Harnessing the Power of Geographical Indication for Tanzanian Coffee: Unique Attributes and Farmer Perspectives

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Abstract: *Geographical Indication (GI) labelling is gaining recognition in global markets due to the increasing demand for high-quality food products. This study examines Kilimanjaro coffee as a potential GI product by analysing its unique attributes and the factors influencing producers' awareness of these characteristics. The primary problem addressed is the underutilization of GI labelling for Tanzanian coffee despite its distinctive quality, which limits economic benefits for smallholder farmers. The study employs a mixed-method approach, incorporating both qualitative and quantitative techniques. A structured household survey was conducted with 150 coffee-producing households and 40 coffee sellers in the Kilimanjaro region. Additionally, key informant interviews with stakeholders such as the Tanzania Coffee Board, Kilimanjaro Native Cooperative Union, and agricultural officers provided further insights. A chi-square test was used to determine the relationship between coffee attributes and geographical factors, while a logit model assessed factors influencing producers' awareness of unique coffee characteristics. Results indicate that Kilimanjaro coffee possesses unique attributes such as a distinct aroma, rich acidity, and a balanced sweet-bitter flavour due to volcanic soil and favourable climatic conditions. The chi-square test confirmed that these attributes are significantly linked to geographical factors. The logit model results show that producers' awareness is influenced by access to markets, knowledge of processing methods, perception of geographical characteristics, and access to extension services. However, awareness of GI labelling remains low, with only 20% of participants familiar with the concept. The study concludes that GI certification could enhance the value of Kilimanjaro coffee, ensuring better market positioning and economic benefits for smallholder farmers. It recommends targeted educational campaigns to raise awareness of GI benefits, policy interventions to facilitate GI registration, and market strategies to promote Tanzanian coffee globally.*

Keywords: Geographical Indications, Coffee, Kilimanjaro, Unique attributes, Tanzania

1. Introduction

Geographical indication (GI) is based on the link between a product and its geographical and human environment (Giovannucci *et al*., 2009). It is a sign used on products with a specific geographical origin, possessing qualities and a reputation essentially (Protected Geographical Indications—PGI) or exclusively (Protected Designation of Origin—PDO) due to spatially embedded natural and human factors (De Filippis *et al*. 2022). GI use has successfully provided consumers with information regarding product attributes, especially for consumers in China and the EU (John, 2023a). GI was recognised as a

particular form of intellectual property by the World Trade Organisation (WTO) in 1994. The backbone of GIs is the Paris Convention for the Protection of Industrial Property of 1883, the Madrid Agreement of 1891, the Lisbon Agreement for the Protection of Appellations of Origin and Their International Registration of 1958, and the World Intellectual Property Organization (WIPO) (Mwakaje, 2021). The African Union's Continental Strategy for Geographical Indications in Africa (2017–2022) and the Comprehensive Africa Agriculture Development Programme (CAADP), now an Agenda 2063 continental initiative, provide a context for encouraging the wise use of market forces and thus market instruments such as GIs that aim to improve trade-related capacities for market access in Africa.[1]

The African Union developed the continental strategy for geographical indications in Africa 2018–2023, which aimed to identify potential GIs in Africa and how they can support food security, sustainable rural development, and encourage trade that can lead to economic growth on the continent (AU, 2017). GIs in Africa have been included in the African Intellectual Property Organization's (OAPI) legal framework for IP since the 1977 Bangui Agreement (revised in 1999). Under the Bangui agreement (Annex VI), GIs are protected through a sui generis system (OAPI, 1999). Africa is endowed with many potential GI products, the first having been identified in Cameroon (Penja pepper and Oku white honey) and Guinea-Conakry and (Ziama-Macenta coffee) (Chabrol *et al*., 2017). Several African countries have identified potential GI products and established characterisations for registration, with an increasing number of registered products. Teuber (2010) and Teuber & Herrmann (2012) reported that increasingly developing countries are establishing legal systems to protect this intellectual property. The legally registered GIs appear in forms such as "Protected Designation of Origin" (PDO), "Traditional Specialty Guaranteed" (TSG), and "Protected Geographical Indication" (PGI) (Giovannucci *et al*., 2009).

Coffee is among the products whose potential for GI has been realised, with consumers valuing the traceability of their coffee. Several studies have estimated the effect of coffee's origin on its price and the trade potential this product holds (Teuber & Herrmann, 2012; Donnet *et al*. 2010). Barjolle *et al*. (2017) showed that coffee cultivated in Colombia was protected through the Community Trademark (CTM) and PGI in Europe and the Certification Mark (CM) and Trademark (TM) in the US. In the same way, Hughes (2012) reported that coffee from Ethiopia, i.e., Sidamo and Yirgacheffe coffee, was protected in Europe and the US with price gains for coffees due to the place of origin factor. The ability of a country to produce a particular good (like coffee) at a higher quality than other countries provides a country with a comparative advantage, which is beneficial to the producers of that commodity (Worku, 2023; Markos *et al*., 2023)

Tanzania has various high-quality agricultural products, such as coffee, tea, rice, avocados, aloe vera, and spices. Coffee is the second highest-valued agricultural export cash crop in the economy after tobacco, grown by most small-scale producers. In 2023 it accounted for 24% of the country's foreign exchange earnings (Zani and Rwegasira, 2023). Coffee quality (taste, aroma, colour) differs from location to location; the northern coffees tend to be pleasant in aroma, rich in acidity and body, with balanced flavours due to the mineral nutrients from volcanic soils that have most buyers' interest (John *et al*., 2020; John *et*

[1] While the EU Quality Regime (which includes the EU GI regime) is part of the taxpayer-funded EU CAP, Africa has no [taxpayer-funded] CAP; instead, Africa has CAADP, which is a very different story.

al., 2016). A medium body and delicate acidity with pleasing fruity and floral aromas characterise Southern coffees (John, 2023b). About 90 percent, of the Tanzanian coffee is exported (TCB, 2021). According to the Tanzania Coffee Board (TCB), average national production is estimated to range between 30-40,000 metric tons per annum; 70 percent of the total national production is Arabica, and 30 percent is Robusta (Mhando, 2019) (Figure S2).

