



A Review on the Integrated Coffee Production and Value Addition in Mambilla Plateau, Taraba State, Nigeria

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ABSTRACT

Despite the Mambilla Plateau in Taraba State having favourable conditions for Arabica coffee cultivation, including a cool climate, high altitude and fertile volcanic soils, coffee remains an underutilised cash crop in Nigeria. Its production has stagnated due to smallholder farming systems, declining soil fertility, poor soil-borne disease management, and limited processing and value addition. This review examined peer-reviewed and open-access literature published between 2021 and 2026, focusing on farming systems and soil fertility, major coffee diseases, processing and value addition, and sustainable production strategies. Evidence from similar African highlands indicates that smallholders dominate production, often cultivating coffee on degraded, increasingly acidic soils with limited soil testing. Coffee berry disease, caused by *Colletotrichum kahawae*, can cause significant yield losses under favourable disease conditions. Unlike other African coffee-producing countries, where wet and semi-washed processing methods support higher bean quality and market value, dry processing remains dominant in Nigeria. The review recommends an integrated approach involving regular soil testing, balanced nutrient replenishment, shade-based agroforestry, disease monitoring and management, farmer cooperatives, and investment in quality-focused processing to improve the productivity, resilience and profitability of coffee production on the Mambilla Plateau.

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INTRODUCTION

An estimated 25 million of the world's coffee-growing smallholder households are dependent on the trade of coffee in over seventy tropical and subtropical countries. There are two species that dominate global production: *Coffea arabica*, with its fine flavour, and grown predominantly at high altitude, and *Coffea canephora*, commonly known as Robusta, which can be grown in the warmer lowlands, and typically higher yields. The early introduction of coffee in Nigeria was during the first decade of the twentieth century as part of the British colonial administration (Gakuo, 2021), and for several decades, it was one of the more important non-oil export earners in the country before petroleum was discovered to shift the economic priorities for the nation away from tree crop production.

The current distribution of coffee in Nigeria includes fourteen out of its thirty-six states, totaling slightly above five thousand hectares of land, of which ninety-four per cent is Robusta, 4% is Arabica and 2% is Liberica (Mustopha *et al.*, 2022). The Mambilla Plateau in Taraba State is a particular area within this national scenario. The plateau is situated above sixteen hundred metres above sea level, and enjoys a cool, misty climate more typical of the East African highlands than of lowland West Africa, and is one of two areas in the country, together with Obudu Cattle Ranch in Cross River State, where Arabica coffee is commercially cultivated (Gakuo, 2021; National Coffee and Tea Association of Nigeria, 2025). Over 100 varieties of Arabica have been tested over the years at various points on the plateau, with decades of agronomic research and experimentation, but this work has yet to result in a stable or growing coffee economy (Gakuo, 2021).

However, in spite of this favourable natural endowment, the production of coffee on Mambilla Plateau as well as the Nigerian coffee subsector has been an area of decline and not increase. Similar farmers' decisions to drop coffee cultivation in favour of more lucrative crops has been reported for farmers in adjoining Kogi State, where a significant proportion of the sampled farmers had totally or partially abandoned coffee farms (Akinpelu *et al.*, 2021). These factors generally attributed to coffee's problems are weak farm management, low and volatile farm gate prices, old and declining tree stocks, and lack of organized processing and marketing structures that would enable the farmers to add value to their coffee produce (Akinpelu *et al.*, 2021; Alli *et al.*, 2021).

The literature on the coffee systems in Nigeria and other similar African countries shows three technical constraints that are common. The first relates to the fertility of soils. Coffee is a nutrient demanding perennial crop that is highly depleting soil reserves of nitrogen, phosphorus and potassium during its productive life, and without systematic replenishment, yields steadily deteriorate even on naturally fertile land (Begumisa *et al.*, 2024). The second is plant disease, especially those associated with coffee berry disease caused by the fungus *Colletotrichum kahawae*, which has caused yield losses in susceptible Arabica varieties in East and Central Africa up to eighty percent, and has not been well documented in the context of Nigeria specifically (Kacko *et al.*, 2024; Adugna, 2023). The third relates to processing and value addition, as the process by which freshly picked coffee cherries are converted to marketable green beans, dry, wet, or semi washed, can have a measurable effect on the density, moisture content, chemical makeup, and therefore the price the crop fetches in the market (Banti & Atlaw, 2024).

