Australasian Agribusiness Review
2024, Volume 32, Paper 3
ISSN: 1883-5675

Assessing Profitability and Cost Competitiveness of Small Ruminant Production in Fiji[1]

Christie Chang[a], David Falepau[b] and Karishma Goundar[c]

[a] Independent Consultant, HSC Market and Value Chain Research Services, Australia
[b] Associate Professor, Charles Sturt University, Australia
[c] Agricultural Officer, Ministry of Agriculture, Fiji

Abstract

In Fiji per capita sheep and goat meat consumption is high by world standards, and nearly 95 per cent of that is sheep meat supplied by imports. There has been government support to develop the small ruminant industry and to increase local production, via research and farmer training and extension, as well as providing breeding stock and farm infrastructure (sheds and fences) to farmers. However, growth in local stock numbers is slow and varied, and imports continue to increase. Poor nutrition and worm infestations were said to be the main contributing factors to low on-farm productivity, and hence slow industry growth. The objectives of this paper were to assess profitability and cost competitiveness of local small ruminant production in Fiji, and to identify issues and areas for improvement. A cost of production and gross margin calculator was developed specifically for the goat and sheep enterprises in Fiji. It was used to develop enterprise budgets for representative goat and sheep farms, as well as to demonstrate the financial impact of changes in production practices and improvements in production parameters. The results show that gross margins were positive for live animals that were sold directly to households at the farmgate, even after accounting for the opportunity costs of family labour and capital. However, locally produced sheep or goat meat may not be able to compete with imports at the formal market in terms of price, quality and consistency in supply. The conclusions were: (1) given the dynamics of the market, continuing on-farm monitoring and market update are crucial for providing reliable estimates to aid policy makers and value chain players in developing the industry; (2) to compete at the formal market with imports, issues along the value chain need to be addressed from improving access to land and other farm inputs to improving marketing infrastructure and to building consumer confidence; and (3) continuing targeted government support on research and extension is key to developing a profitable and sustainable small ruminant industry in Fiji.

Key words: gross margin analysis, value chain analysis, small ruminant production, Fiji

[1] This study is part of the Pasifika Sheep and Goat Improvement Project LS/2017/033 funded by the Australian Centre for International Agricultural Research (ACIAR). The project has produced useful results, and we would like to thank ACIAR for the financial support. We would also like to thank senior staff and researchers of the Ministry of Agriculture and participating farmers in Fiji for sharing their experiences and vast amount of data with us. Their assistance has made this study possible and is much appreciated. Special thanks go to Adrian Ram, and Ajesh Maharaj, Avinesh Kumar, Simon Cole, and Rodd Dyer, for sharing their insight, as well as valuable information and data. Finally, we thank reviewers for their useful comments and suggestions.

Introduction

In Fiji, the demand for sheep and goat meat is high and cannot be met by local production. The deficit is made up by imports mainly from Australia and New Zealand. Sheep meat imports, in particular, account for more than 95 per cent of total sheep meat supply. There has been strong government support for the small ruminant (SR) industry, via research and farmer training and extension, as well as providing grants for breeding stock and farm infrastructure (sheds and fences). However, growth in local stock numbers is slow and imports are increasing. Most SR farms in Fiji have been found to be underperforming, with gastro-intestinal nematode (GiN) infestations and poor nutrition being the major contributing factors to low productivity and high cost of production (Cowley et al., 2019). GiN, when not managed properly, retards growth, reduces productivity, and causes mortality in all ages of animals. On the other hand, poor nutrition affects growth and lambing/kidding rates, resistance to worm infestations, and lamb and kid mortality. The main cause for poor nutrition is that farmers tend to rely on grazing on native grasses as a main source of feed, and supplementary feeding is not commonly practiced even when it is required to maintain health and body conditions.

Productivity and the cost of production may not be a main concern for low-input subsistence farming but is crucial if farmers are to participate in the market and make it a profitable business. To improve profitability and cost competitiveness, changes to some of the current farming practices, such as drenching and feeding, would be necessary. However, it is not always clear whether potential gains in productivity can outweigh the additional investments and costs associated with changing practices, and result in an increase in farm income. The objectives of this paper were to: (1) better understand the current SR production and marketing systems and assess their performance; and (2) identify potential areas for improving on-farm productivity and cost competitiveness, especially against imports. Gross margin analysis and value chain analysis were employed, as well as using technical data generated by the technical team of the ACIAR project of which this paper is a part.

This paper is organised as follows. The Introduction is followed by a description of the gross margin analysis (GMA) method (what GMA is and its key elements and applications) and data sources. An overview of the SR industry in Fiji is then presented, including production and marketing systems. A cost of production and gross margin (CoP/GM) calculator developed specifically for the Fiji SR industry is introduced, followed by enterprise budgets for representative farms, as well as other results, generated from it. They are followed by a discussion of key issues and future prospects for the SR industry in Fiji, and recommendations on areas for further research, as well as potential intervention strategies to further improve productivity and profitability. The paper ends with some concluding remarks.

Research Method

Gross margin analysis

GMA was used in this study to assess the financial performance and cost competitiveness of a SR enterprise in Fiji. Both qualitative and quantitative data have been collected from a variety of sources, including several research components of the Pasifika Sheep and Goat Improvement Project. They include: a baseline survey; a feed resources survey; an on-farm monitoring program; drenching trials; workshops and focus group discussions; and a market survey and industry expert consultations. Those data were used as much as possible to support production parameters and key assumptions in subsequent analyses.

Gross margin (GM) is defined as total revenues minus total variable costs of production. If GM is positive, it means that the enterprise (goats or sheep) has generated enough revenues not only to

cover all variable costs, but also is able to recover some portion of the fixed costs. If the GM is negative, it means the enterprise has not generated enough revenues to cover even the variable costs, and the business will be better off, and money and time saved, by shutting down the operation. In economics, the point where total revenues equal total variable costs (i.e. when GM is zero) is known as the **shutdown** point. A related economic concept is **breakeven** when total revenues equal total costs of production. Breakeven price per kg is calculated by dividing total costs by total live weight produced. The **payback** period can also be determined by dividing total fixed/capital investment costs by GM.

Another important concept in GMA is **opportunity cost**. It is the return that is foregone if a resource were not put to its best alternative use. When a resource has been put to its best use possible or has no alternative use, its opportunity cost would be zero. An opportunity cost is often associated with the hidden cost of using farm-owned inputs, such as family labour, land, and capital; therefore, it is also known as ownership cost. The opportunity cost of family labour may be the return or income that the family members could have earned from off-farm employment, or from engaging in other enterprises. The opportunity cost of farm-owned land may be potential income that could have been earned from growing something else or the rental income if it were leased out. The opportunity cost of farm-owned capital may be the interest or dividend that could have been earned if it were invested in a savings account or in the stock market. Opportunity costs of farmer-owned resources, especially family labour, are often neglected in costing farming activities, but are accounted for in this study.

GM, however, is not profit because it does not account for fixed/overhead costs which, once committed, cannot be avoided regardless of the level of production; i.e. they remain the same even at zero production. But given sufficient time to change, all costs are variable, which increase as the level of production increases. Therefore, gross margin analysis is best used to assess financial performance within a relatively short period of time, e.g. one operation year or one production cycle. Over a longer period, it is more appropriate to look at the net present value or internal rate of return to account for both variable and fixed costs over time and the time value of money (i.e., the decline in the value of a sum of money over time). Another important application of GMA is comparing the financial performance of enterprises that utilise the same overhead and fixed/capital inputs and have similar production systems, but are different in terms of productivity and market demand. Therefore, it is a perfect tool for comparing the relative performance of sheep and goat enterprises, as done in this study. This comparison is very relevant in Fiji because nearly half of the SR farms have kept both goats and sheep.

Costs of production (both variable and fixed costs) to be considered in the GMA pertaining to a SR enterprise in Fiji are summarised in Table 1.

Cost of production and gross margin calculator

A cost of production and gross margin (CoP/GM) calculator was developed specifically for goat and sheep farming in Fiji. It is an adaptation of the budgeting tool developed by Gertner et al. (2021).

The CoP/GM calculator consists of several key components. Each of those components is represented by a separate Excel worksheet, which are linked to each other where necessary. Elements of those worksheets are summarised below:

- Production parameters and assumptions: herd size (defined by the number of female breeders, ewe or doe); breeder replacement/culling rates; lambing/kidding rates; death rates (male and female breeders, pre-weaning, post-weaning); live weight at different ages (at birth, at weaning, at sale) and implied daily weight gain for different age groups; losses that are not production-related, e.g. theft or dog attacks;

Table 1. Variable and fixed costs in SR production

Variable costs: costs that vary with the level of production	Fixed costs: costs that, once committed, do not change regardless of the output level
• Breeding: purchase of replacement stock; • Feeding: feeds and protein supplements; salt/minerals, and other supplements; • Animal health: drenching, vaccination, vet medicine and services, vet supplies; • Marketing: transport/communication; • Running costs of machinery: fuel, electricity, oil/lubricant; • Repairs and maintenance of machinery, animal housing/shed and fences; • Labour: casual and family labour; • Pasture maintenance: seeds, planting materials, fertiliser, herbicides, irrigation.	• Breeding stock; • Land/rental; • Animal housing/shed; • Fencing; • Machinery: tractors/implements/bulldozers; • Trucks/vehicles/motorbikes; • Farming equipment/tools; • Generator/pump/water tanks/pipes; • Establishment of improved pasture; • Overhead: office/office supplies/salaried personnel; • Annualised fixed costs, in the form of: depreciation; interest; Insurance; taxes.

