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Unlocking Economic Potential Through Value Addition: Transforming Pastoral Livelihoods with Gum Arabic in Northern Kenya

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ABSTRACT

In northern Kenya, pastoral communities are becoming more vulnerable following frequent droughts, climate change, and declining livestock productivity. This paper discusses the potential transformative power of gum arabic as a primary livelihood intervention, with special attention given to the value addition prospects which can result in increased revenue and climate resilience. Based on a rich body of regional literature, this paper evaluates the present situation of gum arabic production, major limitations in the value chain, and strategic interventions to achieve sustainable development. The study indicates that although gum arabic adds an average of 4,200 Kenyan Shillings per household per month, the industry is crippled by ineffective value addition, poor market connections, low technical capacity, and ineffective policy support. As the paper shows, strategic investments in processing facilities, capacity building, market development, and supportive policy frameworks can substantially enhance returns to collectors and make gum arabic more of an economic driver than a safety net in subsistence. By looking at examples of effective interventions like the Acacia EPZ Limited model and community-based collection systems, this study offers evidence-based solutions on how to scale up the production of gum arabic without compromising environmental sustainability and equitable distribution of benefits. The evidence indicates that under the right interventions, gum arabic may be both a solution to climate change adaptation and economic transformation among pastoral communities in the arid and semi-arid areas of Kenya.

INTRODUCTION

Northern Kenya arid and semi-arid areas (ASALs), including the counties of Isiolo, Marsabit, Turkana, Samburu, Wajir, Garissa, and Mandera, cover about 80% of the total land area in Kenya and 25% of the national population and half of the livestock in the country (Ngugi & Nyariki, 2005). These areas are typified by abject poverty, with some counties registering poverty levels of more than 90% versus the national

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poverty level of 53% (KNBS, 2009; Mujawamariya & Karimov, 2014; Vellema, 2022). Pastoral communities living in these regions have long used livestock keeping as the main livelihood strategy, yet this model is under increasing pressure due to frequent droughts, climate change, and resource-related conflicts.

Over the last few decades, the occurrence and severity of droughts in northern Kenya have escalated at an alarming rate, with disastrous impacts on pastoral livelihoods. The 2010-2011 drought alone caused disastrous livestock losses and increased awareness of the fragility of pastoral systems (Leeuw et al., 2014). In places like Isiolo County, community members have reported a pronounced increase in climate-related risks, dating back to the 1995-1996 drought, to the 2011-2013 famine declared a national disaster, and continuing drought conditions up to 2021-2023 (King-Okumu et al., 2016; Leeuw et al., 2014). These weather shocks limit livestock production, compelling pastoral populations to seek alternative and supplementary livelihood practices to survive and remain resilient.

One of the most promising of these alternative strategies is the exploitation of gum arabic and other non-wood forest products (NWFPs) of the plentiful Acacia and Commiphora species that grow in the drylands of northern Kenya (Agustino et al., 2011; Oriwo et al., 2025). Gum arabic, a product of *Acacia senegal* and *Acacia seyal*, has been traded since the Horn of Africa and northern Kenya. Yet, its potential as an important source of income is still not fully exploited, and collection is frequently made by traditional means, and the majority of production is exported in raw or slightly processed form (Mujawamariya & Karimov, 2014; Wekesa et al., 2019). This scenario is a lost value addition opportunity that would significantly boost returns to collectors and lead to economic change within pastoral societies.

This paper discusses how gum arabic can transform pastoral livelihoods in the north of Kenya, with particular attention to value addition opportunities. The study answers pivotal questions about the existing production systems, the current limitations of the value chain, effective models of interventions, and policy frameworks required to develop the sector sustainably. This paper will offer practical solutions to stakeholders interested in unlocking the economic potential of gum arabic and developing climate resilience in pastoral communities by synthesizing the evidence of various studies in the region.

CONTEXT AND SIGNIFICANCE OF GUM ARABIC IN NORTHERN KENYA

The Resource Base and Ecological Characteristics

Northern Kenya has a vast vegetation cover dominated by Acacia and Commiphora species, which are classified as Acacia-Commiphora woodlands (Beentje, 1994). These ecosystems generate numerous types of commercially useful gums and resins, the most important of which is gum arabic. The main species of gum arabic is *Acacia senegal* (L.) Willd. var. kerensis and *Acacia seyal* Del. var. seyal, which are highly adapted to the extreme climatic conditions in the ASALs and have intrinsic resilience to the expected climate change scenarios (B. Chikamai et al., 2011; B. N. Chikamai & Odera, 2002; Wekesa et al., 2019).

The gum-producing trees are widely distributed throughout the region, with commercial production being concentrated in the counties of Isiolo, Marsabit, Mandera, Wajir, Garissa, and Samburu. These trees have many ecological purposes other than gum production, such as soil stabilisation, erosion control, water retention, and carbon sequestration. Their extensive root systems allow them to endure extended dry seasons, which makes them especially useful in the light of rising climate variability. Nonetheless, much of the gum available is not collected because of low awareness, poor collection facilities, and poorly structured marketing systems (B. Chikamai et al., 2011; B. N. Chikamai & Odera, 2002; Wekesa et al., 2019).

