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Wild Meat Value Chain Integration Systems: Opportunities for Value Chain Formalisation and Scaling in Africa

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ABSTRACT

Establishing legal, safe and sustainable wild meat sector promises to potentially reduce demand for illegally sourced meat, support livehoods, and contribute to conservation goals. However, institutional mechanisms and systems to champion sustainable wild meat value chains are underdeveloped, making it a challenge for the sector to formalise and scale. This study investigated how value chain systems are/can be organised and integrated. Also, transitional pathways to value chain formalisation and scaling were evaluated. Literature data ($n = 96$) on plains game wild meat value chains in Africa from 2000 to 2023 was subjected to thematic analysis to identify patterns and linkages in the value chain systems. The results show that while rural and poor communities are the largest recipients of illegal wild meat, they are structurally excluded from the legal game meat value chains. Illegal and legal wild meat value chain systems show three levels of integration: fully, partially and independently integrated systems. Each system presents a unique opportunity for scaling up enterprises and developing institutional governance to deliver well-managed wild meat value chains embedded with system-specific sustainable harvesting and use practices.

1 | Introduction

The current incoherent institutional mechanisms and arrangements in the African countries block opportunities for business formalisation and scalability of the wild meat sector. As such, in many countries, sustainable wild meat value chains are unimaginable. Understanding how value chain activities are organised and arranged can offer opportunities for transitional pathways to building legal, safe and sustainable wild meat value chains. Current knowledge on global wild meat value chain systems is in its infancy, and there is limited or inaccurate/incomplete data. This partially explains the wild meat's underdeveloped and poorly understood value chains (Food and Agriculture Organization (FAO) 2018). Existing knowledge largely focuses on wild meat extraction and consumption (van Vliet, Nasi, and Taber 2011; Lindsey, Romanach, Matema, et al. 2011; Lindsey, Romanach, Tambling, et al. 2011; Bergin and Nijman 2014; Rogan et al. 2017); macro and sectorial outlook (Hoffman 2004; Willcox and Nambu 2007; Martin et al. 2020) illegal value chain channels (Kalu and Aiyeloja 2012; Tee, Ikpa, and Tortange 2012; van Vliet et al. 2019; van Vliet, Muhindo, et al. 2022; van Vliet, Puran, et al. 2022; Bachmann et al. 2019; Babalola 2023). This study analysed how actors in the chain systematically interact and coordinate activities, i.e., to harvest, process, wholesale and retail wild meat with the aim to identify and characterise value chain integration systems (for both informal and formal wild meat chains). Also, potential pathways and best practices for a formal and growing wild meat sector are examined.

2 | Background

Wild meat, which is also referred to as bushmeat, game meat or venison, is a source of income for reserve managers, ranchers, hunters and traders. It is also an invaluable source of nutrition

and a form of cultural expression to many consumers throughout the world. It supports livelihoods from both legal and illegal sources (Nielsen et al. 2018; Hickey et al. 2016; Strazdiņa, Jemeļjanovs, and Šterna 2013; Taylor et al. 2020; Fa, Funk, and Nasi 2022) from subsistence hunters to small- and large-scale commercial activities. A study by Lindsey et al. (2015) in Zambia found that illegal meat harvesters earned a median revenue of US$48 per month, a figure that is more than twice (US$15 per month) of the median household income in the studied area. In some regions, wild meat is consumed as the only available source of animal protein, fat, iron and other micronutrients, whereas in some, it is for dietary diversity (Sarti et al. 2015). More so, where livestock husbandry and fishing are not feasible options and during drought periods in African savannas and desert areas, wild meat is an essential part of people's diets, income and local economy. Booker and Wilson-Holt (2020) argue that sustainable use of the wild meat may help meet the increasing demand for protein, alleviate poverty levels and reduce food insecurity in Africa.

There are currently several concerns associated with wild meat consumption. For instance, public health concerns related to zoonoses. Infectious diseases possibly derived from wild animals (van Vliet, Muhindo, et al. 2022; van Vliet, Puran, et al. 2022), such as Ebola, COVID-19 and Mpox are the most recent outbreaks (De Sadeleer and Godfroid 2020; Patel et al. 2023; Titanji, Hazra, and Zucker 2024). Zoonoses is, however, non-specific to wild meat; it is also present in domestic sources of meat (Libera et al. 2022). Current studies are inconclusive on wild and livestock's rate of transfers of zoonoses to humans and hosting capabilities. It is, however, clear that if left unregulated and informal, the trade of wild meat might spread diseases and pathogens quickly with dire public health implications due to poor hygiene and food handling, lack of health inspections and contamination (He and Li 2021; Borz'ee et al. 2020; Doyle 2015; FDA 2015; World Health Organisation [WHO] 2015).

Wildlife population decline is another concern associated with wild meat consumption and poses an immediate threat to biodiversity (Andimile and Floros 2021; Ingram et al. 2021; Makoye 2021; Teutloff et al. 2021). Studies show that a decline in wildlife populations is associated with illegal harvesting, poor law enforcement and unsustainable extraction levels and methods used. For example, in 2398 animals caught by snares over 5 years, 3 in 5 rots in the wild and or were scavenged, 3 in 10 were recovered by rangers and a little over 1 in 10 animals caught were successfully extracted by illegal hunters (Lindsey, Romanach, Matema, et al. 2011; Lindsey, Romanach, Tambling, et al. 2011). Thus nearly 60% of potential meat is lost to scavenging and decomposition. This situation is also observed in many African countries (Lindsey et al. 2013; Bett et al. 2024). In addition, in some countries, while relevant laws and permit systems for harvesting wild meat exist, wild meat is often obtained from illegal hunting where methods like snares, traps, fire, nets and dogs are used (Ahmadi et al. 2018). In Cameroon, between the period from 2020 to August 2021, a total of 1392 kg of illegal meat from various species was seized from poachers at Campo Ma'an National Park (Kubania 2021). More so, in the Congo Basin, an estimated one million tonnes of wild meat is consumed per year and largely from illegal sources (Fa, Peres, and Meeuwig 2002; Nasi, Taber, and Van Vliet 2011). Similar trends are observed in South Africa (Rogan et al. 2017); Algeria (Nijman et al. 2019) and Ghana (Bannor, Oppong-Kyeremeh, and Kuwornu 2022).