This paper focuses on Arabica coffee grown in the Kilimanjaro region for two reasons: Firstly, Kilimanjaro coffee has a very high-quality reputation in the domestic and international markets, with distinctive quality attributes linked to the volcanic soils where it is produced compared to other coffees grown in the country. Secondly, although it has a good reputation within a well-established coffee market, the producers have yet to enjoy the full benefit due to the low coffee prices and high running costs faced by the Kilimanjaro household farmers. In the 2020/21 financial year, the export price for a 50-kilogram bag of dry coffee beans in Tanzania rose to approximately $186.17, up from $130 in the previous season, marking a 30% increase.[2] As of January 2025, coffee prices have continued to rise, with a 6.99% increase since the beginning of the year, reaching 342.91 US cents per pound.[3] Despite these price increases, Tanzanian coffee producers, especially smallholder farmers in regions like Kilimanjaro, often face challenges in fully benefiting from favourable market conditions. Factors such as high production costs, limited access to markets, and fluctuating global prices can erode profit margins, underscoring the need for strategies like geographical branding to enhance the value and recognition of Tanzanian coffee in the global market. The quantity of coffee produced in the Kilimanjaro region is low compared to other areas of Tanzania, such as Songwe and Ruvuma. Still, it is known to be the highest quality compared to different coffees produced in the country (John, 2023b). Figure S1 shows production in Kilimanjaro in 2018/19 compared to other regions (TCB, 2019).

This paper explores coffee's geographical indication (GI) potential in Kilimanjaro, Tanzania. The article contributes to the ongoing GI debate, where developed countries have gained from labelling their products. GI Understanding the benefits can enable agricultural producers to produce high-quality products and label them using GI since quality products are constantly being demanded by consumers, ensuring high earnings for the producers and Tanzania's economy. Therefore, evidence is required to substantiate the potential of Kilimanjaro coffee as a potential GI. The paper focuses on two key research questions: (i) What are the unique attributes of Kilimanjaro coffee (ii) What factors influence the producers' awareness of unique coffee attributes?

2. Methodology

2.1 Study Site

This study employs a case study methodology, with fieldwork conducted between 2017 and 2018. The research concentrated on both urban and rural coffee farms located in the Kilimanjaro region, which spans an area of 13,250 km² (5,120 sq. mi) and is recognized for its coffee and horticultural production. Specific districts were intentionally selected based on data provided by regional agricultural officers regarding the production levels of indigenous

[2] https://www.tridge.com/news/tanzania-coffee-prices-up-by-30pc-as-global-produc?utm_source=chatgpt.com
[3] https://tradingeconomics.com/commodity/coffee

crops in these locales. The primary districts noted for coffee production include Moshi District and Hai District. Within Moshi District, the study specifically targeted the Uru, Marangu, and Kibosho wards, while Hai District was represented by the Masama ward.

The "Kilimanjaro" coffee is primarily grown in the rural areas of Moshi, with the most significant coffee-producing villages being Uru, Kilema, Kibosho, Machame, and Old Moshi. The Rombo district, adjacent to Mount Kilimanjaro and bordering Kenya, ranks second in coffee production within the region, followed by Hai, Mwanga, and Same districts. Notably, Kilema Village is recognized for its practice of selling organic coffee directly to international buyers, such as those in Japan, with whom they maintain contractual agreements for their coffee supply.

2.2 Data Collection

A mixed-methods approach was adopted, using both qualitative and quantitative methods to assess the various attributes of Kilimanjaro coffee and the perspectives of producers and sellers. The household survey used a semi-structured questionnaire administered in a face-to-face interview and included some farm-level observations. The sample was randomly selected from 150 coffee-producing households and 40 coffee sellers with a clear selection of households only involved in the cultivation of coffee. Questionnaires were administered in person at the household's home. This survey directly informed of the awareness the households had of the qualities of the coffee, the history of coffee production in the region with an understanding of the environment, their marketing strategies and challenges, the progress made along the coffee value chain for its development and while providing important contextual information about the impact on livelihood.

The study was supplemented by detailed interviews with key informants from institutions, including the Kilimanjaro Native Cooperative Union (KNCU), the Tanzania Coffee Board (TCB), Tanzania Coffee Research Institute (TaCRI), coffee estate producers, and district and village agricultural officers. Moreover, focus group discussions were held at Uru, Marangu, and Hai. The groups included 8 to 15 producers, with females representing 42% of the participants taking 45 minutes to 2 hours. Larger meetings took longer to allow all who wished to contribute an opportunity to speak. Discussions were done in Kiswahili. Some of the villager's groups allowed themselves to be recorded. For groups that were not happy with the audio recording, notes were taken by the researcher and the assistant to allow triangulation of notes for a more complete record of the meetings. The meeting facilitator created a good rapport with the participants, asking women for their opinions if they did not speak up.