The three constraints are not independent. The loss in vigour caused by the reduction in soil fertility can make the plants susceptible to disease; if the disease can be controlled, then the harvestable crop will be less in quantity and quality; if the disease is not controlled, then the crop will be reduced further by poor processing. This means that addressing them requires an integrated, not piecemeal approach, and that the farming system, soil management, disease management, and post-harvest handling is inseparable and part of a single production and value chain. This holistic view is the impetus for the current review.

This study seeks to evaluate the production and value addition of coffee in the Mambilla Plateau of Taraba State, Nigeria, based on the recent research on open access and similar coffee growing areas in Africa. Specifically, the review seeks to assess the fertility and nutrient status of soils in the area and its farming systems in coffee plantations, establish the prevalence and incidence of the main diseases of coffee production, evaluate the methods of coffee processing and value addition and its impact on quality of coffee beans and market potential, and recommend integrated strategies on sustainable production and value addition of coffee.

Methodology and Approach to the Review

This paper is a desk based, conceptual review and not a report of new primary field data. The approach used was a systematic search of open access databases and journal repositories of academic research, such as Directory of Open Access Journals (DOAJ), Springer Open, MDPI, PLOS, Frontiers, Wiley Open Access, Cogent and Food and Agriculture Organization of the United Nations (FAO) research information system with the search terms developed based on the theme of coffee production, Mambilla Plateau, Taraba State, Arabica coffee, coffee berry disease, soil fertility, agroforestry, coffee processing and value addition. Sources were selected for inclusion where they were published between 2021 and 2026, were available through open access channels that could be independently verified by a reader, and addressed at least one of the four specific objectives guiding the review. For some themes, however, where site specific literature was scarce, the review was based on studies from similar Arabica growing highland areas in East and Central Africa, where similar broad characteristics of altitude, climate and smallholder farming also exist, and which have been more widely studied. The results from these similar contexts are given as indicative rather than a replacement for site specific data and the review specifically calls for additional primary fieldwork on the Mambilla Plateau itself.

Results were presented thematically, based on the four specific objectives. In the following sections, tables and charts have been created by the author to enable a direct visual comparison of the incidence, severity, nutrient removal and processing results in the various settings discussed. This approach can be used to provide a coherent picture from a "fuzzy" literature, while clearly specifying that the data presented is secondary.

Farming Systems, Soil Fertility and Plant Nutrient Status of Coffee Plantations

Farming Systems on the Mambilla Plateau

Smallholder units with an average of one to five hectares of coffee grown are dominant on the Mambilla Plateau and the majority of these farming units grow them in scattered shade trees or under food crops monocultures, much like other parts of Nigeria where the coffee growing areas are dominated by smallholder farming units (Alli *et al.*, 2021). Soil survey work

conducted on the plateau for cocoa suitability assessment, though focused on a different tree crop, offers useful insight into the general soil environment shared by coffee holdings in the same landscape. A soil profile pit survey conducted across the plateau revealed generally deep soils (more than 150cm) that were sandy clay loam to clay loam and had a moderately to slightly acidic reaction (soil pH range between 5.6 and 6.2) (Osujieke *et al.*, 2025). These are generally desirable for perennial tree crop production, such as coffee (Arabica), with fertility actively managed.

An overriding issue in the broader agroforestry literature is selection of either a full sun or a shade grown coffee system – with the latter being dominated by taller trees that provide the shade. When ecosystem services like enhanced soil structure, water capability, biodiversity conservation, and climate buffering are considered, reviews of agroforestry coffee production systems describe the economic performance of well-managed, shaded systems as being equal to or improved over that of unshaded plantations (Nasiro, 2024). A related review concentrated on the relationship of shade and climate change and found that shaded coffee plantations have more stable microclimates which may help to buffer the plants from the extreme temperatures and variability of rainfall patterns that are occurring with a changing climate, and influence the biochemical content of the harvested coffee beans, as well as pest and disease pressure (Koutouleas *et al.*, 2022). The results indicate that the current shade growing of coffee in the Mambilla Plateau is not as intensive as monoculture coffee growing but seems to be more sustainable for the long term since it does not require the elimination of shade in order to maximize short-term gains.