Building a sustainable wild meat sector anchored on the principles of transparency and traceability could help deliver safe, legal and beneficial wild meat value chains while reducing demand for illegally sourced meat. This is reflected in the 14th Conference of the Parties of the Convention on Biological Diversity (CBD COP14) decision on voluntary guidance for a sustainable wild meat sector, noting that, underdeveloped institutional mechanisms, poorly understood value chains and fear of negative impacts associated with commercialisation limits commitment and prospects to formalise and grow the sector in Africa. This also could explain why there are considerable regulatory challenges, with many regions and countries facing limited enforcement capacity. Resultantly, the wild meat sector remains fragmented and poorly managed and its trade largely informal and illegal. As earlier noted by 't Sas-Rolfes (2000), banning trade discourages sustainable harvesting and exacerbates poaching.

Studies on sustainable use, trade and consumption of wild meat are scant globally (Food and Agriculture Organization (FAO) 2018). Empirical evidence describes and maps value chains, illustrates product flow and trade channels in both illegal and legal wild meat harvesting (Lindsey et al. 2013). Less is known about how the current value chains are arranged and integrated. The way actors in the chain systematically interact and coordinate activities, i.e., to harvest, process, wholesale and retail wild meat, could help (i) develop a holistic approach to value chain management, (ii) integrate technological innovations for species traceability and value chain sustainability retention systems and (iii) introduce responsive and adaptive wild meat value chain governance frameworks and policies. Without such comprehensive measures, institutionalising trade alone will not resolve the deep-rooted issues of unsustainable hunting and consumption. This is the research gap addressed in this work.

3 | Value Chain Integration Systems

Value chain integration refers to the interaction, alignment and coordination of activities and processes of multiple actors along the value chain who come together to deliver the product or service. Each actor has varying and unique levels of ownership and control over the chain. Here, value chain integration systems were characterised based on the 'level of ownership' (Aslam et al. 2020) – namely, fully and partially integrated value chain systems as well as independent systems.

- A *fully integrated system* refers to a fully owed value chain system where one single producer manages the entire value chain, from the forest to the final products retailed. This system has no middlemen except in cases where a specific service is sub-contracted by the lead producer.

- A *partially integrated system* involves value chain actors partly managing the product distribution in varying control levels over product distribution. The value chain here is producer and middlemen-driven.
- An *independent system* describes producers, hunters, wholesalers and retailers operating independently to deliver wild meat to the consumer. It is entirely a middlemen-driven system.

4 | Methods

4.1 | Research Approach

In an integrative process, data from peer-reviewed literature (2000–2023) were searched, appraised and synthesised to identify species, as well as draw value chain patterns, themes and relationships for both legal and illegal systems of African plain game animal species (Whittemore and Knafl 2005). Google Scholar, Web of Science, Sage Journal, EBSCOhost and Science Direct search engines were used. Information was aggregated into African sub-regions (North, Central, East, West and Southern Africa).

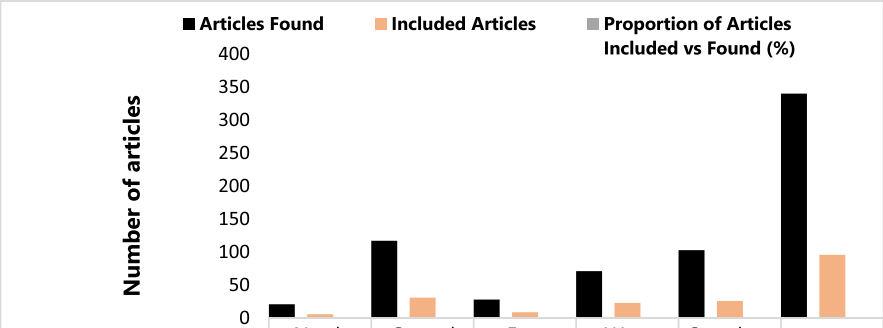
Articles were randomly initially searched using Africa or per country or region. A total of ($N = 1237$) matched key search terms combining 'Africa, region/country name', with words or phrases the following phrases: 'ungulate/plain game meat species' with 'legal/illegal bush/game/wild meat trade or trade channels' and 'wild/game/bush meat value chain analysis'. Preliminary scanning and observation of the 'article titles' to check for relevance resulted in ($N = 578$) articles being selected. This process was followed by a further thorough assessment by observing article 'keywords, abstracts, objectives, results, and conclusions' to isolate those that focused on ungulates/plain game animals and ($N = 340$) articles were selected and aggregated according to the region. In the final stage of literature, scoping was more specific to 'wild/game/bush meat trade/consumption or trade channels and value chains analysis/systems (legal/illegal)'. In this analysis, studies that only focused on consumption, diseases and drivers of wild meat consumption were excluded, and a total of ($n = 96$) were deemed relevant for analysis as shown per region in Figure 1.

The selected articles were scanned initially to familiarise with the data and preliminary structure of the information. Thereafter, three key activities were performed: (i) plain wild game meat species mentioned in an article were recorded per region and country to profile meat diversity and potential, (ii) illegal and legal value chains were mapped to assist in the creation of flowchart diagrams (of actors involved, the flow of meat from the forest to the table and other behavioural chain characteristics) and lastly, (iii) profiling characteristics of the value chain integration systems was performed. Each interaction, stakeholder or activity associated to a particular chain was identified and added to the flow chart. Moreso, meaningful themes providing more understanding of the processes, governance and interaction dynamics within the chains were coded and used to identify bottlenecks in the chain. Data were loaded onto Atlas.ti version 8.1 to build themes and connections. In vivo and Open Coding were applied, where in vivo was used to characterise value chain features while open coding enabled deductive analysis to create key codes and sub-themes. This process involved coding, decoding and re-coding to synthesise value chain characteristics, relationships and map pathways for formalising wild meat value chains.

5 | Results

5.1 | Type of Species in the Value Chains Per Region

There is a wider diversity of wild meat species in the value chains per region with over 60 found (Figure 2). Southern Africa had the most diverse plain game species (27) that make it to the dinner table in African (rural, urban, tourists) and international markets. This region is superior on antelope species such as blue wildebeest, impala, springbuck, gemsbok and wildebeest. Springbuck, kudu, warthog and impala are among the most consumed in this region. Most species in this region were recorded



	North Africa	Central Africa	East Africa	West Africa	Sourthen Africa	Total
Articles Found	21	117	28	71	103	340
Included Articles	6	31	9	23	26	96
Proportion of Articles Included vs Found (%)	28,60%	26,50%	32,10%	32,40%	25,40%	27,90%

FIGURE 1 | Inventory of articles on value chains of African Ungulates per sub-region in Africa.

