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# Potential of geographical Indications towards sustainability: Stakeholder perceptions from the Attapady black goat production system

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**Abstract**

Geographical Indications (GIs) can significantly influence the sustainability of origin-based production systems and the broader territory. The Attapady Black goat, a unique native genetic resource traditionally reared by indigenous communities of Attapady, exemplifies such a system. Its low-input rearing practices and reputation for ethnically valued high-quality meat, position it as a potential candidate for GI status. This study assessed stakeholders' perceptions of the potential of GI towards sustainability of the indigenous production system of Attapady Black goat and its products, using a content-validated, reliability-tested scale. High perception levels were reported across all respondent categories and sustainability domains. For the domain of economic sustainability, governance actors, intermediaries and consumers showed significantly higher perceptions than producers. As for overall sustainability, consumers and governance actors demonstrated significantly greater perception compared to producers. Based on domain-wise mean scores of respondents and distribution of respondents based on their perceptions, a high level of perception was observed across all three domains of sustainability, and the majority of respondents demonstrated high level of perception in each domain.

**Keywords:** Perception, scale, geographical indication, Attapady Black goat, sustainability

## Introduction

One of the key motivations behind the development of Geographical Indications (GIs) is their potential to support sustainable rural development, which depends on effective stakeholder implementation (Vandecandelaere *et al.*, 2010) [14]. Origin-linked products can generate a cycle of positive impacts by promoting long-term conservation of local resources and traditional knowledge through active community participation. This, in turn, supports indigenous production systems and strengthens social networks, contributing to territorial sustainability (FAO and SINER-GI, 2009) [6]. The Attapady Black goat, native to the Attapady hill tracts of the Western Ghats in northeastern Palakkad district, Kerala, is a potential candidate for GI status due to its unique characteristics and its evolution, development, and nurturing by the region's tribal communities for meat production. The establishment and management of GI systems require a careful balance among the three pillars of sustainability, economic, environmental, and socio-cultural, while considering the diverse perspectives of local stakeholders (FAO, 2012) [8]. Evaluating GI development entails engaging stakeholders to understand their perspectives on its potential impacts, based on expectations or prior experiences. Understanding these perceptions is essential for promoting awareness, guiding collective action, and strengthening territorial governance (Belletti *et al.*, 2017) [1]. This study assessed stakeholder perceptions of how GI implementation could promote sustainability of the Attapady Black goat production system across the three dimensions of sustainability.

## Materials and Methods

The study was conducted in the Attapady Block Panchayat, located in northern Palakkad district of Kerala,

encompassing Agali, Pudur, and Sholayur Grama Panchayats, where the Attapady Black goat was traditionally developed by indigenous tribal communities (Stephen *et al*., 2005) [13]. Adopting a case study approach (Yin, 2018) with an exploratory, predominantly inductive research design, respondents were selected using theoretical sampling (Charmaz, 2014; Qureshi, 2018) [2, 23]. A qualitative system dynamics paradigm (Garcia-Dorado *et al.*, 2021) [7] guided the identification and classification of actors in the prospective GI value chain. Snowball sampling was employed to trace respondents at various value chain nodes, with key informants serving as initial referents. A total of 520 stakeholders identified across four categories constituted the respondent pool which included 200 producers (traditional Attapady Black goat rearers of Attapady), 65 intermediaries (aggregators, traders, processors/ butchers), 37 consumers (end users of the product) and 218 governance actors (facilitators of the prospective GI recognition and implementation). Content validated (Waltz and Bausell, 1981) [24] and reliability tested (Cronbach, 1951) [4] scale was developed to analyse the responses pertaining to perception of stakeholders on potential of GI towards sustainability of the indigenous production system of Attapady goats. The preliminary scale was developed on the premises that the prospective GI would serve as a tool that addressed the three complementary and intrinsically associated pillars of sustainability *viz.*, economic, environmental and sociocultural, in case of an origin-linked product (FAO and SINER-GI, 2009) [6]. The items pertaining to the construct were prepared through extensive literature review and consultation with experts. The inventory comprised of forty-two statements which were grouped under three domains *viz*., economic sustainability, environmental sustainability and sociocultural sustainability, with number of items 15, 13 and 14 respectively. The degree of agreement regarding the inventory items was rated by domain experts to indicate the extend of congruence of each statement with the construct measured. The panel comprised of ten judges with expertise in the domain of geographical indications and related governance system. The items were rated against a four-point continuum *viz.*, highly relevant, with score 4, relevant with score 3, somewhat relevant with score 2 and not relevant with score 1. Accordingly, Content Validity Index (CVI) devised by Waltz and Bausell (1981) [24] was computed at CVI (I-CVI) and scale-level CVI (S-CVI) to capture interrater agreementExpert responses were analyzed to assess content validity, and items with I-CVI values of 0.80 or above—indicating excellent content validity—were accepted for inclusion in the scale (Polit *et al*., 2007). The computed S-CVI value was 0.94, meeting the standard threshold for average congruity and confirming the overall content validity of the measurement scale. The reliability of the content validated scale was tested by employing Cronbach's Alpha coefficient (Cronbach, 1951) [4]. The scale was administered among a representative sample of 100 respondents which included diverse stakeholders identified through key informant technique during pilot study. The representative sample included producers, social workers, officials of local institutions and general inhabitants of the region. After administration of the scale and computation of item scores, item analysis was performed by which item scores were correlated with the total scale score. Since all the items had correlation values between 0.2 and 0.8, none were discarded (Di lorio, 2005). Thus, the final scale retained all the 43 items. For the overall scale, the Cronbach's alpha coefficient obtained was 0.804 which could be inferred as 'reliable' (Taber, 2018) [18]. The content validated and reliability tested scale was administered among the diverse stakeholder categories to elicit responses. They were requested to record the extend of agreement to the item statement encompassing the conceptual domains of the variable. The items were scored against a four-point continuum *viz.*, strongly agree with score 4, agree with score 3, disagree with score 2 and strongly disagree with score 1. Focus group discussions and in-depth personal interviews were used to capture the responses.

