






Goat meat supply and demand in Vietnam: global context and opportunities and risks for smallholder producers

Luisa Olmo^{A,*} , Huu Van Nguyen^{B,*}, Xuan Ba Nguyen^B, Thi Nga Bui^C , Cuc Thi Kim Ngo^D, Viet Don Nguyen^{A,C} , Nam Hoang^E, Luis Emilio Morales^E  and Stephen Walkden-Brown^A 

For full list of author affiliations and declarations see end of paper

***Correspondence to:**

Luisa Olmo
School of Environmental and Rural Science,
The University of New England, Armidale,
NSW 2351, Australia
Email: luisa.olmo@une.edu.au

Handling Editor:

Russell Bush

Received: 12 December 2023

Accepted: 5 July 2024

Published: 1 August 2024

Cite this: Olmo L *et al.* (2024) Goat meat supply and demand in Vietnam: global context and opportunities and risks for smallholder producers. *Animal Production Science* **64**, AN23416. doi:[10.1071/AN23416](https://doi.org/10.1071/AN23416)

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ABSTRACT

Goats are the fastest increasing livestock population on earth, growing by 29% in the past decade. In Vietnam, goat numbers grew remarkably faster at 103% in the same period. To understand the reasons for this rapid growth and implications, we explored the characteristics of Vietnamese goat supply and demand and identified risks and opportunities for smallholder goat producers. Our analysis finds that the continued growth of goat consumption in Vietnam is driven by Vietnam's: (1) large and growing population (97.3 million) and economy; (2) high meat consumption relative to Gross Domestic Product; (3) high social value placed on goat consumption; (4) increasing popularity of meat consumption; (5) established socio-cultural goat consumption practices; (6) increasing preference for grass-fed meat; and (7) increasing supply from neighbouring countries. As a result, growth in Vietnamese goat meat prices has continually outperformed growth in goat supply over the past decade. Supply is mainly produced by thousands of smallholder farmers in Vietnam and neighbouring Laos. Hence, there are important livelihood and rural development opportunities for producers to increase and diversify into goats. In Laos, each additional goat sold represents a 4.75% increase in smallholder household income per year. To reduce risks to goat producers, research is needed to: (1) forecast the current and future demand for goats in Vietnam to prevent oversupply leading to price collapse; (2) understand how premiums are awarded for goat characteristics; (3) investigate pathways for formalising trade and its impacts on smallholders; and (4) establish strategies for producers to improve supply without degrading natural resources, or increase disease outbreak risk.

Keywords: international agricultural development, Lao PDR, livestock, marketing, red meat, rural development, smallholder, Southeast Asia, value chains.

Introduction

Research on goats is limited compared with cattle, sheep and pigs, despite their importance to developing countries and their advantages over other livestock species (Morand-Fehr and Lebbie 2004). For instance, goats are a browse species, meaning that they consume leaves, shoots and fruits of trees and shrubs that are less suitable to grazers such as cattle and sheep. This diet reduces the ingestion of gastrointestinal parasite larvae that reside on grasses. Also, goats can adapt to arid and semi-arid regions with variable and low-forage availability (Charambira *et al.* 2021), and they have fewer zoonotic diseases than do other livestock. Their resilience to climate change is suggested, afforded by their long appendages that increase convective heat loss, and their consumption of drought-tolerant browse (Koluman (Darcan) 2023). Therefore, goats are considered highly suitable to smallholders owing to their low capital requirements, adaptability to harsh climate conditions and higher consumption by rural households compared with large livestock (Castella *et al.* 2013; Hedge 2020). In addition, they are more frequently owned by women than men (IFAD 2021). Like sheep, goats have the potential to reproduce twins and triplets twice per year and are more fecund than cattle, which produce single calves up to once per year. Importantly, goat meat

has a broad utility because it lacks the religious taboos associated to beef and pork (Meat & Livestock Australia 2021). Finally, they are dual-purpose, producing both meat and milk in some environments, and their small size enables easy transportation of live animals.

On the contrary, goats have disadvantages that also warrant further research. For instance, goats can be slower growing and yield less meat, because of limited selection for meat production, than do other meat species, except for the South African-developed specialist meat breed, the Boer (Tshabalala *et al.* 2003). Goat meat can have a strong, disagreeable taint, particularly in intact males post-puberty (Louca *et al.* 1977). Also, goats are more susceptible to gastrointestinal parasites if raised on pasture, typical of intensified systems.

Information on goat supply and demand, and trade is particularly limited compared with basic and applied animal research. Although it is reported that goat milk and meat are mostly traded domestically and consumed locally, these findings appear to be anecdotal (Skapetas and Bampidis 2016). Data on global goat exports and imports, stock numbers and farm-gate prices are freely available from FAOSTAT but have not been analysed. An analysis of these data is needed to provide a starting point to understand how trade, supply and demand could be improved to benefit rural populations. However, FAOSTAT data should be used only as a guide because they are based on official, semi-official, estimated or calculated data.

In the past decade, goat demand has increased in Southeast Asia, including Vietnam (Nguyen *et al.* 2023). With Vietnam's large population of 97.3 million, even small increases in per capita consumption of goat could have a substantial impact on the total demand. Increased demand presents opportunities for rural development because goats are predominantly produced by smallholder farmers (FAO 2020). To better understand these opportunities, this review aimed to (1) place Vietnamese goat trade within a global context, (2) investigate

the quantity and characteristics of goat supply and demand in Vietnam, (3) characterise goat trade and value chains in Vietnam and (4) identify risks and opportunities for smallholder goat producers. This review analysed data from FAOSTAT and reviewed grey and published literature.