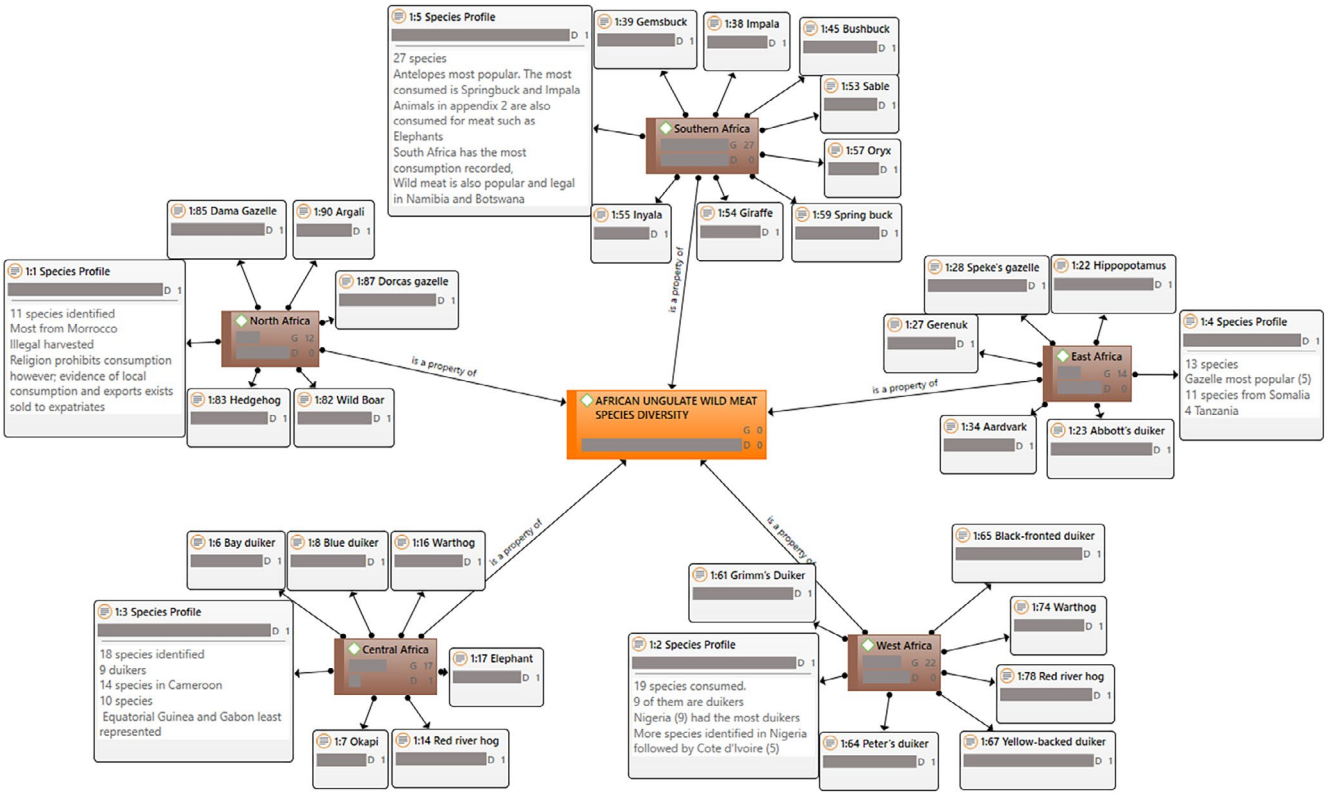


FIGURE 2 | Examples of plains game wild meat species diversity in African sub regions (*Source:* Atlas Ti Version 8.1) (*attached separately*).

in South Africa. Zimbabwe, Namibia, Zambia, Madagascar, Angola and Botswana were also represented.

Nearly an equal number and similar types of species were recorded in west (19 species) and central Africa (18 species). The two regions share similar flora and fauna (Figure 2). The two regions share over 50% of common plain game meat species. Apart from a superior diversity of duikers (12 types) compared to other regions, the two regions share other common antelopes like bushbuck, which are also found in east and southern Africa. A varied number of species in central African dish were identified in Cameroon (14) and Central African Republic followed by DRC (10 species). Fewer species were recorded from Equatorial Guinea and Gabon. In West Africa, most species were recorded in Nigeria (10 species) and Cote d'Ivoire (5 species). Although varied, East and North Africa shared gazelle species as the common antelope consumed in the two regions, and north Africa had the least species (10 species) recorded with most from Morocco. Also, data on species were collected from Algeria, Chad, Egypt and Libya, although religion prohibits wild meat consumption in this region. Above all, there is evidence of local consumption and exports to the Gulf region. Threatened wild meat species like elephants listed in both Appendices 1 and 2 in CITES are also consumed in Southern, East and Central Africa.

6 | Structural Components and Types of African Wild Meat Value Chains

This section analyses the characteristics and integration systems (formal and informal) on the movement of game meat from the bush/forest to the dish following a systematic review.

6.1 | Characteristics Informal/Illegal Value Chains

6.1.1 | Informal Value Chains

Table 1 shows the distribution and flow of informal wild meat from the forest to the consumer. Hunters operate as individuals or travel in groups (hunter porters). They are mostly males who travel longer trips amounting to days, in some instances, to a week. Hunter porters typically refer to individuals who assist in hunting expeditions, often by carrying equipment, meat and supplies. They are usually contracted by the lead hunter(s) who provide supplies such as ammunition, snares, cigarettes and food. Many porters receive minimal pay for their labour, and pay structures can be exploitative, often not reflecting the physical demands of their work. This is so mainly because porters do not have formal contracts or legal protections, making them vulnerable to exploitation. Also, the physical nature of their work can lead to health issues, with little access to medical care especially when working in challenging terrains, poses risks, especially without proper gear or training. Snares, firearms, spears and dogs are common tools and methods used for hunting. There are fewer barriers to entry as the cost of doing business is low.