## Results and Discussion

The figure 1 illustrates the importance of various domains of sustainability based on perception of respondents on the potential of GI.


**Fig 1:** Perceived importance of the potential of GI across various domains of sustainability

The domain of environmental sustainability ranked first with a mean score of 3.68, followed by socio-cultural sustainability (3.66) and economic sustainability (3.63). The overall sustainability score was 3.66. The findings indicated that although environmental sustainability was perceived as the most important domain, socio-cultural and economic sustainability followed closely. Overall, the respondents exhibited a high level of perception across all three domains.

Table 1 and Figure 2 describes the perceived importance and level of agreement regarding the items pertaining to the potential of GI towards environmental sustainability.

**Table 1:** Perceived importance and level of agreement of items pertaining to the potential of GI towards environmental sustainability

| Sl.no. | Items | Mean score | Level of agreement (%) |
|---|---|---|---|
| 1. | GI contribute to protection of local natural resources | 3.90 | 100 |
| 2. | GI is a tool for preservation and protection of local biodiversity and environment (locally adapted species, breeds, varieties and microorganisms) | 3.86 | 100 |
| 3. | Promote conservation of landscape with minimum use of fertilisers in grazing lands | 3.23 | 86.7 |
| 4. | GI prevents disappearance of local habitats, landscape and genetic resources | 3.51 | 100 |
| 5. | GI is an awareness raising tool that signifies the link between product specific quality and geographical origin | 4.00 | 100 |
| 6. | GI contributes to biobased economy of agro-ecosystems | 3.46 | 80.4 |
| 7. | Maintains the breed Attapady Black goat confined to the territorial region | 4.00 | 100 |
| 8. | Protect pure Attapady Black goat germplasm from genetic dilution that results from crossbreeding | 3.57 | 95.2 |
| 9. | GI based organic herd management facilitates species diversity of local plant varieties | 3.04 | 70.2 |
| 10. | GI recognises the rights of indigenous producers as custodians of local biodiversity | 3.87 | 100 |
| 11. | GI promotes green skill development | 3.59 | 98.5 |
| 12. | GI promotes organic production practices | 3.79 | 100 |
| 13. | GI promotes conservation and reputation of the breed and associated local production system | 4.00 | 100 |
| 14. | Mean score of the domain | 3.68 | |