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Market Dynamics and Economic Potential

Gum arabic has a special status in the world markets because of its various uses in food, pharmaceutical, cosmetic, and industrial products. It is used as an emulsifying agent, stabiliser, and thickener in products such as soft drinks and confectionery, adhesives, and printing inks. Gum arabic is consumed in over 45,000 tons each year, with the major importers being France (40%), the United States (21%), and the United Kingdom (12%) (Touré, 2008). The potential production of gum arabic in Kenya is estimated at 3,000 tons per year, yet the actual collection is way below this potential (Dayoub, 2025; Palladium, 2025; Wekesa et al., 2019).

Gum arabic is relatively economical in value but extremely volatile based on quality and level of processing. In Kenya, collectors are paid 33-45 Kenyan Shillings per kilogram at collection points in the north, whereas processed grades can fetch much more in export markets (Cheboiwo et al., 2022; Mujawamariya & Karimov, 2014; Munyua & Mbiru, 2011). This price variance highlights the possible advantages of value addition. In addition, the certified organic and fair-trade gum arabic market offers a prospect of premium pricing, especially in European markets where Kenya has developed commercial relationships. Nonetheless, to achieve this potential, many constraints along the value chain must be addressed.

Role in Pastoral Livelihood Systems

Gum arabic has various applications in livelihood portfolios among pastoral communities in northern Kenya. A study conducted in Garba Tula, Isiolo County, indicates that 59% of families collect and sell gum, earning an average of 4,200 Kenyan Shillings every month (Elzubair et al., 2024; King-Okumu et al., 2016; Salah, 2014). The primary uses of this income are subsistence needs (70% of respondents), school fees (24%), restocking livestock (22%), and supporting livestock-keeping activities by purchasing salt and medication (6%). The ease of entry by both genders and age groups, such as husbands (65%), wives (34%), and youth (22%), is a testament to the accessibility of gum arabic as an economic activity (King-Okumu et al., 2016; Salah, 2014).

CURRENT PRODUCTION AND COLLECTION SYSTEMS

Traditional Collection Methods and Practices

In Kenya, gum arabic is collected mainly through wild harvest with minimal management interventions, as opposed to Sudan and Senegal, where systematic tapping systems have been developed. In this process, collectors employ crude instruments like stones or knives to induce exudation and come back after a few days to collect the dried gum. This conventional method, though with low initial capital investment, leads to variability in product quality and unpredictable yields. The collection season is biannual, starting in January following short rains and finishing in March, and again in June through September following long rains. The average yield per tree is 0.25 to 2 kilograms per season (Oriwo et al., 2025; Palladium, 2025; Wekesa et al., 2019).

The collection activities are usually done on the common lands without systematic tapping or tree management frameworks. Although this open-access system offers access to resource-poor households, it also poses a challenge to managing resources sustainably and controlling quality. Collectors are usually not aware of the best tapping methods, post-harvest handling practices and quality standards demanded by end markets. Research has shown that large amounts of gum are not collected in the forest, and it has been estimated that an estimated 30% of the potential production is presently harvested (B. Chikamai et al., 2011; Elzubair et al., 2024; Mercy Corps, 2025).

Post-Harvest Handling and Quality

The quality of gum arabic and its market value are highly dependent on post-harvest practices, which are a critically weak link in the Kenyan value chain. The main quality indicators are cleanliness, colour, nodule size, moisture level, and absence of contaminants (Elzubair et al., 2024; Oriwo et al.,

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2025). Nevertheless, insufficient drying facilities, improper storage, and poor handling practices often lead to contamination by dust, insects, and moisture, which causes quality deterioration and price penalties.

The absence of mechanised dryers extends the duration of drying and makes the process more susceptible to environmental contamination. Storage habits also need to be ameliorated, since gum must be stored in clean sisal or polyethene bags in cool, dry places, not plastic bags, which encourage the development of moisture and moulds (Dayoub, 2025; Elzubair et al., 2024; Ngugi & Nyariki, 2005). The distance between collection points, seasonal inaccessibility of roads during rainy seasons, and high transportation costs contribute to these quality problems, diminishing producer margins and access to the market (Dayoub, 2025; Ngugi & Nyariki, 2005). These issues are further complicated by the fact that the lack of standardised grading systems at the collection level means that collectors are often not aware of quality parameters that define market prices.

Market Structure and Value Chain Actors

The gum arabic value chain in north Kenya includes various players at different levels, starting with primary collectors and ending with international exporters. Primary collectors, who are mostly women and poor families, collect gum on communal land and sell it to intermediaries at collection points within villages or small trading centres. These agents, middlemen and shopkeepers are intermediaries who bring together small amounts to be resold to traders and wholesalers. The consolidated gum is then shipped to large trading centres like Garba Tula, Isiolo, Nairobi or Mombasa, where exporters buy and export the product to foreign markets (Njeru, 2022; Salah, 2014; UNCTAD, 2018).