In addition, hunters are responsible for carcass dressing which normally takes place in the bush and or in hunter's homes (Table 1). After processing, meat is distributed via various network channels including hunter-direct-to-consumer or through intermediaries like wholesalers and market traders. Market traders are predominantly women who sell in stalls in informal urban and street markets. Women are engaged in entrepreneurial activities related to wild meat, including processing

TABLE 1 | Wild meat extraction value chains in Africa.

Factor	Illegal/informal	Legal/formal
Source	Protected areas, private reserves, ranches and communal lands	Protected areas, private reserves and ranches and communal lands
Harvesting	Males; hunter porter; lead hunters; longer trips; available or specified; no species age or area considerations	Regulated; professional hunters; trophy hunters; consumptive hunters; community consumptive hunters; non-threatened specified species; permitted off-takes
Hunting dynamics	Once a week/when needed; hunter market owns stock	Seasonal – winter; on request – strict selection criteria applied
Methods	Snare; guns; spears; dogs, etc. throughout the year, but mostly winter	Night; light blinding; single bullet head/neck shot
Processing	Bush/home processing; hunter responsible; no strict inspection – visual assessment	On-farm or private abattoirs/butchers; veterinary inspection; disease tests; specific meat handle protocol
Products	Whole carcass; parts; half carcass; smoked; dried and salted	Specific cuts – not yet standardised; sausage (raw and dry); dried (biltong spiced); raw meat
Disposal	Disgraced in the bush or consumed	Head discarded – lead contamination; offal disposed or given to hunters/processors
Distribution	Market traders; wholesalers; hunters; secondary wholesalers; network	On far sales; wholesalers/ butcheries, abattoirs/butcheries
Transport	Public transport, door-to-door delivery	Hunting truck; refrigerated trucks
Market niche	Rural; urban; diaspora; own use; low income and middle class	Tourists; own use; export; high income and urban middle class

and marketing. Selling in informal markets help stabilise food supplies and provide access to protein sources in areas where traditional livestock farming may be limited. Women traders often establish close knit networks with hunters and suppliers, ensuring that wild meat reaches local markets and possess access to food preparation methods to buyers.

In informal channels, meat is dried or smoked for preservation and shipped to urban markets by foot, bicycle, vehicle or public transport like trains and it is sold as a whole carcass; animal part; half carcass; smoked; dried and salted. Unlike formal hunters, market traders are exposed to more law enforcement authorities. Hence, brokers and distributors experience higher transaction costs in the form of transport and bribes. While informal chain predominantly services low and middle-income rural and urban local consumers, it also reaches diaspora international markets (Table 1). For instance, illegal wild meat, mainly from west and central Africa, is recorded and confiscated in Paris, France and Brussels. A survey at Roissy-Charles de Gaulle airport (Paris, France) showed that 7% of the inspected passengers from west and central African countries were carrying bushmeat (Chaber et al. 2010). Also, a study at Brussels Zaventem airport between January 2017 and October 2018 estimated that a total of 80,381.20 kg of bushmeat transited through Brussels airport over the course of the survey, equating to 3876.42 kg of bushmeat arriving in, or transiting through, the airport monthly.

6.1.2 | Formal Value Chains

International/local trophy hunters, professional and local licensed/registered harvesting teams, also referred to as 'consumptive hunters', such as hunters' associations, are responsible for wild meat extraction in the legal meat supply (Table 1). Consumptive hunters refer to individuals who hunt primarily for personal consumption or local commercial purposes. Professional hunters are either independent or members of an association who are hired for meat extraction, for example, by external abattoirs, private, community conservancies, ranches or protected areas services. Unlike the illegal value chains, to adhere to animal welfare standards and public health in terms of bullet (lead) and disease contamination, only firearms are used, and there are strict regulations on shooting procedures prescribed. For instance, in South Africa culling animals is done mainly at night, using spotlights and headshots. There is 10-min allowance before cutting the throat to enable bleeding and carrying the animal to the processing facility/abattoir/chiller within an hour after the kill. These standards were observed in Southern Africa, and this could be influenced by the fact that countries such as Namibia, Botswana, Zambia and South Africa have a legalised and fairly developed wild meat trade and consumption in comparision.

Carcasses are processed in accredited rural/farm or external abattoirs. The abattoirs adhere to the strict regulations like

the European Union Commission Regulation (EC) No 1441/2007 and Regulation (EC) No 2073/ on food safety. In South Africa, Meat Safety Act of 2000 (Act No. 40 of 2000 of South Africa governs the safety and health of game meat. A carcass is dressed, processed into various cuts and sometimes packaged at the abattoir. Abattoirs sell their meat products as a whole carcass mainly to wholesalers and butcheries, cuts of specified weight and meat type, fresh meat, dried meat e.g., biltong and sausage. High income consumers in the urban and export markets are the target group in this chain. Recorded markets for plain game are EU, Asia and USA markets.

6.2 | Value Chain Integration Systems

This section reports the results on how multiple actors along the value chain who come together to deliver wild meat to consumers are coordinated, aligned and arranged based on the level of ownership or control as proposed by Aslam et al. (2020). These are fully and partially integrated value chain systems as well as independent systems.

6.2.1 | Fully Integrated System

In this system, producers (including illegal hunters) have full control and ownership of the entire value chain system from harvesting to distribution to the final consumer. This a centrally managed system entirely permitting monitoring of good practices and quality of the final meat products. Here, the producer or hunter has an elevated ability to maintain environmentally controlled systems and strict food safety and handling protocols. In a legal system, this category includes producers/ranchers with their own processing and food handling facilities and distribution centres (Table 2). Producers here are typically private ranches and protected areas and could be small or large-scale, seasonal or all-year-round producers.

Professional licensed hunters are contracted or part of a team in the farm/reserve and meat processing facilities are typically on the farm equipped with drying, canning, cutting, sausage-making capabilities. Meat sales are done on farms, wholesaled and retailed to the fast-food industry, mainly for tourist markets like hotels and clubs. This system's products reach high-income consumers in the local and global markets.

The illegal system also exhibits similar characteristics to that of the legal system. This system involves illegal hunters who are responsible for the extraction of plain game animals from the private, PAs and communal lands, process the meat and distribute it directly to the final consumer. The hunter in this system extracts, processes and distributes to a network of consumers. Hunters sell only to their trusted networks of customers in rural or urban centres on face-to-face deliveries. Common cuts sold include wholesome, half-animal and or animal-specific parts like legs. These are sold raw, dried or smoked.

