

The Ecological effects of Changes in Cultivation Systems in the Northern Rural Zambia: Agro Production and Environmental Sustainability Practices.

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Abstract: This paper explored the agro ecological effects of the subsistence farming practices, the externally induced agricultural changes and the environmental sustainability. The paper brings to bare the natural culture interaction in the agriculture sector to show the ecological changes that have taken place in the Northern rural Zambia.

Theoretically, the paper is anchored on landscape field theory. These approaches are discussed on the basis of current issues, such as ecological effects in the changes of cultivation system and the hybridisation of landscape, combined with empirical results on the environmental sustainability in the rural communities of the northern part of Zambia.

The paper highlights the Zambia landscape policy operationalisation by analyzing physical ecological conditions before the arrival of the Bemba speaking people and their adaptation in agricultural terms ethnographically. Of concern is the types of agricultural systems and their ecological implications. Noted is that landscaping perceptions differing significantly among genders, ages and social or cultural backgrounds (Buijs et al., 2009; BMUB & BfN, 2014; Kirchoff, 2014; Kuhn, 2019), but there is at least within modern societies of the developed countries consensus in human preferences for and evaluations of specific landscapes (Palmer et al., 1990; Hägerhäll et al., 2018). It is possible that these holds truths on the impacts of social structures on landscapes in rural northern Zambia.

In this article, ecological effects on landscapes due to changes in cultivation are understood as material objects with a set of observable, measurable and countable quantities, or composed of different analysable "layers" that have been unpacked using sociological and psychological landscape research.

The argument in this paper is that the effects of cultivating changes are generally based on consequentialism, which is based on the idea that a good decision is one that best improves the collective well-being of people by optimizing the trade-offs between relevant indicators and affected agents (O'Neill et al. 2008).

Keywords: Ecology, Cultural Capital, Chitemene and Fundikila, environmental sustainability.

1. INTRODUCTION

Agriculture remains a priority sector in Zambia for attaining sustainable economic growth and employment creation (Phiri et al 2024.) This is attributed to the country's vast natural resources such as huge tracks of arable land, water and a youthful population to support all forms of agricultural activities. Yet, traditionally, Sub Saharan African Farmers have practiced and pursued shifting cultivation in response to cohesive forces such as population growth and reduction in agro production due to declining soil fertility. Other factors include displacement of rural population as a result of urban expansion and the gazettement of parks and protected areas have for a long period led to cultivation of new land by extending agricultural activities into the forests, wetlands and pastures. However, extensive agricultural activity is becoming unsustainable or impractical in much of Africa, Zambia included due to land scarcity in the face of population expansion. In short, Zambia like many other African Subsistence farmers are moving from extensive agricultural practice to intensive type due to some cohesive factors highlighted above.

Problem statement

Physical ecological conditions before the arrival of the Bemba people: Agro systems changes in landscape field.

The northern province falls in an area with an annual rainfall greater than 1000mm, which is highest in the country. Other provinces with similar rainfall pattern include Copperbelt, Luapula and North Western. Vegetation type of the area is largely covered by Miombo woodland, dominated by two tree types; these are *Brachystegia* and *Julbernardia*, forming a 15 – 20 meters high, single story, light but closed canopy over a forest floor consisting mainly of *hyparrhystegia* and *digit aria* grass species. The solid are generally acidic and low in inherent fertility, rendering insignificant support for permanent agriculture. The above was characteristic cover type of the landscape before the advent of the Bemba people who came from Luba Lunda Kingdom in the modern day Democratic Republic of Congo. It is also worth mentioning that the above cover type defined the connectivity of the area landscape before being opened up to agricultural activities and other cohesive forces like designation of some areas as National Parks and Forest Reserves. In view of the above natural limitation of acidic soils, local cultivators historically evolved forms of shifting cultivation characterised by short cropping periods and long fallows, known as *Chitemene* and later followed by *Fundikila*. Of concern is whether the changes in ecological conditions has the potential in boosting agriculture production and the economy in Zambia. In agreement with Mubita (2023) who contended that: climate models suggest a future warming of 0.2 - 0.3°C per decade and this is likely to impact negatively on the tourism and agriculture sector in Zambia. For instance, Climate change increases and human activities disaster risks by increasing weather and climate hazards, and the vulnerability of communities and economic activities to natural hazards, particularly through ecosystem degradation (Mubita 2023:129). Below are the examples of the land in northern province before the Bemba speaking people from the DRC occupied the area.