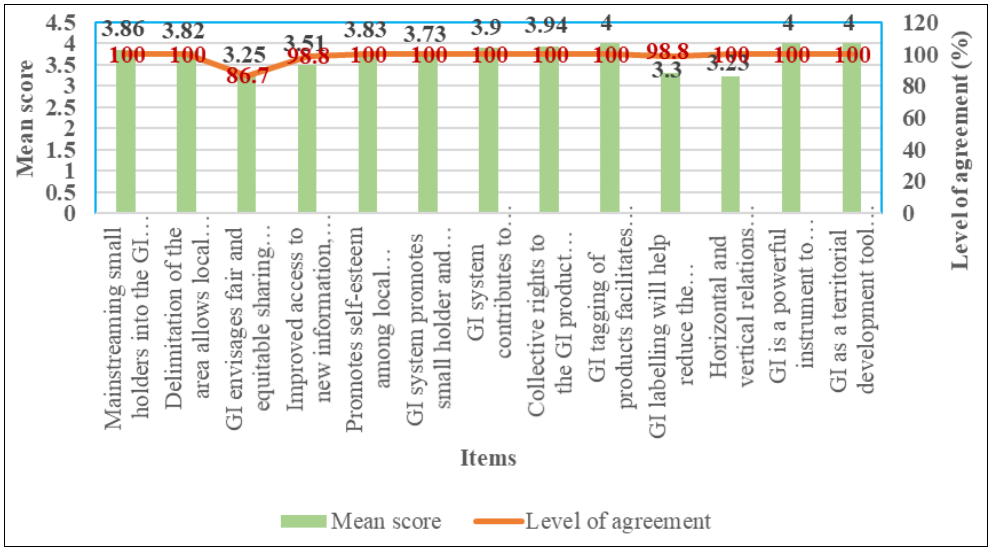


**Fig 2:** Perceived importance and level of agreement of items pertaining to the potential of GI towards environmental sustainability

Among the inventoried items related to the potential of GI in promoting environmental sustainability, the highest-ranked items, based on respondent perceptions included, the role of GI as an awareness-raising tool that signifies the link between product-specific quality and geographical origin, its contribution to maintaining the Attapady Black goat breed within its territorial region, and its role in conserving the breed and the associated production system. Establishing a link between a product and its *terroir* enhances stakeholder understanding of the need for sustainable use of local resources (FAO, 2009) [6]. GI production systems, often rooted in traditional practices, tend to exert less environmental pressure than modern, input-intensive methods (Vandecandelaere, 2010) [14]. Therefore, the GI process supports conservation of essential local natural resources, such as landscapes, soils, and biodiversity, ensuring their sustainability for future generations. The Code of Practice (CoP) associated with GI certification also serves as a regulatory framework to ensure the long-term sustainable use of these resources. Additionally, GI products often rely on locally adapted, traditionally used plant and animal species, varieties, or breeds, which represent valuable genetic resources (Vandecandelaere, 2010) [14]. The continued use and protection of such production systems not only support environmental sustainability but also play a critical role in conserving agrobiodiversity (Larson, 2007) [11]. Raising awareness among local and external actors about the importance of territorial biodiversity and its conservation (Larson, 2007) [11], along with effectively communicating the link between GI products, their geographical origin, and associated cultural heritage, is essential for preventing environmental degradation.

Respondents overwhelmingly rated the GI's contribution to the protection of local natural resources, its role in preserving biodiversity and the environment, and its recognition of indigenous producers as custodians of local biodiversity as highly important. Origin-linked products are closely associated with the reproduction of local natural resources, such as vulnerable ecosystem and breeds, with their impact significantly influenced by the role of traditional producers in the region, both in terms of practices and scale of operation (FAO, 2012) [8]. GI producers often demonstrate a stronger connection to their territory and a heightened sense of environmental responsibility (Belletti *et al.*, 2015) [1]. This awareness encourages the adoption of sustainable practices, as producers recognize that product

quality and reputation are closely tied to the preservation of the *terroir* (Girard, 2022) [10].

A review of empirical studies indicated that negative environmental impacts of GIs were more prevalent in the Global South, where countries faced shared challenges such as improving livelihoods, ensuring food security, and conserving biodiversity (Milano and Cazella, 2021). Larson (2007) [11] also noted that developing countries often experienced more negative or inconsistent environmental outcomes, primarily due to weaker institutional frameworks. Nevertheless, GIs show significant potential to support local production systems, provided they are adapted to diverse institutional, environmental, and economic contexts, and supported by enabling factors that promote positive outcomes.