Global trends in goat meat and live goat demand and supply

Key livestock species – numbers and distribution

FAOSTAT data show that goats are one of the largest and fastest-growing livestock populations on earth. In 2020, their global population was approximately 1128 million head (FAOSTAT 2022). This was five times greater than that for buffalo (204 million), similar to pigs and sheep (953 million and 1263 million respectively), 30% smaller than that for cattle (1525.9 million), and a fraction of the chicken population (33.1 billion; FAOSTAT 2022). From 2010 to 2020, the global goat population experienced the sharpest growth, increasing by 29.0% (Fig. 1). This was followed by chickens (23.3%), sheep (20.7%), cattle (11.4%) and buffalo (4.9%). Pigs decreased by 2.0%, owing to the African swine fever (ASF) outbreak. The goat population is concentrated in Asia (51.4%) and Africa (43.3%). In 2020, only 3.5% of goats were in the Americas, 1.4% were in Europe and 0.4% were in Oceania (includes Australia). Of Asia's 579 million goats (2020), most were in southern Asia (56.3%) and eastern Asia (28.6%). Only 6.5% were in Southeast Asia where Vietnam is located.

Trade in goats and goat meat

Live goats

From 2016 to 2020, live goats were predominantly exported from eastern Africa and southern Asia, with 2.1 and 1.1 million head being exported annually respectively. Both regions are adjacent to western Asia (includes the Middle

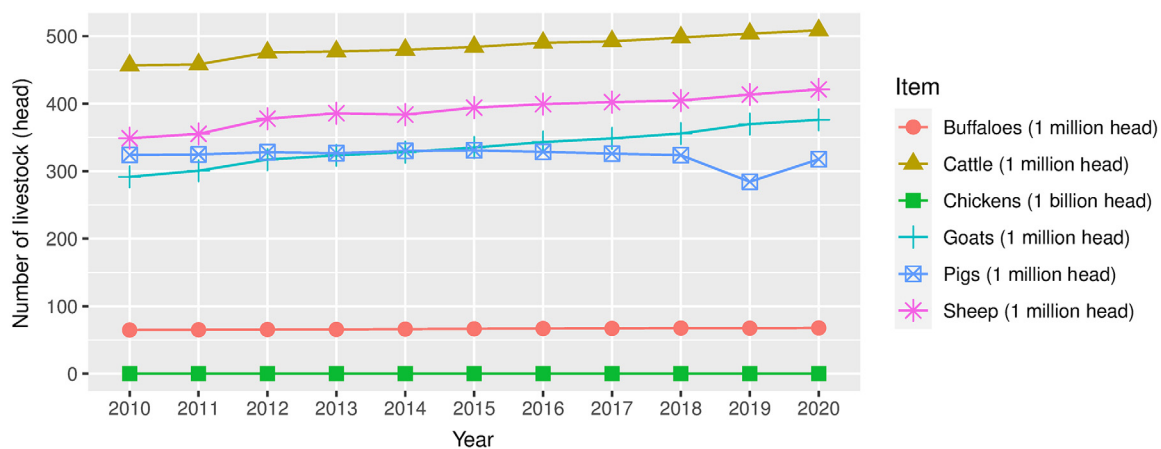


Fig. 1. Total global number of livestock per species from 2010 to 2020. Data from FAOSTAT (2022).

East), which is the largest importer of live goats and sheep, at an average of 3.6 and 9.7 million head annually respectively (Fig. 2). Western Asia was also a main importer of live cattle, presumably because of their requirement of live animals in Halal slaughter for their large Islamic population, and because of increasing water-scarcity in the Middle East, which is reducing the feasibility of rearing livestock (Michaelson 2020). Live cattle were predominantly exported by western Europe and South America. Live-pig trade predominantly occurred within western Europe, and buffalo trade occurred predominantly within Southeast Asia. Hence, geographic location, production constraints and religious practices may contribute to the patterns of live-animal trade.

Fresh, chilled and frozen goat meat

Live animal-trade patterns differ from meat-trade patterns. Australia is the largest exporter of goat meat in the world (Fig. 3), exporting, on average, 22,070 Mg annually, predominantly to the United States of America (USA; Meat & Livestock Australia 2023). The main importers of goat meat are the USA and the United Arab Emirates (UAE; Fig. 4), which import an average 16,296 and 15,612 Mg annually. Australia is also the largest exporter of sheep meat, exporting on average 448,298 Mg annually. The USA is the largest exporter of pork (1.3 million Mg annually) and the second-largest exporter of chicken meat (3.3 million Mg annually). Brazil is the largest exporter of

cattle meat at a mean 1374 Mg annually, and India is the largest exporter of buffalo meat (1145 Mg annually). China is either the largest importer, or in the top three, for beef, chicken, sheep and pork. Although the global population of goat is comparable to sheep and pigs (Fig. 2), their volume of trade is considerably lower (Figs 2–4). This suggests a greater volume of unofficial trade of goat, and/or increased prevalence of domestic consumption, compared with sheep.

The role of goats in rural development

There is a rising demand for animal-sourced protein (ASP) in countries such as China and Vietnam (Hansen 2018; Zhang et al. 2018). The growing urban and middle class have an increasing preference for high-quality ASP products (OECD/FAO 2020). This represents a demand for grass-fed livestock, which can be supplied by rural populations. The production of small livestock such as goats is recognised as an entry point for the most disadvantaged people to improve their livelihoods (IFAD 2021).

Goats will play a leading role in meeting the growing ASP demand. In 2011, the Food and Agriculture Organization of the United Nations (FAO) estimated that the consumption of sheep and goat meat would increase by 88% globally from the year 2000 to 2030 (FAO 2011). This rate is higher than for beef (81%) and pork (66%), but lower than for poultry



Fig. 2. Average number of live imports and exports of key livestock species from 2016 to 2020 by region. Data from FAOSTAT (2022).