6.2.2 | Partially Integrated System

Operations of the partial system are illustrated in Table 2. This system's operations start at the parent/area producer ranching level characterised by producer part ownership and a middlemen-driven system. In a formal system, producers hunt and cull animals but may or may not have their own distribution channels and or processing facilities. In some scenarios, private butcheries/abattoirs have their own hunters who are deployed when needed to hunt as arranged with ranches/reserves. Many producers have permitted off-takes or management plans and cullers/hunters. Customarily, the relations here are governed by backward or forward long-term contracts between game meat producers, abattoirs and wholesalers.

While the meat from the ranches or reserves in this system mainly goes to external partners/processors/abattoirs, some producers have informal makeshift abattoirs for localised and close-knit customer network markets. For example, meat from trophy hunting is typically processed in makeshift/rural abattoirs, and it reaches local market networks of rural consumers and tourists. Produce from the formal partial integrated system has a broader market reach compared to the full integrated system.

The illegal value chains in the partially owned systems, on the other hand, involve extraction/poaching from protected, communal and private lands by illegal hunters who distribute to market traders after processing. In this scenario, the producer or hunter is responsible for the extraction, processing such as skinning, carcass processing and distribution of the product to wholesalers who buy in bulk and sell to market traders in both urban and rural areas (Amir 2006; Lindsey and Bento 2012). In countries like Somalia and Algeria, animals are captured and transported alive (sometimes kept for days) to the market traders. No evidence of illegal live animal sales in the informal markets in regions such as Southern, Central and East Africa was recorded. This could be attributed to religious beliefs related to animal slaughter and standards such as *halaal* standards.

In both formal and illegal value chain systems, brokers have additional written or unwritten contracts with wholesalers and traders to collect meat from the producer/hunters. It is also worth noting that the carcass here is transported via middlemen in refrigerated trucks (formal) and makeshift luggage carriages (informal). For example, sacks (bags) or tree branches (illegal) are in a smoked form (mainly in the Western and Central African regions) or raw, sometimes dried (mainly in Eastern and Southern regions). Meat producers in this system have a huge opportunity to distribute their produce wider through various intermediaries and new market reach ability is enhanced.

6.2.3 | Independent System

Here producers are only involved in the production and are responsible for ranch or landscape management activities like fence monitoring, guarding and other park services. Animals are sold to brokers or middlemen from the site while in the illegal system; hunter porters (linked to the lead hunter) only extract animals at the source. Porters are contracted hunters linked to the lead hunter as a broker who provides ammunition, snares, food and other supplies needed in the illegal extraction of animals. Output distribution chains in this system are largely regulated and controlled by middlemen, including brokers, traders, suppliers and retailers. The producer makes farm-level

TABLE 2 | African plains game wild meat value chains integration systems (illegal and legal systems).

Type of integration	Production system and type	Source and producer type	Harvesting	Value Abattoirs	Processing	Distribution Channels	Markets Type	Export
Fully integrated System	Legal	Private Ranches Small scale Large Scale Protected Areas	Owned Winter All year-round When requested	On Farm	On farm, e.g., wholesome, drying, canned meat, biltong, raw meat and deboning	On the farms sales Wholesales Fast-food	High income Tourists Local and global	Official
	Illegal	Communal, Protected Areas Private Ranches Illegal hunting	Owned All year-round When requested	Bush/home	Bush/home, e.g., wholesome/ parts-based sales	Networks/arranged Face-to-face deliveries	Local Urban and rural	Smuggle
Partial integrated	Legal	Private ranches Protected Areas	External hunters Winter All year rounds On request	External private abattoirs On farm Makeshift abattoir	External private abattoir Makeshift abattoir On farm, e.g., Wholesome/ parts-based sales	Direct on farm sales Wholesale Retail/butcheries Tourists	High income Local and global Urban and rural Tourists	Official
		Trophy hunting	External Hunters Winter			On the farm sales Wholesales		
	Illegal	Communal, Protected Areas, Private Ranches Illegal Hunting	Hunter porters All year-round On request	Bush/Home	Bush/Home Informal Wholesalers	Multiple traders Networks, Arranged	Low income Urban & rural	Smuggle
Independent system	Legal	Private ranches Protected Areas	External hunters Winter All year round – on request	Private abattoirs	Private abattoir	Wholesale Retail	Tourist	Official
	Illegal	Communal/ PAs/ranches Illegal–illegal	External hunters Hunter Consortium all year-round – on request	Lead/ independent hunters	Lead hunter	Food stalls Informal restaurants	Urban and rural	Smuggle

decisions in independent systems like selecting animal species to ranch and ranching/production systems autonomously.

7 | Discussion

A total of ($n = 96$) articles were found relevant for the analysis. In terms of regional distribution, central Africa had the most articles (31) followed by Southern Africa (26 articles). There was less published data on studies focusing on ungulate/plains game wild meat value chains found in North Africa. This data distribution might indicate the region's level of wild meat utilisation and research interest per region, consumer attitudes, policy and legislative environment. For instance, in Central, Southern and West Africa demand for meat is high and ever-increasing (van Vliet, Nasi, and Taber 2011), including in times of war (De Merode and Cowlishaw 2006). Thus, more still needs to be known about wild meat enterprises and value chains across Africa.

The structural components of and opportunities for formalising/scaling plain game meat value chains were assessed in this study. The findings showed a wider variety of over 66 plain game meat species consumed in Africa recorded in literature, with the majority being antelopes. While African regions share common species such as bushbuck, warthog, kudu and elephants, there are species that are region-specific. For instance, giant hog is found in West Africa and Central Africa while Inyala wild meat was recorded in Southern Africa. Also, springbuck and impala were recorded in South, Southwest and Eastern Africa, whereas Dama gazelle is unique to North Africa. The data available, however, rely heavily on market surveys. Thus, the list of species captured may not closely reflect an actual number of shunting levels or species composition as wild meat is mostly consumed locally and may not be captured in the market surveys.