- Revenues from animal sales, by different selling methods (by head or by kg, sold live or dressed) and by the class of animal (male or female), age (young or culled); and estimated value for animals used for home consumption and disposed of by other means, etc.;
- Initial capital investments/fixed costs: breeding stock; farm infrastructure (animal housing and fencing); machinery, equipment/farm tools; grazing land; improved pasture establishment; borrowed funds; overhead (office, office supplies, salaried personnel, etc);
- Variable costs: Expenses on purchases of replacement breeding stock or weaners/growers; feeds; vet medicine and services; marketing/transport; fuel/electricity; repairs and maintenance of shed and fences, improved pasture, machinery/equipment, etc; labour (both hired and family);
- Supplementary feeding: itemised costs and supplementary feeding regimes pertaining to different classes of animals (male and female breeders, newly born, weaners, growers, fatteners) for improving nutrition and boosting productivity;
- Summary budget: total revenues; total variable costs; total and annualised capital investment costs are summarised in this worksheet, as well as gross margin, average cost of production per kg, and payback period.

Data sources

Although GMA is a simple and useful tool in principle, it can be quite involved in establishing the initial database especially for livestock enterprises. Since necessary data on various components of variable and fixed cost of production, as outlined in Table 2, and production parameters were not readily available, they were collated from a variety of sources. They included the following:

***Baseline survey*.** The survey collected information on farm household and farm characteristics from 50 registered SR farmers in the Western and Northern divisions in Fiji. The focus was on flock structure, landholdings, farm infrastructure, and production systems, as well as farming practices related to weaning, feeding, drenching, etc. The results were summarised by Rao and Mala (2023) and used to select farms for participating in the on-farm monitoring program/drenching trials.

***On-farm monitoring program*.** Technical and financial data were collected at different intervals from participating farmers. Technical data collected included: initial flock structure; births and body weight at birth, and every 3 months until 12 months of age; as well as any other changes in flock structure due

to deaths, purchases/sales/transfers, home consumption, theft/disappearances, etc. Financial data collected cover revenues from animal sales and by-products, and expenses in animal feed, healthcare, farm infrastructure, machinery, farm tools, seeds, fertiliser, pesticides, and labour. These data were recorded on a booklet by the farmers as they occurred, and collated and transferred to the CommCare App by project officers on their farm visit once a month. Preliminary results from the on-farm monitoring program were summarised in Prasad and Baleiverata (2023).

Drenching trials. Faecal samples were collected from lactating does/ewes, dry females and growing lamb/kids every other month as part of the drenching trials to assess the effectiveness of different drenching methods and their impact on performance, such as growth rates, lambing/kidding percentages, and death rates. In addition, long lasting drenches, which include Albendazole capsule and Moxidectin Injection, were administered every three months, along with taking observations on FAMACHA (FAffa MAlan CHArt) score to determine the degree of anaemia due to worm infestations and the need for drenching and BCS (Body Condition Score). Preliminary results from the drenching trials can be found in Kour (2023).

Feed resources survey. This survey of registered 248 SR farmers in the Western and Northern divisions focused on sources of feeds, feeding practices and issues in providing supplementary feeds aiming at addressing issues of poor nutrition. Key results can be found in Prasad (2022) and Prasad et al. (2023). The former also includes an overview of the SR industry in Fiji.

Farm visits and farmer interviews. Interviews with farmers with different production systems and in different locations were conducted on several occasions to understand the farm set up and the operating environment, and to collect data on production parameters, sources of revenues and costs of production. Altogether around 20 different farms were visited; some were visited more than once so that data that were previously collected could be verified. Those farmers were also participants of the on-farm monitoring program/drenching trials. This overlap has enabled triangulation and cross-checking of the data collected from separate farmer interviews.

GMA training workshops and group discussions. Training workshops were conducted separately for Ministry of Agriculture (MoA) research and extension staff and project officers, and for farmers. The objectives of the training were to: (1) raise awareness of the need for farmers to become more business-minded and market-oriented as they transition from subsistence farming to semi-commercial/commercial farming; (2) help better understand the costs and returns from goats/sheep farming, and the importance of record keeping; and (3) demonstrate the GM impact of adopting more appropriate production and marketing practices using the CoP/GM calculator described earlier. The lectures on farm economics were followed by group discussions whereby participants, divided into small groupings, were asked to do the following:

- identify major activities associated with SR farming, including the routine activities that are done every day, and those that are done only occasionally or where required;
- identify the inputs required to implement those activities;
- estimate the costs or expenses associated with those inputs used;
- calculate GM, and compare that with the opportunity cost of family labour[2]; and finally
- estimate the cost of production per kilogram and compare that with farmgate prices.

[2] The opportunity cost of family labour is accounted for as a variable cost based on minimum wages in the budgets developed later in this study. However, at the workshops the value of family labour was not recognised or costed by workshop participants, farmers and research and extension officers alike.

The steps included in the group discussions are in fact an on-farm application of the value chain analysis[3] originally proposed by Porter (1985). The essence of the value chain analysis is to break down a firm or a farm into a set of primary and supportive activities. These activities are then costed to assess their impact on margins and profitability, as well as to identify issues and areas for improvement.

Market survey and stakeholder consultation. More than 20 interviews were conducted in the Western and Central Divisions with traders, middlemen, wholesalers, the Fiji Meat Industry Board (FMIB), butchers, supermarkets, and hotels/restaurants. The objectives were to characterise the animal traits of SR that are preferred by buyers at the formal market and to identify potential market segments. In addition, consultations were held with agricultural officers and meat inspectors of MoA, as well as researchers who were involved in the EU-funded value chain project and ACIAR-funded sectoral analysis of the SR sector around the same time. Market survey interview questions focused on: sales volumes; the types of animals they buy; their suppliers; and their customers (especially, their buying preferences); as well as any problems they have encountered in running their businesses. The market survey ended up focusing on goats simply because it soon became clear that few or no local sheep were sold through the formal market as it has been dominated by imports for decades.

Review of literature. The review included GMAs on SR that have been conducted in Fiji and around the world, with a focus on production parameters and assumptions underlying their GMAs, and the treatment of opportunity costs of farm-owned resources.

Overview of the Small Ruminant Industry in Fiji

Both goats and sheep have been continuously present in Fiji since the mid-1800s, having arrived with European settlers and missionaries, but with somewhat different development paths (Manueli, 2022). Over the centuries, the sheep sector has experienced significant ups and down, while the goat sector enjoyed a stable growth, partly due to government policy and partly due to the socio-demographic features of the population, e.g. with nearly 50 per cent being Fijians of Indian descent that favour goats. In the sections that follow, the differences between the two sectors in terms of supply and demand conditions will become more apparent.

Sheep history

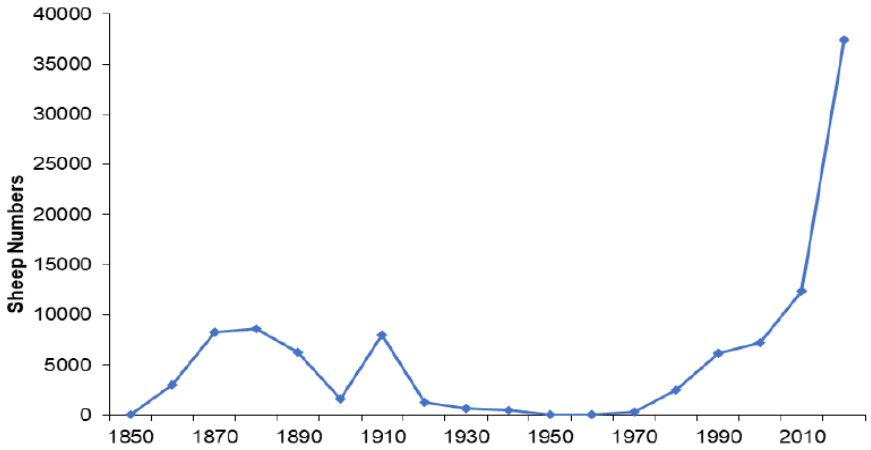
Sheep numbers were said to peak at 8,800 in the 1920s, but fell to 50 head by 1960 (Manueli, 2022). Wrong (woolly) breeds, dogs and wild pig attacks, internal parasite infections, inappropriate (extensive) management systems, and poor-quality pastures were the main reasons for the failure of early attempts to establish a sheep flock in Fiji. However, those issues were not addressed until 1980

[3] The concept of value chain was first introduced by Porter (1985). A value chain is defined as a progression of activities that a business or firm performs in order to deliver a finished product that is of value to customers. The value chain of a business can be broken down into two components: primary activities that are needed to make and sell a product or service, and support activities that help improve the functioning of primary activities. A business analyses its value chain activity-by-activity to find ways they can improve performance and increase customer value, either by reducing costs or differentiating their products with features that customers want. The same framework can also be applied to the value chain of an industry as a whole that emphasises the linkages between all the different players and businesses that are involved in creating and delivering a product to end users. Porter (1985) calls the value chain of an industry a "value chain system", which is analogous to terms such as marketing system, market chain or supply chain that were more popular previously. Nowadays, it seems a value chain analysis more often than not refers to a value chain analysis of an industry rather than a business. In this study, both value chain perspectives are used. That is, at the macro level, it is used to identify issues and opportunities for the SR industry value chain in Fiji, and at the micro level, it is used to identify, and cost, primary and supporting activities of a SR farm business, facilitated by a gross margin analysis.

when the Fiji Mutton Sheep Project was established to develop more suitable breeds of sheep for Fiji. Finally in 1991, upon completion of the breeding program and quarantine, a new Fiji breed (the Fiji Fantastic, a crossbreed of Wiltshire and Blackbelly Barbados), was released to farmers. Fiji Fantastic was said to be well adapted to the climatic conditions of Fiji, and to have good performance characteristics, as well as able to shed its wool naturally (Manueli, 2022). In 2016, 74 Dorper and three Australian White rams were imported from Australia, aimed at improving the conformation of Fiji Fantastic. In 2019, F1 of Fiji Fantastic and Dorper were released to farmers.