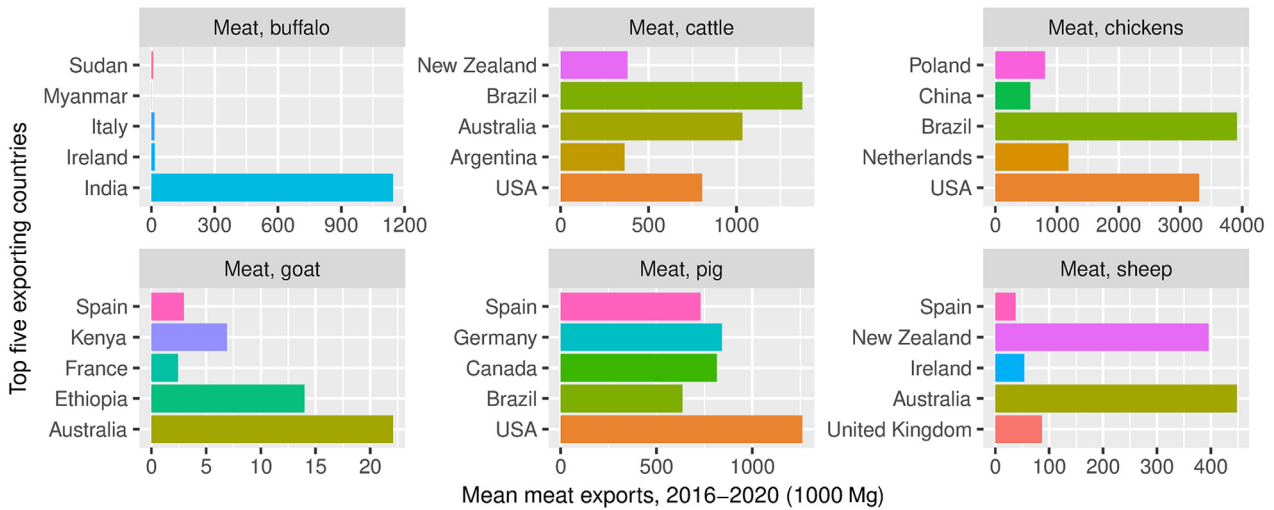


Fig. 3. Average quantity of meat exports from 2016 to 2020 of the top-five importing countries. Data from FAOSTAT (2022).

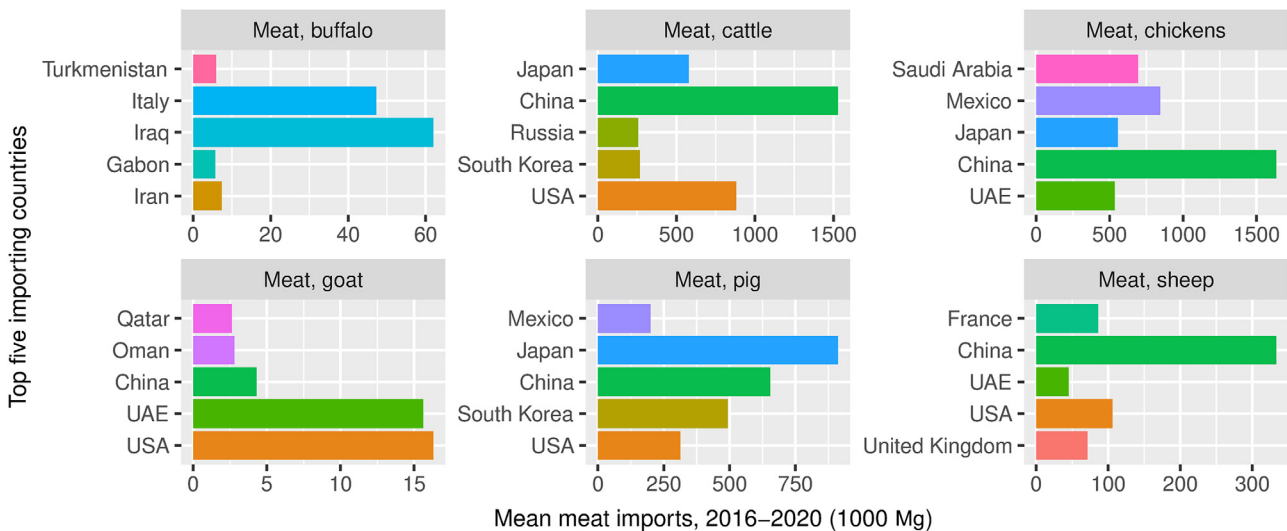


Fig. 4. Average quantity of meat imports from 2016 to 2020 of the top-five importing countries. Data from FAOSTAT (2022).

(170%; FAO 2011). The higher prevalence of diseases in pigs, including erysipelas, classical swine fever, porcine reproductive and respiratory syndrome, foot-and-mouth disease (FMD; Holt *et al.* 2019), and, more recently, ASF (OIE 2019), has reduced the viability of pig production by smallholders, as has the cost of compounded feed and the low value of pig meat compared to red meat. Pig production is likely to transition towards medium- to large-scale production, because they are more capable of maintaining biosecurity standards (Woonwong *et al.* 2020) and achieving sufficient economies of scale for inputs and outputs. In Vietnam, the replacement of pigs with goats has been observed on some smallholder farms because of the suitability of facilities for conversion to goats (Gray *et al.* 2019), with lower feed input costs but higher

farm-gate prices per unit of bodyweight. ASF outbreaks in Asia led to compensatory growth in poultry and ruminant consumption (Woonwong *et al.* 2020). The price of sheep and goat meat was estimated to remain the highest by Year 2029 at approximately US\$3926/Mg, followed by beef (US\$3333–3472/Mg), poultry (US\$1035–1980/Mg) and pig meat (US\$1323–2048/Mg; OECD/FAO 2020). However, faster than expected post-drought herd rebuilds in Australia and New Zealand have led to unexpected oversupply and price reductions from mid-2022 (McCosker 2023), although high import demand from Asia is likely to help prices recover (OECD/FAO 2020). With the projected consumption growth, and suitability to rural households, goat production has a high potential of achieving rural development and nutrition security.