Figure1. *Miombo Woodland in Northern Zambia*

Source: [https://www.researchgate.net/publication/282133337:Fire Management Assessment of Eastern Province Zambia](https://www.researchgate.net/publication/282133337:Fire_Management_Assessment_of_Eastern_Province_Zambia)

Historical evidence shows that the Bembas and other tribes originating from DRC came with the practice of shifting cultivation in the 17th Century. Later on, there were exogenous factors which induced

change in the landscape field largely championed by the Government in a bid to make the land accessible.

Theoretical framework: The Landscape Field Theory

Landscaping theoretical framework provides an ideal link between human nature interaction, ecological stability and change. The problems of nature culture interactions have become significant in landscape ecology. Lapka (2001) argues that the terms land and landscape for example, are themselves connotative of varying levels and results of nature culture interaction. In highlighting the limitations of traditional approaches Lapka (2001) argues that polarised perspectives of natural or social sciences fail to understand the complexity of landscape systems in terms of their unique combinations of natural and cultural elements, or by way of particular mix of natural and cultural heritages in given landscapes. Therefore, he advocates for some kind of trans-disciplinary approach to landscapes as well as landscape ecology. Through the perspective of landscape field, the dynamism of social changes in tandem with landscape field in view of the fact that it provides a better understanding of the dynamism interaction of nature and culture on a landscape scale. Lapka (2001) highlights three main points, which make the theory of landscape, field indispensable one to landscape ecology in the Northern part of Zambia.

The first being that the concept of landscape field permits us to conceive of nature culture interactions in the landscape as a dynamic system combining natural and cultural patterns with life of local community. The local community in this regard is that of Northern Province in Zambia.

Secondly, landscape fields define a spatial sphere of symbiotic nature culture interactions; it is a multidimensional space that reflects and incorporates long-term accumulations of natural and cultural qualities within the cultural landscape. The concept of multidimensional space refers to multiple outcomes of the nature culture interaction, which requires a holistic approach to understand it. The symbiotic sphere of the nature culture interactions to be looked at herein is the area of agricultural practice of the people of Northern Province over time. Finally, Lapka (2001) indicates that landscape fields have great potential both for dynamism in its overall structure and for stability through cohesive forces of natural and cultural patterns. The concept of landscape field extends the concept of landscape as a set of ecosystems with their own internal influence and qualities.

Forman (1997) uses the concept of cohesive force to denote human culture. However, it can also be used in a more general sense connecting society and landscape together, Lapka (2001). Culture does not only turn inward on itself or society, but also acts to integrate society and the environment. Forman (1997) contends that some cohesive force is vital in keeping people working together, and culture appears to be the most appropriate cohesive force. Similarly, culture can act as a cohesion force in landscape fields. Equally, women leadership positions are ignored as being part of human culture. For example, most studies on human culture argued that for a number of years, so many leadership positions that women can lead have only been given to men (Kalumba, Daka, et al 2023). This implies that most traditional land has sidelined women participation in acquiring it in the rural Northern part of Zambia.

Besides the above concept, the concept of cultural capital is cardinal to the understanding of the concept of landscape field. Cultural capital is considered to be the connection between natural and human made capital reflected our world view, values, knowledge and institutions influencing the way in which we treat the environment, Lapka (2001). In other word it is the accumulation of the non-biological heritage that provides human societies with the means and adaptations vital to deal with the natural environment. According to Lapka (2001) local culture is an intricate construct that recognises the ability and agency of people to create and sustain local knowledge. "Local values provide a milieu and socially constructed template within which residents build and rebuild knowledge systems through detailed and dynamic exchange of information between the socio economic and ecological patterns", (ibid: 135). Therefore, we can understand local culture as also incorporating the actual experience that people use to identify themselves with certain area, soil, climate and wildlife in forming a sense of themselves, their location, identity, and their history. It embodies the social constructions of culture that people employ to identify themselves as part of special places, ibid.

To get a better understanding of the role of cohesion forces and cultural capital in cultural landscapes, one needs to specify a sphere, a domain or zone of influence of these cohesive forces and the emergence of cultural capital in physically bounded landscape areas like a field. Main structures of the field

encompass natural patterns, social patterns and cultural patterns tied together in certain landscapes at a given socio-historical time. Socio-historical time refers to a specific shared timeframe of the people in given geographical area reflected in their values, beliefs and knowledge evolving out of the nature cultural interaction process. This infers the relevance of cultural capita for a country food security because it helps to promote environmentally sustainable agriculture.