Another notable finding was the perceived benefits of GIs in promoting organic production practices, developing green skills, protecting the pure Attapady Black goat germplasm from genetic dilution through crossbreeding, and preventing the loss of local habitats, landscapes, and genetic resources. GIs are built on the unique link between a product and its *terroir*, shaped by local knowledge, cultural practices, and natural resources. Defined by locally developed standards through participatory processes, GIs reflect the social and environmental context of the area and often promote organic and eco-friendly practices suited to local conditions.

Productive intensification is commonly reported as a negative environmental consequence of GI systems, often associated with a decline in genetic diversity due to the replacement of traditional varieties and breeds with high-yielding alternatives. For instance, in the case of the Tequila GI, this process led to the erosion of species diversity. In an analysis of prospective GIs in India, Soam reported that GI registration holds significant potential for reducing genetic erosion and promoting the conservation and sustainable use of indigenous livestock breeds—particularly given the limited systems in place for managing animal genetic resources in India. Since many of these breeds are reared by smallholder producers in marginal areas, GI recognition could enhance their livelihoods by attracting commercial interest.

A case study on the Neuquén Criollo goat breed of Argentina further highlighted the role of the CoP in preserving the breed's distinctive traits and traditional production system. By incorporating these characteristics into the CoP, particularly those contributing to the unique flavour of the meat, the system successfully supported both genetic conservation and cultural heritage (Centeno, 2007).

Additionally, respondents perceived the GI's contribution to the bio-based economy of agro-ecosystems, landscape conservation through reduced fertilizer use on grazing lands, and the support for species diversity of local plant varieties via GI-based organic herd management as highly important. The reduced use of chemical fertilizers and pesticides, along with the conservation of local varieties and breeds, has been widely recognized in the literature as a positive environmental outcome of GI systems (Conversa *et al*., 2020; Hoang *et al*., 2020). Milano and Cazella (2021) concluded that the environmental outcomes of GIs are shaped by key factors such as strong social organization, active participation of local producers, and coherent policy frameworks. Critical elements include a well-defined product-*terroir* link, the inclusion of environmental objectives in GI specifications, compliance with regulatory standards, promotion of eco-friendly practices, respect for traditional knowledge, and support for small-scale production and related activities like tourism

Table 2 and Figure 3 shows the perception of respondents on the importance of items pertaining to the potential of GI towards economic sustainability.

**Table 2:** Perceived importance and level of agreement of items pertaining to the potential of GI towards economic sustainability

| Sl.no. | Items | Mean score | Level of agreement (%) |
|---|---|---|---|
| 1. | GI labelling facilitates further localisation of the product | 3.84 | 99.8 |
| 2. | Enhances local revenue and employment at different stages of production, processing and distribution | 3.97 | 100 |
| 3. | Eco-labelling the products with clear definition and standards will increase consumer acceptance and awareness | 3.82 | 100 |
| 4. | GI is a value addition tool that ensures premium price for local producers | 3.68 | 99.6 |
| 5. | Eco-labelling the GI products fetch more income | 3.96 | 100 |
| 6. | GI enhances product reputation and visibility | 3.82 | 100 |
| 7. | Improved access to new market segments at local, regional, national and international levels | 3.35 | 76.7 |
| 8. | GI is a legal tool that prevents unfair trade practices and counterfeiting of genuine products | 3.97 | 100 |
| 9. | GI is an effective tool for development of rural economy | 3.69 | 100 |
| 10. | Promotes related industries as well as local tourism and gastronomy | 3.37 | 71.2 |
| 11. | The tourism inflows will add value to other local products | 3.27 | 81.0 |
| 12. | GI benefits local communities through the localization of economic activities | 3.62 | 100 |
| 13. | Networking between internal and external actors of the GI system enhances efficiency of the supply chain | 3.22 | 85.6 |
| 14. | GI takes into account consumer welfare | 3.21 | 85.6 |
| 15. | GI tagging increases market share of the products | 3.68 | 100 |
| | Mean score of the domain | 3.63 | |