The FGDs asked participants to list the qualities of coffee after clearly describing what GI is. They were further asked if they could associate those qualities with the environment. To understand their market perspective, they explained the market trend for coffee over the years and how production has changed. At the end of the meetings, we asked if they would agree on collective action if GI were implemented to offset the market problems and create a more holistic negotiating environment. Secondary data were sourced from various documented materials and reports from TCB, the International Trade Centre (ITC), published journal articles, and grey literature.

2.3 Empirical Model

A descriptive analysis of the characteristics was conducted to investigate the unique characteristics of Kilimanjaro coffee and the factors influencing the key characteristics of coffee attributes. At the same time, a logit regression model was used to analyse the factors influencing these attributes. Logistic analysis has been widely used in economics to evaluate the characteristics of agri-food products from the producer, and a logit model from a survey of households was used to identify variables that had a more significant influence on the decision to participate in quality labels based on geographical indication. They found that the information on the geographical characteristics provided on the label linked to geographical origin presents a significant difference. Furthermore, regional context also explains the degree of acceptance of each product. Ngokkuen & Grote (2012) also used a logit model analysis to identify factors likely to predict the behaviour of rice households in Thung Kula Rong-Hai who are adopting GI certification. The authors indicated that institutional and social factors such as information on product quality sourced from different entities and membership in a cooperative influence the awareness of GI certification. Similarly, using the logit model, Das (2009) investigated whether registered GI products provide an enhanced premium price to producers and traders. With a logit model, the study found that benefits go to the producers in terms of higher prices due to an increase in consumers' willingness to pay for quality products. This could potentially improve the welfare of the producers in terms of higher gains from their activities.

2.3.1 Logit model

The logit model with two categories in the dependent variable is based on the normal probability distribution. The dependent variable has a value of zero when no outcome occurs and a value of one when an outcome occurs. The outcomes of **y** are mutually exclusive and exhaustive. Data were generated from a random sample of 150 observations denoted by *i = 1…. N.* Thus, the observations of y must be statistically independent of each other to rule out serial correlation. The Logit model explains the conditional distribution of the discrete variable. The Logit model was selected since the goal is set as a binomial-type decision or dependent variables tied to a set of independent variables (Greene, 2012). The logit model is often appealing because it does not make the unrealistic assumption that irrelevant alternatives are independent (Papke & Woolridge, 1993). The specification of the logit model equation is presented in Equation 1:

$$L_i\,(Y) = \ln\left[\frac{P_i}{1 - P_i}\right] = \beta_0 + \beta_k X$$

$$L_i\,(Y) = \beta_0 + \beta_1\, x_i + \varepsilon_i \qquad (1)$$

where; Y_i be the observed response for the ith household with 1 for aware of unique attributes and 0 otherwise. x_i is a list of independent variables: level of education, income, gender, the number of years the respondent had resided in the village or region, employment or occupation, size of land area, price, marketing of the product, household size, and member of cooperative and GI awareness. β_0 Is an intercept, $\beta_i\, are\, the$ magnitudes of the estimated coefficients and ε_i is the error term. With attributes as factors that influence prices, the logit analysis method is a useful approach to studying the factors

that influence producers' awareness of the unique attributes of coffee. Regression diagnostics were applied to detect the interaction effects, pairwise correlations, and other specification errors.

The logit model offers several advantages in studying Kilimanjaro coffee attributes, particularly in analysing producers' awareness of unique coffee characteristics. It effectively handles binary outcomes, making it suitable for this type of analysis. The model's estimated coefficients can be interpreted in terms of odds ratios, providing valuable insights into the influence of independent variables on awareness. Additionally, its flexibility in accommodating various predictor variables allows for a comprehensive understanding of the factors shaping awareness. Unlike multinomial logit models, it does not assume the Independence of Irrelevant Alternatives (IIA), making it a more realistic approach. Moreover, the logit model does not require normal distribution assumptions, ensuring robustness when working with diverse datasets.

However, the logit model has some limitations. It assumes a linear relationship between the log odds of the dependent variable and independent variables, which may not always hold in practice. Unobserved heterogeneity can lead to biased estimates if key influencing factors are not included in the model. Additionally, the model requires large sample sizes for reliable results, making it less effective when data is limited. While odds ratios provide useful insights, they can be difficult for non-experts to interpret. Lastly, multicollinearity among independent variables can distort coefficient estimates, affecting the reliability of findings.

3. Results and Discussion

3.1 Descriptive Statistics of Key Variables

Table 1 presents the summary of the variables used in the analysis. It was found that 81% of the households were aware of the unique characteristics of coffee. Out of this percentage, 67% were men with an average age of 52 with significant coffee cultivation experience. Understanding the product's characteristics and long-standing reputation was mainly linked to people of higher age who were also the primary consumers of coffee. Other key factors include marital status, where the majority were married, with at least 62% being literate. Most of the respondents were involved in agricultural activities as their primary occupation.

Additionally, most coffee households were members of either a coffee group or the Kilimanjaro Native Cooperative Union (KNCU). Most of the coffee households—about 66%—are members of a group or community-based organisation that has helped them produce more quality coffee. Thereby, they can earn a higher price and conduct direct exports of their coffee (organic coffee). Most coffee households (49.3%) were members of KNCU, the primary coffee cooperative before TCB was established in 2001. With KNCU, the prices were low after the government took ownership in 1967 during socialism, and since then, coffee prices from KNCU have been very low compared to households who sell at TCB. The other group (16.7%) of households called themselves the primary group, *"chama cha msingi"*, which is organized and controlled by village members. Most of them sell their coffee

directly to TCB by acquiring a selling permit, which enables them to earn a relatively higher price than the price offered by KNCU. This was not the case for all households on Kilimanjaro because only a few areas were united. Moreover, efforts were made by the village officers to ensure that all households could join such groups.