2. THE CHITEMENE SYSTEM

The above system is a form of slash and burn cultivation, but it is unique in that the lopped area is much larger than the cropped area. The system originated from the DRC formerly Zaire. The Northern part of Zambia which includes Luapula have a similar vegetation and soils as DRC. The process involves branches getting lopped from trees within a chosen area between July and September, laid out to dry, and before the start of the rains in November are gathered into a heap into the centre of the cut area. Generally, the area of the heap is around 0.4 hectares, while the size of the cut area depends on the quantity of woody biomass in that area. Forest regeneration of the area subjected to this type of agricultural system can take up to a period of 30 years. Clearly, such a system of agriculture requires vast areas for each farmer, as an individual site may be used for only 2 to 3 years. The heap is burnt just before the first rains, with finger millet usually being the first crop sown in the ash plot. The subsequent cropping differs from place to place, but typically groundnuts, beans and maize follow in that order. Normally, cassava is planted as an intercrop with millet in the first year and harvested gradually from the third year onwards. When the field is exhausted after 2 to 3 years, it is abandoned and traditionally left fallow for 20 to 30 years, and another field opened, Mansfield (1973). The abandonment of the fields is due to declining yields often attributed exclusively to deteriorating soil conditions. The main factor for the decline is the rapid accumulation of herbaceous weed phytomas and the large demands for labour needed to control these acts as a major incentive to field abandonment. Rough estimates show that the *Chitemene* system could support between 2 to 4 persons per square Kilometre depending on the amount of suitable land available, Mansfield, *et al* (1975). Landscapes used for *Chitemene* cultivation were characterised by low population densities, from the air, appear as patchwork of a few fields and remnant patches of the original forest, and many abandoned fields at various stages of fallow vegetation re-growth.

The rise in population caused mounting pressure on the traditional cultivation systems, more especially *Chitemene* resulting in longer cropping periods and shorter fallow periods. This has had the effect of increasing the cleared area relative to the cropping area, a reduction in length of fallow periods required for regeneration for example from 25 down to 12 years, Chidumayo, (1987). Further, some studies have revealed rampant corruption in traditional land allocation by some chiefs affecting the *chitemene* system in the northern part of Zambia. According to Phiri (2020) corruption is rampant in land allocation affecting traditional authority commonly known as *Nichekeleko*¹ in Zambia. The phenomenon of *Nichekeleko* has widely been considered to be a problem by Zambians. Its persistence remains a major concern. The word, literary, means “cut as lice for me or what is in it for me?” (ibid 2020). This somehow explains its everyday usage by the people of Zambia to mean corruption, such as bribery, theft, embezzlement of funds to the exchange of small improper gifts and use of personal connections to obtain favours (Phiri, 2020). The change from extensive agricultural practice to intensive type is associated with the cohesive force of population growth with the consequent deforestation facilitated by corruption. This implies that, there was a shift in agricultural practice from *Chitemene* system to *Fundikila* type due to the above identified cohesive forces such as corrupt practices in traditional land allocation for the *Chitemene* system to flourish in the Northern part of Zambia.

Although the above slash and burn system of agriculture made ecological sense in earlier times due to small population against vast *Miombo* forestry woodland, the increase in population and changes in social and market characteristics have made such traditional practices maladaptive to varying degrees. The above argument is supported by Gliessman, (1990:31) who contends that,

“Wooden agriculture made ecological sense in an age when long fallow periods were possible, but the various socio-political factors that currently control farm economies demand much more intensified

¹ See Chidongo Phiri (2020) on *Nichekeleko* to mean “cut a slice for me or what is in it for me?”

land use than can generally be sustained by these traditional practises''. Shifting cultivation enhances the rejuvenation of soil fertility during the time it is fallow as compared to a portion of land, which is constantly subjected to cultivation especially under traditional agriculture system without alternative measures for improving it. 'competition by large forest trees is temporarily removed and a competitive advantage given to light demanding species, including the fast growing pioneer trees that are found sporadically in the tree fall gaps of manure forests''.

*Furthermore, the opening up of forests for agriculture leads to transformation of the vegetation which may lead to the growth of other light demanding herbaceous species not normally found in forest gaps to situate and increase their populations in these large disturbances. These are what make up the weed populations of the field. 'competition between grass and trees is mostly for light so that a complete canopy of trees is competitively overwhelming to grass where as competition between a very low biomass of trees and grass always favours grass'', *ibid*:345.*

However, the *Chitemene* system has got other ecological implications which include the disturbance of the habit of wildlife like the giraffes which rely on upper leaves of trees like the *Miombo* woodland. The disturbance automatically forces such animals moving to areas where the forest habitat is suitable for their survival. This may mean a large population of such wildlife species confining itself on a reduced habitat, which may not be adequate for the whole population of the specie especially when the population is large than the size of the habitat in relation to the needed tree species population.