Goat supply and demand in Vietnam: quantity and characteristics

Demand

In Vietnam, goat and sheep meat consumption was 0.2% (186 g) of annual per capita meat consumption in 2021 (Meat & Livestock Australia 2021). Beef consumption was 2.8 kg (3%), fish was 49.3 kg (53%), pork was 27.0 kg (29%), and chicken was 14.0 kg (15%) per annum per capita (Meat & Livestock Australia 2021). The total annual meat consumption of 93 kg per capita, which is majority fish (Meat & Livestock Australia 2021), did not include dog and 'wild meat', which are common, but unquantified (Hansen 2018). Although these figures suggest that ruminant meat is a small component of the Vietnamese diet, these are viewed as superior meats with greater nutritional value, attracting higher retail price (Meat & Livestock Australia 2021). In Vietnam in 2023, beef retail price was approximately A\$16.40–20.80/kg, pork retail price was A\$7.50–8.30/kg, goat retail price was A\$19.20–25.60/kg and chicken was approximately A\$3.50–5.00/kg (V. D. Nguyen, pers. comm.). There are differences in retail price within the goat carcass. Boneless ribs attract the highest price at 360,000–400,000 VND/kg, followed by goat thighs at 300,000–350,000 VND/kg (Phuong 2024). Goat necks are cheaper at 220,000–250,000 VND/kg (Phuong 2024).

The meat scarcity that was endured by most Vietnamese during the Vietnam war years and prior to market reforms in 1986 (Hansen 2018) has been compensated for by Vietnam's disproportionately high meat consumption relative to gross domestic product (GDP) today. Vietnam's 2013 per capita meat consumption of 55.2 kg (not including 33 kg of seafood) was equal to that of Malaysia (56.2 kg), and higher than those of Indonesia (13.6 kg) and the Philippines (35.1 kg), despite having a GDP 78%, 47%, and 19% lower respectively, at the time (Hansen 2018). Hence, Vietnam has additional drivers of meat consumption that favour growth.

One of these drivers is the cultural view of meat consumption as a symbol of health, increased living standards and social status (Hansen 2018). It is perceived by consumers that 'meat can be considered as something that higher income people can consume' (Hansen 2018, p. 65), and there is a meat hierarchy. The consumption of beef steak, goat (including the reproductive organs) and endangered wild meat from wild pigs, deer, birds, lizards, water dragons and civets, are positively viewed as luxury foods, and their consumption provides greater social leverage in urban regions (Hansen 2018). They are commonly consumed by middle-class and educated men, in social gatherings with alcoholic drinks, as a means to communicate social status and masculinity (Sandali et al. 2016). Hence, goat meat is positioned within the high-value market.

Consuming goat meat is also infiltrating mainstream meat consumption with what Hansen (2018) calls the 'meatification'

of social practices in Asia. Vietnams' rising household income is positively associated with Vietnam's meat consumption (Phuong et al. 2014). The westernisation of the diets is leading to increased intensity of meat in traditional dishes, the increased consumption of foreign cuisines that contain more meat, and the increased frequency of eating out (Hansen 2018). This strongly favours goat consumption because goat meat is offered in many restaurants and it is predominantly eaten at restaurants (Gray et al. 2019; Bui et al. 2023). Most consumers (76%) in Ho Chi Minh City believe that goat meat is difficult to cook at home (Meat & Livestock Australia 2021). There are a growing number of specialised goat meat restaurants in Vietnam (Ørskov 2011), which are marketed to the expatriate and wealthier populations (Dubeuf 2014). Goat meat supply is also more hygienic, with consumers more commonly purchasing goat and sheep meat at supermarkets (67%), rather than street wet markets (54%; Meat & Livestock Australia 2021).

Goat demand is highest during the wedding season, the lead up to the Tet festival in January, and during winter (November to April) when goat is often used in hot-pot dishes (Gray et al. 2019). Vietnamese slaughterhouses generally prefer non-castrated male goats (Gray et al. 2019). Premiums are afforded to 'grass goat' or 'mountain goat'. Grass goat (or Co goat) are a small native Vietnamese goat commonly found in remote low-land areas (Hung 1992; Le Thi et al. 2009; Norton et al. 2009). They have a mature bodyweight of 26 kg in females and 30 kg in males (Le Thi et al. 2009). They are the most common goats in Vietnam and are consumed for meat, having a low average annual milk yield of 50–60 kg per year (Le Thi et al. 2009). They are preferred over Bach Thao goats, which are a stabilised cross among exotic dairy breeds: Saanen, Alpine, Jamnapari and Beetal (Hung 1992; Norton et al. 2009). Bach Thao are predominantly reared in central coastal provinces and are dual-purpose, with a higher average annual milk yield of 220–250 kg per year (Le Thi et al. 2009). They have a higher mature bodyweight of 45 kg in females and 65 kg in males (Le Thi et al. 2009). Boer goat is increasingly present as a cross-breed in Southeast Asian and other goat-producing countries. Mountain goat refers to native goats raised extensively, and can be from Laos or Vietnam (Gray et al. 2019). They are indistinguishable in appearance from grass goats, but grass goats are allegedly raised in low-lands, whereas mountain goats are raised in mountainous areas (N. X. Ba, pers. comm.; Bui et al. 2023); however, it is unclear how this is verified. Some traditional dishes specifically require mountain goat to be authentic, and cannot be substituted with cross-breed goat meat (Hoang 2013). Both grass and mountain goats are preferred owing to an innate 'clean' and 'green' image, presumably matched by a milder flavour. It is unclear whether the positive image is more associated with the production systems and provenance or the native goat phenotype (Gray et al. 2019). Grass and mountain goat can receive a farm-gate price premium over Vietnamese Bach Thao and other cross breeds