This market structure is characterised by significant power imbalances, with collectors receiving the smallest share of the final export value. The bulk of profits accrues to traders and exporters who control market information, transportation, and access to international buyers. Cartels often dictate prices at collection points, and the absence of organised producer groups limits collectors' bargaining power (King-Okumu et al., 2016; Salah, 2014). Furthermore, the thinness of the market, infrequent trader visits due to poor infrastructure and high transaction costs create uncertainty that reduces expected returns and discourages investment in quality improvement. These structural challenges underscore the need for interventions that strengthen market linkages, improve price transparency, and enhance collective action among producers.

VALUE ADDITION OPPORTUNITIES AND INTERVENTIONS

Processing and Value Addition Potential

Value addition constitutes the most prominent prospect of augmented returns to gum arabic gatherers in northern Kenya. Presently, all production is exported in a raw or semi-processed form, with only one company, Arid Land Resources Limited, performing simple value addition by grinding and grading and then exporting it (Dayoub, 2025; King-Okumu et al., 2016; Munyua & Mbiru, 2011). This restrictive processing implies Kenya is foregoing significant potential revenue through high-value derivatives like emulsifiers, stabilisers, and refined grades in the food and pharmaceutical sectors.

Processing opportunities are available at various levels of complexity and capital investment. On the elementary level, better sorting, cleaning, and grading in collection points can boost product values dramatically. These operations need small-scale infrastructure, such as covered drying space, sorting tables, grading equipment, and adequate storage facilities, yet may add 15-30% to prices (Njeru, 2022; Oriwo et al., 2025). Intermediate processing includes mechanical grinding, size classification, and packaging to suit particular market needs. High processing, such as spray-dried powder production, standardised emulsions, and speciality grades, represents the greatest value addition but involves high capital expenditure and

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technical skills. There exist successful models of value addition in other parts of Africa. In Sudan, processed infrastructure and quality control systems allow the production of different gum grades to serve different market segments (Dayoub, 2025; Elzubair et al., 2024). The same processing capacity in Kenya would attract a bigger portion of the global gum arabic market, worth more than half a billion dollars each year. In addition, the processing plants would provide new jobs in the rural regions, improve skills among the local communities, and generate other economic activities. The main difficulty is the mobilisation of investment capital, the creation of technical capacity, and the stable supply of quality raw material.

The Acacia EPZ Limited Success Model

Acacia EPZ Limited offers a strong illustration of how strategic interventions in the gum arabic value chain can reshape the quality of the product and the livelihoods of collectors. Acacia EPZ operates in Marsabit and Samburu counties and has adopted an integrated strategy that tackles several constraints in a single move (Njeru, 2022; Palladium, 2025). The firm has educated more than 2,566 gum collectors on proper collection methods, quality standards, and post-harvest management practices (Njeru, 2022). This education has led to significant quality gains, and collectors can now distinguish and sort various grades of gum based on market specifications.

The effects of this intervention have been significant. According to the CEO of Acacia EPZ, the volume of business increased fivefold within about 18 months of implementation. The company can pay collectors higher prices and save on processing costs due to the better quality (Njeru, 2022). Most collectors are women who now earn much more than under the old system. An example of this transformation can be seen in one collector, Ngulisia, in Marsabit County. In 2018, gum arabic collection became an economic saviour after drought wiped out her family's livestock (100 goats). She was able to acquire 20 goats through sales to Acacia EPZ, enrich her family diet with vegetables and fruits, and achieve the ability to invest in agriculture inputs during rainy seasons (Njeru, 2022). Beyond individual benefits, Acacia EPZ has fostered community-level impacts through innovative institutional arrangements. Collectors who consistently deliver high-quality gum receive performance bonuses pooled into communal funds managed by the collectors themselves. Members can access small loans for urgent needs such as school fees, medical bills, or livelihood investments. As loans are repaid, capital is recycled, enabling communities to build resilience and financial independence. This model demonstrates how private sector engagement, when properly structured, can simultaneously improve business outcomes and advance social objectives in pastoral communities.

Capacity Building and Technical Training

To ensure effective value addition, there must be thorough capacity building that focuses on various areas of the gum arabic value chain. The training requirements are technical in nature and include sustainable harvesting techniques, post-harvest management, quality evaluation, business skills, and market intelligence. Experience of other interventions shows that specific training has a substantial positive impact on the quality of products and the income of collectors. The collaboration between Acacia EPZ and Laisamis Technical Training Institute to create a gums and resins curriculum is a significant move towards institutionalising knowledge transfer (Njeru, 2022). These initiatives can be upscaled to cover other training institutions in northern Kenya. The curriculum content must include botanical identification of gum-producing plants, techniques of tapping to maximise yield without causing harm to the tree, techniques of good collection, methods of good collection, grading of quality, safe handling and storage procedures, and some basic business management skills such as record-keeping, cost-benefit analysis, and marketing within a group.