Generally shifting cultivation is land demanding, forest squandering, low yielding and last but the least, labour intensive, Weischet and Caviedes (1993). Moreover, the socio cultural matrix of shifting cultivation is relatively poor in comparison with permanent field cultivation due to its temporal nature, which makes it difficult for people to improve their settlements and fields. Kellman and tackberry (1997) argue in support of the above assertion by highlighting some of the socio economic drawbacks, which include logistical difficulties, to get to fields situated in distant locations and the absence of road network hinders the development of cash cropping. This also presents immense difficulties and cost to the efforts aimed at provisions of social services, such as schools and clinics in view of the highly dispersed population. As regards their cultivation areas, the system does not allow planting of fruit trees like oranges and Bananas on such temporal fields. Worse still, the system can only support a small population in comparison with permanent field system.

The *Chitemene* ash bed.



Source: http://cop21.unicef.fr/app/uploads/2015/11/pic_rapport6_zambie.jpg



Figure3. *Julbernardia* Tree.

Source:<https://www.researchgate.net/profile/RasmusRevermann/publication/271083342/figure/fig5/AS:392147120476161@1470506567097/Miombo-forest-dominated-by-Julbernardia-paniculata-south-of-Longa-photo-R-Revermann.png>

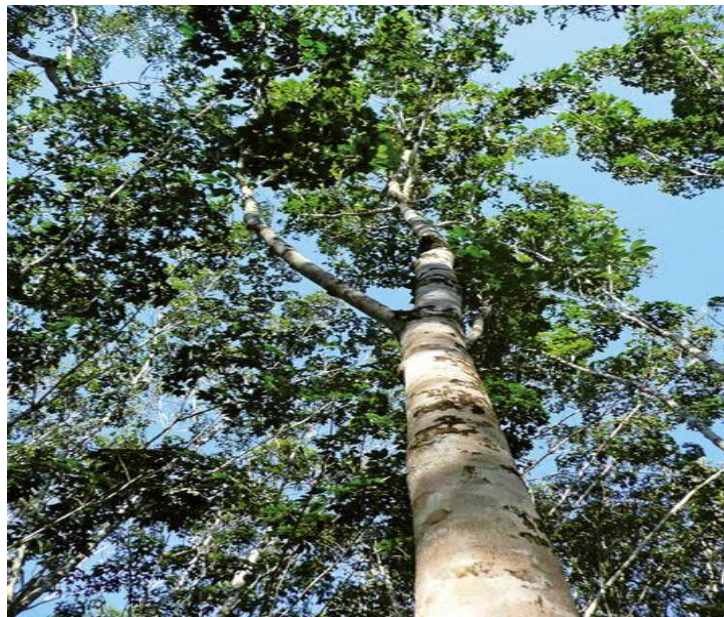


Figure4. *Brachystegia* Tree.

3. THE FUNDIKILA SYSTEM

In the North eastern part of the region, changes engendered by high population, massive deforestation due to shifting cultivation that has forced the Mambwe people to develop the Fundikila or grass-mound system of cultivation. The system is said to be a result of abandonment of the *Chitemene* as an increasing population (Stromgaard, 989). The process involves the formation towards the end of the rainy season of mounds of grass predominantly *Hyparrhenia filipendula* and *pennisetum purpureum* covered by earth on a previously fallowed site. The grass roots within the mound during the dry season, and at the start of the next rains, the mounds are levelled, then finger millet is planted. Subsequent growing season such fields may be used to grow crops like Maize, Beans, sorghum and groundnuts. Millet is usually planted again in the third year, followed by legume. In some cases, the field may be mounded every

second year, and the crop planted on the mounds. According to Stomgaard (1990), the combination of green-manufacturing and alternating cereal crops with legumes helps to slow the exhaustion of soil fertility. There is some evidence that the system is ecologically sustainable and that in practice the cropping period is 3 to 5 years, and the fallow period is traditionally up to 20 years, Mansfield (1973). Estimates show that the *Fundikila* system is able to support 20 to 40 persons per square Kilometre considerably more than the *Chitemene* system. The socio cultural matrix of the community under this system is comparatively well developed since it is a permanent system of agriculture allowing people to improve their settlements and diversify their fields. Other than the above, positive aspects associated with the system, weed infestation, which accounts for field abandonment under shifting cultivation, becomes an inescapable phenomenon under this permanent and intensified system of agriculture. Although to a limited extent the intermingling can have some benefits to farmers through for instance helping diversify predator complexes, the benefits are usually outweighed by their negative impact on crop yields. It is worth noting that the evolution of Fundikila by the local community marked the beginning of intensified agricultural practice a shift from extensive *Chitemene* system. Agricultural intensification usually consists of transformation in farming practice such that a greater proportion of the available land is intensively exploited. In addition to the above, a given area is used more often or the level of technological and other agro inputs are raised. The later point will be demonstrated under the hybrid maize production, which required the use of massive inputs under Government led subsidy provision to local small scale farmers for the promotion of food production.