(Gray *et al.* 2019). Although there is no formal branding or certification of these attributes, the image and reputation are widespread. Clarity is needed on exactly how goats are distinguished, and on what merit the premiums awarded (Bui *et al.* 2023).

Through Vietnam's rapid growth in supply of cheap, mass-produced meat, several serious food-safety scares have occurred in recent decades (Nguyen-Viet *et al.* 2017). This has increased the desirability of imported meats (Hansen 2018) and Vietnamese consumers will pay premiums for food with hygiene and safety images (Meat & Livestock Australia 2021). This is reflected by 'country of origin' being the number one attribute that Vietnamese consumers value when purchasing meat from supermarkets (Meat & Livestock Australia 2021). This has been facilitated by the opening of Vietnam's market for imports, accelerated by Vietnam joining the World Trade Organization in 2007 (Hansen 2018). There is also demand for whole goat carcasses, which are displayed in Vietnamese restaurants (Fig. 5), appealing to the consumer as a guarantee of freshness. This preference favours the importation of live goats.

Supply

From 2010 to 2019, the total number of live goats in Vietnam increased by 103%, to 2.7 million head (Fig. 6). In the same

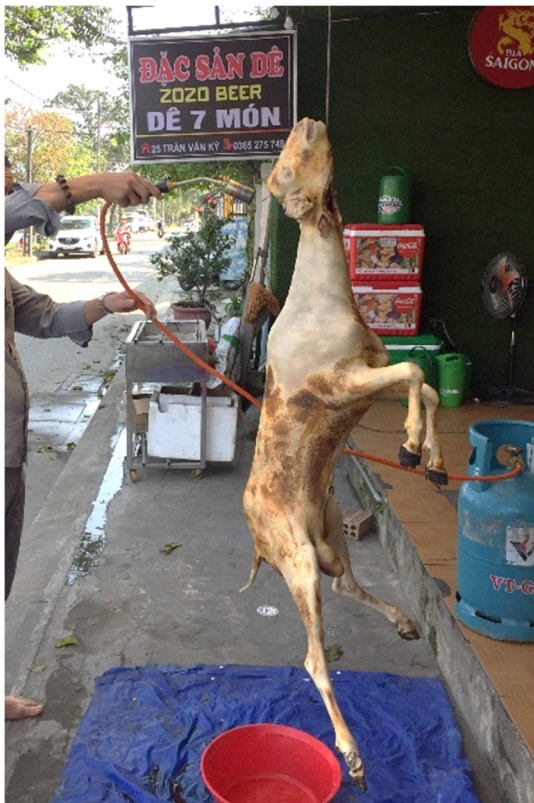


Fig. 5. Whole goat carcass being prepared at a goat restaurant in Hue, Vietnam, 2021.

period, the proxy developed by FAOSTAT (2022) for goat price *in lieu* of official data, 'producer goat price index', increased by 167%, indicating a high demand. This review paper calculated the total supply of goat meat and offal in Vietnam by summing the FAOSTAT (2022) estimate of Mg of goat meat and offal supplied in Vietnam with the number of live imported goats, and subtracting the number of exported goats, after both were multiplied by the average meat and offal per male carcass of 9 kg and 0.8 kg (Luc *et al.* 1992). This does not account for older, heavier carcasses. This resulted in an estimated total supply of goat meat and offal of 23,286 Mg per year (Table 1). This is much higher than the FAO (2011) projection of 10,800 Mg of goat and sheep meat produced by 2030, suggesting faster than expected growth in goat supply, although numbers are limited to crude estimates. Meat & Livestock Australia (2021) estimated total annual sheep and goat meat consumption in Vietnam of 18,097 Mg (Table 1). These data suggest that strong demand is keeping farm-gate prices high, and is likely to do so into the future, which offers producers considerable opportunity and confidence to increase supply.

Goats supplying the Vietnamese market are predominantly produced in thousands of Vietnamese smallholder farms. They are characterised by extensive or semi-intensive management, small herds of 5–100 head, the farmer having a primary-level education, reliance on family labour, and small land holdings of 2–7 ha (Norton *et al.* 2009; Gray *et al.* 2019; Nguyen *et al.* 2021). Typically, a few thousand square metres of forages are cultivated as grazing land is scarce (Norton *et al.* 2009). However, free-grazing of native grass is still common and occurred for 7–8 h per day, and was supplementing the small quantities of low-quality feed in south-eastern Vietnam (Norton *et al.* 2009). Typically, only one breeding buck was retained per farm, which was the slowest-growing buck as faster-growing bucks were sold once they reached 25 kg at approximately 18 months of age (Norton *et al.* 2009). It is likely that this resulted in inbreeding and a lack of selective breeding, preventing genetic improvement. All females were retained for breeding, and does typically conceived at 8 months of age, gave birth at 14 months of age and milk supplies waned at 100 days post-parturition (Norton *et al.* 2009). Typical productivity constraints included moderate annual mortality (10%) caused by endemic diseases, unavailability of disease prevention and treatment options and knowledge, poor nutrition and a lack of reproductive management, resulting in an annual turn-off rate of 17.8% (Norton *et al.* 2009). Although the Vietnamese Government has been actively promoting goats as a tool for rural development since 1993 (Norton *et al.* 2009), the goat population remains almost 1 million head below Vietnamese government targets (Nguyen *et al.* 2021), indicating supply constraints.

