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*Article*

# A Scholarly Analysis of Indigenous Agricultural Practices: Evaluating the Efficacy of Chitemene Farming in Addressing dry Spell Challenges in Zambia

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**Abstract:** This working paper presents a scholarly synthesis of Chitemene farming, an indigenous farming system critical to the livelihoods of communities in the Miombo woodlands of Zambia and its capacity to tackle dry spell pertinence. Chitemene farming hails from a traditional farming practice in Zambia. It follows a technique that involves cutting vegetation or biomass and heaping it before burning to create an appropriate fertility top dress through ash. However, this method has offered several moral and sustainable means of food production over the years. However, due to its various environmental impacts, it has come under much scrutiny and criticism over time, such as deforestation, loss of biodiversity and declining soil fertility. Besides this, sufficient production in current scenarios is harrowing to achieve and further criticizhing it over long-term sustainability due to climate change and population growth. This research employs ethnographic fieldwork in Chiunda Ponde, Luvushimada District, and an agronomic and ecological data review. The research shows two stories of practice by analyzing the practice using ecological, social and economic perspectives. On the one hand, Chitemene farming taps into the factor of adaptation in increasing crop productivity, improving water holding capacities in the soil and offering a temporal cushion between the farmer and unpredictable rainfall distribution. On the other hand, the method is declining due to the alarming rates of deforestation, reduction in nutrient availability, and the variability of climate change factors such as the extended dry season. As such, Indigenous techniques must be harmoniously combined with contemporary techniques to make farming sustainable and cope with the impacts of climate change. Some of the specific suggestions based on the recommendations include supporting agroforestry involving planting trees and food crops, practising conservation farming to avoid disruption of soil fertility, and carrying out community-based tree planting to rehabilitate degraded areas. Furthermore, there is a need to promote climate-smart agriculture and locally endorsed innovation to encourage smallholder farmers to respond to change. Besides considering Chitemene farming as a way of farming common in the past and appreciated in culture, this study is useful in discussing sustainable agriculture that could develop strategies appropriate for areas facing the same conditions. Finally, the study recommends integrating conventional practices, their limitations, food security, and effective environmental management for improved Zambia and other countries.

**Keywords:** Farming, Agriculture, Dry, Conditions, Climate Change, Agroforestry, Crop Productivity, Environmental Change

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## 1. Introduction

The sector has seen a steady decline in contribution to the country's GDP despite the fact that the majority of the Zambian population still depends on agriculture as their source of income, particularly in the rural sub–tenanted regions. Chitemene, one of the practices, has formed the basis of agricultural practices in Zambia's Miombo woodlands

for generations. Though appreciated for improving fertility and supporting the local community, the method has begun receiving criticisms from environmental and climate change challenges that question its sustainability. Therefore, the purpose of this study, in addition to proposing an assessment of the effectiveness of Chitemene farming in responding to dry spell issues in Zambia, is to skim through the comparative effects between the Indigenous practice and evolving global issues such as climate change and food security [1].

The Chitemene farming system has been among the most targeted farming systems in history by many end users and scholars. This has resulted in numbers coming up with various formulations and analyses of the processes in this farming type and its effects. Chitemene is a type of swidden agriculture where the vegetation in an agreed piece of land is cut and dried before setting it on fire. This process improves the fertility of ash and makes it suitable for growing crops since nutrients from the ash enhance soil fertility. Youth have pointed out its importance as a soil conservation practice, especially where soil humus levels are low. Mukosha and Solberg (1999) defined Chitemene as a viable approach to countering poor soils, especially in Zambia Miombo ecosystems, through the acts of clearing followed by burning, thereby enhancing the regeneration of necessary nutrients in the grounds. In the same context, Frost (1996) opines that the practice favours crop production because it augments the supply of micronutrients in the production system requirements for plant nutrition [2].

Still, Chitemene farming has received criticism from one or two persons, with some pointing out the following. Lee (2002) and Campbell et al. (1998) have raised some issues about these models, stressing that the growth is sustainable in one way, for example, through deforestation, reduction in the diverse bio-sphere and ground pollution. These scholars opine that even though Chitemene is advantageous in the short run, problems of soil degradation emerge in the long run due to continuous use of Chitemene as population densities and, hence, demand for land rises with time. Also, since the practice is coupled with high rainfall and relies on it as its central rainfall, the fluctuating climate conditions make it hard to afford solutions for droughts and other implications of climate change.

**Defining the Chitemene System of Farming**

A Brief Discussion of the Chitemene System of Farming The Chitemene system of farming is a type of shifting cultivation, also known as slash-and-burn farming, used by the rural people of Zambia for many years. Chitemene farming, as defined by Houghton (1986), entails felling trees and vegetation, stacking them to form a humus layer, and then burning them. The ash from the burn also adds nutrients to the soil for the season in which crops like maize, millet peanuts or groundnuts are farmed. This cycle of chopping, burning and planting is normally practised over a period of three to five years before the land is left to rest, after which another plot has to be cleared to rest.

Recently, Chileshe (2017) has focused primarily on the social and ecological aspects of Chitemene farming. For this reason, such a system is not always regarded as purely agricultural but as cultural, which implies people's spiritual relationship with the ground and a shared approach to the resources. Some other parts practice Chitemene along with what can also be considered agroforestry, where certain Tree species are left in the crop field to provide shade and conserve the soil for erosion. However, this research also reveals that Chitemene has its dynamism associated with its mobility, which has enabled it to be practised in the different ecological regions in Zambia [3].