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Extension services are important in translating training to practice. Collectors in remote locations can obtain hands-on learning experiences through mobile processing units and field demonstrations. Farmer field schools or collector groups are examples of peer-to-peer learning where knowledge is shared, and problems are solved (B. N. Chikamai & Odera, 2002; Country Government of Isiolo, 2023; Gordon & Kinyua, 2025). Refresher training is conducted regularly to maintain skills and keep pace with changing market needs. Capacity building must not be seen as an expense but as an investment in sustainable sector development that will yield returns in terms of better quality, higher prices, and better access to the market.

Constraints and Challenges in the Gum Arabic Sector

Market and Value Chain Constraints

Market development is one of the greatest limitations to the potential of gum arabic as a transformative economic activity. The existing market model in northern Kenya is underdeveloped, with poor connections between collectors and end-users (Oriwo et al., 2025; Salah, 2014), a lack of market information and intermediary exploitation. With poor information on market trends, prices, and quality requirements, collectors are prone to price manipulation by middlemen who, in most cases, act as cartels that dictate local markets.

These challenges are further exacerbated by the lack of structured marketing mechanisms. No recognised collection facilities with appropriate infrastructure to sort, grade, and bulk gum arabic exist. This physical infrastructure inefficiency adds transaction costs, diminishes the bargaining power of individual collectors, and brings unpredictability in supply chains that deter investment by processors and exporters (Birch, 2021; Dayoub, 2025; Ngugi & Nyariki, 2005). The distance between production-prone regions and the lack of effective road systems that become inaccessible during rainy seasons exacerbate the cost of transportation and restrict market accessibility. Such infrastructural shortcomings essentially alienate pastoral communities from lucrative markets and deny them an equitable share of value.

Financial and Capital Constraints

Inadequate access to financial resources is a significant impediment to value addition and market development within the gum arabic industry. Collectors are not provided with the resources to invest in equipment that can enhance quality, like proper collection tools, drying facilities, and storage containers (Birch, 2021; Oriwo et al., 2025). Small processors and traders are unable to access credit to finance inventory purchases, transportation, or processing equipment. There are very limited financial institutions that provide products designed to suit the gum arabic industry, and traditional lending criteria tend to disqualify pastoralist communities who do not hold formal collateral or credit records (Mujawamariya & Karimov, 2014; Salah, 2014).

The gum production is also seasonal, which poses further financial burdens. Gum arabic earns income at particular times, resulting in cash flow gaps, which households have to cover over the year. Collectors lack access to savings mechanisms or credit facilities and must sell at harvest, frequently at depressed prices when supply is high (Gordon & Kinyua, 2025; Njeru, 2022). This liquidity limitation does not allow collectors to hoard gum to sell it at a higher price in the off-season. In addition, lack of financial services reduces collective action capacity because producer groups cannot obtain working capital to build bulking facilities, negotiate directly with exporters, or invest in value addition infrastructure.

Environmental and Resource Management issues

The sustainability of gum arabic production in northern Kenya is under threat due to environmental pressures. Climate change effects, especially protracted droughts and unpredictable rainfall patterns, pressure gum-producing ecosystems and lower yields. The extensive

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logging of the acacia trees to provide firewood and charcoal reduces the resource base, and overgrazing in some regions inhibits the natural regeneration. The invasive species, especially *Prosopis juliflora*, aggressively spreads and replaces native acacias and degrades the habitat quality of gum-producing trees (Agustino et al., 2011; Elzubair et al., 2024; Leeuw et al., 2014).

There is a need to improve resource management practices to achieve sustainable exploitation. Existing open-access agreements in common areas provide incentives to overexploitation without investing in tree management or regeneration. Evidence-based planning and monitoring of harvest sustainability cannot be achieved due to the absence of thorough resource mapping. Moreover, collectors are usually unaware of sustainable harvesting methods that would maximise long-term productivity without harming the health of trees (Dayoub, 2025; Leeuw et al., 2014; Oriwo et al., 2025). To tackle these environmental issues, combined strategies involving conservation incentives, community-based resource management, tree planting programs, and invasive species control are needed.

Policy and Institutional Gaps

The gum arabic sector suffers from inadequate policy attention and weak institutional frameworks at both national and county levels. Unlike cash crops such as tea, coffee, and pyrethrum, which enjoy dedicated government support through research institutions, extension services, and marketing boards, non-wood forest products, including gum arabic, receive minimal institutional backing. This neglect manifests in the absence of specific policies governing the sector, limited allocation of resources for research and development, inadequate extension support for collectors, and weak coordination among multiple government agencies with overlapping mandates.

Regulatory frameworks are similarly underdeveloped. There are no standardised quality control systems, certification mechanisms, or traceability requirements that would facilitate access to premium markets. The informal nature of the trade leads to under-reporting of exports and loss of potential tax revenue. Weak regulatory oversight enables exploitation of collectors by unscrupulous middlemen. Moreover, coordination challenges between national and county governments under Kenya's devolved system create ambiguity regarding responsibility for sector development. Addressing these policy and institutional gaps requires deliberate efforts to mainstream gum arabic within agricultural and forestry development frameworks, establish clear governance structures, and allocate adequate resources for sector support.