As indicated in Figure 1, the national sheep flock has increased significantly since the 1970s, and 37,435 sheep on 4,341 sheep farms were found in the 2020 Agricultural Census.

Figure 1. Sheep numbers in Fiji, 1850-2020



Source: Reproduced from Manueli (2022)

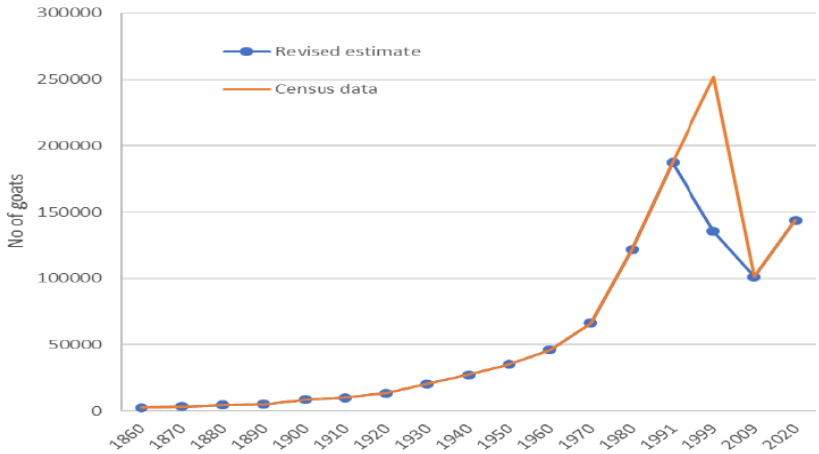
Goat history

In contrast to sheep, goat numbers have increased steadily ever since they were first introduced. This is because, according to Manueli (2022): goats are managed in a semi-intensive system, as opposed to the extensive system for sheep in the early days; goats are un-fussy eaters, able to thrive on poor pastures and browse a range of plants (sheep are grazers); and goats are more agile, and better able to elude dog attacks than sheep. In addition to their natural advantages, research and breeding programs for goats started early in 1950 at Sigatoka Research Station (SRS) and continued over the decades, with the introduction of new breeds every so often. Goat numbers from 1860 to 2020, based on the Agricultural Census that is conducted every 10 years, are shown in Figure 2.

As can be seen, the goat industry has grown at an increasing rate for more than a century until 2009 when, against the trend (the orange line), the stock number was significantly reduced from 187,235 in 1991 to 101,196 in 2009 due to heavy rainfall and severe flooding[4]. The stock number increased to 143,853 (on 9,212 farms) in 2020. Whether the turnaround found in the 2020 Agricultural Census signals a new growth era for the goat industry is yet to be verified in the next Agricultural Census, possibly in 2030.

[4] According to the Fiji Meteorological Service (2009), January 2009 was the wettest first month of the year in more than a century at several locations in Fiji. The total monthly rainfall was equivalent to or above 200 per cent of normal at more than 75 per cent of reporting stations in the Western, Central and Eastern Divisions of the country. The January 2009 floods were seen as the worst natural disaster 'economically' to affect Viti Levu since the drought of 1998.

Figure 2. Goat numbers in Fiji, 1860-2020



Source: Reproduced from Manueli (2022)

Current industry structure

In 2022, there were 2,272 farms raising goats, with a total stock number of 88,448 head (Last column, Table 2). By contrast, there were 1,027 farms raising sheep, with a total stock number of 35,370 head. Total SR production was 331 tonnes, with goat and sheep meat production being 211 tonnes and 120 tonnes, respectively (Prasad, 2022).

Table 2. SR production on registered farms in Fiji, 2013-2022

		2013	2014	2015	2016	2017	2018	2019	2020[5]	2021	2022	Average
Goat	No. of Farms	777	935	938	1,307	1,351	1,541	1,603	2,136	2,195	2,272	1,506
	No. of Stock	35,931	38,000	40,097	35,439	58,019	63,041	66,391	93,628	85,564	88,448	60,456
	Production (t)	154	105	84	77	184	194	187	160	186	211	154
	Imports (t)	111.8	118.6	130.7	81.89	5.79	89.71	2.59	0	0	74.03	62
Sheep	No. of Farms	503	495	514	552	685	753	827	917	982	1,027	726
	No. of Stock	18,603	15,327	21,386	21,613	28,013	27,697	31,651	30,743	32,061	35,370	26,246
	Production (t)	199	41	74	80	84	120	90	126	146	120	108
	Imports (t)	4,498	4,461	4,856	4,790	4,020	4,630	3,510	3,190	3,280	4,210	4,145

Source: APAARI (2021); Prasad (2022); Tridge (2024a,b)

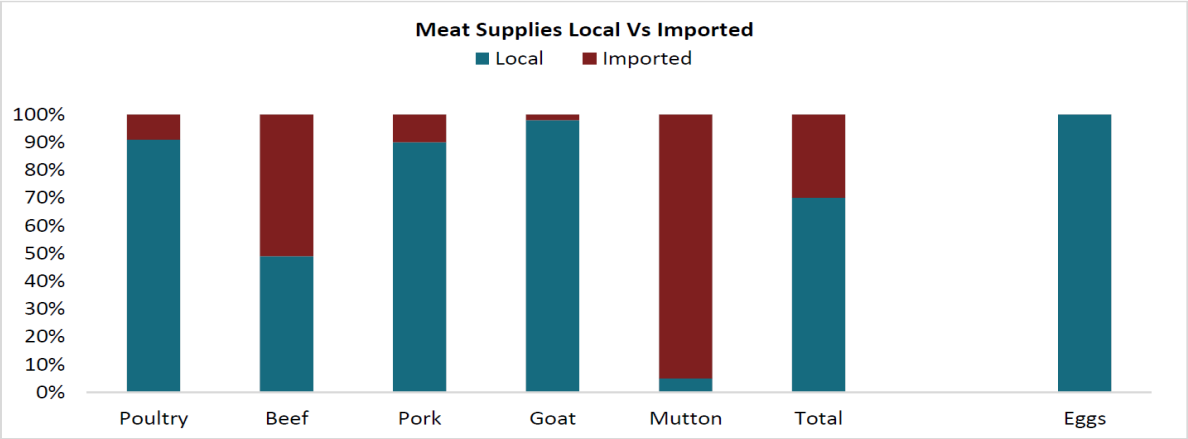
Although the goat population is 2.3 times as large as sheep, the market for sheep meat is much greater than that for goat meat. In fact, goat meat consumption accounts for only 5 per cent of total SR consumption. The sheep meat market is supplied by imports, which account for 99 per cent of total SR imports. From 2013 to 2022, imports averaged 62 tonnes for goat, and 4,145 tonnes for sheep (last column, Table 2). This means that the market for sheep meat can be considered as mainstream, consumed by the general population, while the market for goat meat is niche, consumed by some social groups for special purposes. Differences in the demand and supply of sheep and goat meat are illustrated in Figure 3, as well as across different livestock sectors.

[5] Note that these numbers are different from what were reported in the 2020 Agricultural Census of 37,435 sheep on 4,341 sheep farms and 143,853 goats on 9,212 farms. The difference is because the numbers shown in Table 2 are based only on farms that are registered with the Ministry of Agriculture, and therefore, are smaller in both total stock and farm numbers. However, the average stock number per farm is larger for registered farms, as shown in the baseline and feed resources surveys.

Consumer preferences for sheep vs goat meat

Based on FAOSTAT, annual per capita sheep and goat meat consumption in Fiji was estimated to be around 5.06 kg in 2020 (World Population Review, 2024). It was quite high compared with the world

Figure 3. Local supply vs imports for meat types in Fiji



Source: Cole (2022)

average of around 1.9 kg (Cole, 2022). The corresponding numbers were 10.55kg for Australia and 12.32kg for New Zealand – the world's two largest SR meat producers and consumers.

Demand for SR products in Fiji is seasonal, peaking at religious festivals such as Easter and Christmas for Christians, Godly Sacrifice for Hindus, and Quabani and Ramadan/Eid-al-Fitr for Muslims (Prasad, 2022; APAARI, 2021). Farmers are known to hold on to the animals until these festival times for higher prices. However, some social groups prefer goats over sheep. That is, goat is preferred by Indo-Fijians at functions to mark important family/social events such as weddings, funerals, birthdays, the naming of new borns, graduations, etc when large quantities are required. In fact, Indo-Fijians made up 90-95 per cent of goat consumers in Fiji (Cowley et al., 2019). A demand study conducted in the United States found that demand for goat came mainly from ethnic groups and migrants during cultural and religious festivals (Hill, 2013), and it seems Fiji is similar. Indo-Fijians make up 38 per cent of the total population of Fiji while local iTaukei make up 57 per cent. In addition, 65 per cent of the Fijian population are Christians, with 28 per cent being Hindus, 6 per cent Muslims, and 1 per cent others. Ethnic and religious diversities of Fiji are illustrated in Table 3.