However, Chitemene farming has the following main challenges Despite its historical and cultural implications. As climatic changes progress, fire alongside rain, which the practice relies on, increasingly inconsistently endangers the soil and crops. Moreover, new challenges such as population expansion and land holding problems in the farming areas of Zambia have put restrictions on the practice for better future continuity and further enhanced the problems of conservation. With this background, this study seeks to carry out a critical analysis of Chitemene as a sustainable agricultural

system in Zambia and its effectiveness in dealing with dry spells threatening food security in the country.

**Literature Review**

The following sections of the paper shall, therefore, review the literature on the Chitemene farming regime relating to the historical background, ecological and socio-economic contexts, and interrelated perspectives of Dry spells in Zambia. First, it integrates empirical studies of Chitemene that show the practice's strengths and weaknesses to understand its features comprehensively in modern agricultural conditions from different viewpoints [4].

**Historical and Ecological Context of Chitemene Farming**

As mentioned above, Houghton (1986) and Mukosha and Solberg (1999) refer to Chitemene as a coping way of dealing with the deteriorated Miombo soil nutrient regimes. However, they observe that the effects of burning on increasing soil fertility are only short-lived while noting that shrubs are crucial for growing crops such as maize, millet and beans at such places. However, one major problem with the system is that it largely depends on burning vegetation, and it has various ecological implications, as throughout the years, it contributes to deforestation and loss of biological diversity (Campbell et al., 1998). The ecological sustainability of Chitemene is therefore questioned, particularly if the activity is repeated on the same piece of land with limited time for vegetation growth.

One Indigenous agricultural activity widely condemned for its effect on the ecosystem, especially the adverse effects on the natural resource base, is Chitemene farming, an Indigenous farming system primarily used in the Miombo woodlands of Zambia [5]. However, some scholars have recently pointed out some benefits of the Chitemene system, particularly in climate change mitigation and agricultural practices. One of the most vital points lies in the possibility of speedy tree growth, which is a valuable weapon against climate change.

1) **Rapid Tree Regeneration and Carbon Sequestration**

It is perceived to favour soil productivity in the short term due to the deposition of ashes after the vegetation is burnt. This process also supplies substances such as potassium and phosphorus but, more importantly, assists the ground to conserve moisture (Frost, 1996). Water retention is beneficial in areas where the effects of climate change mean that droughts are becoming both more common and more severe. The ash also helps grow trees and crop production by altering the soil structure and increasing organic matter [6]. Because of higher micro-nutrient availability in this smothered earth coupled with faster tree growth, farmers would get better yielding and -more muscular agriculture production systems against different climate change vagueries, including fluctuating rainfall patterns and high temperatures.

2) **Improving Fertility of the Soil and Water Holding Capacities**

The Chitemene system is also recognized to improve soil fertility for a short while after burnt vegetation deposits ash to the soil surface. This process not only supplies nutrients such as potassium and phosphorus but also enhances the activities of water in the soil (Frost, 1996). Water retention is critical in areas where climate change enhances the number and intensity of droughts. The ash also has beneficial effects on tree regeneration and crop production because its accumulation modifies the structure and organic composition of the ground. It also means that it can give farmers even more stable forms of agriculture that have a better chance of maintaining yields and adaptability to climate changes, including erratic rains and high temperatures.

3) **NPC-Climate Change/Communicated Elements 2/Agroforestry Potential for Climate Adaptation**

The chitemene system, If implemented by adopting Modern practices of Agroforestry, has the potential to increase Climate resilience. Agricultural technologies that involve growing trees together with crops are known as Agroforestry

technologies. Research evidence has also indicated that the Miombo woodlands, which is an everyday land use of Chitemene farming, can grow a variety of tree species within a short period and hence have the potential to restore balance in the ecosystem [19]. The chitemene system, when practised together with the agroforestry techniques, then leads to a situation whereby farmers obtain the best trees that they require for timber, fuel wood and other associated products in addition to enhancing the soil fertility and water retainer among them. Hence, the diversification of land use could enhance the prospects of food security and economic stability, including in the wake of climate shocks [7].

**4) Reproduction of ecosystems™**

The regrowth of trees in Chitemene areas significantly rejuvenates ecosystem services required for climate resilience. These include increasing soil fertility and water quality and supporting an area's biotic diversity. During the regrowing process, trees form a canopy, which reduces soil erosion, which is contributed to by climate factors such as increased rainfall and unfavourable weather that result from climate change [19]. Also, the regeneration of trees in the cleared lands can help bring back the provision of shelter to wildlife, hence checking on the conservation of biodiversity. The Chitemene system can aid these regenerative processes. It can play an essential role in reinforcing the ecosystems so that the random nature of climatic changes does not have profound impacts [8].

**5) Climate Change adaptation analysis from an Indigenous Knowledge perspective**

The Chilean farming system is based on indigenous knowledge, accepted as a viable response to climate change. The timing of the Chitemene system, selecting suitable land for regeneration, and improving soil fertility are critical to local people in making the Chitemene system sustainable for production. When combined with current approaches to managing natural resources, this experience can improve the resilience of agricultural practices to climate change [20]. Moreover, a speedy rate of tree regeneration in Chitemene plots indicates that the indigenous systems can effectively adjust to new climate conditions and may become the model of responsible land management in case of climate change.