The third category comprised households that were not in any group (about 34%). They had reasons for not being part of any group association. Some claimed that the village office dealing with agricultural activities was not well established to give them the support they needed to form groups. Some of the benefits mentioned by the producer groups were training in good farming and processing methods, which allowed them to produce more and obtain quality coffee that was highly rated in the market. They received organic fertilisers like "*Minjingu*". They were taught better ways to control coffee diseases such as coffee rust by using "cow urine," which enabled them to produce coffee free from chemicals, hence organic farming. They also received higher prices for their produce because of the collective bargaining power they had and upon late payment. They could get loans that enabled them to buy inputs and employ labourers.

Access to the market where households could sell their produce was of utmost importance, as it determined the prices they obtained. Of the surveyed households, 58 percent had market access, but at least 90 percent believed that they received a better price because their coffee was of high quality and grade. The majority of households obtained information from extension offices, which makes extension an essential factor in increasing awareness about the unique characteristics of coffee. At least 54 percent of households had access to extension services.

How the crops were managed and processed significantly impacted the quality of coffee. At least 66 percent of the households knew the best processing methods influencing the coffee attributes. Moreover, among other factors, 61 percent of them linked these attributes to the geographical characteristics of the region where the coffee was being produced. However, most coffee households were unaware of the concept of GI.

The study revealed that only 20% of the participants were familiar with the Geographical Indication (GI) concept despite being aware of the distinct features of Kilimanjaro coffee linked to its origin. When the EU logos were shown and asked if they had seen the symbols used to identify a GI product, only 2% of the respondents recognised the logo, whereas the remaining 98% had never come across it. This implies that most people lacked knowledge about GI and needed to be educated on the subject. However, 80% of the participants were aware of the distinctive traits of coffee, such as its ability to be traced back to a specific geographical location.

Table 1: Descriptive statistics

Variable name	Description	Mean	Std. Dev.	Min	Max
Awareness	Producer's awareness of unique coffee attributes.	0.813	0.391	0	1
Gender	Gender of household: one if male	0.673	0.471	0	1
Age	Age of household	52.653	10.593	19	79
Marital status	1 if married	0.807	0.396	0	1
Education	1 if have attained some level of education	0.62	0.487	0	1
Occupation	1 if on-farm	0.82	0.385	0	1
Member of cooperative	if a member of Coffee Cooperative 1 if yes	0.753	0.433	0	1
Market access	1 if has access to markets	0.587	0.494	0	1
Extension services	1 if access extension services	0.547	0.499	0	1
Price perception	1 if better perception of the coffee price	0.9	0.301	0	1
Processing	1 if knowledge of processing methods	0.667	0.473	0	1
Perception Geographical characteristics	1 if geographical characteristics influence product quality	0.613	0.489	0	1
Aware of the GI concept	Meaning of Geographical indication	0.2	0.401	0	1
Trading of commodity	1 if understanding of the trading of the commodity	0.66	0.475	0	1

3.2 Product Unique Characteristics

The households were asked to identify and describe the unique characteristics of Kilimanjaro coffee compared to other coffee products in Tanzania. Establishing the product's potential as a GI (Geographical Indication) product by linking the producer's perspective with market awareness of the product is important. The results indicated that the households recognised the special attributes of their products that make them unique as GI products. 82% of the respondents believed that Kilimanjaro coffee is unique compared to other regions.

When asked to rank the different attributes of Kilimanjaro coffee, producers highly ranked its aroma (52%), followed by its richness in acidity and body (23%), sweet-bitter taste (11%), and that it was organically farmed (15%) (Figure 1). Tanzanian coffee varies by region, with northern coffees being pleasant in aroma, rich in acidity, sweet-tasting, and balanced in flavour due to mineral nutrients from volcanic soils. Buyers are particularly interested in these attributes. On the other hand, Southern coffees are distinguished by their medium size, fine acidity, and fruity and floral aromatic flavour. Coffee beans are handpicked, traditionally wet-processed, and sun-dried on patios. The refinement of this traditional method has often been associated with excellent cup results throughout the years. From the survey, 29% of respondents noted that the product has a high reputation in the market among both consumers and sellers.