An average of 6037 live goats per year were officially imported to Vietnam between 2016 and 2020, mainly from France (55.0%; FAOSTAT 2024). However, it is proposed that the greatest number of imported goats to Vietnam occurs

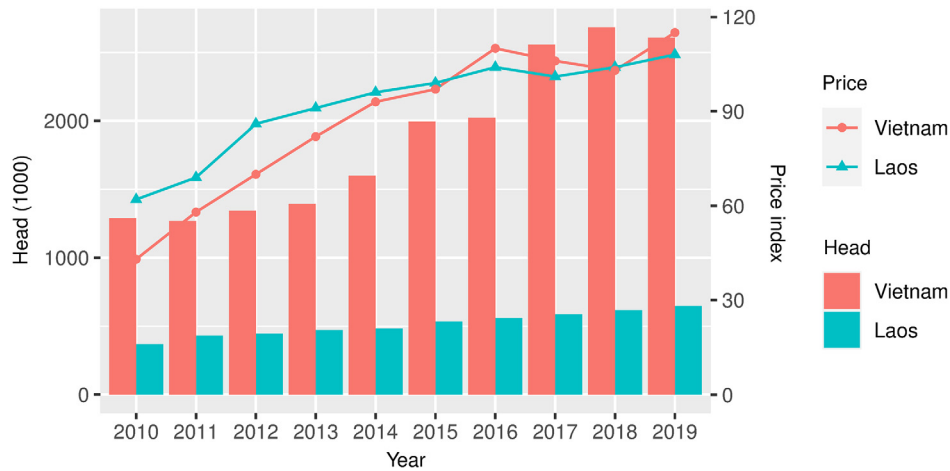


Fig. 6. Average annual change over time in producer price index and number of goats reported in Laos and Vietnam. Data from FAOSTAT (2022). Note: FAO producer price indices measure average annual change over time in the selling prices received by farmers at the farm-gate or at the first point of sale. The indices are constructed using the Laspeyres formula with price data in local currency.

Table 1. Annual goat and goat meat demand and supply in Vietnam.

Item	Variable	Value	Unit	Source
Demand	Per capita annual goat meat consumption ^A	186.0	g	Meat & Livestock Australia (2021)
	Vietnam population 2022 ^B	97.3	Million	FAOSTAT (2022)
	Total annual goat demand ^{A × B}	18,097.8	Mg	
Supply	Vietnam annual goat meat production ^C	18,150.8	Mg	FAOSTAT (2022)
	Vietnam annual goat offal production ^D	3670.4	Mg	FAOSTAT (2022)
	Total goat produced for consumption in Vietnam ^{C + D}	21,821.2	Mg	
	Annual goat meat imported to Vietnam ^E	1429.0	Mg	FAOSTAT (2022)
	Annual goat offal imported to Vietnam ^F	0.0	Mg	FAOSTAT (2022)
	Annual live goats imported to Vietnam ^G	6036.5	Head	FAOSTAT (2022)
	Annual goat meat and offal from imported live goats ^H	59.2	Mg	Luc <i>et al.</i> (1992), FAOSTAT (2022)
	Total goat imported to Vietnam ^{E + F + H}	1488.2	Mg	
Exports	Annual goat meat exported from Vietnam ^I	20.0	Mg	FAOSTAT (2022)
	Annual live goats exported from Vietnam ^J	342.0	Head	FAOSTAT (2022)
	Annual goat meat and offal from exported live goats ^K	3.1	Mg	Luc <i>et al.</i> (1992), FAOSTAT (2022)
	Total goat exported from Vietnam ^{I + K}	23.1	Mg	
	Total annual goat meat supply ^{C + D + E + F + H - (I + K)}	23,286.3	Mg	

Unless specified, data are FAOSTAT data based on 5-year annual averages from 2016 to 2020.

^HGx average meat and offal from male goat carcass (9.8 kg).

^KJx average meat and offal from male goat carcass (9.8 kg).

unofficially and originates from Laos. Because of the unofficial nature of this trade, estimated volume of goat imports varies tremendously. Goats depart Laos for Vietnam via the following three export market chains: (1) the north-eastern corridor via Houaphanh province, (2) the northern corridor via Xiengkhouang province, and (3) the southern corridor via Savannakhet province (Phengsavanh *et al.* 2017). From Savannakhet province where research has occurred, estimated

numbers of goats traded annually to Vietnam range anywhere from 1500 head to 109,500 head, as reported by Lao authorities, Vietnamese authorities, slaughterhouses and traders (Gray *et al.* 2019). A survey by Hoang *et al.* (2017) suggested 30,000 head per year through the southern corridor, as an overall estimate. The official southern corridor transit point is the Lao–Bao border crossing, but unofficial, nearby routes are used because there is no official goat trade agreement

between Laos and Vietnam. Because Lao goats have been reported to receive farm-gate price premiums over cross-bred Vietnamese goats of 30–45% (Hoang 2013; Gray *et al.* 2019), and there is no traceability, supply chain actors could falsify native Vietnamese goats as goat stock originating from Laos, to increase profit.