**6) Agriculture Support Program for Small Holding Farmers**

The Chitemene farming system affords the shortest time for trees to grow, hence giving smallholder farmers a competitive edge to meet the ever-increasing demand for timber, fuelwood, and other forest products within less than three years. Due to the relatively limited availability of other sources of revenue in some areas, the Chitemene system can serve as a long-term means of income through the sale of timber and other products from the plantation. This ability to re-establish trees within a short period not only serves the farmers' near-term food requirements but also makes a significant contribution towards the enduring food security of farmers. In light of climate change, which is likely to enhance the volatility of crop production, Chitemene farming acts as a buffer for farmers and fosters general economic diversification [9].

Though people claim that the Chitemene farming system has specific adverse effects on the environment, one can also outline several positive effects that have to be discussed in connection with climate change adaptation. The ability to develop trees within less than three years enhances carbon sequestration, soil fertility and water retention needed for climate stability. Additionally, Shade and Environmental Combining Chitemene with agroforestry and modern environment are practices that can increase sustainable farming systems and positively impact smallholder farmers' livelihood. More and more global agriculture is under threat due to the effects of climate change; hence, understanding the Chitemene system brings to bear indigenous knowledge and practices for better sustaining agricultural systems in Zambia and the world.

**Enhancing the Capability of Soil and Water Retention**

The Chitemene system also increases soil fertility after burnt vegetation deposits on the soil's surface. It also provides essential elements such as potassium and phosphorus and increases the capacity of the water that makes up the soil (Frost, 1996). Water retention, as a critical factor, plays a vital role in conditions where climate change contributes to increased frequency and severity of drought. The ash also positively impacts tree regeneration and crop production since its accumulation alters the physico-chemical structure and the organic content of the ground. It also means that it can provide farmers with even more assured types of agriculture that can better withstand deteriorating conditions such as erratic rain and high temperatures [10].

**Agroforestry Potential for Climate Adaptation**

Even though the climate system can be implemented by embracing modern agroforestry practices, it can increase climate resilience. This is a technology whereby crops and trees are grown side by side or intermixed at the farms, and these technologies are called Agroforestry technologies [11]. Research evidence has also shown that there is potential for rehabilitation because the Miombo woodlands, which are used every day by Chitemene farming, can grow various trees within a short span despite the seeming destruction that it portrays. When practised in conjunction with agroforestry technology, it leads to a situation whereby the farmers get the best trees they need for timber fuel wood and other related products, as well as increase soil fertility and water retainer among the rest. Therefore, diversification of land could improve the chances of food availability and economic growth, even in the wake of climate-related changes.

**Reproduction of ecosystems™**

The re-growth of trees in Chitemene areas enhances a number of ecosystem services that are important for climate change. Some of these are improved soil and waterарод reserves and promoting the biotic capacity of a given area. Trees develop a canopy during regrowing, and this, in turn, reduces soil erosion through climate factors such as increased rainfall as well as unfavourable weather due to climate change (Campbell et al., 1998). Also, procurement of trees in the cleared lands can ensure the provision of shelter to wildlife; hence, the conservation of biodiversity is checked. The Chitemene system may help these you-nurturing processes. It has an important function of restating the ecosystems so that the haphazard changes do not massively occur in the climate [12].

**Adaptation climate change analysis from an Indigenous Knowledge perspective**

The Chilean Grown system is one of farming based on traditional knowledge, which is recognized as a valid solution to climate change. The Chitemene system, critical input that local people find helpful in making the Chitemene system efficient for production is the timing of the Chitemene system, the choice of appropriate land for regeneration, and the question of soil fertility regeneration. Integrated with current practices of natural resources management, this experience can enhance the agricultural practices' vulnerabilities to climate change [20]. Furthermore, Chitemene plots show a rapid rate of tree regeneration to demonstrate that the indigenous systems can adapt to the new climatic conditions and may emerge as the critical model of responsible land use in the event of climate change [13].

**Saudi Arabian Agricultural Export Support Program for Small-Holding Farmers**

In the Chitemene farming system, trees take the shortest time to grow. This offers smallholder farmers a competitive window to supply the growing demand for timber, fuelwood and other forest products within less than three years. Considering that the number of other potential sources of revenue in particular regions is still somewhat limited, the Chitemene system can thus be a long-term source of income from saleable products like timber from the plantation. This ability to replace trees over the short term not only meets the farmer's immediate food needs but also makes a strong contribution to

the long-term food needs of farmers. Relative to climate change, which is expected to increase the variability of crop production, chitemene farming helps farmers absorb shocks and encourages more overall risk diversification.

While people rehearse the general predation of the Chitemene farming system as harming the environment, one can also list the potential benefits they have to mention about climate change adaptation. The potential to grow trees that take less than three years improves the absorption of carbon required for a stable climate, as well as improving soil fertility and water retention. Moreover, Chitemene, combined with the agroforestry system and the modern environment, is an effective measure that helps farming systems become sustainable in order to improve smallholder farmers ' living standards. Climbing affects more and more global agriculture is at risk; thus, knowing more about the Chitemene system brings into play Indigenous knowledge and practice for a better way of sustaining the Zambian and world agriculture system.

**Chitemene Farming and Climate Change**

More about Chitemene farming is the issue of climate change and how farming is related to it. Like the majority of other nations in the southern African region, Zambia is becoming more vulnerable to the impacts of climate variability and change, with erratic rainfall patterns, early-season dry spells, prolonged dry periods, and average temperatures negatively affecting crop production. This appears to be a hint that farming based on fire cycle and rainfall pattern, known as chitemene farming, is most at risk in such conditions.