Table 3. Composition of ethnic and religious groups in Fiji (in per cent)

	Fiji population	Christian	Hindu	Muslim	Other
iTaukei	57	99	0.2	0.1	0.5
Indo-Fijian	38	6	74	20	
Other	5				
Fiji	100	65	28	6	1

Source: adapted from 2007 Census

In addition to religious and cultural reasons, goat meat is preferred to sheep meat by Indo-Fijians because of its leanness and gamey taste while sheep meat is considered fatty and to have an unpleasant odour. However, younger generations of Indo-Fijians, like the majority of the Fijian population, seem to prefer lamb because it is more suitable for fast cooking and a variety of dishes such as steak, grill/BBQ, roast, stir fry, etc, not just curry. It is also quite likely that lamb is preferred

for convenience reasons because it is more available at the supermarkets in small packages. As discussed earlier, the lamb market has been dominated by imports, and younger people's preferences for lamb poses a potential threat to the goat sector.

Furthermore, the ethnic make-up of the country has changed gradually in the last two decades, with a reduction in the Indo-Fijian population and an inflow of Europeans, Asians, and Pacific islanders. These changes in socio-demographics impact on the demand for goats in Fiji, as well as local supply since the majority (80 per cent in the Western division and 92 per cent in the Northern division) of SR producers are Indo-Fijians (Rao and Mala, 2023).

Industry Value Chain

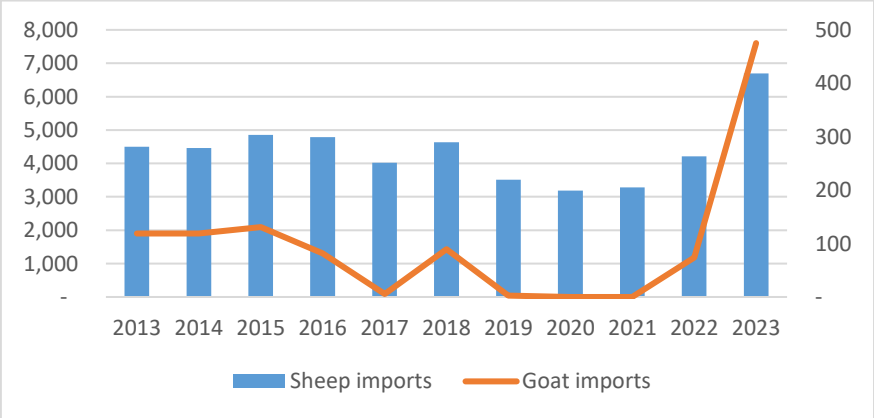
In Fiji, the market for sheep and goat meat is supplied through three value chains, two of which supply the formal market and one the informal market. They are: (1) imported SR meat that is sold through formal markets such as supermarkets and butcher shops (hereafter V1); (2) locally produced live animals that are sold directly to consumers at the farmgate (V2); and (3) locally produced live animals that change hands through traders, slaughterhouses, and supermarkets/butcher shops/restaurants before reaching the consumer (V3).

V1

Australia and New Zealand are the major SR meat suppliers to Fiji, and together they account for 99 per cent of total imports. In 2023, Australia had a market share of 55 per cent (valued at US$19.1 million), and New Zealand, a market share of 44 per cent (valued at US$15.5 million) (TrendEconomy, 2024). But this was not always the case. For example, in 2019, New Zealand had a market share of 50 per cent (at US$11.9 million), and Australia, 49 per cent (at US$11.7 million). Import shares change because of a range of factors, such as demand conditions in Fiji, supply conditions in Australia and New Zealand, exchange rates, and relative import prices between the two suppliers.

Import volumes. As shown in Figure 4, between 2013 and 2023, sheep meat imports averaged 4,377 tonnes per year (units shown on the left-hand side) while local production averaged 100 tonnes per year. By comparison, goat meat imports averaged 100 tonnes/year over 2013-2023 (units shown on the right-hand side), with some years being very small or zero as in 2019-2021. Note that in 2023 there were significant increases in SR meat imports, from 74 tonnes in 2022 to 475 tonnes in 2023 for goat, and from 4,210 tonnes in 2022 to 6,700 tonnes in 2023 for sheep (Tridge, 2024a,b).

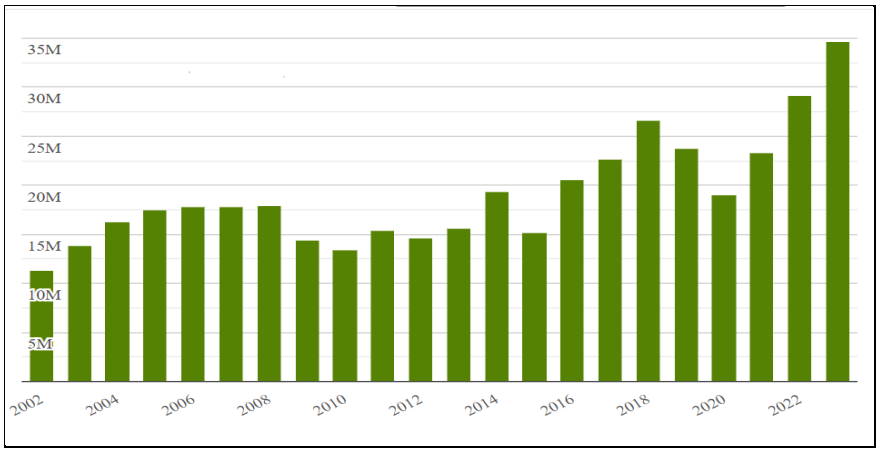
Figure 4. Fiji import volumes of sheep and goat meat, in tonnes, 2013-2023



Source: Tridge (2024a,b)

Import values. Total import values of sheep and goat meat combined have been trending upwards in the past two decades, despite some ups and downs (Figure 5).

Figure 5. Fiji import values of sheep and goat meat, in US$, 2002-2023



Source: TrendEconomy (2024)

Import composition. In 2023, mutton, frozen and bone-in (**020442**)[6] (78 per cent) and boneless (**020443**) (5.59 per cent), account for 84 per cent of total import value (Table 4).

Table 4. Composition of sheep and goat meat imports in Fiji, 2019 and 2023

Commodity group	**Import value** (in US$) **(2023)**	**Value share** (in %) **(2023)**	**Value share** (in %) **(2019)**
020450 - Meat of **goats**, fresh/chilled/frozen	2.00 million	5.78	0.017
020410 - Carcasses/half-carcasses of **lamb**, fresh/chilled	498 thousand	1.43	0.047
020430 - Carcasses/half-carcasses of **lamb**, frozen	22 thousand	0.07	5.74
020421 - Carcasses/half-carcasses of **sheep** (excl. lamb), fresh/chilled	NA	NA	0.126
020422 - Meat of **sheep** (excl. lamb & carcasses), fresh/chilled, bone-in	1.44 million	4.16	4.96
020423 - Meat of **sheep** (excl. lamb), fresh/chilled, boneless	1.32 million	3.81	5.98
020441 - Carcasses/half-carcasses of **sheep** (excl. lamb), frozen	123 thousand	0.36	0.066
020442 - Meat of **sheep** (excl. lamb & carcasses), frozen, bone-in	27 million	78	75
020443 - Meat of **sheep** (excl. lamb), frozen, boneless	1.93 million	5.59	7.33
Total	**34.6 million**	100	100

Source: TrendEconomy (2022)

[6] Frozen lamb shanks, lamb racks and lamb flaps are classifiable in subheading **020443.20 HTSUS.**

Carcasses/half-carcasses of lamb, fresh/chilled (**020410)** and frozen **(020430),** made up less than 1.5 per cent of the total. The import share of goat meat, fresh/chilled/frozen (**020450**), was 5.78 per cent. When 2023 figures were compared to those in 2019, one can see that the share of different cuts did not change much, except there was an increase in the import share of goat meat (**020450)** and a decrease in lamb (**020430)**. Based on these data, the unit import cost of SR meat was on average US$4.82/kg (FJ$10.85/kg, at an exchange rate of 2.25) in 2023, and was US$6.72/kg (FJ$15.12/kg) in 2019 – quite a cost reduction from 2019 to 2023.

In a survey of supermarkets and butchers in Viti Levu, Cowley et al. (2019) found "budget" cuts, which include sliced necks, curry pieces (frame bones), chump chops, shanks, and shoulder pieces, account for 77 per cent of all cuts on the shelf, with an average price of FJ$15/kg. "Mid-range" cuts (such as whole roasting legs or shoulders, bone in), which account for 23 per cent of all cuts for sale, were on average selling at F$20/kg. No "premium" cuts (from the loin area) were observed. Those results are consistent with what are presented in Table 4.

