thing to note is that Pare community they are so good [better] in terracing than Shambaa community".

6) Describe the difference of food security of your community compared to surrounding communities for the last few generations.

-"Food security was as follow[s]: Cassava, maize. Also, the diversification of food helps the community to have strong food security. While Pastor Msafiri Mbillu has different perspective on this; food security is only taken at the family level. This is to say that every family has the responsibility of taking care of his/her family because. Food security depends on the availability of harvests in that particular year. If it has rained enough that means food will be available for a couple of months if not years. In my community people just own small pieces of land therefore they cannot have enough to save for a very long period of time. Compared to other neighbouring community where there is other possibility of growing some cash crops such as vegetables etc. They can therefore have possibility of selling vegetables and purchase other food crops such as maize etc.".

7) Describe the difference in health of your community compared to those in surrounding communities for the last few generations.

-"To be honest [the members of the] Shambaa community they are very health[y] that's why they have high [large] population. And to them every disease that arise[s] has its medicine. Furthermore, according their climatic condition[s] they have few relative tropic diseases. But [it is] important note here is that if there is [was] [an] eruption of very deadly diseases like bubonic plague and leprosy, thus, people had to be placed in quarantine".

8) Why was your community less affected by the previous plague outbreaks compared to nearby Western-style farming areas?

-"First of all, our grandparents they had local knowledge for the prevention of the diseases and whether the disease seemed to be very fatality they isolated the sick one until they are healed or die. Secondly is the climatic condition of the Shambaa community[, which] favour[ed] them with [low rates of] tropical disease and they had proper ways of preserving the forest which were the main reserve of rodents".

9) Describe your agricultural system and how and why it is resilient to food shortages.

-"In my community they prefer to use communal production by using hand hoe. The area was very resilient to food security because of the diversification of crops and most of the crops can sustain drought".

10) Describe how the soil is fertilised, keeps moisture, protected from erosion and temperature changes.

-"First in the virgin land they burn the bushes for fertilizer, crop rotation, mixed cropping, planting trees to avoid erosion and they had developed traditional irrigation."

11) How did ecological changes for your community's lands differ from lands outside of the community before and during the plague years?

"It also should be noted that, the destruction of ecological system[s] has resulted to serious social and economic effects due to the fact that, it resulted to unknown diseases and hence swept the population of an area. This was well cemented by the following H. Kjekhus[3], M. Turshen[4], who, collectively, view issues of health and diseases as outcomes of the way society is organized, especially the way subsistence and surplus are produced and distributed among the members of society."

12) Describe the locations and basic characteristics of different plots of land that belongs to the people.

-"Plain[s] area[s, which] are located in valley and they collect water from the hills.

[3] H. Kjekshus. *Ecological Control and Economic Development in East African History*: *The case of Tanganyika, 1850-1950.* (Dar es Salaam, Mkuki na Nyota, 1996)., p. 126.

[4] M. Turshen. *The Political Ecology of Disease in Tanzania*. (New Brunswick, N.J: Rutgers University Press, 1984).

-Hills".

13) How are problems or potential problems uncovered and observed by the community? and,

14) What is the procedure for addressing problems within the community?

-"In all cases it begins from the family level and continuous to the next level through oral means. The procedure of addressing problems is by local administration and later to the official rulers of our organisation. This means the problem is addressed from the village level and later by the higher authorities."

15) Has this procedure changed over the generations? If so, could you describe these changes.

-"To be honest there [are] huge changes particular in medium of communication, now days phone and other medium they are used in calling the meeting. Furthermore, few people are involved now[-a-]days in the decision making compared to the past".

16) How are limited resources shared within the community?

-"In our community and Africa in general the only social safety net remained for the distribution and sharing of the limited resources is extended family. Family is the only and powerful means of help in Africa and particular in my community".

17) Is water a limited resource in the community, at times? If so, how is that dealt with?

-"In the past water was not a serious problem but as time goes on water has been a very serious problem because the population has grown which resulted to high demand of land. Clearing of forest has sped up the problem."

18) Describe how decisions are made within the community.

-"In my community is more organised because there is clear structure to be followed from the family level to the community. Through these structures all information are shared and therefore decision[s] can easily be made through based on this. The selected elders become the member the decision board".

19) Why are these decisions adhered to?

-“Since the decisions are reached through this structure, it is an obligation of each to follow and obey what has been decided. Myth, penalty has been the main enforcement mechanism. Most decisions are for the benefit of all community members e.g. clearing roads during and after rain seasons, cleaning water wells etc., therefore everyone feels responsible to comply with the decisions because of the direct benefit”.

20) What is done if people need assistance for food and farming?

- “In my community, during this time, people are organised to go and work in nearby community in exchange of food.”

21) Is there a responsibility for those receiving assistance to reciprocate it in some way? If so, please describe how the help would be reciprocated.

- “Working in farm or any other activities given to them.”

22) What are the consequences of *kubana shi* “harming the land”?

- “The consequences are very clear and vivid to any because of the visible draught, erosion, lack of water etc.”

23) What leads to *kubana shi* “harming the land”?

- “According to my community, going against the direction of the elders, and sin against god has been the source of the Harming the land.”

24) Please describe what is needed for *kuzifya shi*, “healing the land” to take place.

-“First of all to seek forgiveness from ancestors and provide sacrifices then the following should also be part of the next steps.

- the proper use of manure instead of artificial fertilizers
- crop rotation
- terrace farming
- planting some erosion protecting plants on the hills of mountains
- zero grazing and reduction of animals such as cows.”

25) What is thought to be important to maintain good health?

- “food, drinks, fruits.
- reduce excessive use of fat, alcohol etc.
- maintain weight”

26) What are different ways that illness can be dealt with in the community?

- “The use of local herbs, proper use of prescribed medicine.”

27) What are present problems or potential problems that the community is faced with?

- “Water, electricity, food security, climate change, diseases like coronavirus…

traditional ways of living has been affected”.

28) What actions are being taken by the community to address these problems?

-“To be realistic we cannot escape the effect of globalization because our economic system has been integrated to the capitalist system. However, the following can be taken into consideration to mitigate the problem

- Political will of our leaders
- Strong political institutions like local council, parliament, judiciary and executive.
- Practising inclusive economy”.

"The Anthropocene has still the rank of a scientific hypothesis. Yet, it has already sedimented in our imagination with its stories of climate change and mass extinctions, global pandemics and energy crisis, technofossils and oceanic plastic, social justice and new minerals that are changing the face (and the bowels) of the planet. Investigating this imagination from multiple angles, Narratives in the Anthropocene Era, brilliantly edited by Charles Travis and Vittorio Valentino, is an indispensable tool for situating these stories into the conceptual horizon of the environmental humanities".

(Serenella Iovino, University of North Carolina at Chapel Hill)

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