The variety of wild meat species found in Africa offers the continent a unique opportunity to dominate and tap into the existing global venison markets. Globally, the venison market dominated by deer species is estimated at USD1745 million as of 2021 with a projection to reach USD2591 million by 2031 (Business Research Insights 2023). The top exporter of deer venison meat in 2022 was New Zealand, with a revenue of over USD110 million (Hall 2023). The main markets include countries like the USA, China and Germany. This accounted for 58% of total deer product exports. Although estimates for African wild meat value are difficult to obtain, the value per country ranges from USD20 million annually in Gabon (Noutcha, Omenihu, and Okiwelu 2016) to over USD200 million annually in Ghana (Davies and Brown 2008). It is worth noting that data on trade and use of different species is scant. The currently recorded data may significantly exclude the value of rural consumption. It is, however, estimated that the wild meat trade in Africa will likely exceed USD1 billion annually with extraction of between 1 million and 5 million metric tonnes.

Results also revealed that the value chain structure and integration systems in illegal and legal value chains are analytically similar in design, yet different in the methods, distribution and channels used. While both legal and illegal value chains service urban and international markets, the target niche differs. For example, in the international market, illegal value chain systems target diaspora African markets in the EU and Asia (Morrison-Lanjouw et al. 2023), whereas legal meat reaches foreign consumers in the same countries. The results show a huge demand in rural, urban and international markets. However, legal chains are not adequately developed to supply diverse species and meet rural consumer demand leaving this market vulnerable to illegal hunting. Many factors might contribute to this, including pricing models, distribution channels and general access to legal meat. Consequently, the population of game meat species are put under constant pressure of over exploitation due to illegal, unsustainable and wasteful harvesting techniques such as the use of snares, spears and traps (Lindsey, Romanach, Matema, et al. 2011; Lindsey, Romanach, Tambling, et al. 2011). Setting up legal abattoirs in private reserves, communal lands and PAs, as well as the creation of artisanal hunters, could increase the supply of legal meat and help fight the overexploitation of species.

The analysis further revealed that both formal and illegal value chain systems were fully, partially and independently integrated. Full integrated value chains are also known as 'vertical integration'. This system shows a fully owned system and involves a producer (ranchers/PAs) controlling the whole downstream processes or partners from harvesting to processing and distribution of wild meat. Fully integrated systems allow the rancher or producer to guarantee and ensure traceability, transparency and meat quality. Moreover, this system is better positioned to achieve sustainable outcomes due to its characteristics, such as greater control over product value chains, the ability to balance demand and supply and effective law enforcement. On the other hand, this system has limited local reach in its current design in that a significant number of rural or urban consumers are excluded from the chain. It is also difficult to start and enter this system as a new entrant due to large capital requirements.

Also, an independent system is another value chain where illegal hunters, ranch owners and/or PAs partner with hunters, abattoirs, wholesalers and traders to supply wild meat. An independent system could also be thought of as 'relational integration' where long-term and trust-based relationships between hunters, ranchers, PAs, abattoirs, wholesalers, traders and customers. The independent system presents various business opportunities for different actors along the chain with the high level of specialisation. This can enhance product innovation and quality; subsequently, better value creation and enhanced customer satisfaction (Rosenzweig, Roth, and Dean Jr 2003). This model can realise a wider consumer reach, including supplying legal meat to rural or urban markets. The close collaboration between the actors within this chain will likely result in improved wild meat enterprise and value chain performance (Huo, Zhao, and Zhou 2014). However, the high cost of doing business associated with monitoring and law enforcement to different actors to meet transparency, traceability, hygiene and health inspection standards is experienced in this system.

Results also indicated that wild meat value chains are partially integrated and operational. In a partially integrated system,

producers influence more than one part of the chain. An example is a rancher who owns an abattoir and distributes directly to consumers. It could also be those hunters and ranchers controls/influences two or more parts of the chain and have some level of reach to the customers through direct farm sales and tourists. Actors in this system have greater flexibility to innovate products and penetrate the market deeply compared to the fully integrated system. More so, partially integrated systems require the producers to depend on other partners and share decision-making authority.

The African Continental Free Trade Area (AfCFTA) can facilitate sustainable and formal legal wild meat value chains across the continent and help to remove the existing trade barriers on the use of wild meat in some African countries. Under the AfCFTA, countries with legal superior game meat species diversity and numbers can export game meat to countries with high demand and low/no legal supplies. All this can be supported by profiling adequate data on species abundance, genetic superiority, not being threatened by extinction, as well as sustainable harvesting procedures.

8 | Transitional Pathways to Formal and Scaled Wild Meat Value Chains

The journey to formal, legal, safe and sustainable wild meat value chains is complex and involves addressing various social, economic and ecological factors. To design pathways to formal value chains, we mapped the characteristics of the three integration systems to identify formalisation and scaling opportunities and challenges (Table 3). This is premised on the understanding that each system operates differently and requires varying strategies for scaling metrics. For example, ranchers or industry players owning the entire value chain system formalise and scale differently from those that control/own part(s) of the chain. Also, each system's specialisation level influences the extent and scale of innovation to formalisation and improving industry processes and products.

In designing the pathways the following assumptions are made in developing the pathways:

Model Assumptions:

- An increase in legal meat supply = reduced demand for illegal meat
- Convenient rural and urban markets for legal meat = reduced demand for illegal meat
- Price differentiation and market segmentation = competitive and sustainable sector
- Value chain inclusion of local communities = sustainable sector

Figure 3 illustrates three transitional pathway scenarios to formal scalable value chains. Each path is described below.

8.1 | Path 1: Formalisation

The analysis revealed that illegal meat mostly supplies or services low-income rural and middle-class consumers/markets. These markets have very limited or no access to legally sourced meat. This presents an opportunity for developing a legal supply of meat in this market to reduce the demand for illegally sourced meat. By building sustainable value chains that benefit local economies, communities could be incentivised to protect wildlife rather than exploit it. Communities often lack the infrastructure, resources or support to develop and access formal markets for sustainable products. For instance, integrating artisanal hunting and establishing more on-site or specialised abattoirs, private ownership rights of animals and communal/state land use rights are some of the strategies to consider.

TABLE 3 | Opportunities and challenges associated with value chain integration systems.