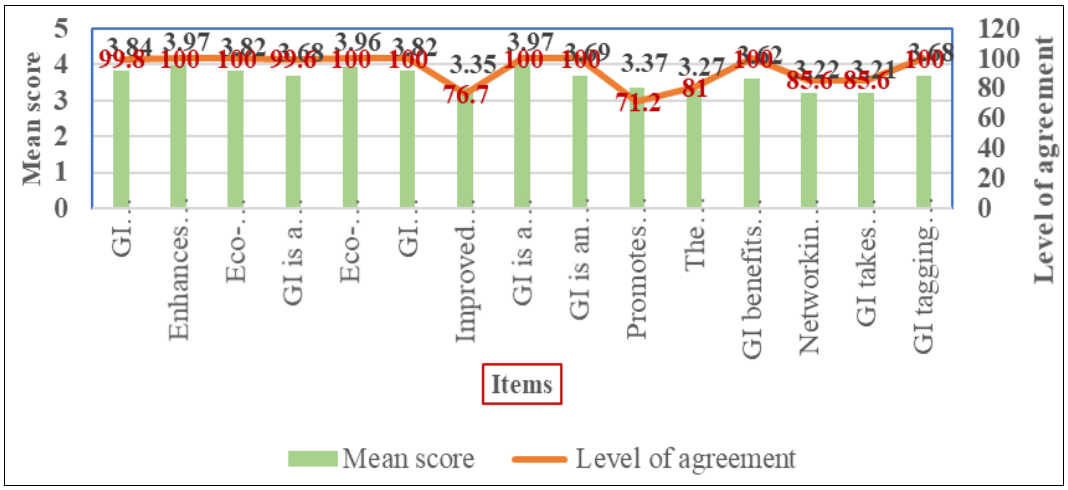


**Fig 3:** Perceived importance and level of agreement of items pertaining to the potential of GI towards economic sustainability

Under the domain of economic sustainability, respondents identified the most important items as the role of GI as a legal tool to prevent unfair trade practices and counterfeiting of genuine products, along with their contribution to enhancing local revenue and employment across various stages of production, processing, and distribution. These were closely followed by items such as eco-labelling leading to higher income, facilitation of product localization through GIs, increased consumer acceptance and awareness due to clear definitions and standards associated with eco-labelling, and improved product reputation and visibility. According to FAO (2012) [8], economic growth within GI systems is driven by key factors such as legal protection against misuse and unfair competition through GI registration, higher product prices, increased turnover including exports, and improved access to new markets by meeting food safety and logistical standards. GIs serve as protective tools that generate economic benefits by increasing producer incomes and enabling value redistribution to the initial stages of the value chain (Vandecandelaere *et al.*, 2020) [21]. These benefits are particularly evident in products already recognized as GIs, which have demonstrated the capacity to meet consumer expectations regarding authenticity and distinctive characteristics. By adhering to defined codes of good practice, GI producer groups contribute to sustainable territorial development. Despite facing export barriers, producers, often regarded as custodians of traditional practices, remain central to GI value chains. GIs also respond to urban demand for quality-differentiated products, support dietary diversity, and preserve traditional foods (Albayrak and Gunes, 2010). A similar trend was observed in the case of Kadaknath black chicken meat, where the demand for chicks and birds from Jhabua increased in recent years across other districts and states, attributed to their GI status (Tripathy *et al.*, 2022) [19].

In its report on the successful GI protection of Cabrito de Tete, a locally bred goat from Mozambique, UNCTAD (2023) emphasized the importance of leveraging GIs for rural development and developing sustainable value chains that support both rural livelihoods and ecosystem health. Certain GI products have faced socio-economic and environmental challenges such as poverty, migration, climate change, biodiversity loss, and cultural erosion, all of which threaten their long-term sustainability (Nirosha and Mansing, 2024). For that matter, Vinayan stressed the importance of safeguarding interests of marginalized producers by ensuring their inclusion and empowerment within the GI framework. Consequently, given the role of GIs in poverty alleviation, analyzing and developing pro-poor value chains, with attention to governance structures, stakeholder roles, and efficiency, can help policymakers improve economic outcomes and generate broader social benefits, including employment and gender equity (Tripathy *et al.*, 2022) [, 19].

Respondents in the present study perceived GIs not only as economic tools but also as instruments for promoting sustainable consumption and production. Multiple studies have highlighted the benefits of GI labelling, demonstrating its positive effects on product sales, price premiums, differentiation, consumer trust, and improved market access (Chilla *et al.*, 2020; FAO, 2012) [3, 8]. Cassago *et al.* (2021) showed that metabolomics can effectively link food attributes to regional *terroir* and traditional knowledge, offering a valuable tool for marketing, quality assurance, and legal protection, while also providing a framework for future research and GI promotion strategies.