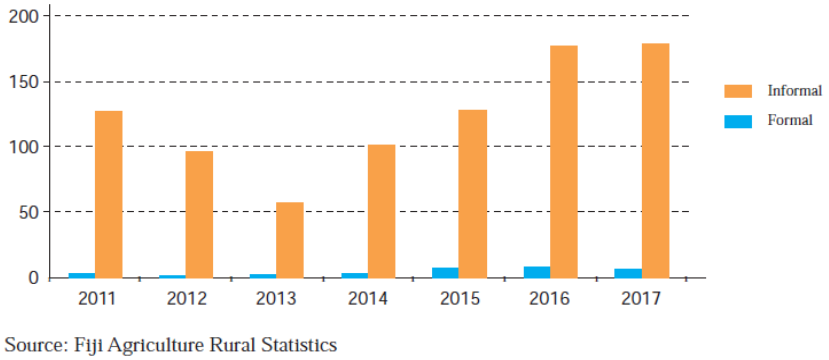
V2

According to Cowley et al. (2019), demand is high for live SR marketed at the farmgate (ie through V2) for several reasons: (1) customers get to pick the right animal they want (in terms of age, sex, size, body and health conditions, etc)[7]; (2) purchase and kill occur when needed to ensure the meat is fresh and tastes good); (3) meat is cheaper, compared to orders from the trader, supermarket or butcher shop; and (4) the whole animal, including blood, offal, head, testicles, etc, can be used according to traditional and cultural practices. Farmers also prefer selling through V2 because prices are higher than selling to traders. As a result, V2 accounts for 95-98 per cent of all domestic SR traded.

V3

The volume of local SR traded through V3 is quite limited and is mostly goats. For example, APAARI (2021) showed that, in 2017, 9,964 goats were sold on-hoof to households through V2 while 402 goats went through registered slaughter facilities (V3). The latter accounts for 4 per cent of total local goat supply. However, the market share could be as low as 1-2 per cent in some years, such as in 2011-2014 (Figure 6). The situation had not changed much in a recent survey conducted by Cole (2022).

Figure 6. Live goat traded through informal market (V2) and formal market (V3)



Source: Reproduced from APAARI (2021)

[7] From the market survey, preferences for live goat differ between Hindus and the Muslims. While Hindus prefer young male goats of 10-12kg cwt, and between 1 to 1.5 years old, Muslims seem to prefer larger males that are more than 20kg cwt, mature but less than 2 years old. Halal-certified and male animals (to save females for breeding and to avoid killing pregnant females) are two very important requirements for Muslims.

Live sheep traded via V3 is even smaller. To illustrate, the numbers of sheep and goats slaughtered at the Nasinu Abattoir are shown in Table 5. As can be seen, the number of goats slaughtered (367 head) was 17 times that of sheep (22 head). Also noticeable from Table 5 is the high percentages of females that were slaughtered -- 95 per cent for goats and 86 per cent for sheep. Data over a few quarters indicate that this is not an isolated case, but common at Nasinu and Vuda Abattoirs. Data in Table 5 also show that carcass weights were much higher for sheep than goats: 45 per cent higher for males and 31 per cent for females.

Table 5. Slaughter numbers for sheep and goats, by sex, Nasinu Abattoir, February-April 2022

	Gender	Head	%	Average cwt (kg/head)
Goat	Buck/male	20	5	12
	Doe/female	347	95	11
Sheep	Ram/male	3	14	22
	Ewe/female	19	86	16

Source: Nasinu Abattoir (2022)

V3 is able to operate simply because females and culls are much cheaper to buy, and apparently, it is hard to tell the difference between young males (what the customers want) and (culled) females (what the customers do not want), after carcasses had been cut into pieces and slow cooked in curry for hours. Interestingly enough, the preferred carcass weight of 10-12kg of young male goats also applies to females and some culls.

Relative profitability between V3 (male goats) and V3 (female goats) for farmers, traders and other value chain players discussed in Cole (2022) is reproduced in Table 6, along with our understanding of V2. As can be seen, farm share was 100 per cent for live male goats sold via V2, but was reduced to 68 per cent for males and 43 per cent for females if they were sold through traders via V3. For traders, their shares of the consumer dollar were 23 per cent for male goats and 31 per cent for female goats. Clearly, margins were higher for both traders and retailers in trading female goats. Consumers in V2 also paid substantially lower prices at the farmgate than at the supermarkets or butcher shops. However, the consumers did assume the marketing services originally provided by all the intermediaries, such as assembling, transporting, and processing. With continuing changes in socio-demographics, these costs could become too high to bear at some point.

Table 6. Distribution of margins along the goat value chain, V2 vs V3

	V2: Males		V3: Males		V3: Females	
	FJ$	%	FJ$	%	FJ$	%
Farmer	14.27	100	14.27	68	9.00	43
Trader	0	0	4.73	23	6.61	31
Abattoir	0	0	0.10	0	0.32	2
Retail	0	0	1.90	9	5.07	24
Consumer	14.27	100	21.00	100	21.00	100

Source: Adapted from Cole (2022)

These seem to be astonishing findings. That is, what is supplied to the formal market (V3) is in fact the leftovers from V2, ie females and culls, rather than the other way around. Normally, one would expect the formal market to have better quality offers because of government regulations and private quality standards. Results presented in Tables 5 and 6 also help explain why consumers would prefer to pick their own at the farmgate, and why V2 had a clear competitive edge over V3, especially for farmers.

Production Systems

Based on the literature review and results from various components of the ACIAR project, small ruminant farms in Fiji can be characterised as follows:

Enterprise mix and sources of income

In addition to raising SR, farmers are involved in the production of a diverse range of farm commodities, such as cattle, chicken, sugarcane, honey, vegetables, rice, cassava, etc, as well as off-farm employment. Although the majority of the farmers indicated that goat/sheep farming was a good source of income, 40 per cent of farmers in the North claimed to have off-farm income while it was 72 per cent in the West (Rao and Mala, 2023).

Prasad (2022) found that of 248 farms surveyed, 50 per cent of the farms kept both goats and sheep, 20 per cent had only sheep, and 30 per cent had only goats (Table 7). In addition, the survey showed that although 33 per cent (40/122) of the dual farms had nearly equal numbers of sheep and goats, the share of goats on dual farms ranged from 5 per cent (nearly all sheep) to 97 per cent (nearly all goats). In terms of stock numbers, on average, sheep-only farms had 38 head of sheep and goat-only farms had 60 goats while dual farms had 83 head of sheep and goats in total. The latter result means that dual farms tend to be larger than farms with a single species.

Table 7. Enterprise mix of SR farms in Fiji

Province	Sheep farms	Goat farms	Sheep/Goat farms	Total
Macuata	11	19	33	63
Bua	16	13	34	63
Ba	12	21	29	62
Ra	13	21	26	60
Total	52	74	122	248

Source: Prasad (2022)

From personal interviews with farmers, it appears that those farmers who raised both goats and sheep did so in order to supply both markets while offering their customers a choice. Some farmers did prefer to raise either sheep or goats. Sheep were preferred because they are faster growing and easier to manage as sheep are not as active/agile and do not jump over or break fences as much.

In this paper, budgets were developed to compare the profitability of sheep and goat farming. Table 8 compares prices and body weight at 9 months old of goats and sheep, based on an interview with a very productive dual farm in the North. Note that, for this farm, goats received FJ$2/kg more than sheep. For many other farms, sheep and goats were sold at the same price.

Table 8. Price and live weight differentials between sheep and goat

		Live weight		Price/head	
	Price/kg	Male	Female	Male	Female
Goat	FJ$13	35kg	30kg	FJ$455	FJ$390
Sheep	FJ$11	45kg	38kg	FJ$495	FJ$418

Flock structure

The baseline survey conducted in the Northern and Western divisions recorded the numbers of ewes/does, rams/bucks, and growing females and growing females on 50 registered SR farms. The average size for a sheep farm was 70 sheep in total, with 40 ewes, and for a goat farm, 102 goats in total, with 55 does (second and third columns, Table 9).

Table 9. Flock structure, based on average stock numbers per farm

	Sheep	Goat	Sheep	Goat
	in stock number		in ratio	
Ewes or does	40	55	0.57	0.55
Rams or bucks	5	6	0.07	0.06
Growing females	14	19	0.20	0.18
Growing males	11	22	0.16	0.21
Average no. of animals per farm	70	102	1.00	1.00
Ewe/Ram or Doe/Buck	40/5	55/6	8	9

Source: Calculated from the baseline survey

Breeder females to total stock ratios. Breeder females were found to account for approximately 57 per cent of total sheep stock, and 55 per cent of goats.

Breeder female to breeder male ratios. Average breeder female to breeder male ratios were found to be 8:1 for sheep and 9:1 for goats. These figures are low compared to the ratio of 20-25 to one as recommended by the Fiji Ministry of Agriculture (2014, p. 100). It means that there were more breeder males than was necessary, ie breeder males were under-utilised. Extra feeds and other inputs (shed space, management time, etc) that were required to keep them on farm would no doubt result in higher costs of production.

Lamb/ewe or kid/doe ratios. Unfortunately, it was not possible to make any inferences on lambing/kidding rate or the like from the data shown in Table 9, because the numbers of growing females and males reported include both kids/lambs, as well as yearlings/hoggets.

However, more detailed data were available from the 2020 Agricultural Census. As shown in the last column of Table 10, the average farm size nationwide was 15 in total for a goat farm, and 9 for a sheep farm.[8] Also, the average kid/doe ratio was 0.43 (3/7) and lamb/ewe ratio 0.50 (2/4), at the national level. Those low percentages (43 per cent and 50 per cent) would be an issue, if they could be used as an approximation for kidding or lambing rate, and were compared to the benchmark kidding/lambing rates of 120 per cent - 150 per cent (Cowley et al., 2019; Metawi, 2019; Schoenian, 2015).