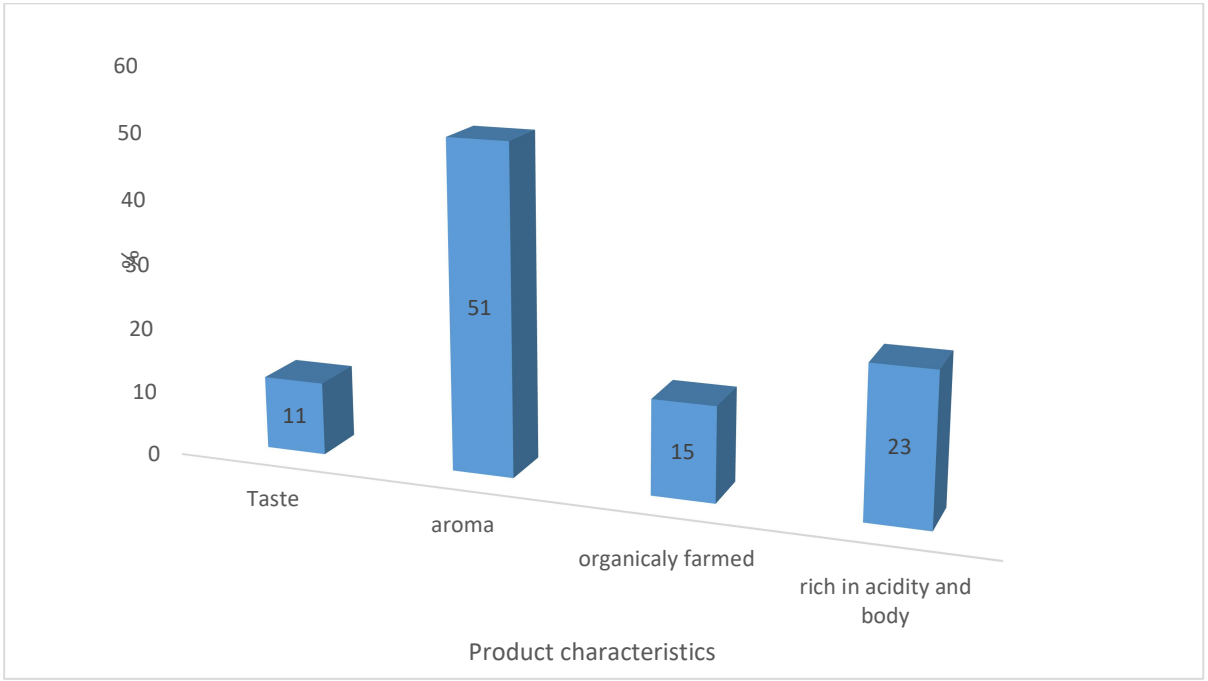

Figure 2: Product characteristics

After surveying several producers about what made their coffee high quality, the responses were as follows: 50% of the producers believed that the volcanic soil played a significant role, 14% attributed it to the processing methods (from harvesting to roasting of the beans), 11% credited organic farming and 25% believed that the climatic conditions were the most important factor (Figure 2). The volcanic soil was perceived as the most important factor, followed by the climatic conditions. The producers attributed this to the water flowing from Mount Kilimanjaro. According to the respondents, the quality of coffee and

other crops grown on the slopes of Mount Kilimanjaro is positively influenced by geographical factors such as climatic conditions, the level of nutrients in the soil, traditional production techniques, and local knowledge. The "volcanic soil" is rich in minerals, and the water flowing from Mount Kilimanjaro also contributes to the unique attributes of crops such as aloe vera, sugar, plantains, beans, maize, rice, and potatoes.

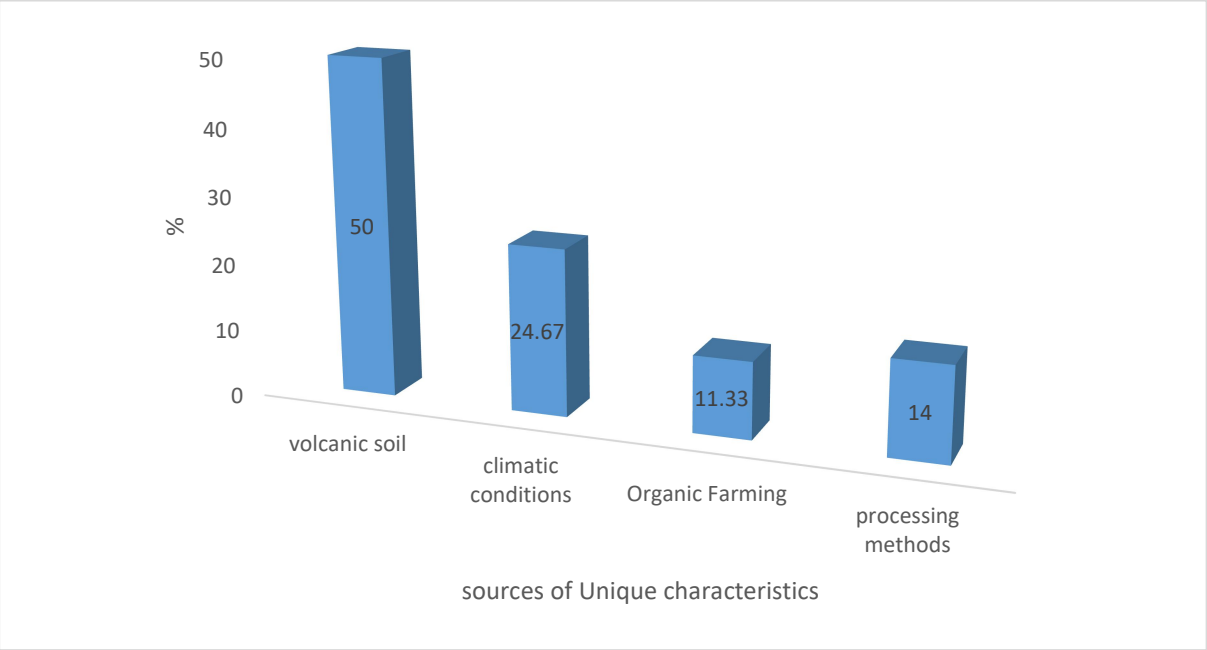

Figure 3: Sources of product characteristics

3.3 Qualitative Analysis of the Geographical Link

According to the results of a qualitative study that involved in-depth discussions with informants, the highest quality coffee is grown on Mount Kilimanjaro (TACRI). The respondents interviewed agreed with this finding. Most producers believe that the coffee produced in Kilimanjaro is of high quality and attribute this to the volcanic soil. They explained that the soil is rich in minerals, particularly potassium, which allows households to produce coffee organically without using chemical fertilisers. Additionally, they noted that the climate in Kilimanjaro provides a favourable environment for coffee production.