Soil Fertility Status

Soil fertility across Nigerian farmland in general has been described as under significant pressure from continuous cultivation without adequate replenishment, a pattern that soil testing studies attribute to farmers applying fertilizer without reference to the specific nutrient status of their soil or the nutrient demand of the crop being grown. Similar coffee growing highland areas in East Africa exemplify the general pattern for coffee. The meta-analysis of soil fertility data from the Kagera coffee growing region revealed 70 sites with a good category rating and 3 sites with a moderate category rating, with most soils falling into the moderate category, and not into the good category as many farmers in the region believed, despite local perceptions that the soils were too naturally fertile to need external nutrient inputs (Maro *et al.*, 2024).

Another study on the impact of land use conversion on soil fertility and acidity in a coffee growing district of western Ethiopia reported that the exchangeable cations, cation exchange capacity and base saturation of the forest and coffee farmland were higher than those of the land that was converted to grazing, eucalyptus plantation, and continuous cropland, respectively, but also confirmed reduction in soil pH and essential macronutrients across all land use types studied which the authors attributed to the sustained cultivation pressure without adequate soil management (Regasa *et al.*, 2024). The results in these locations are also relevant for the Mambilla Plateau where the majority of coffee farms are similarly mixed with forest remnants, grazing areas and fields for food crops, and the soil fertility trend of continued cultivation without routine soil testing is also expected to be negative rather than stable, based on the similar evidence.

Plant Nutrient Status & Nutrient Depletion

Coffee is one of the more nutrient demanding perennial tree crops, as compared to annual crops, which are planted seasonally, and which do not have to occupy the same soil for many decades, but continuously use the soil for vegetative growth, flowering and fruit production. According to the Food and Agriculture Organization of the United Nations'

Arabica Coffee Manual, a plantation can lose about 40 kg of nitrogen, 2.2 kg of phosphorus and 53 kg of potassium per tonne of green coffee bean harvested from the soil, which are all nutrients that need replenishment if yields and soil health are to be maintained over time (Agriculture Institute, 2026). In Figure 1, this high ratio of potassium and nitrogen removal to phosphorus is shown.

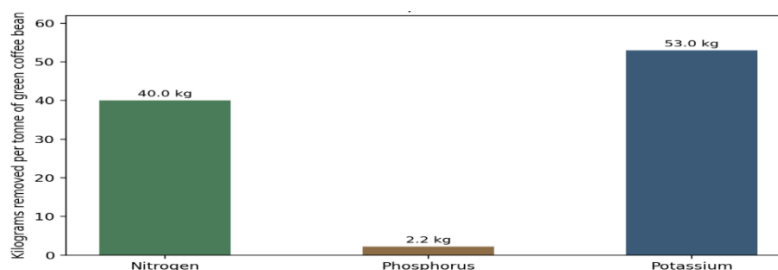


Figure 1: Estimated Nutrient Removal from Soil Per Tonne of Harvested Green Coffee bean (Agriculture Institute, 2026, based on the Food and Agriculture Organization Arabica Coffee Manual)

The study on evaluating sustainable soil fertility management practices by smallholder Arabica coffee farmers in Ibanda Municipality, found that farmers who applied the practice of organic soil fertility management, that is, utilizing mulching, composting and intercropping with nitrogen fixing species had a significantly higher coffee yield as compared to those who practice natural soil fertility management without any external input (Begumisa *et al.*, 2024). This discovery

strengthens the argument of soil fertility management as a continuous and regular activity in the Mambilla Plateau coffee farms as opposed to a reactive and occasional one. Table 1 summarizes the indicative soil fertility rating classes that might assist with extension recommendations for coffee farms in the study area, based on similar highland coffee soil assessment systems.

Table 1: Indicative Soil Fertility Rating Classes for Coffee Growing Soils, Adapted from Comparable Highland Coffee Soil Assessment Frameworks (Maro *Et AL.*, 2024)

Fertility Class	Overall Rating Score	General Soil Description	Recommended Management Response
Poor	0 to 1	Low organic carbon, low cation exchange capacity, strongly acidic reaction	Full recommended fertilizer dose, liming, organic matter incorporation
Marginal	1 to 2	Below average nutrient reserves, moderate acidity	Full to near full fertilizer dose combined with organic amendments
Moderate	2 to 3	Average nutrient reserves typical of many cultivated highland soils	Balanced maintenance fertilization guided by periodic soil testing
Satisfactory	3 to 4	Above average organic carbon and exchangeable cations	Reduced fertilizer rates, focus on maintaining existing fertility
Good	4 to 5	High organic carbon, high cation exchange capacity, near neutral pH	Minimal external inputs, priority on erosion and organic matter conservation

The evidence regarding farming systems and soil fertility suggest that the Mambilla Plateau coffee sector is in a naturally favourable soil and climatic base, but that, without regular soil analysis, fertilizer balance and use of appropriate shade management, it is moving towards a similar downwards fertility trend seen in other highland coffee areas in Africa.