STRATEGIC INTERVENTIONS FOR SECTOR DEVELOPMENT

Production Enhancement and Resource Management

The process of sustainable production improvement necessitates combined strategies that focus on both short-term collection and long-term resource management. Priority interventions involve encouraging sustainable harvesting methods by training and demonstration, introducing mobile processing plants and better drying technologies to collection sites, planting community-managed tree plantations of high-yielding acacia varieties, conducting a thorough resource assessment to map gum arabic resources, updating information regularly, implementing community-managed natural resource management systems on community-owned areas, and controlling invasive species and encouraging regeneration of native acacias (Cheboiwo et al., 2022; Mercy Corps, 2025).

The feasibility of gum arabic plantations as an addition to wild harvesting is evidenced by other regions. In Sudan, agroforestry systems, organised to produce gum arabic, crop and livestock enterprises, have improved productivity and environmental performance (Dayoub, 2025; Elzubair et al., 2024). Modifying these models to the Kenya context, with sufficient attention to land tenure systems and community preferences, would raise supply by a significant margin and alleviate pressure on natural forests. Community

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participation in plantation development and operation guarantees local ownership, job generation, and ecosystem services such as soil protection and carbon capture.

Market Development and Value Chain Strengthening

Enhancing market connectivity and building effective value chains are key to realising the economic potential of gum arabic. Strategic measures to be taken are the strengthening of producer associations and cooperatives to enable them to market and negotiate prices collectively, establish local collection and bulking points with adequate infrastructure to sort, grade, and store products, invest in rural road infrastructure and transportation systems to lower costs and enhance market accessibility, create market information systems that would enable collectors to receive timely information about prices, demand, and quality requirements, promote linkages with foreign buyers and access to certification schemes like organic and fair-trade, and the establishment of quality control laboratories to support testing and certification of products (Mercy Corps, 2025; Mujawamariya & Karimov, 2014; Vellema, 2022).

The establishment of powerful producer organisations is especially essential in the value chain to combat power disparities. There are successful examples in other commodities and regions. Gum Arabic and Resins Association (GARA) in Kenya, although still developing, offers a space of collective action and advocacy. Other organisations, like the National Association of Gum Arabic Producers, Processors and Exporters, which are similar in Sudan, have been instrumental in enhancing quality, conflict resolutions and market linkages (ENNDA, 2025; Muga et al., 2021; Palladium, 2025). Development partners should support the growth and capacity of such associations by training them in governance, business management, and market negotiation.

Value Addition and Processing Investment

Expanding value addition involves prudent investment in processing facilities across several levels. Local processing units, such as basic cleaning, sorting, and grading, at the community level, would allow the collectors to capture a greater value and decrease transportation expenses on bulk raw material. These should be connected to collection centres and managed by community groups or cooperatives, supported by extension services and quality guaranteed by specific laboratories (Muga et al., 2021; Njeru, 2022). Locally, creating mechanical grinding, size classification, and packaging facilities would make Kenya a source of processed products to industrial users. These facilities involve larger capital investment but may serve more than one collection area and provide substantial employment. At the national level, development of high processing capacity to produce speciality grades, spray-dried powder and other high-value derivatives would allow Kenya to compete in international markets to produce refined gum arabic products (Muga et al., 2021; Njeru, 2022). This involves the attraction of the private sector investment with the right incentives, the assurance of quality raw material supply and the building of technical capacity to handle the advanced processing processes.

Sustainable sector development requires the establishment of conducive policy and institutional frameworks. Among the key interventions are the creation of county-level legal frameworks to regulate the gums and resins sub-sector within devolved government structures, and the harmonisation of policies across various ministries such as agriculture, forestry, trade, and environment. The establishment of clear institutional mandates and coordination mechanisms between national and county governments, the creation of favourable fiscal policies, including tax incentives to invest and promote the export of gum Arabic (ENNDA, 2025; King-Okumu et al., 2016; Muga et al., 2021). The creation of quality standards and certification systems to meet international standards, and the strengthening of research and

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development capacity through increased funding of institutions such as the Kenya Forest Service.

New policy trends offer mainstreaming of gum arabic. The Forest Conservation and Management Act (2016) of Kenya acknowledges that drylands and non-wood forest products are essential, and the Climate Change Act (2016) permits community-based adaptation initiatives, which may facilitate gum arabic development. The county governments of Isiolo, Marsabit and Samburu have come up with climate change funds and natural resource management laws that offer entry points into sector support. Expanding on these frameworks, the enabling environment for transformative growth in the gum arabic sector can be achieved through coordinated efforts by the government, the business sector, the development partners, and the community organisations.