Positioning GI products around values such as tradition, taste, and sustainability, supported by a national GI logo and collective branding (FAO, 2009; Vandecandelaere, 2010) [6, 14], further enhances consumer recognition and preference. Certifications such as “organic” and “fair-trade” increase product visibility and consumer trust (FAO, 2012) [8]. GIs enable local producers to access niche markets and command fair prices despite competition from lower-cost alternatives, by leveraging origin-linked differentiation (Larson, 2007; Vandecandelaere *et al.*, 2020) [11, 21]. GIs also foster consumer confidence through traceability and quality assurance, while promoting the sustainable use of local resources (FAO, 2009) [6].

Respondents recognized the significant economic benefits associated with GIs, particularly their role in fostering rural economic development and enabling local producers to command premium prices through value addition. GIs were noted for localizing economic activity to benefit rural communities and for supporting complementary sectors such as tourism and gastronomy. They were also credited with enhancing market access at local, regional, national,

and international levels, and contributing to consumer welfare by ensuring authenticity and quality. Effective GI marketing has been linked to improved rural livelihoods, promotion of complementary sectors like tourism (FAO, 2018) [8], prevention of rural out-migration, and preservation of unique local assets such as traditional breeds, plant varieties, and landscapes (FAO, 2012; Falasco *et al*., 2024) [8, 9]. Moreover, by delimiting the production zone, CoP enhances the bargaining power of primary producers by preventing downstream actors from sourcing raw materials outside the designated region, thereby minimizing delocalization (FAO and SINER-GI, 2009) [6].

A study by Das and Dileep (2023) [5] among local and foreign tourists in Kerala found that GI-tagged products generated substantial socio-economic benefits in rural areas by offering high-value, differentiated goods with strong consumer purchase intent. Their findings highlighted the potential of GIs to promote local identity and market these products internationally through their unique regional attributes. From an economic perspective, GIs ensure fair value distribution along the supply chain, with actors involved in production, processing, and marketing compensated in accordance with their contributions (FAO, 2009) [6]. Vandecandelaere *et al.* (2020) [21] examined nine GI cases worldwide and reported positive economic outcomes in all instances, attributing the results to the fact that each product met the legal definition of a GI and satisfied the fundamental conditions required for registration.

The GI "process" describes the progression by which a reputed product is formally linked to its producers—such as farmers and processors, through collaboration with public authorities responsible for registering and safeguarding the geographical name (Vandecandelaere *et al.*, 2020) [21]. Overall, respondents viewed GI as an effective tool to protect product authenticity while enhancing income, employment, product visibility, and consumer trust through legal safeguards, eco-labelling, and territorial anchoring.

Table 3 and Figure 4 demonstrates the perceived importance and level of agreement of items pertaining to the potential of GI towards socio-cultural sustainability.

**Table 3:** Perceived importance and level of agreement of items pertaining to the potential of GI towards socio-cultural sustainability

| Sl.no. | Items | Mean score | Level of agreement (%) |
|---|---|---|---|
| 1. | Mainstreaming small holders into the GI system ensures inclusive development | 3.86 | 100 |
| 2. | Delimitation of the area allows local producers to stay and live in the terroir | 3.82 | 100 |
| 3. | GI envisages fair and equitable sharing of benefits among the actors | 3.25 | 86.7 |
| 4. | Improved access to new information, technologies and skill set | 3.51 | 98.8 |
| 5. | Promotes self-esteem among local producers as their role, identity and way of life are recognised | 3.83 | 100 |
| 6. | GI system promotes small holder and women entrepreneurship and empowerment | 3.73 | 100 |
| 7. | GI system contributes to food, nutritional and livelihood security of the community | 3.90 | 100 |
| 8. | Collective rights to the GI product ensure development of the local community | 3.94 | 100 |
| 9. | GI tagging of products facilitates maintenance of traditional production and processing systems | 4.00 | 100 |
| 10. | GI labelling will help reduce the geographical and cultural distance between producers and consumers | 3.30 | 98.8 |
| 11. | Horizontal and vertical relations of local actors in the value creation process strengthens social networks | 3.23 | 100 |
| 12. | GI is a powerful instrument to safeguard traditional know-how and cultural heritage of local stakeholders | 4.00 | 100 |
| 13. | GI as a territorial development tool has the potential to increase the reputation of the region as a whole | 4.00 | 100 |
| 14. | GI process results in development of managerial and technical skills of local stakeholders | 3.18 | 82.9 |
| | Mean score of the domain | 3.66 | |