Other prior studies by Zulu et al. (2014) suggest that in Zambia, the number and severity of dry spells are rising, and this has further raised challenges that cropped up in practices of traditional farming techniques that include Chitemene. Even though the ash from burning vegetation improves fertility and moisture content in the soil in the short run, the worst part is that this cycling system may not be very effective when the rains become more irregular. The ravages of drought become more severe. Furthermore, the practice indicated that forest clearing, on which the practice relies, contributes to the increase in soil vulnerability to erosion and other types of deterioration during drought [14].

However, some scholars have suggested that Chitemene needs to be combined with other types of farming to make it better prepare for climate change shocks. Applying some of these technologies for agroforestry, that involve maintaining trees or other vegetation types within the farming system, the soil might be stabilized and the effects of land clearing minimized. According to Frost (1996), the integration of trees in Chitemene systems might do more than address soil erosion issues; it might also offer further revenue streams via the sales of timber and non-timber forest products.

**Evaluating the effectiveness of Chitemene in dealing with dry spells**

Chitemene farming is still controversial as a strategy for managing risks occasioned by dry spells. Those supporting the practice believe the technique will improve water retention in the sub-surface water and produce a micro-climatic environment that may shelter crops from an irregular wetting pattern. The fertilizer from the ashes makes the soil fertile, providing crops with nutrients during the dry seasons. In addition, rotation of the fields of shifting cultivation provides opportunities for vegetation cover to restore the soil and restore it with nutrients [15].

Nevertheless, as it has undesirable effects on the environment, coupled with the long-term unpredictability of weather patterns, the sustainable use of Chitemene is in question. [19]. have opined that while deforestation happens, the detrimental effects on the surface and species are only augmented. Moreover, due to the practice's dependency on fire, the feedback is enhanced, making the land more sensitive to erosion and desertification, particularly under conditions of drought stress.

**Conclusion and Research Area Limitations**

Although theoretical and empirical literature exists on Chitemene farming, focusing on the activity's environmental and socio-economic effects, there needs to be more literature about the system's capacity to adapt to change through dealing with the emerging threats posed by climatic change, particularly the dry spells. Another ASDA–W combination gap is the lack of research on how Chitemene can be combined with modern Agricultural practices to enhance the farming system's climate resilience. This research aims to fill these gaps by exploring the ecological, social and economic factors of Chitemene farming within the context of a rising number of dry spells experienced in Zambia to chart how it could be effective in modern-day production.

In different literatures, Chitemene farming is described as a potentially robust traditional way of farming and a threatened system. The review shows that Chitemene can be helpful in the short run for fertility and water retention. However, it has imposed challenges for sustainable production with climate change and population pressure on the land tenure system in the long run. As a result, an assessment of available technologies to integrate indigenous knowledge with modern, sustainable agricultural practices to improve food security and sustainability in Zambia is appropriate.

## 2. Materials and Methods

This research uses quantity and quality research to assess the effectiveness of Chitemene farming in responding to the issues of dry spells in Zambia. Inherent in the practice analysis, the practical approach entails considering the ecological, social, and economic factors obtained by applying qualitative and quantitative research methods. Below is an overview of the critical components of the research methodology:

*1. Research Design*

The study uses both qualitative and quantitative approaches to capture the different attributes of the Chitemene farming system. The cross-sectional qualitative approach describes detailed information about the locals' views, culture, and social structure of Chitemene farming. On the other hand, the quantitative one evaluates factors such as crop production yields, soil fertilization, and fertilization, as well as the effects of periods of drought.

*2. Sampling and Study Area*

The research takes place in a rural setting in Zambia, in the Luvushimada province's Chiunda Ponde village in the Miombo woodlands, where Chitemene farming is endemic. The region is selected because it contains people who still encounter recurring dry seasons and who are still relying on conventional farming methods.

*a) Sampling Population*

In this study, a purposive sampling technique is used to ensure that small-scale farmers, male and female farmers, and local agricultural experts are chosen. The selection targets clients who have practised Chitemene farming for three to five years. Sample Size: One hundred farmers drawn from the study area will be surveyed, fifty male and fifty female. Furthermore, ten farmers specializing in horticultural farming and ten local government personalities will be asked questions about the policy and supporting framework of Chitemene farming.

*3. Data Collection Methods*

To ensure a comprehensive understanding of the Chitemene system, data will be collected using the following methods:

*a) Qualitative Methods*

**Semi-structured Interviews:** Structured interviews and focus group discussions are conducted with farmer households, chiefs or village heads, traditional rulers, and agricultural extension agents. The interviews seek to establish an appreciation of the system in Chitemene, its efficiency in combating dry spells and challenges, and

awareness of contingency measures in Chitemene. These interviews also describe and explain the practice's social and cultural implications. Focus Group Discussions (FGDs): Farmers will be interviewed to conduct focused discussions to enhance their understanding of Chitemene farming. This approach allows the researcher to obtain different views of the advantages and disadvantages of Chitemene and its versatility in changing climates. Observational Field Visits: In this case, the researcher will physically visit the Chitemene farms to make balanced observations and assessments. The state of the land, the method used in clearing, planting, and harvesting the crops, the general condition of the crops, the soil and trees, and several others shall be notable assessment areas. These observations will offer background information and supplement interview information.