The Implications for Farm Level Practice

For individual coffee farmers on the Mambilla Plateau, the practical implication of this evidence is that soil management cannot be treated as a one-time activity carried out at planting and then largely ignored for the remainder of a tree's productive life, which in the case of Arabica coffee can extend beyond three decades. Even in situations where soil testing is not done often due to cost or access constraints, farmers and extensionists would benefit from targeted fertilizer recommendations, using soil test results to determine the rate for a specific plot, which would enhance yield performance and use of purchased inputs as

demonstrated in Begumisa *et al.* (2024). If soil fertility testing is not possible immediately, visual signs of reduced leaf vigour, smaller berry size and reduced canopy density provide a decent interim indicator for smallholder decision making and the general rule that the nutrients removed at each harvest should be replaced with nitrogen, phosphorus and potassium should be followed. Incorporating the appropriate shade trees as a planned introduction or retention, in combination with this nutrient management, would deal with soil fertility and microclimate regulation and long term farm resilience in one unified and integrated set of farm practices rather than separately and competing to each other.

Incidence and Severity of Major Diseases Affecting Coffee Production

Coffee Berry Disease

Coffee berry disease is an anthracnose disease of green Arabica coffee fruits (Coffee Bean) caused by the fungus *Colletotrichum kahawae*, first identified in Kenya in the early

part of the 20th century and one of the biggest coffee diseases affecting the African continent, causing up to eighty percent losses in susceptible varieties when not properly managed (Adugna, 2023). The direct attack on green immature berries by the disease, unlike the many fungal diseases of coffee which attack the foliage, is one of the main reasons for its economic importance.

A set of recent field surveys from Ethiopia provide examples of the different levels of coffee berry disease that can be found within a specific growing district and season. The authors noted the disease incidences (24.2-45.3 percent) and its severity (23.5-45.2 percent) recorded in a survey of ninety coffee farms from the Seyo Nole district of the West Wellega Zone were the indication of the upward trend of the disease, despite the persistent efforts of its management (Dingeta et al., 2024). Genetic analysis of the pathogen population in the

major coffee-growing regions of Ethiopia has also revealed high pathogen aggressiveness across the country, which makes it difficult to breed disease-resistant Arabica varieties that can withstand the pathogen and makes management strategies tested in one place difficult to extrapolate to another (Alemu et al., 2021).

Losses of up to eighty percent on coffee smallholder farms due to unmanaged disease, reported from studies in Cameroon, indicate that this is not a localized Ethiopian problem, but a production constraint across the continent caused by Arabica coffee disease, namely coffee berry disease (Kacko et al., 2024). The reported incidence and severity data are shown in figure 2 in the different coffee growing districts, which shows the extent of the problem and also the variability between the districts within Ethiopia.

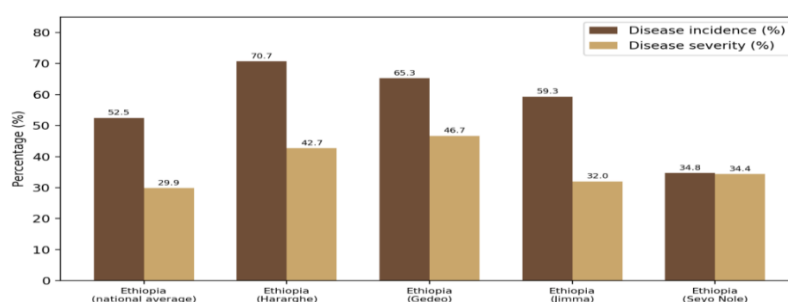


Figure 2: Reported Coffee Berry Disease Incidence and Severity across Selected Coffee Growing Districts (Compiled from Dingeta et al., 2024, and Comparative Ethiopian Regional Survey Data Cited Therein)