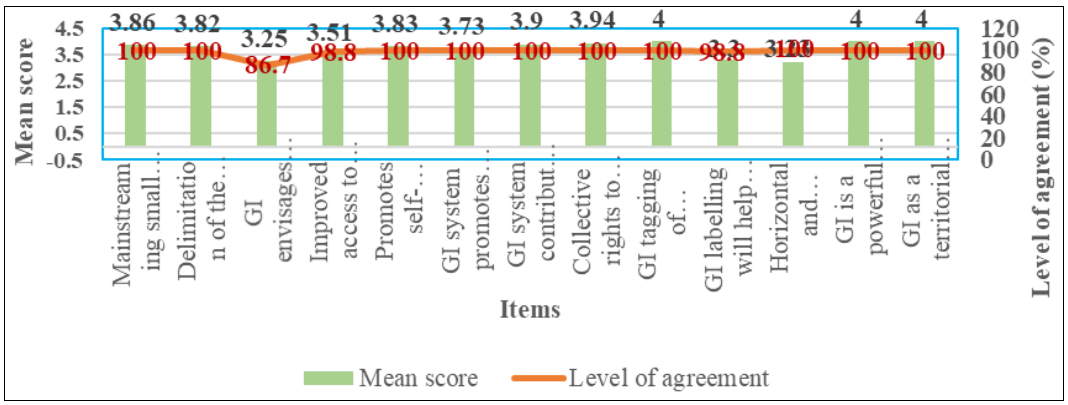


**Fig 4:** Perceived importance and level of agreement of items pertaining to the potential of GI towards socio-cultural sustainability

In the domain of socio-cultural sustainability, respondents identified the highest-ranked items as, GI tagging facilitating the preservation of traditional production and processing systems, safeguarding indigenous knowledge and cultural heritage, and serving as a territorial development tool with the potential to enhance the region's reputation.

Geographical Indications (GIs) can serve as powerful instruments for preserving social and cultural resources by strengthening regional identity, promoting social equity, safeguarding traditional knowledge and lifestyles, and supporting food diversity and culinary heritage through

strategic regional communication (FAO, 2012) [8]. GIs also offer effective protection for tangible indigenous knowledge by reinforcing its link to place, respecting collective community rights, and restricting use to the designated geographical area. As territorial development tools, GIs have been recognized as public goods that support regional wealth creation and landscape resilience. Sharma *et al.* (2022) [15] had reported that the demand for Kadaknath black chicken increased during the COVID-19 pandemic, attributed to its reputed immunity-boosting properties, though scientific validation was limited. The authors argued that validating its nutritional profile could have strengthened branding, market penetration, and conservation efforts. The case of Cotija cheese illustrated the importance of protecting product reputation, as inferior imitations led to its genericisation, compromising authenticity and value (Vandecandelaere, 2010) [14]. Such cases underscore the vital role of GIs in preserving socio-cultural identity and safeguarding origin-linked reputations.

Respondents in the present study also expressed strong agreement on several socio-cultural aspects, including the collective rights associated with GI products supporting local community development; the contribution of GIs to food, nutrition, and livelihood security; and the potential of GI frameworks to integrate smallholders, thereby fostering inclusive development. According to FAO (2009) [6], the collective nature of origin-linked products strengthens social ties among local actors by encouraging organization at the local level, promoting equity in the production system, and involving external stakeholders such as public institutions, the tourism industry, and educational organizations. Several studies have emphasized the significance of traditional diets, which are typically nutrient-rich and rooted in locally available resources, in enhancing food security and preserving cultural heritage (Swanepoel and Raneri, 2022; Sidiq *et al*., 2022) [16, 17]. Muca *et al*. (2022) [12], in their study, observed a shift in consumer preferences during the COVID-19 pandemic, driven by socio-economic and policy factors, including increased demand for eco-friendly products and a marked preference for GIs as sustainable choices. Consistently, the present study found that the demand for Attapady Black goat meat had increased during the pandemic, attributed to its organic, traditional, and ethnic attributes. GIs also have considerable social impact by sustaining livelihoods in remote areas, enhancing producers' self-esteem, and preserving traditional food knowledge and practices (Vandecandelaere *et al.*, 2010) [14]. The collective organization surrounding a GI product fosters collaboration among producers and expands social networks by involving a broad spectrum of local actors. Societal recognition of the unique value of GI products, grounded in traditional knowledge and local heritage, instils a sense of pride and identity among community members, particularly among small-scale producers and women engaged in production and processing. The intrinsic connection between product, people, and place often transcends mere economic value, making GI products powerful cultural markers and symbols of regional identity.