Integration system	Opportunities	Challenges
Fully integrated	• Greater control over product quality • Ability to balance demand and supply • Effective law enforcement – centralised system • Enhanced transparency and traceability • Ideal for export market	• Low product innovation • Limited market reach • Higher start-up cost • Many barriers to entry
Partially integrated	• Wider market reach • Enhanced specialisation and innovation • Innovative products • Flexibility • Contracts ensure reliability in the system • Ability to influence other actors in the chain as a competitor or through contracts	• Limited autonomy
Independent	• High specialised • High productivity • Ideal for further and deeper market penetration • Respond swiftly to market demands • Industry-driven and competitive • Limited barriers to entry • Each player or intermediary has autonomy	• High cost related to transparency and traceability • Market-driven pricing

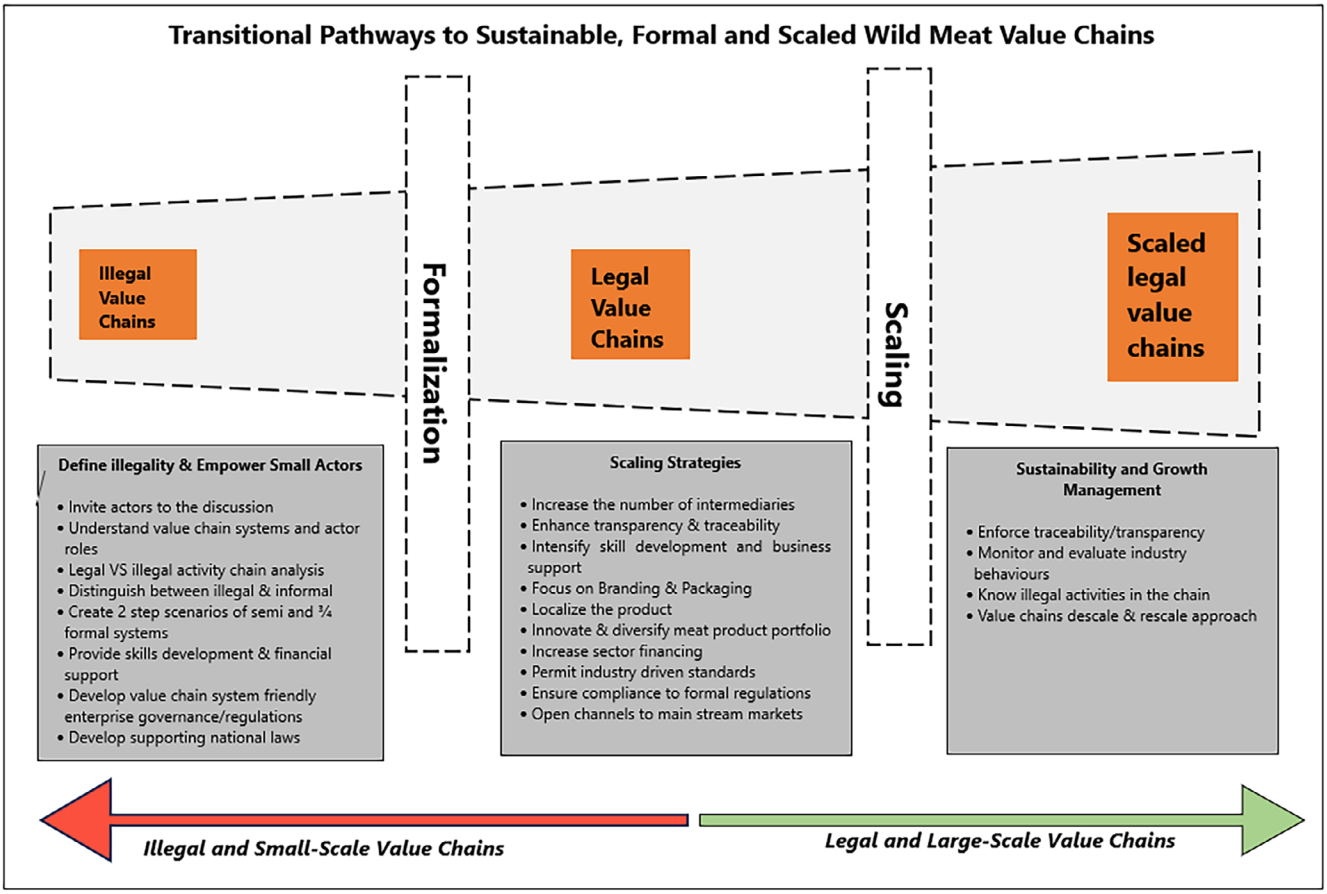


FIGURE 3 | Pathways to formalising and scaling African ungulate wild meat value chains.

Literature also shows that hunting regulation is widely varied from combinations of legalities to total bans. For example, in countries like South Africa, Botswana and Zambia, animals within none's properly fenced property are theirs and may be used for meat production. In Namibia, Benin, Cameroon, Ethiopia and South Africa, one requires a permit to cull animals for meat while a quota system is used in Zimbabwe and also Namibia (Barnett and Patterson 2006; Morgera and Cirelli 2009; Willcox and Nambu 2007). In other countries such as Kenya and Ivory Coast, wild meat trade is banned. Ivory Coast banned since banned hunting in 1974. However, harvesting (not hunting) of forest resources is permitted, including the collection of non-endangered animals and insects for consumption (Gonedelé-Bi et al. 2022). Also, in some countries, wildlife is considered without ownership, belonging to the state and or president. The land tenure type (private, communal and protected areas) and property rights, including animal ownership and use rights (hunting rights and wild meat supply in the market), will determine the possibility and extent of the transition to formalised legal wild meat value chains.

Countries with private ownership or long-term lease permits and quota systems for animal off takes are better positioned to formalise and scale swiftly. For instance, issuing more permits or increasing quotas to boost the legal supply of meat. Private or communal lands offer options for reintroduction of wild meat species to increase the supply of meat. In countries where consumption is banned, or meat is a by-product of hunting, there is a need to assess the existing value chain systems (e.g., supply, consumer behaviour and cultural attributes) and understand context-specific ways for sustainable use. Starting with genetically and reproductively superior species offers easy wins for moving towards and experimenting with legal and sustainable wild meat utilisation. These insights should inform the adaptation of national legislation and policies to systematically introduce wild meat in the markets.

At the distribution level, there are opportunities for entrepreneurs to act as middlemen (distributors, traders and marketers), including support services mostly in partial and independent value chain integration systems with relatively less costly and fewer entry barriers. A methodical and systematic approach is required to facilitate the transition from an industry largely illegal and informal. A two-step scenario of semi-and-¾ formal systems needs to be developed to support the transitioning of actors in different parts of the chain and their practices from informal to legal (Figure 3). Industry-driven enterprise governance standards and wild meat consumption friendly national policies are a requirement to ensure sustainability in the process.