Other Major Fungal Diseases

Beyond coffee berry disease, Arabica coffee is affected by several other fungal pathogens with meaningful economic consequences. *Hemileia vastatrix* is a biotrophic fungus which causes coffee leaf rust in more than fifty coffee growing countries worldwide and is regarded as one of the most important fungal diseases of Arabica coffee worldwide (Lu et al., 2022). *Cercospora* leaf spot, also known as brown eye spot, caused by the fungus *Cercospora coffeicola*, is found worldwide in the tropics and subtropics, and is more likely to occur when plants are water-stressed or nutrient deficient, and can cause losses over 30 percent in both leaves and berries (Lu et al., 2022). Finally, there are two other fungal diseases of coffee that are commonly reported: *Fusarium* berry disease caused by *Fusarium* spp., and thread blight caused by *Ceratobasidium* spp., which are basidiomycete fungi. As with coffee leaf rust, these two fungal pathogens have a similar level of agronomic importance, but scientific understanding is still much less advanced, with a full review of these three diseases noting that *Fusarium* berry disease is the most prevalent and least understood of the three diseases (Moreira-Morrillo et al., 2023).

The synergy of these diseases indicates that the main pathogens are seldom encountered alone on a coffee farm, and diagnostic misidentification of the diseases may result in inappropriate or late decision to take action, e.g. when coffee leaf rust becomes apparent in the early stages of the disease, it is misdiagnosed as *Cercospora coffeicola*. This is of direct concern for the Mambilla Plateau since there is apparently a limited formal plant pathology surveillance compared to other similar Arabica growing regions in Africa where formal disease pressure is documented.

Disease Management Approaches

Currently the most readily available management tool for coffee berry disease is fungicide based control. Four fungicide active ingredients namely propiconazole, difenoconazole, azoxystrobin and a combination of chlorothalonil and carbendazim were applied for two seasons consecutively, in smallholder fields in Cameroon, and the results demonstrated efficacy in reducing disease incidence at the branch level and improving yield compared to non-treatments, although the efficacy differed among the active ingredients and application rates (Kacko et al., 2024). The use of certified disease resistant planting material from recognized disease research institutions is also highlighted as an important preventive measure, as there is a significant difference in susceptibility among varieties; some are bred to exhibit enhanced resistance to coffee berry disease in specific agro ecological zones (Mustopha et al., 2022).

In addition to chemical control, shade management is another intervention that could be relevant, given that the microclimate provided by adequate shade management can impact humidity and temperature conditions that influence the development of fungal disease, however, too much or poorly designed shade can, on the other hand, provide advantage for certain fungal pathogens (Koutouleas et al., 2022). The application of fungicides, therefore, is not enough to manage diseases on the Mambilla Plateau and should be combined with variety selection, shade regulation and regular field monitoring as is observed in the reviewed literature in integrated pest and disease management.

Implications for the Mambilla Plateau

A review of the literature revealed that disease surveillance reports specific to the Mambilla Plateau are not formally available in the open literature, a surprising discovery for this study. In the absence of evidence to the contrary, it would be

reasonable to assume the level of disease pressure in the plateau is broadly the same as in other parts of Africa where the diseases of coffee berry disease and coffee leaf rust are usually most prevalent, and the general absence of systematic, documented disease control programmes in the area would increase the possibility that losses due to fungal diseases are not currently being monitored or controlled. To design cost effective and locally appropriate recommendations for disease management, it is necessary to have baseline evidence from a periodical field survey across a representative sample of farms of incidence and severity each season, although for this review this has had to be done by extrapolation from other countries, a process that may have been unsafe.

Coffee Processing, Value Addition and their Influence on Bean Quality and Market Potential

Processing Methods

At the smallholder level, coffee cherries are typically processed using one of three broad methods. The dry method (also called the natural method) consists of picking and separating the fruit from the trees, drying the cherries naturally or artificially, and peeling the dried cherries to reveal the green coffee bean. The wet method uses peeling to take the outer skin off before the wet parchment coffee is fermented for a specific period, washed and dried before it is peeled again to give the green bean. Other intermediate methods, known as honey processed, semi dry or semi washed, are a combination of both methods and have become more prevalent as producers attempt to stand out in specialty market (Agricultural Institute, 2026).