*b) Quantitative Methods*

**Surveys and Questionnaires:** Structured interview schedules will be used to administer the selected farmers. The questionnaire will obtain crop yields, soil moisture, water retention capacity, income from farming, and dryness effects on farming. This data will enable the use of statistical parameters to determine the relationship between Chitemene practices and agricultural yield.

Soil Testing: The concept of soil sampling is simple. Soil samples from Chitemene farm areas will be taken, and results on fertility indicators like nutrients, organic matter, and pH will be determined. This will afford an empirical quantification of the effects of the Chitemene system on the health of the soil.

**Climate Data Analysis:** Rainfall data for the merged zones and temperature trends over the last ten years will be obtained from the Zambia Meteorological Department. This data will be employed to establish the relationship between the experience of dry spells and Chitemene farm production.

*4. Data Analysis*

The data collected from both qualitative and quantitative methods will be analyzed using the following approaches:

*a) Qualitative Data Analysis*

Thematic Analysis: Transcripts and notes taken from the interviews and focus group will then be analyzed thematically. The researcher will analyze literature reflecting the effectiveness, challenges, and perceptions of Chitemene farming. This procedure will regard devices and response codes under major subjects like "climate adaptation," "economic advantage," and "environmental issues."

**Triangulation:** Qualitative data collected from interviews, FGDs, and observations shall be valid and reliable. This will assist in confirming the obtained results and ensure that a broad understanding of the Chitemene system has been ascertained.

*b) Quantitative Data Analysis*

Descriptive Statistics: Quantitative data from surveys and soil tests will be analyzed using measures of central tendencies, including mean, median, and standard deviation. This will assist in explaining how Chitemene practices have influenced factors such as soil fertility, crop yield, and income.

**Correlation Analysis:** A Pearson correlation coefficient will be used to test the relationship between the frequency of dry spells and the total yield from Chitemene farms. It will also establish how chitemene farming supports or fuels the impacts of dry spells.

**Comparative Analysis:** To determine the efficiency of Chitemene against traditional farming, another comparison will be made between farms carrying out Chitemene and those practising what is referred to as regular farming to compare the yields, fertility of the soil, and resistance to climatic change.

*5. Ethical Considerations*

**Informed Consent:** Participants will be explained the reason for the study, and consent will be sought before they are administered, either through interviews or questionnaires. Respondents will also be informed of the anonymity of responses and the voluntary nature of the study. Cultural Sensitivity: The researcher will also respect the local and cultural beliefs of farming practices in the appropriate areas. Of course, emphasis shall be placed with reference to gender issues especially conforming to gender expectations and balanced contributions.

*6. Limitations of the Study*

**Scope of Study Area,** The study will only cover the Chiunda Ponde region, and therefore, the results attained in this research may need to be more conclusive than those of other regions practising Chitemene farming. Data Reliability: Some respondents may not wish to tell the truth, especially in aspects like yields, income, etc., to avoid embarrassment or simply because they value their privacy. Climate Variability: This study focused on the various weather conditions during the farming season under analysis; changes in weather conditions within the studied period make it challenging to generalize the findings in other farming seasons.

*7. Expected Outcomes*

*The study expects to:*

Offer data regarding Chitemene farming practices regarding climatic change with special reference to dry spells. Introduce the Chitemene farming technique and focus on its ecological and socio-economic advantages and disadvantages, but mostly point out whether it is useful and disadvantageous in regard to soil fertility and crop yields. Chitemene can be recommended and aligned with current production practices to boost food security and climate change resilience in Zambia, and policy recommendations can be provided. This research method provides a rich and comprehensive focus on Chitemene farming. It switches between the emic and etic perspectives to identify its possibilities for mitigating climate issues in Zambia's agricultural sector.

**Theoretical Framework**

This academic study focuses on the Chitemene farming system, which originates from Zambia within the Miombo woodlands, and this research incorporates Eco-technological solutions and socioeconomic development. In assessing the profitability of Chitemene against the challenges of dry spells, the theoretical framework uses several theory theories and models in cross-discipline fields, able to distinguish between modern and traditional farming practices and climate change effects on farming.

1. Sustainable development theory was proposed to explain the reality of sustainable development. Chitemene farming's long-term stability plan is given a fundamental outlook on the theoretical model of sustainable development. The central themes of this theory are the economic, social and ecologically sustainable approaches towards farming. Regarding Chitemene, setting fire to plants has the negative outcome of enhancing soil fertility but has serious ecological impacts, including Deforestation and eradicating soil fertility productivity. This theory allows us to assess how Chitemene can be modified to address present-day environmental issues, such as global climate change, by combining traditional knowledge with modern practices, such as agroforestry and conservation farming.
2. Climate Resilience Theory

   Climate resilience theory studies how systems can get through impacts and transition through climatic transformation. For Chitemene – which relies upon slash-and-burn techniques – this theory is invaluable when deciphering whether or not dry spells may be either lessened or intensified. The theory can be used to evaluate if Chitemene improves water holding capacity, soil nutrient supply, and crop production under fluctuating rainfall and more frequent occurrence of drought, which are challenges resulting from climate change. The Chitemene is

selected in this theory to identify how the existing practices can be adapted to enhance the yields under climate change conditions.