Tables 4 and 5 depict the domain-wise mean scores of respondents and the distribution of respondents based on their perceptions. The mean scores were categorized into three evenly distributed classes: 'low' (mean score less than 2), 'medium' (mean score between 2 and 3), and 'high' (mean score greater than 3). A high level of perception was observed across all three domains of sustainability, and the majority of respondents demonstrated a high level of perception in each domain.

**Table 4**: Domain wise mean score of respondents

| Category of respondents | Economic sustainability | Environmental sustainability | Socio-cultural sustainability | Overall sustainability |
|---|---|---|---|---|
| Mean ± SE | 3.63 ± 0.01 | 3.68 ± 0.01 | 3.66 ± 0.005 | 3.66 ± 0.005 |

**Table 5:** Distribution of respondents based on perception

| Category of respondents | Low (%) | Medium (%) | High (%) | Level of perception |
|---|---|---|---|---|
| Economic sustainability | 0 | 11 (2.1) | 509 (97.9) | High (3.63) |
| Environmental sustainability | 0 | 0 | 520 (100) | High (3.68) |
| Socio-cultural sustainability | 0 | 0 | 520 (100) | High (3.66) |
| Overall sustainability | 0 | 0 | 520 (100) | High (3.66) |

Table 6 illustrates the domain wise mean score of the respondents of diverse categories *viz.*, producers, intermediaries, consumers and governance actors for the four domains as well as for the overall scale.

**Table 6**: Domain wise mean score of respondents of diverse categories

| Domain | Mean score of the respondents | | | | $\chi^2$ value (P value) |
|---|---|---|---|---|---|
| | Producers | Intermediaries | Consumers | Governance actors | |
| Economic sustainability | $3.56^{b}$ ± 0.02 | $3.64^{a}$ ± 0.03 | $3.67^{a}$ ± 0.04 | $3.69^{a}$ ± 0.01 | 37.810** (<0.001) |
| Environmental sustainability | 3.68 ± 0.01 | 3.68 ± 0.02 | 3.67 ± 0.03 | 3.68 ± 0.01 | $0.201^{ns}$ (0.977) |
| Socio-cultural sustainability | 3.68 ± 0.01 | 3.66 ± 0.01 | 3.67 ± 0.02 | 3.65 ± 0.01 | $4.666^{ns}$ (0.198) |
| Overall sustainability | $3.64^{b}$ ± 0.01 | $3.66^{ab}$ ± 0.01 | $3.67^{a}$ ± 0.02 | $3.67^{a}$ ± 0.01 | 9.568* (0.022) |

** Significant at 0.01 level; * Significant at 0.05 level; ns non-significant
Means having different letter as super script differ significantly within a row

The Kruskal-Wallis ANOVA followed by Dunn's test (table 6) revealed significant differences in stakeholder perceptions across categories. Economic sustainability perceptions differed significantly at 1 per cent level ($p < 0.01$), with intermediaries, consumers, and governance actors reporting higher mean scores than producers. For overall sustainability, significant difference was observed at the 5 per cent level ($p < 0.05$), where consumers and

governance actors exhibited higher perception scores than producers. These results indicate that non-producer stakeholders perceived greater sustainability benefits from GI, particularly in economic terms.

## Conclusion

The stakeholders perceived GI as highly beneficial across all three domains of sustainability. In the environmental domain, GI was seen as a key tool for conserving natural resources, protecting biodiversity, and preserving the native Attapady Black goat and its production ecosystem. Economically, GI was recognized for its role in preventing unfair trade practices, enhancing local income, employment, and market visibility through eco-labelling and product differentiation. In the socio-cultural domain, GI was valued for preserving traditional knowledge, strengthening cultural identity, and promoting inclusive development by supporting smallholders and women. These findings highlight the strong perceived potential of GI implementation to promote holistic and sustainable development of the Attapady Black goat production system.

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