> *The region's weather conditions, volcanic soil, and water flow from Kilimanjaro primarily determine the quality of Kilimanjaro coffee. Some people believe they can grow the same coffee plant in other areas and achieve the same quality as ours. However, volcanic soil is a crucial geographical factor that contributes to the unique taste of Kilimanjaro coffee (150730_003).*

The quality of coffee is also influenced by the processing methods used. To ensure high quality, only fully ripe red cherries are handpicked to avoid mixing them with green or overripe beans. After harvesting, the beans go through various processing stages before being sold. The coffee cherries are first spread out on threshing floors to sun-dry for a few days before hulling the beans and parchment to obtain "natural" green coffees. Then, wet processing involves pulping the fruit to release the seeds in their parchment from the hulls. The seeds are then fermented or "washed" to initiate a series of chemical reactions that

improve the aromatic and flavour qualities of the coffee. The beans are sun-dried, polished, sorted to weed out defective ones, and graded based on size, shape, and colour. They are then ready for selection and shipment.

> *"Processing methods vary from one person to another, depending on the knowledge one has. The wet processing and drying of the coffee beans are the key factors that maintain coffee quality after harvesting".*

Coffee undergoes a series of quality control tests to ensure its quality. These tests detect and eliminate defective beans and involve cupping and grading (classification) to select green coffees that meet the specified quality and taste requirements. This process is essential to ensure good quality coffee.

3.4 Link between the Geographical Characteristics and the Product Attribute

A test was conducted to determine the link between coffee's aroma, acidity, body, taste, and organic attributes with its production area's geographical characteristics. The idea behind this was to establish if the various attributes of coffee are connected to the area where it is grown, which includes factors such as climate, soil, temperature, latitude, rainfall pattern, and processing and production methods. This link is crucial in establishing a product as a potential Geographic Indicator (GI). To test this, we used the chi-square independence test, and the null hypothesis was that the product attributes are independent of the geographical characteristics, as shown in Table 2.

Table 2: Chi-square of Product and Geographical attributes.

Variables	Pearson Chi-Square (df)
Climate	0.013 (9) **
Production Method	0.001 (6) ***
Rainfall	0.365(9)
Soil	0.025(9) **
Processing method	0.185(3)
Breed/ Variety	0.034(6) **
Organic inputs	0.767(3)
Harvesting method.	0.998(3)

*** Significant at 1%, and **Significant at 5%

Based on the results in Table 2, we reject all the null hypotheses that product attributes are independent of geographical characteristics. This means that there is strong evidence that the product attributes are, in fact, dependent on geographical attributes. This finding further strengthens the argument for the quality of Kilimanjaro Coffee.

3.5 Factors Influencing Producer Awareness of Product Attributes

The results of the logit model on the factors influencing the producer's awareness of unique coffee attributes are presented in Table 3. The regression coefficients indicate that factors such as occupation, market access, extension services, knowledge of processing methods, trading of the commodity, and perception of the geographical characteristics have

a significant impact on the producer's awareness of unique characteristics at the significance level of 10%, 5%, and 1%. On the other hand, all other factors appear to be insignificant.

The analysis shows that occupation has a negative and statistically significant effect at a 5% level. This suggests that the probability of a producer being aware of the unique characteristics of their product decreases if they are solely engaged in farming activities, compared to those who engage in more than just farming. Access to the market, on the other hand, is believed to influence producers' awareness of their product's key characteristics. This is due to Kilimanjaro Coffee's reputation in the market over time. GI certification has significantly contributed to the marketing of coffee in different countries by providing necessary information about product characteristics and specificity related to the origin-linked product. The most significant constraint for coffee trade production lies in the existing international marketing channels. Consumers already pay premium prices for the uniqueness of the product, so increasing the prices further may not be feasible. However, expanding the trade base can provide more channels for producers to sell their products (Maina *et al*., 2018). Tanzania can protect its specialty coffee through GI certification, which increases the nation's income and adds a premium to the producers, resulting in a welfare impact. To establish the potential in Tanzania, high-quality coffee needs to be identified and linked to the area where it is produced, as in the case of Kilimanjaro. Tanzania can learn from several key attributes of coffee and establish similar potential (see Table S1).

Table 3: Marginal effects of logit results

Variable	**dy/dx**	**Std. Err.**	**P>z**
Gender	0.0281	0.0526	0.5930
Age	-0.0002	0.0020	0.9030
Marital status	0.0135	0.0582	0.8160
Education	0.0177	0.0511	0.7290
Occupation	-0.0924**	0.0397	0.0200
Member of cooperative	0.0674	0.0699	0.3350
Market access	0.2704***	0.0822	0.0010
Extension services	0.0982*	0.0503	0.0510
Household Price perceptions	0.1684	0.1447	0.2450
Processing	0.2574**	0.1228	0.0360
Perception Geographical characteristics	0.1159***	0.0442	0.0090
Aware of the GI concept	0.0082	0.0589	0.8890
Trading of commodity	0.2147**	0.0870	0.0140

*** Significant at 1%, **Significant at 5%, and *Significant at 10%

In addition, the availability of information on a commodity's trading is linked to an increase in awareness of its uniqueness compared to similar products. A study by De Filippis *et al*., (2022) found that Geographical Indications (GIs) positively impact trade, as they support international trade and help resolve controversies among countries over their certification. The study also confirmed that GI certification leads to increased trade for both intra- and extra-EU countries, as well as for China, which has the highest number of registered GIs and uses two distinct regimes: collective trademarks and sui generis rights (Ferrante, 2021). GI certification provides the user with the right to protect the registered GI

on specified goods, and it enables the producer to control prices, i.e., charge premium prices that enhance profits. The presence of GIs in the EU has positively impacted the export markets' extensive and intensive trade margins. They affect export prices, which consumers associate with higher-quality products (Ferrante, 2021).