Also from Table 10, breeder females accounted for approximately 45 per cent of total stock both for goats and sheep; and the breeder female to male ratios were approximately 4:1 for both goats and sheep. The latter figures were much lower than the results from the baseline survey of 9:1 and 8:1. It is clear that the recommended ratio of 20-25:1 cannot be achieved for small farms with less than 20 ewes or does, which made up the majority of SR farms in Fiji.

In comparison, in Kenya, the female to total stock ratios for goats ranged from 32 per cent to 40 per cent, depending on the intensity of input use (Table A2.1 in Appendix 2). Kenyan performance also

[8] These numbers were calculated based on the 2020 Agricultural Census in Fiji that found 143,853 goats on 9,212 farms and 37,435 sheep on 4,341 farms.

shows that, the higher the input use, the higher the kidding rate (ranging from 127 per cent to 187 per cent), and the lower the ratio. The negative correlation seems to imply the lower the ratio the better. The high ratios reported in Fiji could be an indication of high numbers of unproductive females that are not culled, or not culled in a timely fashion (Cowley, et al., 2019). Flock structures for goat and sheep farms in Kenya, by age and sex, are reproduced in Appendix 2.

Table 10. Flock compositions of SR in Fiji, in stock numbers, by region, 2020

Goat	**Central**	**Eastern**	**Northern**	**Western**	**Total**	**Stock no. per farm**
Doe	2,010	313	20,593	38,999	61,915	7
Buck	1,025	160	7,476	12,622	21,283	2
Yearlings	609	148	8,837	22,105	31,699	3
Kids	1,047	98	8,382	19,429	28,956	3
Total	4,691	719	45,288	93,155	143,853	15
Sheep	**Central**	**Eastern**	**Northern**	**Western**	**Total**	**Stock no. per farm**
Ewes	433	197	8,762	8,232	17,624	4
Ram	235	94	2,290	1,871	4,490	1
Hogget	69	222	3,768	4,143	8,202	2
Lamb	285	193	3,048	3,593	7,119	2
Total	1,022	706	17,868	17839	37,435	9

Source: Prasad (2022)

In any case, flock structure, and its implications on productivity and industry growth, cannot be assessed without further data disaggregation by sex and by age, as well as tracking over time. Optimal flock structure will vary from farm to farm, depending on farming objectives (growing vs maintaining the herd size), the operating environment (e.g. feed supply), and farmers' personal circumstances (e.g. need for cash).

Land tenure

As a key input to agricultural production, access to land and land tenure are an important factor in determining the herd size and the potential for growth. Land tenure has become an issue for some SR farmers in recent years who encountered problems and long delays in renewing their land leases. Land in Fiji is managed through three systems: native (or iTaukei or customary) land, freehold land, and Crown (or state) land. Customary land makes up 84 per cent of all land, freehold 8 per cent, and Crown land 8 per cent (ADB, 2016). Neither customary nor state land can be bought or sold, but is available on a leasehold basis, for up to 99 years for state land and up to 30 years for customary (agricultural) land. In rural areas, people of other ethnicities either own freehold land (a small proportion), or lease land. Customary land is managed by the iTaukei Land Trust Board (ILTB), and is divided into 'reserved' and 'non-reserved'. The former is limited to mataqali members' own use and the latter can be leased. Land rentals vary with land use, such as commercial, foreshore/tourism, industrial, residential, and agricultural uses. Rentals for agricultural land also vary with location, land quality/fertility and topography (eg land lease is cheaper for grazing than for cropping). Land use is restricted by what is agreed upon in the contract, and cannot be changed. That is, land leased for sugar production cannot be used for vegetable production on a large/commercial scale. Land ownership and tenure are shown in Table 11.

Table 11. Land ownership and tenure in Fiji

Location	Freehold	Mataqali Lease	ILTB (Native land)	Leasehold (Crown land)	N
North	36%	12%	40%	12%	25
West	8%	16%	72%	4%	25
N	11	7	28	4	50

Source: Rao and Mala (2023)

Grazing system

Most SR production systems in Fiji are semi-intensive with animals grazing during the day for on average eight hours, and housed in the shed during the night. Various supplementary feeding regimes were employed by farmers, as discussed below.

Supplementary feeding. Prasad (2022) examined feeding practices in both Northern and Western divisions. It was found that the majority of sheep and goats grazed on unimproved pasture in a semi-intensive production system. However, there were significant regional differences in terms of supplementary feeding, i.e. based on improved pastures versus using mineral supplements or concentrates. For example, 93.7 per cent and 6.3 per cent of respondents in Macuata in the North reported to have improved pasture and used salt/mineral supplements, respectively (Table 12). The corresponding figures were 14.5 per cent and 96.8 per cent for respondents in Ba in the West. In addition, 4.8 per cent versus 40.5 per cent of respondents in Macuata and Ba had used concentrates.

Table 12. Feed resources used by farmers in the Northern and Western divisions

	Northern division		Western division	
	Bua	Macuata	Ba	Ra
No. of observations	63	63	62	60
Unimproved pasture	88.9	88.9	100	98.3
Improved pasture	63.5	93.7	14.5	53.3
Mineral supplements	17.5	6.3	96.8	56.7
Concentrates	4.8	4.8	40.3	23.3
Crop residues/food scraps	4.8	1.6	8.1	33.3
Forages/fodders	12.7	3.2	43.5	63.3

Source: Prasad (2022)

Differences in feeding practices can be expected to result in different cost structures. For example, relying on improved pasture will require an initial investment in establishing an area of improved pasture (a fixed cost), which also requires cutting and regular maintenance (a variable cost). On the other hand, mineral supplements and concentrates would most likely to be purchased from outside (a variable cost), but would be less labour intensive than cutting grasses. Price differentials for various farm inputs were found to exist between different divisions, as well as different locations within the same division. That means cost of production may differ simply because of price differentials in feed ingredients.

These results would have significant implications both for feeding costs and returns, as well as productivity. Again, GMA would be able to quantify the benefits and costs associated with different feeding regimes, as well as the cost of marketing for delivering the product to main markets from different production areas.

Supplementary feeding regimes. A table for supplementary feeding was found in the training manual for MoA staff developed/revised by Manueli (2022),[9] with recommendations on when to give, daily allowance and feeding duration for different classes of SR, based on a mixed ration of 50 per cent copra meal and 50 per cent mill mix. The table is reproduced below (Table 13).

Table 13. Recommendations on supplementary feeding of SR

	Stock class	Duration	Daily intake (g/hd/day)
Flushing pre-mating	Adult females Breeding males	3-weeks before the start of mating	250
Mating	Adult females	Duration of the first cycle (21/18 days)	250
	Breeding males	Duration of mating (63/54 days)	250
Late gestation	Pregnant females	Before birth (4-6 weeks)	250
Lactation	Lactating females	Until weaning (12 Weeks)	250
Pre-weaning	Young- reared indoors	From 2-3 weeks after birth until weaning	50-75
Post-weaning	Weaners	Up to 6 months of age (depending on feed conditions)	150

Source: Manueli (2022, page 72)

Actual feeding regimes implemented at the main research stations for SR in Fiji, SRS (Sigatoka Research Station) for goats and NQS (Nawaicoba Quarantine Station) for sheep, are shown in Tables 14 and 15.

Table 14. Supplementary feeding, SRS

Feed Supplements	Type of feed	Kg/hd/day
Kids	Mixed ration	0.15kg
	MNB;	4 blocks per year;
	Cut grasses	10% body weight
Growers	Mixed ration	0.15kg
Does	Mixed ration;	0.25kg;
	Cut grasses	10% body weight
Does (flushing/lactating)	MNB	8 blocks per year
Bucks	Cut grasses	10% body weight
Bucks (flushing)	MNB	6 blocks per year

Source: Interviews with SRS. MNB = Mineral Block

Supplementary feeding currently in use at SRS appears to consist of a "mixed ration", plus something else when an extra boost is needed. For example, for weaners, they are given 150 grams of mixed ration while for does are given 250 grams of mixed ration, plus cut grasses that account for 10 per cent body weight, plus MNB that is given for flushing/lactating. Mixed ration at SRS is 50 per cent copra meal and 50 per cent mill mix, while at NQS it is made of copra meal, mill mix and molasses. Note that in addition to mixed rations, SRS uses MNB (Mineral Block) while NQS uses UMB (Urea Molasses Block). MNB costs FJ$35 for a 20kg block, and it is not recommended for sheep because of copper toxicity. The market price for a 20kg UMB is FJ$30, and the home-made version at NQS was estimated at FJ$23/block (FJ$1.15/kg). Cut grasses include mainly Guatemala and Juncao and are fed based on 10 per cent of body weight.

[9] The training manual for small ruminants covers all aspects of SR husbandry and can be made complete with the inclusion of GMA as one of its training and capacity building modules.