Figure5. *Fundikila mounds.*

Source:<https://www.researchgate.net/profile/RasmusRevermann/publication/271083342/figure/fig5/AS:392147120476161@1470506567097/Miombo-forest-dominated-by-Julbernardia-paniculata-south-of-Longa-photo-R-Revermann.png>

4. HYBRID MAIZE PRODUCTION

In a bid to transform the National economy from a situation of food insecurity, the Zambian Government Agricultural policy since independence was aimed at increasing national maize production to enhance national food security. In Northern Zambia, in the past two decades from 1970 to 1990, this policy focused on promoting maize production by the small scale farming sector through subsidised schemes involving the use of hybrid varieties and imported fertiliser, Stomgaard (1984). Through this cohesive force factor of agro-policy, there was a noticeable change in the landscape field in terms of the predominant crop production from low yielding varieties to high yielding varieties. In addition, there was also a marked reduction in the production of traditional subsistence crops like millet, sorghum and low yielding local maize. Furthermore, there was a rapid population increase during the period between 1970 – 1980 in the region, causing pressure on the traditional *Chitemene* system of shifting cultivation, and forcing many subsistence farmers to intensify their farming practices Chidumayo (1987). Population density in some areas during the above period, Northern Province has been recorded at 12 persons per square. In agreement with Stomgaard (1985) who observed that a well settled *Chitemene* system has a capacity of around 2 – 4 persons per square Km (Mansfield *et al*, 1975). Because of the above factors, maize production, based on official figures from the Ministry of Agriculture, increased

from 18000 tones in 1978 to almost 160,000 tonnes in 1988, representing 11% of total marketed maize in Zambia. The other crop, which was promoted, is Soya beans often grown in rotation with Maize. With time, the programme was found to be unsustainable due to over reliance on Government subsidies coupled with donor support, which was to be phased out after a period. This was later proved true in that maize yields began to fall despite increased fertiliser application Bolt and Holdsworth (1987). This was due to delays in timing of fertiliser supply caused by reduction in the finances for the programme from the government and the Donors, an increase in continuous maize mono-cropping with lack of crop rotation practices, and also acidifying effect of some chemical fertilisers. To worsen the issue, subsidies on fertiliser and seed were removed in 1990, and maize production opened to market forces, exposing farmers in the remoter areas of the province to completion on the same terms as those closer to the points of consumption and input supply. As a result, many small-scale farmers, unable to afford inputs, had to revert to the traditional system of *Fundikila* cultivation marking a change in the landscape field in terms of agriculture cultivation system due to the cited cohesive force.

Although agricultural production normally rises because of intensification, this often is accompanied by damage to the natural resource base. Intensification may damage non-agricultural systems within or outside the developed area, leading for example, to declines in forest, losses in wildlife or reduction in recreation or amenity values. Under hybrid agricultural programme, the adoption of high yielding maize varieties to a great extent led to the abandonment of indigenous crop varieties leading to considerable erosion of crop genetic diversity in this rural landscape, which previously facilitated spreading of risk. Furthermore, Kellman and Tackaberry (1997), contends that the paradox of the loss of traditional variety diversity destroys the ingredients used in breeding the new varieties. It further poses problems of bringing about monocultures of new varieties, which tend to be considerably susceptible to major pest outbreaks and this was actually the case with maize crop production in the province in question.