3. Systems Theory
   According to systems theory, agriculture practice, communities, and the environment are interrelated and interdependent. Scholars have used this framework to predict how Chitemene farming functions in terms of agricultural production and sustainability as well as communal livelihoods within a socio-ecological system. With this theory, the study will evaluate the effects of Chitemene on the bio environment, such as soil fertility and forest resources, and on the socioeconomic welfare of farmers, such as income and food balance.
4. Agrarian Change Theory
   Agrarian change theory investigates how innovative technologies, such as kets and environmental barriers, change and shape agricultural systems and processes. It helps explain how Chitemene responded to traditional conditions and how it will adapt to new conditions, such as climate change, formulateformulate policies, and enter the international market. After this, it will enable the examination of how various farmer adaptation strategies, like changing crop types or farming practices, affect the sustainability of Chitemene farming under modern circumstances.
5. Indigenous Knowledge System (IKS)
   The main focus of the Indigenous Knowledge Systems (IKS) theory is lo, cal, trade, and national knowledge in managing natural resources and practice in agriculture. Chitemene, an Indigenous farming system, has been practised and developed over the years through farming experience managing forest and nutrient resources. This theory assists in explaining how systems of indigenous knowledge, including colour and timing of burning land clearing and crop rotation, among others, are helpful in enhancing agricultural sustainability and managing climate change. The study will examine how Chitemene draws from IKS practices and how these practices can be adapted to work harmoniously with contemporary technologies to produce climate-smart production systems.
6. The Theory of Environmental Justice
   Environmental justice theory, as established, distributes rewards and punishes environmental stresses fairly and sensibly by establishing and recognizing the rights of environmentally concerned victims of environmental discrimination to enjoy an adequate and healthy environment and agricultural products. This theory is especially applicable to Chitemene as this practice is controlled by rural farmers, who can suffer from climate change's negative consequences more than others. By applying this concept, the study will look at the economic, social and other benefits and costs of Chitemene farming, such as Deforestation, land degradation and effects of climate change on the Chitemene farmers.
7. Agroecological Theory
   Agroecology focuses on principles of ecology in agroecosystems, including the establishment of diverse species and sustainable use of soils. This theory is valid when explaining how Chitemene can be modified or improved to prevent further land degradation, and focus can be put on techniques like agroforestry, mulching, and organic farming. The ability of Chitemene to embrace shifts in climatic situations without affecting the ecological structure will also be explained under agroecological theory. These unforeseen issues are arbitraged by the theoretical focal frameworks that interrelate these disciplines to determine the Chitemene farming system's readiness to avoid challenges in dodging dry spells in Zambia. It offers an integrated policy stance emphasizing environmental footprint, socioeconomic impact, and climate vulnerability. The analysis, therefore, seeks to add a better understanding of factors that may help enhance long-standing

Indigenous farming systems such as the Chitemene in responding to the current climate change challenges and in enhancing agricultural productivity today.

## 3. Results

The analysis section of this study will outline mixed-methods findings obtained in Chiunda Ponde, Luvushimada Districts, Zambia, to determine the effectiveness of Chitemene farming in managing dry spell challenges. The results are organized into three key categories: They present information on the ecological effect, social and economic consequences, and climate change adaption. Interviews, focus group discussions, questionnaires, soil sample tests, and climate data underpin the above study's conclusions.

### 1) Effects of Chitemene Farming on its Environment

Chitemene farming and its effect on the local ecology were examined by comparing land clearing, burning, and testing of the local soil.

*Soil Fertility,* Laboratory analysis showed that Chitemene farming has a positive short-term effect on soil fertility because of the ash the growers leave behind after burning. The findings revealed a rise in soil organic matter content and nutrient stocks (potassium and phosphorus) right after the burn. However, after some time, especially when deforestation continued, the soil became poorer with the constant cropping. Soil samples showing low organic matter content and decreased soil acidity were obtained from farms that engaged in Chitemene for over five consecutive years.

*Water Retention***,** Farmers report that the soil's water-holding capacity increased during the first three years after they burned the land. Nevertheless, as time went by, water retention capability decreased in areas that fully applied Chitemene and without other techniques, such as mulching or changing the patterns of planting crops.

*Deforestation,* Although Chitemene farming can be productive in the short run, the study revealed it as a cause of deforestation. This is because extensive areas are turned to agriculture, especially in the Miombo woodlands. In the long run, excessive deforestation in a given region leads to soil erosion and loss of species" The crisis load is described in the following terms:

### 2) Social and Economic Outcomes

The study used crop production, income, and community perception to assess the consequences of Chitemene farming.

*Crop Yields,* According to the survey, crop yields increased among farmers who engaged in Chitemene because of the practice. This was especially so in the two to three years following the burn period, mostly in crops such as maize and cassava. However, after some years, the yields drop down because the fertility of the centre soil has reduced. This study found that those who incorporated other sustainable practices like crop rotation and agroforestry managed to reap more uniformly. Income Diversification: Most farmers stated that Chitemene farming, along with other income-earning activities like raising livestock and cultivating cash crops such as tomatoes and peppers, diversified the main source of income. Nonetheless, more reliance on this technology alone could not support needed to support cash income throughout the year since crops' production and market were unpredictable and sometimes dominated by dry spells.

*Social Perceptions,* The Chitemene system is culturally and historically appreciated by the local people due to its impact on food security. Some farmers commented that in Chitemene, a number of crops can be grown at the same time, thus increasing food variety. However, some farmers also had some qualms that were more long-term and about soil quality degradation and variance of rainfall patterns more frequently.

### 3) Adaptation to Climate Change

The study sought to establish how farming practices in the Chitemene basin adjust to climate change constraints such as dry spells and fluctuating rainfall patterns by checking the practices of Chitemene farmers.