Table 15. Supplementary feeding, NQS

	Type of feed	FJ$/Kg	CP %	Kg/hd/day	Days on Feed
Lambs	Creep feed[10]	1.57	23.1	0.08	90
Growers	UMB	1.15	34	0.15	60
Ewes (flushing)	Mixed ration;	0.92;		0.25;	14
	Cut grasses	0.21		10% body weight	
Ewes (lactating)	Mixed ration;	0.92;		0.25;	30
	Cut grasses	0.21		10% body weight	
Rams (flushing)	UMB	1.15	34	0.08	77

Source: Interviews with NQS. UMB = Urea Molasses Block

When the supplementary feeding regime of NQS was applied to a herd of 50 ewes and 2 rams, the total cost of supplementary feeds amounts to approximately FJ$2,000-3,000/year. However, the levels of growth rate or lambing rate the feeding regimes were aimed for are unknown. Such information will be needed to compare the GM impact of changing feeding practices.[11]

As mentioned in the Introduction, poor nutrition is a main contributing factor to low productivity and underperformance of the SR production in Fiji as supplementary feeding is not commonly practiced. Reasons why farmers did not provide supplementary feeds were discussed in Prasad (2022). The main reasons were lack of knowledge (as they were never trained in SR husbandry and nutrition) followed by high costs of feed, transport issues, and unavailability of feed ingredients (Table 16). Clearly these issues need addressing if farmers are to improve animal nutrition. Also noticeable is the locational differences in response to the same question.

Table 16. Reasons for not providing supplementary feeds to SR

	Western division		Northern division	
	Ba (n=62)	Ra (n=60)	Bua (n=63)	Macuata (n=63)
Never trained on SR husbandry/nutrition	82.3	81.7	74.6	41.3
High cost of feed inputs	59.7	30	82.5	19.0
Transportation issues to get it on farm	17.7	31.7	82.5	14.3
Unavailability of feed ingredients	51.6	8.33	81.0	4.76
Lack of storage facilities	27.4	23.3	3.17	58.7
Lack of manpower on farm	24.2	38.3	14.3	22.2
Poor rate of return	14.5	3.33	28.6	11.1
Lack of Interest	3.23	0	1.59	0

Source: Prasad (2022)

[10] Creep feeding was part of a feeding trial of this ACIAR project, which showed improvements in daily weight gains and death rates (Chandra et al., 2023). However, it is not normally practiced at NQS or by farmers.

[11] Originally, it was planned to develop budgets for representative farms based on data from NQS for sheep and SRS for goats. However, this was not possible because being government funded research stations, their operations were, to varying degrees, influenced by government policies and allocated budgets. For example, their breeding stock were sold to multipliers and farmers at prices that were substantially below market prices. Thus, CoPs or GMs could not be derived to assess their financial performance and commercial viability.

Animal housing and fencing

Both sheds and fencing are an essential part of a semi-intensive grazing system. They are necessary to ensure the safety of the animals from the weather, and in Fiji, theft and dog attacks. However, they require large investments. Consequently, grants to goat/sheep farmers for shed construction and fencing are a major component of the SR development program of the MoA. The size of the grants for sheds is based on farm size, ranging from FJ$9,000-12,000 for smallholder (does ≤ 70 or ewes ≤ 50) to FJ$18,000-25,000 for semi-commercial (71-120 does or 51-100 ewes), and FJ$40,000-45,000 for commercial farms (>121 does or >101 ewes) (last column, Table 17). Subsistence farms are not eligible to apply for these grants.

Table 17. MoA's grants for shed construction based on farm size

Farm classification[12]	Goats	Sheep	Shed size	Grant size
Commercial	≥121 does	≥101 ewes	20m x 14m	$40,000-$45,000
Semi-commercial	71-120 does	51-100 ewes	14m x 8m	$18,000-$25,000
Smallholder	≤70 does	21-50 ewes	11.3m x 3m	$9,000-$12,000
Subsistence	1 to 40 does	1 to 20 Ewes	NA	NA

Source: Fiji Ministry of Agriculture (n.d.)

The grants include costs of materials and delivery. Labour for the construction of sheds is covered by farmers themselves, which can cost another between FJ$1,000 and FJ$5,000, depending on the size of the shed. In the budgets developed in this study, FJ$11,000 was assumed for constructing a shed to house a herd with 50 ewes or does for smallholder farms.

Labour input

Family labour is the major input for of SR production in Fiji, regardless of farm size. The baseline survey found that on average, there are two family members working on the farm, either husband and wife or father and son (Rao and Mala, 2023). Moreover, due to labour shortages, more and more farmers are resorting to hiring casual workers. The baseline survey also found that 44 per cent of farmers have used 2-3 casual workers at an average hourly rate of FJ$4.43/hour in the North and FJ$2.90/hour in the West. Casual workers are usually hired for fencing and shed construction, and their repairs. Eighteen percent and 8 per cent of the farms surveyed in the North and in the West, respectively, had hired permanent workers.

At the GMA training workshops, primary SR farming activities were identified and divided into daily routines and occasional or periodical work. The results show what is done on a daily basis includes checking and counting the flock, cleaning the shed, providing water and feed supplements, cutting grasses, checking the fence, patrolling and watching out for stray dogs and thieves. In some areas, farmers stay with the animals while they are grazing to keep stray dogs and thieves away. What is done occasionally or periodically includes drenching, fencing repairs, marketing (negotiating prices with buyers and sellers), caring for sick animals, caring for babies and mothers during lambing/kidding time, clipping hooves, travelling to town to buy farm inputs, etc. Overall, family labour averaged 3-5 hours/day/farm. In this study, the opportunity cost of family labour was included as a variable cost in the budgets and GMA, based on the minimum wage of FJ$3.0/hour, 3 hours/day for 365 days, unless stated otherwise. Hours spent on SR farming activities are outlined in Appendix 1.

[12] In this study, Fiji MoA's classification for sheep was adopted and applied to both sheep and goat. However, it should be noted that the current classification system can cause confusion in a market economy where SR are a major source of income; therefore, they are kept for economic reasons, i.e. for sale, regardless of farm size.

Production parameters and impact of drenching on productivity

A budget for a goat enterprise was found in the *Fiji Farm Management Budget Manual 2014* (MoA, 2014), but not for sheep. The goat budget was developed for a large, commercial farm with 200 does on 40 hectares, with the following assumptions:

a. Kidding rate = 120 per cent
b. Death rate of kids = 10 per cent
c. Death rate of does = 5 per cent
d. Culling rate for does = 20 per cent
e. All male kids are sold while 15 per cent of females are kept as replacement does.

Other useful parameters for goats were found in Cole (2022) and are reproduced in Table 18.

Table 18. Production parameters of goats

	Level of productivity		
	Low	Average	High
Litters per year	1.1	1.3	1.5
Kids/litter	1.1	1.2	1.4
Pre-weaning mortality	40%	18%	8%
Post-weaning mortality	50%	28%	6%
Cull percent (female)	15%	27%	35%
Live weight (male) kg	23	27	35
Live weight (female) kg	17	24	25
Live weight (culled) kg	15	17	17
FJ$/Kg (dressed weight)	$14.00	$15.30	$17.60
FJ$/Kg (male) (liveweight)	$7.00	$9.14	$10.00

Source: Cole (2022)

Although there was no budget for sheep in the *Budget Manual*, it contains the following production parameters for Fiji Fantastic, as shown in Table 19 below.

Table 19. Production parameters for Fiji Fantastic

Variety	:	Fiji Fantastic
Lambing %	:	97%
Birth- weight	:	Single 4kg, Twins 2.5kg
Weaning Age	:	3 months
Weaning Weight	:	18kg
Puberty	:	6 months
1st Mating	:	18 months
Mating Ratio	:	1Ram: 20 Ewes (Paddock Mating); 1 Ram:6 Ewes (Handmating)
Breeding Intervals	:	8 months
Mortality Rate	:	5%
Life Expectancy	:	Ewe - 7 years Ram - 5 years
Dressed Weight	:	Fatteners - 35%, Hoggots -40%, Cull Ewes & Rams - 50%.
Carrying Capacity	:	8 Sheep/ha pasture (depend on the topography - 4days grazing)

Source: MoA (2014)

Recent data on productivity generated from the on-farm monitoring program and drenching trials of the current project are presented below.

Preliminary results from the drenching trials. The impact on productivity of proper drenching, which is based on need, rather than every 3-4 weekly,[13] is reported by Kour (2023). Preliminary results showed clear improvements in lambing/kidding rate (Table 20). For example, for sheep, there was an increase from 100 per cent to 133 per cent on Farm FJ965, an increase from 147 per cent to 173 per cent on Farm FJ1325.[14] However, the impact on daily weight gain (Table 21) was mixed, and less clear-cut. Due to the small sample size, the impact on productivity was therefore inconclusive, and more research is needed. Nevertheless, useful production parameters and information have been generated, such as variations between farms and between goats and sheep, as well as the declines in growth rate as kids and lambs grow older.