There is a measurable impact on the quality of the bean produced, depending on the method of processing. In Ethiopia, the wet processing methods have been found to yield coffee of higher intrinsic quality than dry processing,

resulting in a more uniform product with fewer defective beans, and this is reflected in the wet processed coffee market prices, which tend to be much higher in international markets as a direct consequence (Tamru & Minten, 2023). A study compared the total raw quality scores of washed, semi washed and natural processed coffees from three growing locations in Ethiopia and consistently showed that washed coffee had the highest total raw quality scores, though the specific ranking between the two washed processing methods fluctuated slightly depending on growing location, suggesting that the processing method interacts with growing location to help determine final quality (Banti & Atlaw, 2024).

Bean Quality and Biochemical Composition

Processing method also interacts with drying method and coffee variety to shape the biochemical composition of the green bean, which in turn influences the sensory characteristics that determine market value. A study conducted in Jimma Zone, southwestern Ethiopia, revealed that the variety, processing method, and drying method had a significant impact on most of the biochemical components of the green bean, suggesting that the quality outcomes were not only dependent on one factor but also on the interaction among the three factors (Eshetu *et al.*, 2022). An extended analysis based on a large database of coffee quality found that processing method and coffee variety influence the sensory attributes in different ways for each coffee type, suggesting that there is more variability associated with processing and/or regional origin for Robusta as compared to Arabica, where specific processing methods tend to create more consistent quality signatures (Teran, 2024). The general quality implications of the three major processing methods reviewed are summarized in Table 2.

Table 2: Comparative Quality Implications of Major Coffee Processing Methods, Compiled from The Reviewed Processing and Quality Literature (Tamru & Minten, 2023; Banti & Atlaw, 2024; Eshetu *Et Al.*, 2022)

Processing Method	Description	General Quality Implication	Relative Market Value
Dry (natural)	Whole cherries dried directly using natural or artificial drying before peeling to expose the green bean	More variable bean quality, higher risk of defects, distinctive fruity or fermented cup notes when done well	Lower to moderate
Wet (washed)	Cherries pulped, wet parchment fermented, then washed and dried before final peeling	More homogenous beans, fewer defects, cleaner and brighter cup characteristics	Higher
Semi washed / honey	Combines partial pulping with elements of natural drying, mucilage left partially intact during drying	Intermediate quality outcomes, can approach washed coffee quality depending on management and location	Moderate to higher

Value Addition and Market Potential

Value addition in coffee is the series of operations that are carried out to convert the harvested cherries into a higher value, more market ready coffee product, which includes both the primary processing steps (pulpation, fermentation, washing, drying, grading etc.) and the secondary processing steps (dry milling, roasting, grinding, packing etc.). A study that broke down the coffee value chain amongst smallholder farmers in Embu and Kirinyaga counties, Central Kenya, revealed that the farmers interviewed practised little value addition (primarily primary processing) through farmer cooperatives, while a small number of farmers participated in the secondary processing of their coffee, which involved roasting and brewing (Wambua *et al.*, 2024).

The situation observed in the farm level in this study is similar to the findings in the Nigerian coffee producing areas where farmers also sell their coffee at lower price despite the fact

that the wet processing, standardization, grading and the production of finished coffee with a premium brand name gives the coffee its higher value (Akinpelu *et al.*, 2021; Alli *et al.*, 2021). This is further complicated by market linkage issues, as smallholders in similar African contexts are likely to have access to poor market price information, poor transport infrastructure and a number of intermediaries between the farm gate and the export markets which further reduce the final sale price farmers receive. (Wambua *et al.*, 2024)

On the Mambilla Plateau, the problem and its solution identified in this review is the existence of a true differentiated product high altitude Arabica coffee with described flavour notes of chocolate, fruit, and floral aromas coupled with the lack of infrastructure for processing and branding coffee downstream. If there is no organized wet or semi washed processing and consistent grading, then the

plateau's Arabica coffee is likely to be sold as a mass-produced commodity which will not capture the price premium of its altitude and growing conditions in the specialty coffee market.