*Resilience to Dry Spells*, Chitemene farming provides a measure of protection against drought in the short run because of the increase in soil fertility and water availability following the burn. Nevertheless, farmers also said the system could have been more helpful in addressing long-season drought since some areas they cultivate have changed and are characterized by irregular rainfall. The study also revealed that the regions under Chitemene were longer likely to be more affected by drought and poor yields during dry seasons than those that practised crop diversification.

Adoption of Modern Techniques: Some of the farmers who adopted 'new economy' practices such as conservation tillage, drought-resistant seed varieties, and trees for improved production noted that the new practices assisted in overcoming dry seasons. Chitemene, together with other modern practices such as hybrid practices, was noted to have increased productivity, fertility, and sustainability among farmers.

Climate Change Awareness: Regarding climate change, farmers reported increased knowledge about climate changes, especially rainfall. The study realized that some farmers have started implementing adaptation measures that include changing planting dates and crop types to drought-resistant crops through careful examination of the causes of climate change and adaptation measures that include changing planting dates and crop types. However, the adoption of such practices, in combination with conventional practices like chitemene farming, has not yet been fully integrated.

**4) Information on Climate and analysis of the correlation.**

A cross-sectional assessment of the climate records in the last decade indicated a decline in rainfall and a rise in temperatures as typical of climate change in the area. This work also confirmed that wet periods of the year have reduced in their frequencies and durations, which greatly affects Chitemene farming.

*Correlation between Dry Spells and Crop Yield*, Survey data analysis shows that Chitemene practices are strongly associated with a significant decrease in crop yields and reduced wet spell incidence. Even though the short-term returns were good, they took a steep tumble whenever a dry spell extended over several weeks. Those farms that adopted Chitemene and climate-smart practices like water pans in rainwater harvesting and the production of drought-resistant varieties chalked better results.

Deforestation and Soil Erosion: The level of correlation that was established between deforestation and soil erosion was also as follows: The areas that were subjected to rigorous Chitemene tillage revealed a higher level of soil erosion. The increased threat of deforestation, which decreased the land's capacity to hold water, further compounded difficulties that would previously be pronounced in dry areas.

*Conclusion of Results:*

The findings also suggest that although Chitemene farming provides temporary food security and resistance to dryness in Shongo la Chitawa, it is unsustainable in the long run due to problems such as soil erosion, deforestation, and frequent changes in climate patterns. The research, therefore, supports the call for adopting new and sustainable technologies and practices in the Chitemene system, particularly in adopting techniques like agroforestry, crop diversification, and water harvesting to sustain the system in the face of changing climate conditions. In the subsequent phase of the research, suggestions that may be of great help in the evolution of Chitemene farming and the general improvement of climate-wise farming in Zambia will be made

## 4. Discussion

This study's section discusses the outcomes of the research undertaken in the context of sustainable agriculture and climate change adaptation. It also analyzes the ability of

Chitemene farming to cope with some of the problems brought by short rains in Zambia from ecological, social, and economic points of view and about the consequences of climate change in the long run. This section also highlights the advantages and disadvantages of Chitemene farming and provides direction on how best to improve this farming practice to meet future environmental challenges.

*1. Sustainability of Chitemene practised in the Eastern Province of Zambia*

From the approach used in the ecological assessment of Chitemene farming, it is evident that though it has given positive fertility and water conservation results in the short run, the ecological benefits of the practice remain dubious in the long run. As indicated by the enhanced effect of ash from the burning process, nutrient enrichment temporarily contributes to fertility status. Through cultivation, soil fertility diminishes without inputting more organic matter. Chitemene practices that we analyzed have been found to affect the soil in terms of fertility and pH, suggesting that after some years of practice, the fertility gains might be compromised if measures for conserving the soil nutrients are not adopted.

Furthermore, deforestation in connection with Chitemene farming leads to long-term long-term negative environmental impacts. When practised in the Miombo woodlands, where it is most rife, large-scale land clearing for farming negatively impacts the biosphere and diminishes the forest's role in water control. This, in turn, accelerates soil erosion, diminishes the area's water-holding capacity, and, by extension, reduces its water availability to plants during dry periods. This ecological feedback renders this potentiality indefinitely incapable of supporting Chitemene as an adequate ecological, resource-conservative agricultural system vis-à-vis climate change.

*2. Economic and Social Impacts*

Economically, Chitemene farming is a sustainable source of income for most small-scale farmers in Zambia's rural areas, especially the Chiunda Ponde. The practice contributes to food security by increasing crop production in the short run and has revealed a variety of economic benefits among farmers, such as increased crop production, crop diversification, and additional income through animal farming. Land cycling and the practice support long-term productivity and economic stability because of declining fertility and unpredictable rainfall.

Declining soil yields quickly balance the small gains from the continued production in the form of income, and the flexibility of Chitemene farming decreases when there are unfavourable weather shocks. Though some farmers take up other income-earning activities, Chitemene farming per se does not guarantee other income throughout the year. Furthermore, farmers who only practice Chitemene may find themselves in trouble financially during bad years by trying to make do with the yields for the entire year without reasonable rainfall, as was observed from the study where the yields decreased due to extended dry seasons.

On the social aspect, Chitemene farming is of cultural importance. This has been a mainstay in rural Zambia, especially among the people of the Miombo region. For many, the hoo is one of those things where you come from, and farming is interconnected. This way of sharing knowledge of farming techniques across generations helps to support the social practices of the practice's local community. However, as global climate change worsens, the Chitemene system must adapt to higher environmental conservation for food production in Zambia.