Numerous studies, including those by John *et al*. (2020) and Lee *et al*. (2020), have identified the importance of information. In particular, extension services information has played a crucial role in increasing coffee producers' awareness about their product's uniqueness. The results of this study are consistent with those of (Ramos *et al*. (2015), which found a 12% increase in producer awareness due to improved understanding of geographical characteristics. One of the hypotheses explored in this analysis is that using GI labelling with geographical information could enhance awareness among both consumers and producers.

Additionally, knowledge of the processing method has increased awareness of unique product characteristics, as proper handling is vital for maintaining the best aroma in coffee. Well-managed products that have undergone quality assurance processes can positively impact product characteristics and increase the value of coffee. The use of GI as an instrument to add value to alliances of producers in a region is also discussed.

4. Conclusion

This research underscores the potential of Kilimanjaro coffee as a Geographical Indication (GI) product, highlighting its distinctive characteristics and the level of awareness among producers. In alignment with prior studies, our results affirm that terror-related factors, including soil characteristics, elevation, and climatic conditions, play a crucial role in determining coffee quality. However, this investigation contributes to the existing literature by offering empirical insights into farmers' views on GI branding, an area that has received limited attention within the Tanzanian coffee industry. From an empirical standpoint, this study identifies the essential features that set Kilimanjaro coffee apart in the international market. It also sheds light on producers' awareness levels and their perceived advantages of GI protection. Theoretically, the research enhances the discourse on geographical branding by connecting strategies for product differentiation with the economic benefits available to smallholder farmers.

Nevertheless, the study is not without its limitations. Constraints related to data and the specific regional focus may restrict the applicability of the findings to other coffee-producing areas. Moreover, the emphasis on producer awareness neglects consumer viewpoints, which are vital for evaluating market acceptance. Future investigations should delve into consumer attitudes towards Kilimanjaro coffee as a GI product and examine the economic ramifications of GI certification on farmers' incomes. Additionally, comparative analyses with other coffee-producing regions could yield broader insights into the role of GI branding in promoting competitiveness and sustainability within the coffee industry.

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Declaration of Competing Interest

The author declares that she has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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SUPPLEMENTARY MATERIAL

A. Supplementary Table

Table S1: GI registered and potential coffee

Coffee/country	Attributes	Certification
Colombia Coffee	In the mouth, it combines animal aromas with a remarkably fresh flavour.	Certification Mark (CM)
Ethiopian coffee	Shape and organoleptic qualities	No GI certification
Ziama Mount in Guinea Forest	Tart and slightly bitter taste, high aromatic intensity, and a persistent aroma; strong and fine. These characteristics relate to the soil and microclimate around Ziama Mount in Guinea Forest.	GI certified in 2014
Kilimanjaro Coffee-Tanzania	Aroma, richness in acidity, and a pleasant, sweet-bitter taste. The volcanic soil is perceived as the most important source influencing quality, followed by the climatic conditions, linked to the water flowing from Mt. Kilimanjaro.	No GI certification,
Coffee Robusta Temanggung, Indonesia	Physical characteristics, taste, cultivation techniques, as well as its harvesting and processing methods	GI certified in 2016
Kintamani Bali Arabica Coffee, Indonesia	Unique taste	GI certified in 2008
Kenyan Coffee	Rich floral flavour, acidic and sharp.	There is no GI certification, but there is a bill for GI.
Burundi Coffee	full body, bright acidity, and sweet flavour	In the process of registration