Intensification may also damage other agricultural systems downstream of the area through for instance flooding because of silting of the riverbed due to intensive agricultural activities near the river. During heavy downpours, the agricultural field soil is washed into the river, which accumulates with time resulting in raised riverbed therefore contributing to floods, which destroy crops downstream leading to starvation of such communities within the province. Kellman and Tackaberry (1997) contend that in agricultural systems using large inputs like the hybrid programme which was pursued in Zambia, high productivity is bought at the expense of a reliance on external factors over which the farmer has little control, a loss of flexibility and ability to spread risk, and potentially severe environmental degradation. Indigenous local knowledge about successful low input management techniques is usually lost which new intensive techniques are adopted especially over length period. They further argue that such agricultural systems produce much bare soil and induce accelerated rates of soil erosion. All these factors bring into question the long term viability of these systems as a means of improving food production, irrespective of their immediate successes in feeding an exploding population (Kellman and Tackaberry 1997)



Figure6. Photo of hybrid maize field

Source:<https://images.theconversation.com/files/77560/original/image-20150409-1523113zm7ko.jpg?ixlib=rb-1.1.0&q=45&auto=format&w=1012&h=668&fit=crop>

5. AGRO-FORESTRY CULTIVATION SYSTEM

In view of the above developments, there was increasing awareness for the need of finding ways of sustaining agriculture production other than the use of fertilisers. Through research acting as a cohesive force for change, biological methods of maintaining soil fertility, and alley cropping in particular, were suggested as potential solutions to the problem of declining yields due to loss of soil fertility, AFRENA (1989). The use of trees to improve fertility is not a new concept to the subsistence farmers of Northern Zambia, traditional *Chitemene* cultivation practice, which was predominant in the region in the past, used nutrients accumulated by trees of the Miombo woodland. Alley cropping retains the fundamental principles of traditional bush fallowing and tries to maintain all the land productive at the same time. Agro-forestry concerns the science and management of trees on farms. That is combination of trees with crops and or livestock form a very important component of the rural landscape. Weischer & Caviedes (1993), indicate that agro-forestry is assumed to have stabilising effect on the environment and stable in its output of products, which may range from food to fuel. Many Governments including Zambia are redefining the objectives of rural land use policy not just in terms of production targets but also in the sustainability of rural businesses and communities and the environment. Although the Zambian government has made the above goal in policy terms, Non- Governmental Organisations are the ones, which have moved in practically to help communities use their lands in a sustainable manner. It is hoped that agro-forestry may lead to ecological sustainability and environmentally friendly agricultural practice. According to Weischer & Caviedes (1993:367), “an ecologically sustainable agriculture maintains the resource base upon which it depends, relies on a minimum of artificial inputs from outside the farm system, manages pests through internal regulating mechanisms, and is able to recover from the disturbances caused by cultivation and harvest through important succession processes. Therefore, ecological sustainability demands more intensive management and adequate knowledge of important ecological processes. Hence, the driving force for this change is the growing awareness of environmental degradation and the need for sustainable agricultural practice to curb waning environmental quality.

From an ecological perspective, agro-forestry practice tends to maximise certain environmental conditions that are ideal to subsistence crops and large scale agriculture in humid and sub humid tropics, *ibid*. Sharing the resource pools that is, zonal advantages such as light conditions, and water and soil nutrients in agro-forestry systems necessitates competition as trees, shrubs, herbs and crops try to gain access to the zonal advantages mentioned above. The other strength of this system is that it entails the exploitation of resources in a partitioned manner, such as root depth and perimeters. Kellman and Tackaberry (1997) contend that trees are potentially vital components of rehabilitation efforts in steep lands. As has already been highlighted trees originally formed vegetation cover of the province in question and when used in agricultural landscapes alongside crops, they can help to stabilise soils against erosion. Research findings over the past 20 years have confirmed that agro-forestry can be more biologically productive, more profitable, and be more sustainable than forestry or agricultural monocultures.

Research has also confirmed that agro-forestry systems can include the following benefits:

- “They can control runoff and soil erosion, thereby reducing losses of water, soil material, organic matter and nutrients.
- They can maintain soil organic matter and biological activity at levels satisfactory for soil fertility. This depends on an adequate proportion of trees in the system – normally at least 20% crown cover of trees to maintain organic matter over systems as a whole.
- They can maintain more favourable soil physical properties than agriculture, through organic matter maintenance and the effects of tree roots.
- They can lead to closed nutrient cycling than agriculture and hence to more efficient use of nutrients. This is true to an impressive degree for forest garden/ farming systems.