*3. Adaptation to Climate Change*

Another primary purpose of this research was to assess the suitability of this innovative Chitemene farming system and its preparedness in responding to climate change effects, especially the enhanced and prolonged dry spells. The conclusion, therefore, is that while Chitemene has previously been able to thrive in conditions characterized by periods of short rain failure, it is becoming increasingly less capable of adapting to long-term climate stress. The system relies solely on natural precipitation, and

the combined effect of degrading soils and cutting down trees increases the system's vulnerability to unpredictable climate changes.

Crop varieties, fertilizers, and a recommended package of practices that included drought-tolerant varieties of crops, mulching, and effective water harvesting measures were found to have a higher level of adaptation to such conditions on the part of the farmers. This concurs that Chitemene farming on its own, done in its traditional methods, is not enough to meet the various challenges that come with climatic change. Though it continues to be a worthwhile exercise in some settings, it must be refashioned and complemented with climate-sensitive strategies for its continued sustainability.

*4. Policy Conclusions and Suggestions*

The findings of this study are indicative of the fact that there is a need for increased integration in implementing agriculture as a process in Zambia, where Chitemene is seen as a viable local traditional practice that has to be blended with the ability to implement sustainable and appropriate farming practices for the country under the current climate circumstances. Based on the findings, several recommendations can be made to enhance the effectiveness of Chitemene farming in the face of climate change:

*a) Agroforestry and Reforestation*

On the same list as goals and objectives, Joshi also outlined several strategic intervention recommendations, one of which seeks to promote the practice of agroforestry to avoid deforestation and to maintain soil fertility through planting trees along the crops to be grown. It also maintains the soil, recovers degraded habitats, and increases the chances of successful rainmaking in acts of rainmaking, hence improving farming during dry seasons.

Climate-Smart Agricultural Practices: This paper has shown that improving current farming practices like conservation tillage, mulching, rainwater harvesting, and using drought-related crops to improve Chitemene farming could improve climate change resilience. Such methods can assist in averting soil erosion, retaining water, and increasing production during unpredictable precipitation.

*b) Farmer Education and Extension Services*

As a result, there is a need to mobilize resources to finance agriculture extension and farmer education for enhanced implementation of sustainable practices. Other specific recommendations include crop management/training, which will enable farmers to abandon unfriendly practices and adopt soil health, crop rotation, and water management practices.

*c) Policy Support for Sustainable Agriculture*

Government policies should promote the use of resilient farming systems and motivate farmers to practice sustainable land management. Formulating policies that can foster reforestation and other land regeneration exercises will be of great concern in ameliorating the adverse effects of Chitemene farming on the environment.

*5. Conclusion*

This paper has shown that despite Chitemene farming, which has previously been vital in supporting farming within Zambian rural areas, the practice is currently being challenged by climate change. The environmental impacts of chitemene include soil erosions and pollination, deforestation, and rainfall instability misy, which are the significant chitemene inhibitors in a farming system in the long run. However, through policy support, the subject farming technique can be modified to be climate smart, such as agroforestry, thereby transforming chitemene farming into a more sustainable technique. In conclusion, this work brings out the fact that there is a centrality that should be agreed on: blending the culture of indigenous farmers and technological advancement in farming. In so doing, it becomes easier to protect food security, enhance living standards, and design other agriculture systems in Zambia that will enable the country to cope with the effects of climate change.

## 5. Conclusion

In this scholarly analysis, the author explores how the indigenous agricultural practice of Chitemene farming could help Zambia during dry spells. From this work, the unique gross to acceptable scale assessment of the Ecological, Social, and economic consequences of Chitemene in Chiunda Ponde Luvushamada District has captured the successes and pitfalls of this traditional farming system with special reference to climate change.

The study indicates that although Chitemene farming was found to have efficiently sustained rural people's lives and improved crop productivity in the past, it has existed with various sustainability problems. In the short run, it provides results of increasing ash deposition, better water retention, and yielding better crops than before. However, the long-term impacts present issues such as soil degradation, deforestation, and the efficiency of Chitemene reduction in the future due to climate change with random rain patterns.

Chitemene practice is still relevant to the farming practices of Zambia's rural people today, including food security and culture. However, its sustainability was found to be at the mercy of environmental changes. When practised alone without complementing practices, the farmers get exposed to possible dangers of their fields getting exhausted, large-scale deforestation and droughts causing poor yields in dry seasons. Given the current trends in climate unpredictability and worsening drought situations due to effects such as global warming, Chitemene farming must adapt and be relevant and efficient in supporting the production of food crops.

Hence, the study recommends embracing an innovation development approach combining Indigenous Knowledge with modern agricultural technology. This paper identifies a number of climate-smart measures through which Chitemene farming can be improved: agroforestry, Water Conservation techniques, and Crop Diversification. Moreover, cooperation with the government machinery and local private sector is crucial for mainstreaming sustainable initiatives as well as helping smallholders with funds and Knowledge on how to cope with climate change.

In conclusion, Chitemene farming remains essential for food security and rural development, and system checkers in the future performance of this activity depends on climate change. This can be done in consultation with modern and ancient practices as a way of fruitful agriculture while preserving this environment for future farmers. Implications from this analysis are thus informative not only for Zambia but more generally for other regions where indigenous farming systems are at the crossroads of climate change. By such interrelated approaches, the best applicable agricultural practices can be maintained and improved to meet future food needs and keep the environment safe for future generations.

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