B. Supplementary Figures

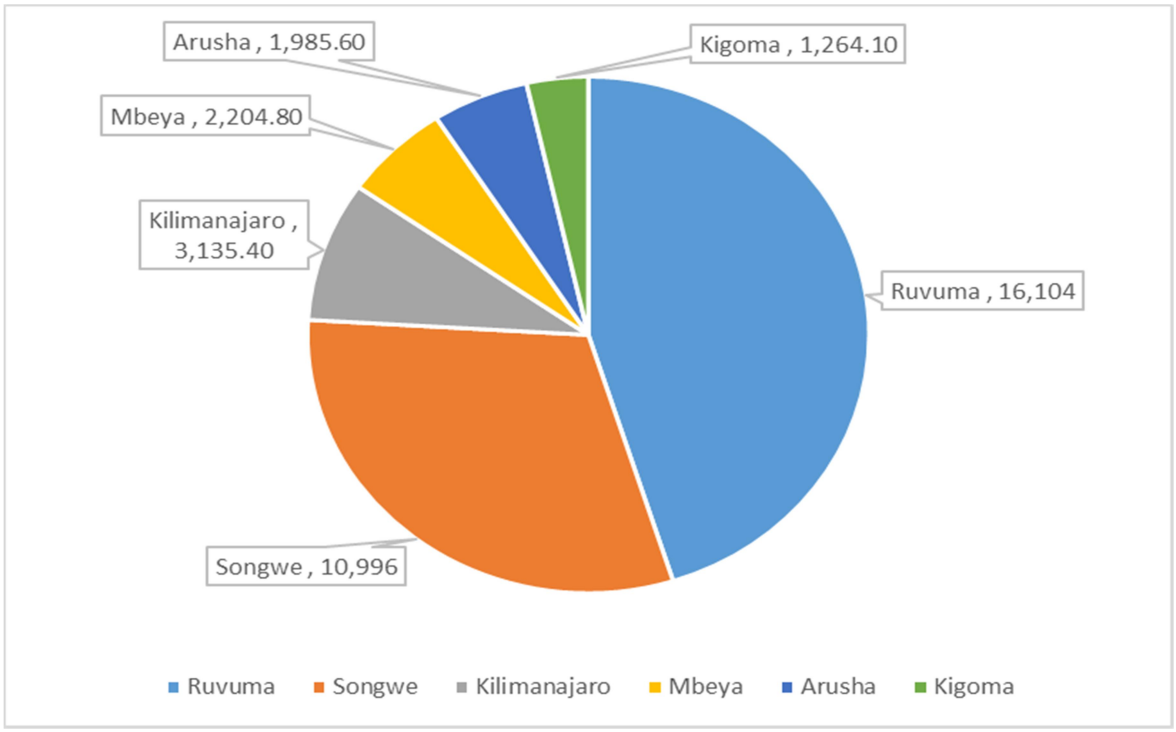

Figure S1: Coffee Production in different regions in Tanzania

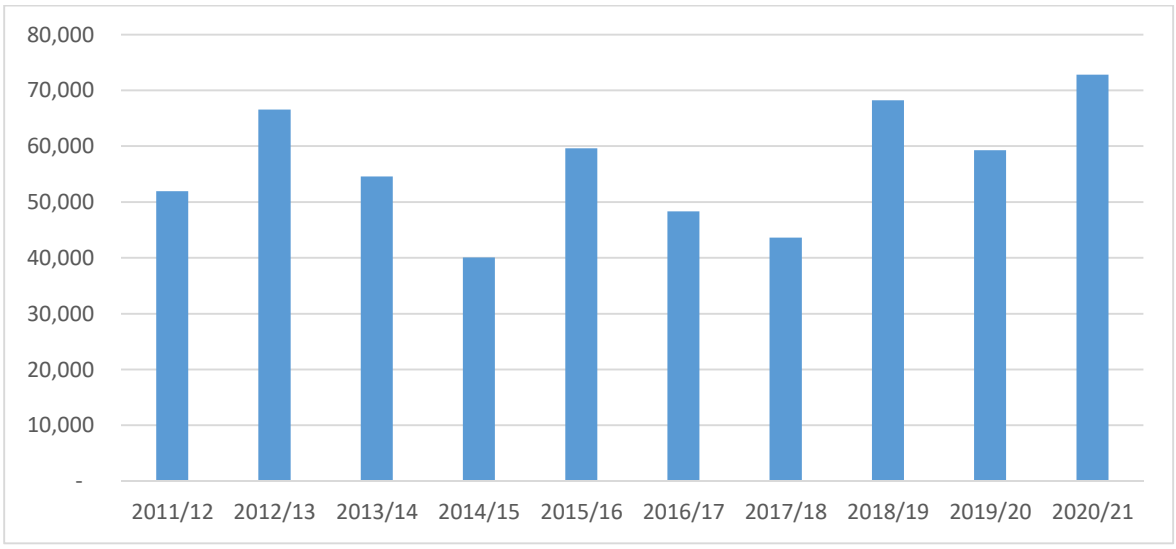

Figure S2: Coffee production in Tanzania, 2011/12 to 2020/21

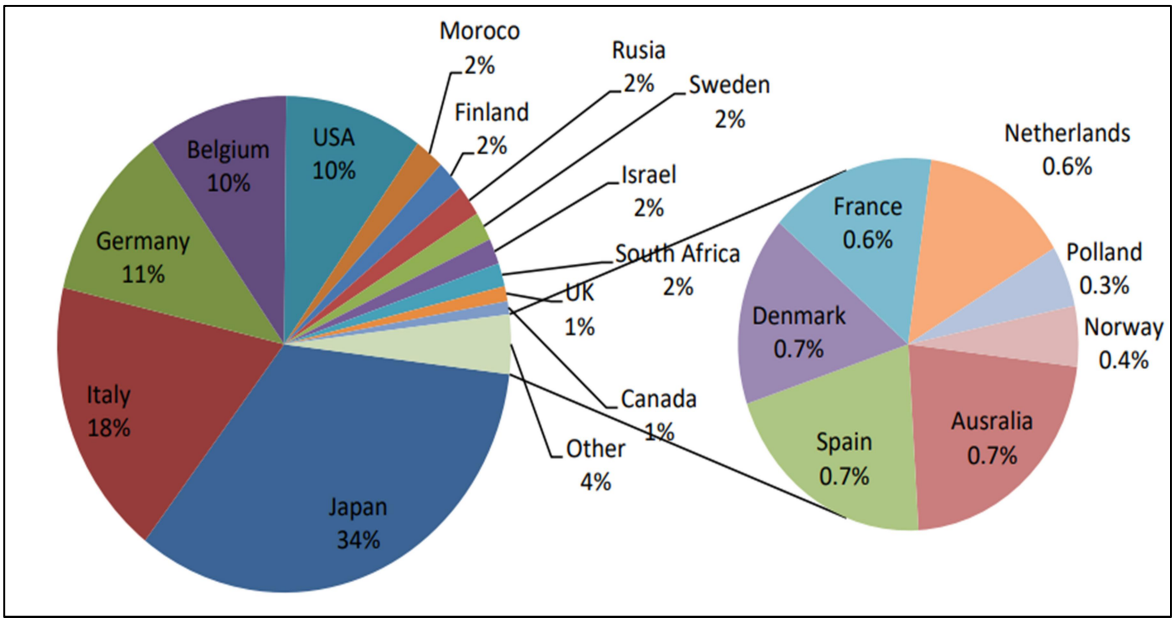

Figure S3: Destination Countries of Tanzanian Coffee in 2018/19
Source: TCB, 2019