- They can check the development of soil toxicities, or reduce existing toxicities, both soil acidification and salinization can be checked, and trees can be employed in the reclamation of polluted soils.
- They utilise solar energy more efficiently than mono-cultural systems – different height plants, leaf shapes and alignments all contribute.
- They can lead to reduced insect pests and associated diseases.
- They can be employed to reclaim eroded and degraded land.
- They can create a healthy environment – interactions from agro forestry practices can enhance the soil, water, air, animal and human resources of the farm. Agro-forestry practices may use only 5% of the farming land area yet account for over 50% of the biodiversity, improving wildlife habitat and harbouring birds and beneficial insects, which feed on crop pests. Tree biodiversity adds variety to the landscape and improves aesthetics.
- They can moderate microclimates. Shelter given by trees improves yields of nearby crops and livestock. Shade in summer can be beneficial for livestock, reducing stress.
- Agro-forestry can augment soil water availability to land use systems. In dry regions, though, competition between trees and crops is a major problem.
- Nitrogen – fixing trees and shrubs can substantially increase nitrogen inputs to agro forestry systems.
- Trees can probably increase nutrient inputs to agro-forestry systems by retrieval from lower soil horizons and weathering rock.
- The decomposition of tree litter and pruning can substantially contribute to maintenance of soil fertility. The addition of high-quality tree pruning (i.e. high in Nitrogen but which decay rapidly) leads to large increases in crop yields.
- The release of nutrients from the decomposition of tree residues can be synchronised with the requirements for nutrient uptake of associated crops. While different trees and crops will all have different requirements, and there will always be some imbalance, the addition of high- quality pruning to the soil at the time of crop planting usually leads to a good degree of synchrony between nutrient release and demand.
- In the maintenance of soil fertility under agro-forestry, the role of roots is at least as important as that of above ground biomass.
- Agro-forestry can provide a more diverse farm economy and stimulate the whole rural economy, leading to more stable farms and communities. Economic risks are reduced when systems produce multiple products” Crawford (2002:1).
- Agro-forestry practices can also reduce corruption. Nevertheless, there is no clear-cut, global definition of corruption (Phiri, 2021). This is because, the English word “corruption” is not restricted to the public sector, but also applies to the private sector (ibid,2021) such as traditional land allocation.

Despite their benefits, promotion of trees in land rehabilitation in this part of Zambia faces many obstacles. Firstly, tree growth is slower compared to that of annual crops and demands a long term devotion if it is to be successful. Besides the slow rate with which benefits accrue from tree planting may constitute a strong cohesive force to deter people from enlisting themselves to Non-Governmental Organisation like ICRAF involved in promotion of agro-forestry. The establishment of local tree seedlings is relatively costly and labour intensive process that normally requires the preparation of nurseries by the above NGO and other stakeholders who should have access to necessary capital. It also demands for considerable effort and time following the establishment of the nursery to protect seedlings during maturation. In view of the above reasons, trees should be considered as one vital important element of land rehabilitation, but not necessarily a panacea. It is for this reason that the adoption of agro-forestry in Northern Province from the conventional point of view has not been widely embraced

despite massive sensitisation campaign by NGOs on its benefits. Although a majority have not adopted it, some of the people have done so signalling change in the landscape field. Since the programme was introduced recently, more farmers may adopt it with time especially when they see benefits accruing to those who have embraced and especially if measures can be put in place to make it less costly and shortened timeframe for yielding the benefits. Hence, the aerial photos if they were to be conducted now compared to the way the situation was 40 years ago, noticeable changes would include isolated agricultural fields with food crops and trees within them compared to the time when such fields only had food crops.



Figure7. A photograph showing the practice of agro-forestry

Source:<https://th.bing.com/th/id/OIP.xPGcuUsk6IoK7J6RzQ4AxQHAEi?rs=1&pid=ImgDetMai>

6. DISCUSSION ON SUBSISTENCE AGRICULTURAL LANDSCAPE CHANGE IN RELATION TO THE THEORETICAL FRAMEWORK – NORTHERN ZAMBIA.

The Bemba people socio historical changes over the last 30 to 40 years have experienced naturally and culturally induced cohesive force factors leading to the development of cultural capital reflected in their coping mechanisms. After the arrival of the Bemba people, they revived their slash and burn system in view of the similarity in the nature of the soil and vegetation of their new settlement with their place of origin. This action ties well with the concept of cultural capital of the landscape field theory. According to this theory local culture includes actual experience that people use to define themselves with certain area and soil in developing a sense of who they are, their location, identity and their background, Mack (1996). Hence, the people employed advance knowledge of the physical conditions to overcome the natural cohesive force of infertile soils.

As highlighted above, with the growth in population coupled with massive deforestation, the practice of shifting cultivation could no longer be sustained, other than the two internal cohesive factors, part of their area was alienated from them by the Government, which designated it as Forest and Game Reserve areas constituting an external force to which the community had to respond. According to Forman (1997), cohesive forces as cultural aspects link the society and landscape and that these are responsive to both internal and external forces of change. Therefore, the Bembas change in their agricultural practice was caused by both endogenous and exogenous factors leading to development of *Fundikila* system. The realisation by the locals of the effects of shifting cultivation evidenced by soil degradation, limiting the necessary regeneration of forest and range ecologies gave them the vital impetus to explore alternatives for agricultural production.