8.2 | Path 2: Scaling

Lessons for scaling widely meat sector can be learnt from practical examples of past and current thriving game industries. Literature shows that while countries in the Southern African region like Namibia, Botswana, South Africa and Zimbabwe (before land reform in 2000) have general and legal commercial

use of wild meat, the animal populations have remained stable and in increasing. In South Africa, for example, the sector has continued to grow since the 1970s, currently contributing R9.1 billion a year (0.27%) to the GDP of South Africa. Also, countries such as Germany, New Zealand and Australia have a well-established game meat industry. Property rights such as land tenure (communities, private and state land) and animal ownership emerge as central to the success and scalability of the sector. In countries with little or no private land ownership rights, public–private partnerships to ranch animals on state land should be considered on long term lease agreements, i.e., a 99-year lease with private investors and/or communities. In the context of the AfCFTA and International Trade, countries with legal superior game meat species diversity and numbers can export game meat to countries with high demand and low to no legal supplies. Largely, plain game meat species in Africa are antelopes such as Kudu and warthog and are similar making inter-African trade possible.

Scaling of wild meat value chains includes increasing the number of intermediaries to enhance and improve the reach of legal value chains and localising the product. Lack of access to legal markets for meat and alternative livelihoods for meat leads to illegal hunting and black markets where demand is high, and profits are more accessible. Consumers also concern themselves over the harvesting techniques, type of species and health. Transparency and traceability showing legal extraction, production systems, species type, place, quality and grading standards are key to improving the confidence of both local and international consumers. In addition, creating clear and enforceable standards for legal hunting, wildlife product sourcing and trade is fundamental to sustainable management. Standards should define acceptable practices, quotas and restrictions that ensure both wildlife protection and economic viability for communities. Also, standards should be culturally and economically appropriate to local communities. Certifying legal wildlife products like sustainable forestry or fisheries certifications could help differentiate legally sourced products in the market.

Failure to enforce anti-use laws in the past indicates that reliance on government-driven enforcement of regulatory standards and governance of wild meat value chains may not yield the desired results. In addition to stringent penalties for non-compliance, a right complimentary mix of different roles for government, entrepreneurs and the industry in setting standards/governance of value chains must be found. Non-voluntary and voluntary industry standards should be developed to champion sustainable scaling of the sector. Programmes such as industry-driven skills development and business support, branding and packaging, product diversification and sector financing are some of the key strategies that can be used by entrepreneurs and value chain actors to grow wild meat businesses.

Wildmeat production-specific carbon credit schemes must be explored as part of financing the sector for sustainability. Carbon credits are a transparent, measurable and results-based way for wild meat production to support activities, such as protecting and restoring irrecoverable natural carbon sinks. Nunes et al. (2021) show that a mean per capita wild meat consumption of 41.7 kg/year for a population of ~150,000 residents at 49 sites can spare ~71 $MtCO_2$-eq annually under a bovine beef substitution scenario. Moreso, wild meat offtake by these communities could generate US$3M or US$185K in carbon credit revenues under an optimistic scenario. Thus, total compliance with the Paris Agreement by 2030 (i.e., carbon price = US$50/$tCO_2$-eq) and US$1M or US$77K under a conservative scenario (conservative carbon price of US$20.81/$tCO_2$-eq). Over and above, channelling and mainstreaming markets (including rural and global trade) present a myriad of opportunities for business growth and improved incomes for intermediaries.

8.3 | Path 3: Management and Governance

Legal game meat consumption has potential long term unintended socio-economic consequences, including negative impacts on food security through the decline in populations due to elevated demand for meat protein through legal wildlife-based land uses. This causes loss of tourism-based employment and wildlife heritage. Value chain management approaches are key to realising long term sustainable wild meat consumption. Continuous monitoring of industry transparency and tracking of activities within the chains through research and enterprise data regarding species populations, consumption patterns and market demand should be used to inform decision-making and policy. One approach is using intermediate value chains. This involves value chain up- and down-scaling to manage supply and demand through off takes control, emphasis on seasonal hunting and product innovation and technology to improve shelf life and ensure availability year-round. Up-scaling involves expanding the value chain to increase capacity or improve infrastructure at rural and urban active markets with demand is high. This allows for higher quality or more efficient processing, packaging and storage, as well as delivery of legal wild meat. For instance, introducing centralised processing facilities for small and emerging producers with limited capital to set own processing facilities and comply. Moreso, investing and promoting through incentives land use change from other uses in favour of wildlife, particularly agriculture nonproductive lands, barren landscapes and under-utilised private or communal lands. Downscaling scaling involves selectively reducing parts of the chain during low-supply seasons or periods at both macro and firm/producer levels, thereby preventing overexploitation or harvesting and hence reducing the strain on wild meat species populations. Seasonal down-scaling may involve minimising harvest levels during non-peak times or restricting off-takes in particularly vulnerable areas.

9 | Conclusions

This study assessed the value chains of legal and illegal in Africa and explored options for formalisation and scaling. While value chain systems are structured the same under the full, partially and independent systems, the formal systems service mainly urban and high-income consumers, while informal value chains service mainly rural communities. The inability to meet the demand for meat in poor communities in the legal value chains resulted in illegal hunting that poses a threat to wildlife populations and wastage of meat.

Incorporating and integrating local hunters into the extraction of meat as artisanal hunters and setting up more abattoirs in public, private and communal lands will open opportunities for formalisation and increase the supply of legal game meat. Opening more distribution centres as intermediaries and using price discrimination would allow for value chain scaling and could potentially reduce the demand for illegal game meat.

Unpacking the wild meat value chain integration systems offers a number of advantages to ranchers, hunters, abattoirs, wholesalers and traders such as cost and waste reduction in the chain, improving quality and consistency, traceability and increasing consumer satisfaction. Ordinarily, understanding these systems creates opportunities for actors to enhance innovation and differentiation by leveraging the capabilities, resources and insights of different actors in the chain. Furthermore, knowing how wild meat value chains are integrated can strengthen actors' competitive positions and bargaining power by creating synergies and economies of scale and reducing entry barriers, thereby opening opportunities for formalisation and scaling.

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Ethics Statement

The study was based on a literature review, and open access data was used.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All reviewed documents are available and can be submitted upon request.

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