How goats are traded in Vietnamese goat value chains

Goat value chains in Vietnam consist mainly of smallholder goat farmers from Laos and Vietnam, middle-men (traders) who buy and sell goats, Vietnamese abattoir owners and Vietnamese restaurant owners, some of whom slaughter their own goats. These actors function as producers, traders, preliminary processors and distributors respectively (Nga *et al.* 2022). There is evidence of vertical linkages between supply chain actors, but limited horizontal linkages among farmers or traders (Nga *et al.* 2022). Data on these supply chains are scarce.

Vietnam

Goat traders frequently visit Vietnamese smallholder goat farms, enabling ease of sale by farmers (Hoang *et al.* 2017). An unquantified proportion of traders add value to goats purchased at approximately 25 kg, by fattening them to market weight of approximately 28 kg (Norton *et al.* 2009). Some regions lack goat-specific abattoirs, so traders sell goats directly to restaurants where live goats are stored and slaughtered on demand (Norton *et al.* 2009). In most regions, goats abattoirs exist and traders sell directly to them, who on-sell to restaurants (Gray *et al.* 2019). It is believed that abattoirs have the greatest influence on goat prices within the value chain (Gray *et al.* 2019; Nga *et al.* 2022). Goats can be held in

small paddocks owned by abattoirs and are slaughtered in the morning. They are sold to goat restaurants daily. This reflects the shorter shelf life of meat due to limited cold chain management, and enables a daily market equilibrium where abattoirs are strong influencers of price. There are many goat restaurants in Vietnam, with an estimated 1000 restaurants serving goat in Ninh Binh alone; a province of 1 million residents in northern Vietnam (Gray *et al.* 2019). In Ninh Binh, goat marketing is predominantly driven by restaurant owners through eye-catching advertisements for goat meat restaurants (Fig. 7).

Laos

Lao middle-men travel deep into Laos to purchase live goats from smallholders, which they deliver to Vietnamese traders across the border (Hoang 2013). In 2017, middle-men were visiting villages, on average, 13 times per month to purchase goats (Phengsavanh *et al.* 2017), reflecting the strong demand. Approximately 90% of goats purchased by middle-men are exported to Vietnam and only 10% are sold to domestic markets (Gray *et al.* 2019). The advantage of the domestic market is that goats can be sold in poorer body condition, but the demand is lower, with only 30–40 restaurants serving goat meat in the capital city, plus 2–4 small restaurants per large provincial town, each slaughtering one or two goats per day (Gray *et al.* 2019). Sales to Vietnam require health certificates, an animal trading license, and trading and export fees, which collectively cost between A\$6.00 and A\$11.40 per goat to cross the border (Gray *et al.* 2019). All or part of these fees may be avoided by illegal movement of goats across the border. There are no goat slaughterhouses in Laos, with goats being processed directly at restaurants. There are no formal contracts among or between traders and farmers, or traceability (Nga *et al.* 2022).



Fig. 7. Typical examples of roadside goat advertising around Ninh Binh. Dê Núi is 'mountain goat' and Thịt Dê is 'goat meat'.

Opportunities for smallholder producers

The growing goat demand in Vietnamese stands to benefit a range of supply-chain participants. This is particularly apparent in Laos, where goats are identified as a pathway to reduce rural poverty (Phengsavanh *et al.* 2017). In 2022, adult goats attracted a farm-gate price of 1 million kip per head (~US\$100). Therefore, each goat sale represents a 4.75% increase in household income per year (21.03 million kip; L. Olmo, unpubl. data). Goats are also produced cheaply on forest and communal land, with 66 farmers from central Laos reporting total annual input costs per herd of only ~US\$20 per year (L. Olmo, unpubl. data). Inputs costs are higher in Vietnam, where Bach Thao goat farmers in south-eastern Vietnam reported mean annual expenditure of US\$774 per herd (exchange rate on 1 January 2006; Norton *et al.* 2009). Expenditure consisted of purchasing breeding stock, feed, labour, veterinary cost and facilities, and annual income from goats was US\$871 (exchange rate on 1 January 2006; Norton *et al.* 2009). Input costs are probably lower on farms raising grass goats with fewer inputs.

Risks for smallholder producers

Although increased goat output will increase profit in the short term (Norton *et al.* 2009), increasing smallholder goat supply across the board could lead to oversupply and farm-gate price collapse. Additionally, the enforcing of the current import regulations by Vietnamese officials could cause market saturation in Laos because of the impossibility to export goats to Vietnam, leading to plummeting farm-gate goat prices. In the longer term, under official export conditions, more producers would consider premium quality to maintain profitability. However, it remains unclear what the potential size of Vietnamese goat demand could be, and to what degree the premium for Lao mountain goat or Vietnamese grass goats are, awarded for phenotype or to management system. To inform smallholder objectives, the Vietnamese goat market needs further definition through market research to determine a hierarchy of attributes demanded by segments of Vietnamese consumers willing to pay higher retail price premiums for high-quality goat meat. To secure the market for smallholder producers, feedback on consumer preferences is needed and assistance to apply it to their production systems.

Vietnam is unlikely to be self-sufficient in satisfying domestic goat demand, owing to limited grazing resources (Huyen *et al.* 2013), nor does it aim to (Socialist Republic of Vietnam 2022). Thailand, India and Australia are the geographically closest countries officially exporting live goats to Vietnam, and present competition to Laos. Whereas Thai improved goat breeds (US\$4/kg) were less valuable than Lao goats sold to Vietnam in 2017 (US\$6/kg; Gray *et al.* 2019), the strength of consumer preference for Lao goat remains unclear.