GUM ARABIC AS A CLIMATE CHANGE ADAPTATION STRATEGY

Resilience Benefits for Pastoral Communities

The exploitation of gum arabic presents several avenues through which climate resilience can be established among pastoral communities. Acacia species, which produce gum, are a drought-tolerant resource that offers consistent income even when livestock productivity is reduced. Garba Tula's research has shown that families tend to collect more gum in drought years and use income to buy food, feed remaining animals, and satisfy basic household needs (Salah, 2014). This safety net role is especially relevant to poor households who have lost livestock to drought and who are in poverty traps that are not easily escaped.

The income diversification that gum arabic facilitates mitigates the vulnerability to climate shocks on overall livelihoods. Instead of relying solely on livestock, families with access to gum income have a higher ability to absorb shocks, sustain consumption during times of stress, and rebound more quickly when a disaster strikes. Research records the utilisation of gum income in restocking livestock following drought losses, which in effect acts as a buffer to replenish primary livelihood assets (Agustino et al., 2011; Oriwo et al., 2025). In addition, the seasonal nature of gum harvesting, which is carried out during dry seasons when other sources of income are limited, offers essential cash flow in the hardest periods of the farming year.

Environmental Co-benefits

The production of gum arabic creates substantial environmental returns that go beyond economic immediate gains. Acacia trees offer various ecosystem services such as soil stabilisation, erosion control, water infiltration, and carbon sequestration. Their extensive root systems reach into water that is not accessible to shallow-rooted plants, allowing them to survive long dry periods, but also enhancing soil structure and water uptake ability (Mujawamariya & Karimov, 2014; Wekesa et al., 2019). The ability of Acacia species to fix nitrogen improves soil fertility, which benefits related vegetation and contributes to the overall productivity of ecosystems.

The transformation of standing trees into economic value offers incentives to conservation and sustainable management. Gum arabic provides a reliable income to communities, and they have a strong incentive to conserve trees instead of burning them down to make charcoal or ploughing them down to make farmland. This conservation effect is evidenced by project interventions: collectors trained by Acacia EPZ protect gum-producing trees actively, understanding they are valuable assets (Njeru, 2022). This change in perception of common-pool resources of little personal value into managed resources that do produce quantifiable benefits is a paradigm shift in human-environment relations.

Moreover, the manufacturing of gum arabic can underpin landscape restoration programs. The ecological restoration of degraded areas, coupled with livelihood development through planting Acacia species, yields win-win situations. The trees contribute to reversing desertification, replenishing biodiversity, capturing carbon and

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generating income for communities. These nature-based solutions are compatible with international initiatives such as the Bonn Challenge, African Forest Landscape Restoration Initiative (AFR100), and the United Nations Decade on Ecosystem Restoration, making gum arabic a strategic intervention to fulfil several Sustainable Development Goals concurrently (Mansourian & Berrahmouni, 2021; Reij et al., 2021).

Integration with Climate Finance Mechanisms

The climate resilience and environmental benefits of gum arabic production create opportunities for accessing climate finance. County-level climate change funds, such as those established in Isiolo, Marsabit, and Samburu, provide mechanisms for community-based adaptation projects. These funds support interventions including tree planting, sustainable harvesting training, processing infrastructure, and market development, all critical components for gum arabic sector development (Leeuw et al., 2014; Mansourian & Berrahmouni, 2021). The participatory planning processes embedded in these mechanisms ensure community ownership and alignment with local priorities.

At the national level, Kenya's National Climate Change Action Plan and National Adaptation Plan identify livelihood diversification in ASALs as a priority area. Gum arabic development fits squarely within these frameworks and should be explicitly incorporated in implementation strategies. International climate finance sources, including the Green Climate Fund, Adaptation Fund, and Global Environment Facility, could support scaled-up interventions (ENNDA, 2025; Gordon & Kinyua, 2025; Njeru, 2022). Additionally, carbon finance opportunities through afforestation and reforestation projects using Acacia species could generate additional revenue streams while contributing to climate change mitigation. Integrating gum arabic into these various climate finance mechanisms would mobilise resources for transformative investments while positioning the sector as a model for climate-smart development in pastoral areas.

Empirical Evidence and Data Analysis

Analysis of household engagement and income data from northern Kenya provides quantitative evidence of gum arabic's role in pastoral livelihoods. Table 1 presents livelihood diversification patterns in Garba Tula, Isiolo County, demonstrating the prominence of gum arabic collection alongside traditional pastoral activities (Salah, 2014).

Table 1: Livelihood diversification patterns in Garba Tula, northern Kenya

Livelihood Activity	Households Practising (%)
Livestock sale	52
Gums and resins collection	59
Hide and skin trade	13
Charcoal burning	8
Pole sales	4
Average monthly income from livestock (KSh)	4,730
Average monthly income from gum arabic (KSh)	4,200

Source: (Salah, 2014)

Table 1 reveals several important patterns. First, gum arabic collection is practised by 59% of households, even livestock sales (52%), which demonstrates its significance in local livelihood portfolios. Second, the average monthly income from gum arabic (KSh 4,200) approaches that from livestock (KSh 4,730), underscoring its economic importance. Third, the data shows clear livelihood diversification, with households engaging in multiple activities rather than relying on a single income source (Salah, 2014). This diversification is precisely what resilience frameworks recommend for managing risk in variable environments.