Nigeria's Coffee Market Position

In the global and continental context, the production of coffee in Nigeria is very small compared to the leading Arabica producers like Ethiopia, despite possessing at least one growing environment, the Mambilla Plateau, that can produce truly specialty grade coffee. The problems of coffee marketing among smallholders in Nigeria are repeated, consisting of poor soil fertility, unmanaged plant disease, irregular timing of rainfall, the inability of farmers to access farm inputs, and the fear of the crop not having a sure market once it is ready, thus discouraging the investment in farm maintenance and processing needed for better marketability (Akinpelu *et al.*, 2021). Resolving this cycle will take action

both in the production sector (as discussed in this review, soil fertility and disease management) and the market sector (cooperative organization, quality grading and, ultimately, the type of origin based branding that has enabled other parts of Africa, such as the Arabica countries, to command export prices significantly higher than the price for commodity grade coffee).

Integrated Strategies for Sustainable Coffee Production and Value Addition

As described above, soil fertility decline, disease pressure and inadequate processing capacity are not independent issues but mutually intertwined, as are the strategies identified here – they are not listed as discrete actions, but as a package of interventions. The main challenges identified, along with strategies and their expected outcomes, are summarized in Table 3 for the three themes of this review.

Table 3: Integrated Framework Linking Identified Challenges to Recommended Strategies for The Mambilla Plateau Coffee Subsector, compiled by The Author from The Themes Addressed in This Review

Identified Challenge	Recommended Integrated Strategy	Expected Outcome
Declining soil fertility and nutrient depletion	Routine soil testing, balanced nitrogen, phosphorus and potassium replenishment, organic matter incorporation through mulching and composting	Restored nutrient reserves, improved plant vigour and yield stability
Unshaded or poorly structured farming systems	Structured agroforestry with appropriate shade tree species integrated into existing mixed farms	Improved microclimate, soil conservation, climate resilience and bean quality
Coffee berry disease and related fungal pathogens	Certified resistant planting material, routine field surveillance, targeted fungicide application, shade regulation	Reduced incidence and severity, more stable cherry yield
Dominance of low value dry processing	Cooperative investment in shared wet or semi washed processing infrastructure and grading systems	Higher and more consistent bean quality, improved price capture
Weak market linkage and limited value addition	Farmer cooperative strengthening, roasting and brewing skills training, branding of Mambilla Plateau Arabica as a distinct origin	Greater farmer share of final sale value, stronger market positioning
Limited site specific evidence for the study area	Dedicated field research on Mambilla Plateau soils, disease pressure and processing practices	Locally validated recommendations replacing extrapolation from other regions

There are three cross cutting priorities identified from this review, in addition to the specific technical measures outlined in Table 3. The first is the need for site specific baseline research on the Mambilla Plateau itself, since much of the quantitative evidence drawn upon in this review originates from comparable but distinct East and Central African settings, and confirming whether similar patterns of soil fertility decline, disease incidence and processing gaps hold true locally would considerably strengthen the case for targeted intervention. This would greatly enhance the argument for targeted intervention. The second is farmer organisation, as the literature on value chains reviewed consistently reveals that farmer groups or cooperatives are the ones that enable smallholder farm households to access shared processing facilities, training and market information that is too expensive or otherwise unavailable for individual households. The third is deliberate brand and market positioning of Mambilla Plateau Arabica as a high altitude specialty coffee; a strategy which would enable the plateau to be perceived as a coffee of quality and origin, not just volume, and which has been adopted by other highland coffee-producing regions in Africa, to drive export value.

CONCLUSION

The Mambilla Plateau has the topographic, climatic and soil conditions favorable for the cultivation of Arabica coffee, with the coffee subsector in the study area still not performing up to its natural potentials. It has been found from the literature accessed in Nigeria and similar highland coffee producing areas of Africa that soil fertility on such farms is likely to deteriorate over time when there is no routine soil testing, and balanced nutrients replacement. Also, coffee berry disease and other fungal diseases can cause significant and variable losses of production when surveillance and integrated control systems are poor. In addition, it is revealed that simple dry methods of processing dominate over wet or semi-washed methods as this leaves a lot of bean quality and market value left un-realized.

None of these three constraints can be dealt with in isolation, for soil fertility is one stage in a production system, while plant health and post-harvest quality are linked stages in the same production system. The proposed integrated approach for soil testing coupled with nutrient management, agroforestry with shade trees, coordinated disease management and cooperative based processing investment along with deliberate market positioning in this review provides a coherent foundation to revitalise coffee production

and value addition on the Mambilla Plateau. Realising this potential will, however, depend on site specific field research to confirm the extent to which patterns documented elsewhere in Africa apply locally, together with sustained investment in farmer organisation, extension services and processing infrastructure specific to the study area.

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