However, 'mountain goat' from Laos can receive premiums in Vietnam (Bui *et al.* 2023). Further, the recent devaluing of the Lao kip against the Vietnamese dong, by 37.5% from September 2021 until September 2022 (Trading Economics 2022), may improve the desirability of Lao goat. Australia may be less of a competitor because goat production is heavily exposed to the volatile supply of rangeland goats, creating challenges in securing steady supply (Meat & Livestock Australia 2021). Additionally, since 2017, the increasing price of Australian live goats, became a barrier to trading to Malaysia, which was previously the greatest importer of Australian live goats and was by air freight (Meat & Livestock Australia 2023). However, the recent plummeting of goat prices in Australia in 2022 may reverse this.

It remains unclear whether smallholders should focus on fattening to produce goats at market weight, or reproductive efficiency to produce more young goats to be fattened by down-stream supply-chain actors. It is probable that Vietnam will prefer unfattened goats from Laos, in line with the Vietnamese Government policy which encourages the replacement of 'low-value-added outsourcing production models' (Socialist Republic of Vietnam 2022). However, whether middle-men have the interest, resources or motivation to value-add at a large scale is unknown. Vietnamese middle-men may prefer to engage smallholders in 'contract farming', as is common for cash-crops in northern Laos (Cole 2022). Connecting interested middle-men with Lao farmers, and developing a contracting business model where traders supply material support such as veterinary treatments, could be a valuable research and extension activity. These linkages could also provide annual feedback to farmers on market demand.

Preparing pathways for official trade from Laos to Vietnam is necessary to reduce the risks of promoting an unofficial supply chain, which is vulnerable to the Vietnamese government enforcing existing importation laws to quell illegal trade and improve biosecurity. The Vietnamese decree no. 13/2020/ND-CP Law on Animal Husbandry outlaws the use of substances prohibited in Vietnam (e.g. use of antibiotics as growth promoters) by producers in exporting countries, the use of unofficial border-gates, and importation without certification from exporting countries. In Laos, decree no. 230/GoL states that export certification is granted on the grounds that live animals have not come from areas with a current disease outbreak, do not have current disease infection or have undergone appropriate isolation, and have received necessary vaccinations, e.g. FMD. Unofficial trade undermines biosecurity, increasing the risk of transboundary animal disease outbreaks, such as ASF, which can collapse supply chains. Smith *et al.* (2015) recommends consulting traders in the border-control process, because their support of procedures determines their compliance. Improving infrastructure on official trade routes such as roads may motivate traders to comply with border controls, if it benefits their economic bottom-line (Smith *et al.* 2015).

Another risk to increasing goat numbers in Laos is the degradation of communal native grasslands, which most producers completely depend on for goat nutrition (Olmo *et al.* 2022). Erosion owing to goat grazing is not yet considered a problem in Laos, possibly because of the comparatively low grazing pressures (Gray *et al.* 2019), or a lack of scientific enquiry. As grazing land is being encroached by crop intensification and commercial forestry (Gray *et al.* 2019), increasing grazing land scarcity are imminent. Cultivating forages can overcome over-grazing of forests, but it increases labour requirements and uses cropping land. This may lead to unsustainable trade-offs from crop-production (Millar and Photakoun 2008). Over-grazing forage plots would increase parasite burdens, requiring deworming treatments to avoid weight loss. Government and NGO support is required to help secure the sustainability of increased goat production in Laos.

Conclusions

Vietnam's goat demand is likely to continue increasing while maintaining high farm-gate and retail prices, because of the socio-economic factors favouring consumption. Therefore, there is considerable opportunity to increase goat supply. This has major rural-development significance because supply comes from thousands of smallholders in Vietnam, and increasingly by smallholders in Laos. Despite this potential, several challenges must be overcome to secure the sustainability of goat-supply chains. Clarity is needed on how the native goat phenotype or the management type incur premiums, to inform producers whether to increase supply through cross-breeding, or preserve the native goat phenotype. Contracts between supply-chain actors are needed to improve traceability and ensure that premiums are awarded fairly. The creation of a formal goat-trade agreement between Laos and Vietnam would provide an alternative to illegal trade, which would enforce biosecurity requirements that reduce the risks of disease outbreaks. Government and NGO assistance could lower the risk of environmental degradation caused by rising goat numbers in Laos. Because of the unofficial nature of trade, research is needed to accurately forecast current and future demand for goat in Vietnam, to help prevent oversupply, leading to a price collapse. Finally, improving rudimentary goat health and husbandry remains pertinent to increasing the supply of goats. This warrants further research to address endemic disease and mortality, improve local veterinary services, and develop optimum smallholder production regimes.

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Data availability. The data that support this study are available in FAOSTAT at <https://www.fao.org/faostat/en/#data>.

Conflicts of interest. Stephen Walkden-Brown is an Associate Editor of *Animal Production Science*. To mitigate this potential conflict of interest they were blinded from the review process. The authors declare that they have no other conflicts of interest.

Declaration of funding. This review received financial support from the Australian Centre for International Agricultural Research (Project number: LS-2017-034).

Acknowledgements. The authors thank the staff at the University of Agriculture and Forestry, Hue University, Hue, Vietnam, the Vietnam National University of Agriculture, Hanoi, Vietnam, the Vietnam National Institute of Animal Science, Hanoi, Vietnam, and the National Agriculture and Forestry Research Institute, Vientiane, Laos, for support and guidance with this review.

Author affiliations

^ASchool of Environmental and Rural Science, The University of New England, Armidale, NSW 2351, Australia.

^BUniversity of Agriculture and Forestry, Hue University, Hue, Vietnam.

^CVietnam National University of Agriculture, Hanoi, Vietnam.

^DNational Institute of Animal Science, Hanoi, Vietnam.

^EUNE Business School, The University of New England, Armidale, NSW 2351, Australia.