Table 2 presents data on income utilisation patterns from gum arabic sales, illustrating how this income supports both immediate consumption and investment in productive assets.

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Table 2: Utilisation of income from gum arabic sales in Garba Tula, northern Kenya

Use of Income from Gum Arabic	Respondents (%)
Subsistence (food and household needs)	70
School fees	24
Restocking (purchasing livestock)	22
Supporting livestock activities (salt, medication)	6

Source: (Salah, 2014)

Table 2 demonstrates that gum arabic income serves multiple functions within household economies. The predominant use for subsistence needs (70%) confirms its role as a safety net, helping households meet basic consumption requirements during periods when livestock income is insufficient. Investment in education (24%) represents a forward-looking allocation that can break intergenerational poverty cycles. Most significantly, 22% of respondents use gum income for restocking, effectively rebuilding their primary productive asset base after drought losses. An additional 6% support ongoing livestock activities. These investment patterns indicate that gum arabic serves not merely as a coping mechanism but as a pathway for asset accumulation and recovery from shocks.

CONCLUSION AND RECOMMENDATIONS

Key Findings

This examination of gum arabic's potential to transform pastoral livelihoods in northern Kenya has revealed several critical findings. First, gum arabic already plays a substantial role in household economies, with 59% of households in study areas engaging in collection and generating an average monthly income of KSh 4,200, nearly equivalent to livestock income. Second, the sector operates far below its potential due to multiple interrelated constraints, including limited value addition, weak market linkages, inadequate technical capacity, insufficient financial access, poor infrastructure, and gaps in policy and institutional frameworks. Third, successful interventions such as the Acacia EPZ model demonstrate that targeted support addressing quality improvement, market linkages, and capacity building can generate rapid returns both for businesses and for collectors, particularly women.

Fourth, gum arabic offers unique advantages as a climate change adaptation strategy, given the drought tolerance of Acacia species and their ability to provide reliable income during periods when livestock productivity declines. Fifth, environmental co-benefits including soil conservation, carbon sequestration, and biodiversity support, create opportunities for integrating gum arabic development with landscape restoration and climate finance initiatives. Sixth, the widespread accessibility of gum collection across gender, age, and wealth categories makes it an inclusive economic activity that can reach the most vulnerable populations. Finally, Kenya's policy environment is increasingly favourable, with new frameworks on forestry, climate change, and devolved governance providing entry points for mainstreaming gum arabic development.

Strategic Recommendations

Based on these findings, this paper advances strategic recommendations for realising gum arabic's transformative potential across several interconnected dimensions.

Production and Resource Management

The most fundamental priority is comprehensive resource mapping, which sets up baseline information about the gum arabic resources so that evidence-based planning and sustainable exploitation can be implemented. Based on this body of knowledge, it would be necessary to promote sustainable harvesting methods by conducting specific training programs for all collectors, with special focus on sustainable practices that can promote maximum yield without compromising the health of trees in the long term. Demonstration plots and pilot projects of Acacia plantations provide chances to integrate gum production with larger environmental goals such as soil conservation and carbon sequestration. In response to short-term quality concerns, the introduction of mobile processing units and enhanced drying technology on-site at

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collection points would improve product quality and minimise contamination at the point of origin. Moreover, the introduction of community-based natural resource management regimes on communal lands, including clear governance frameworks and effective benefit-sharing arrangements, would offer institutional underpinnings of sustainable exploitation. These should be supplemented with measures to address invasive species, especially the aggressive *Prosopis juliflora*, and at the same time encourage natural regeneration of native Acacia species.

Value Addition and Processing

Introduction of local processing units at collection centres is a key initial move in value addition because it allows simple cleaning, sorting, and grading of products to be performed by community groups with proper technical assistance. On this basis, investing in regional intermediate processing plants would offer capacity in mechanical grinding, size classification, and packaging, with service to various collection points and economies of scale. To access market segments with higher value, there is a need to attract private sector investment in more sophisticated processing capacity, especially in the production of speciality grades and high-value derivatives that fetch a higher price in the international markets. These processing investments should be accompanied by quality assurance infrastructure, necessitating the development of quality control laboratories capable of testing and certifying in line with international standards. Establishing organic and fair-trade certification standards and protocols would open the doors to higher-end markets where customers are prepared to pay a price premium to purchase sustainably produced goods.