Through their experience the Bembas learned and accumulated ways of handling the nature culture challenges leading to the development of cultural capital. Within the concept of landscape field, cultural capital is considered as an accumulated knowledge that provides human societies with the means and adaptations necessary to deal with the natural environment. After abandonment of *chitemene* system, which contributed to habitat destruction of some species, the locals came up with *Fundikila* type of agriculture practice. It involves formation of mounds of grass, which is left to rot within the mounds before levelling at the start of the rain season. Then crops are planted. It is worth mentioning that the evolution of this type of agro practice by the locals made it possible for them to establish permanent structures enriching the social matrix of their settlements. Evidence provided by some studies favours this system as compared to shifting cultivation in view of it being ecologically sustainable, Mansfield (1973). Sustainability refers to the maintenance of total factor productivity, the combination of ecological sustainability and fulfilling human needs without compromising future productivity of the agricultural land in this regard, Lynam and Herdt (1989).

Although the above system proved sustainable and affordable for the locals, reality dawned on the Government and other stakeholders on the need to improve food production to offset the recurrent food deficit condition in the country. To realise the above goal, the Government came up with Hybrid Maize production scheme supported by subsidies, which attracted a lot of small scale farmers to get involved. During this historical epoch, the local agricultural landscape changed to almost a monoculture type in that few farmers continued to grow some of the traditional crops like Millet and Sorghum, which did not enjoy subsidies like hybrid maize. This clearly demonstrates the role of external cohesive force in the form of agro policy acting and influencing change in the Northern Province. Despite contributing greatly to food production, the government and its stakeholders realised that they could not sustain the programme due to dwindling resource base and soil degradation effect caused by the chemical fertiliser. It is worth noting that there was further improvement in the infrastructure under this scheme in that modern storage shades were erected in rural settlements coupled with elaborate market and social service infrastructure. Hence the social matrix was further enriched. The withdraw of government subsidies and market service made the local people revert to their *Fundikila* system, highlighting the vital role of cultural capital in providing the locals with alternative coping mechanisms accumulated over time. The adverse effects caused by the fertiliser made the government through research stations and in collaboration with international environmentally concerned Non-Governmental Organisations to champion efforts aimed at rejuvenating the degraded agricultural land of the people through the promotion of Agro-forestry. Although the use of trees in improving fertility of the soil was not something new in the province, the practice under agro-forestry is different. Under agro-forestry the locals are required to grow crops and soil enriching trees. For this reason, few farmers have embraced the practice of agro-forestry. For the few who have adopted it, have in a way altered the local landscape field in that aerial view would highlight the remarkable differences between fields in view of the above. As shown earlier on, there are numerous ecological benefits as far as the practice is concerned. These include control of runoff and soil erosion, and also maintain soil organic matter. In spite of the benefits, the scheme is costly in terms of time for yielding benefits as well as capital money for raising the seedlings. With regard to the concept of landscape field theory, the move by the Government and its stakeholders shows the role of external cohesive force in influencing local changes.

7. CONCLUSION

This paper has tried to demonstrate changes that have occurred over the landscape of the Bemba people through the timeframe of 60 to 70 years citing both natural and culturally induced changes as a result of cohesive forces. To do this, the paper in agreement with Phiri *et al* (2023:74) on all qualitative studies has argued that it highlights the methods used to gain data which mostly were interviews and documentary analysis. For example, besides, the concept of cultural capital as accumulated knowledge of the people equips them with the means to adapt and be able to deal with their natural environment. Through the pages of this paper marked changes in agricultural terms started with *Chitemene* system a form of slash and burn followed by *Fundikila*, which uses grass mounds to improve soil fertility. Both systems were through accumulated knowledge of the local people defined herein as cultural capital in accordance with the theory of landscape field. Later on external factors largely by the Government and its stakeholders in terms of agro policy influenced changes that took place within the area of the Bembas. The changes were from hybrid Maize production using chemical fertilisers, which contributed

to degradation of the environment to an environmentally friendly programme of agro-forestry. Although the agro-forestry programme is ideally of great ecological soundness, its costly nature and slowness to yield benefits for those engaged in it, puts it at a great disadvantage in comparison to the *Fundikila* system. It is for this reason that *Fundikila* system remains a predominant form of cultivation.

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