Market Development and Value Chain Strengthening

Empowering producer associations and cooperatives by providing holistic training in governance, business management, and collective marketing enables collectors to achieve higher value and better terms with buyers. Organisational capacity building is complemented by physical infrastructure development, where collection and bulking facilities are established to offer adequate storage infrastructure, lower transaction costs, and allow collective negotiation based on positions of strength. The existing information asymmetries that favour collectors can be resolved by designing market information systems that can provide real-time data on prices, demand trends, and quality requirements to all value chain actors. Enabling direct connections between producer groups and foreign purchasers minimises the number of intermediaries that now reap high margins, and more value is returned to the primary collectors. Such market-based interventions necessitate the incentivization of investments in rural infrastructure, such as roads, storage facilities, and communication networks that lower costs and enhance market accessibility. Lastly, the encouragement of trade fairs, exhibitions, and buyer-seller meetings broadens the market and develops commercial relationships that may convert informal deals into formal business relationships.

Capacity Building and Technical Support

Expanding training initiatives on sustainable harvesting, post-harvest management, quality evaluation, and business skills helps overcome human capital limits that are currently limiting sector performance. Instead of ad hoc training programs, creating and formalising gums and resins curriculum in technical training institutes and extension systems will provide systematic transfer of knowledge and skill development across generations of collectors. Field demonstrations and farmer field schools provide a platform of peer-to-peer learning and knowledge exchange, utilising local expertise and social capital. Enhancing extension services by allocating special personnel and resources to specifically target gum arabic collectors is a way of getting technical support to those who need it most. In addition to direct assistance to collectors, training county government staff, development partners, and community leaders on gum arabic sector development creates the larger ecosystem of support needed to ensure the continued growth of the sector.

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Financial Services and Investment.

The creation of customised financial products to serve the gum arabic industry tackles capital limitations that presently restrict investment in quality enhancement and value addition. The investment would be unlocked by seasonal credit, inventory financing, and equipment loans tailored to the temporal patterns and risk profiles of gum arabic production. Enabling access to microfinance and cooperative funding mechanisms provides working capital to collectors and small-scale processors to meet operational requirements and small-scale investments. In the case of larger infrastructure investments, grants and subsidies to establish processing infrastructure and quality improvement investments can precipitate transformative change that would not have been financially viable previously. The establishment of special investment funds with a specific focus on value addition and market development within the gum arabic industry is an indication of commitment and patient capital to ensure long-term development. Lastly, connecting producer groups to climate finance tools such as county climate funds, national adaptation funding, and international climate finance sources increases access to increasing resource streams to climate-smart development in pastoral regions.

Policy and Institutional Framework

The establishment of detailed county policies and legal frameworks that govern the gums and resins sub-sector forms the regulatory basis of orderly sector development within the Kenyan devolved governance system. Such county-level structures need to be aligned with policies at the concerned ministries and government levels to establish consistent support systems as opposed to fragmented and possibly conflicting interventions. Clearly defined institutional mandates and coordination mechanisms between national and county governments help in clarifying responsibilities and facilitating effective collaboration. The establishment of fiscal incentives to attract investment by the private sector in processing, such as tax holidays and duty-free importation of equipment, and assistance in export promotion, mobilises private capital and skills in value addition. The mainstreaming of gum arabic into national development plans such as the Vision 2030, the National Climate Change Action Plan, and the Agricultural Sector Transformation and Growth Strategy will ensure that the sector gets the attention it deserves in relation to its potential contribution to the national goals. Enhancing research and development capacity by increasing funding to the Kenya Forestry Research Institute and other appropriate institutions produces the body of knowledge required to inform evidence-based policy and practice. Lastly, the formation of multi-stakeholder platforms involving government, private, civil, and community organisations to align sector development formulates dialogue, problem-solving, and collective action mechanisms that can hasten transformation.

These strategic recommendations reinforce each other, as advancements in one area facilitate and enhance improvements in others. To achieve such a comprehensive agenda, the effort must be long-term, involving various stakeholders, mobilisation of resources, and responsive management that learns by experience and modifies strategies to meet it. Gum arabic has the transformative potential of pastoral communities in northern Kenya, but achieving this potential requires concerted efforts across production systems, value chains, capacity development, financial services, and policy frameworks.

Future Research Directions

Although this paper has summarised a considerable body of evidence on gum arabic in northern Kenya, some aspects require further research. Economic analysis is required to measure the total costs and benefits of value addition investments at various levels of processing, including cost-benefit analyses of community processing units, regional facilities, and advanced processing plants. Longitudinal research monitoring household outcomes with time would give more evidence on the effects of gum arabic in reducing poverty and enhancing resilience. Strategic positioning would be

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informed by market research on demand trends, price elasticity, and opportunities in emerging markets, including certified organic and fair-trade products.

Studies on the most effective governance frameworks to manage resources within communities on communal lands may offer examples of sustainable exploitation that can strike a balance between productivity and conservation. Gender dynamics in gum arabic value chains, such as power to make decisions, benefit sharing, and empowerment outcomes, would be strengthened in research to enhance understanding of social impacts. Climate finance applications would be supported by environmental research that quantifies the carbon sequestration potential, biodiversity benefits, and soil improvement of Acacia plantations. Lastly, comparative studies on the lessons learned by successful gum arabic sectors in other countries like Sudan, Nigeria, and Senegal might assist in identifying transferable strategies that can be used in Kenya to speed up the growth of the sector.

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