Table 20. The impact of drenching on lambing/kidding rate

Lambing or Kidding %						
Farm	Species	Group	Total Ewes/Does enrolled	Ewes/Does given birth	Lambs/kids born	Lambing /kidding (%)
FJ965	Sheep	Treatment	9	9	12	133
	Sheep	Control	9	6	9	100
FJ551	Goat	Treatment	10	9	22	220
	Goat	Control	10	10	17	170
FJ1325	Sheep	Treatment	15	11	26	173
	Sheep	Control	15	14	22	147

Source: Reproduced from Kour (2023)

Table 21. The impact of drenching on daily liveweight gain (LWG) of lamb and kids

LWG (g/day)						
Farm	Species	Group	Birth weight (Kg)	0 to 3 months	3 to 6 months	6 to 9 months
FJ965	Sheep	Treatment	3.4	167	68	47
	Sheep	Control	2.8	137	77	37
FJ551	Goat	Treatment	3.3	80.4	78	40
	Goat	Control	3.4	80.6	80	43
FJ1325	Sheep	Treatment	2.2	158	104	83
	Sheep	Control	2.4	194	108	66

Source: Reproduced from Kour (2023)

Preliminary results from the on-farm monitoring program. The three farms which participated in the on-farm monitoring program and drenching trials were characterised by Prasad and Baleiverata (2023) as follows:

[13] The baseline survey found that drenching was done nearly monthly (averaging 11 times per year), which cost on average FJ$247 per farm per year or FJ$2.07/head/year, plus 2-3 hours of family labour per drench application of 100 animals.

[14] These figures are much higher than the 60-70 per cent reported in Cowley et al. (2019) and seem to be a result of high percentages of twins and triples. They also suggest that the benchmarks of 120-150 per cent is achievable in Fiji with good management.

FJ965 - WAINIVOCE TAVUA

- This is a "**subsistence**" sheep farm, with 20 ewes, 3 rams, 18 growing females and 4 growing males.
- The farmer is 56 years old, an Indo-Fijian, has a primary education, with 6 years of experience in sheep farming.
- He had goats before, but now prefers sheep as they require less work, such as fencing repairs.
- He is assisted by his son who has a high school diploma and keeps records of farm operation.
- The total land area is 23 acres, with 12 acres of native pasture. The size of the improved pasture is unknown, but it has carpet grass, guinea grass and Nadi blue grass.
- The farmer also has other livestock, including dairy cattle and poultry, as well as sugarcane, corn, rice, cassava and beans.
- Sheep farming is semi-intensive as sheep are locked up in the shed at night and are released to graze from 10am to 5pm.
- The animals are not provided with any feed supplements.
- Lambs are not weaned nor are the rams castrated.
- Drenching is administered based on animal symptoms and by estimated body weight.
- 56 per cent of animals disposed were for sale, and 44 per cent for home consumption.
- Daily weight gains during a 12-month period are shown in Table 22. Notice the decline in growth rate, ie the DWG declined from 166.4 g/day for lambs of 0-3 months of age, to 105.6 g/day (3-6 months), to 49.4 g/day (6-9 months), and to 34.15 g/day when lambs were 9-12 months old. Also noticeable are the differences in birth weight and growth rate between single births and twins. Data like these have the potential to help decide what the optimal weight/age combination is and when to sell to maximise GM.
- The main issue is adult mortality.

Table 22. Daily weight gains from birth to 12 months old, based on data at FJ965, Sheep

Type of birth	Birth weight	DWG (0-3 m)	DWG (3-6 m)	DWG (6-9 m)	DWG (9-12 m)	N
	in kg		in gram			
Single	3.3	166.4	105.6	49.4	34.15	17
Twins	3.0	144.2	83.6	41.5	38.11	14

Source: Prasad and Baleiverata (2023)

FJ 551- MULOMULO, NADI

- This is a "**smallholder**" goat farm, with 40 does, 1 buck, 15 each of growing females and males.
- The farmer is 53 years ago, local iTaukei, with a high school diploma, and 15 years of farming experience.
- It has a total land area of 35 acres, 28 acres of which is grazing land. Improved pasture is planted with Juncao.
- No livestock or crop on the farm were reported.
- The farm is managed by the farmer and his wife.
- Grazing system is semi-intensive; goats graze in fenced areas from 9am to 5pm and are kept in the shed at night.
- Animals are provided with mineral and concentrates supplements.
- No drenching or weaning when the baseline survey was conducted.
- 85 per cent of animals disposed were for sale, and the remaining were used for home consumption and given away as a gift.
- Daily weight gains presented in Table 23 also show diminishing returns. It also shows that DWG for goats is much slower than sheep. High percentage of twins is the reason for achieving high kidding rates of 177 per cent and 220 per cent (Table 20).

- The main issue is theft.

Table 23. Daily weight gains from birth to 12 months old, based on data at FJ551, Goat

Type of birth	Birth weight	DWG (0-3 m)	DWG (3-6 m)	DWG (6-9 m)	DWG (9-12 m)	N
	in kg		in gram			
Single	3.4	56.9	60.5	11.2	41.48	26
Twins	3.3	56.2	64.1	31.3	46.50	30

Source: Prasad and Baleiverata (2023)

FJ1325- YASIYASI, TAVUA

- This is probably one of the most productive sheep farms in Fiji.
- It is classified as "**semi/commercial**". During the baseline survey in early 2022, it was reported to have 120 ewes, 1 ram, 20 growing females and 11 growing males. In June 2023, it had 72 ewes, 2 rams, 61 growing females and 31 growing males.
- The farmer used to work for MoA and was a stock manager at the Yaqara station that runs cattle, sheep and goats.
- The farmer is 62 years old, local iTaukei, with an undergraduate degree and 6 years of farming experience (may be sheep farming was started after retirement).
- The farm has a total land area of 79 acres; with around 60 acres of grazing land and 2 acres of improved pasture, planted with Juncao (red and green), Koronivia, Vaivai (Leucaena), Guatemala, and Guinea grass.
- Ewes are given home-made silage before and after lambing.
- Other livestock on the farm are beef cattle, pig and poultry, as well as corn, cassava, coconut and fruit trees.
- The grazing system is extensive, and animals are not locked up at night, despite having a well-constructed large shed.
- Lambs are weaned, but the timing will depend on the weather and body weight (15-17kg).
- Ewes lamb twice a year, and achieved a lambing rate of 215 per cent, with high percentages of twins and some triples (as shown in Table 24). They are achieved through sire selection.
- All lambs are for sale. Some are sold in pairs as breeders.
- The main issue is not having enough grazing land for expansion to a target of 200 ewes.

Table 24. Daily weight gains from birth to 12 months old, based on data at FJ1325, Sheep

Type of birth	Birth weight	DWG (0-3 m)	DWG (3-6 m)	DWG (6-9 m)	DWG (9-12 m)	N
	in kg		in gram			
Single	2.8	163.3	154.3	110.2	71.1	57
Twins	2.3	134.5	115.5	98.4	NA	108
Triples	1.8	NA	101.5	95.7	NA	6

Source: Prasad and Baleiverata (2023)

Enterprise Budgeting

Budgets for representative goat and sheep farms were developed using the CoP/GM calculator. They are termed "representative" because they are assumed to possess the farm characteristics, production parameters and a set of farming practices that could be considered as the benchmarks/best practices for the SR industry in Fiji. Due to space limitations, only the budget for the

representative goat farm is presented and discussed in detail in the main text, with other results summarised only briefly. The representative farm was assumed to have 50 ewes or 50 does simply because it was the average number of breeder females for both goat and sheep farms found from the baseline survey (shown in Table 9).

Budget for the representative goat farm

It is assumed to have 50 does and 2 bucks with a kidding rate of 150 per cent. Out of 64 kids that have survived post weaning. Together, they generate a total of 1,763kg in live weight. Eight females are retained as replacements, and the remaining are sold, generating FJ$16,849 in revenue (bottom of Figure 7).

Financial performance of the representative goat farm is presented in the summary budget (Figure 8). As shown, running a goat farm with 50 does and 2 bucks requires an initial capital investment of FJ$58,861, which includes the purchase of breeding stock, the lease of 10 acres of grazing land (assuming a carrying capacity of 5 does per acre), the establishment of one acre of improved pasture, and the construction of shed and fences to support a semi-intensive grazing system, as well as tractor/truck, watering facilities and other farming equipment. These costs are annualised according to the percentages at which they are used by the goat enterprise, as well as their salvage values, and years of service. The resulting figure is FJ$5,167 per year, which is composed of land rental, depreciation, taxes, interest payments and insurance. Total variable cost (FJ$11,806) consists of expenses on supplementary feeds, vet medicine and services, repairs and maintenance of shed, fences, and machinery, and the running cost of the machinery and farm equipment (tractor, truck, water pump, grass cutter, etc), and the costs of hired casual workers, as well as the opportunity cost of family labour valued at FJ$3,285 = FJ$3/hour * 3 hours/day * 365 days.

The GM for the representative goat farm is FJ$5,043/year, after deducting TVC (FJ$11,806) from TR (FJ$16,849). This is a favourable result since a positive GM means not only that the goat farm generates enough revenues to compensate for the use of family labour and own capital, but also has extra to recoup some of the initial investment cost of FJ$58,861, although it would take 12 years to recoup it all. Secondly, variable CoP and total CoP are FJ$7/kg and FJ$10/kg, respectively, both of which are lower than the prevailing market price of FJ$8-12/kg. Thirdly, both GM and CoP were generated based on conservative estimates, ie TR is estimated on the low side while costs are estimated on the high side.

Other GMA results

Two more budgets were developed to compare the relative profitability between running a goat farm and a sheep farm, as well as to demonstrate the impact of a lower kidding rate on GM and CoP. The budget for the representative sheep farm differs from the goat farm in three aspects: (1) a 5 per cent loss of lambs to dog attacks (less agile); (2) faster growing, with heavier live weights at sale; (3) farmgate price is FJ$2/kg cheaper than goat, based on farmer interviews as discussed previously. A second budget for goats was developed, based on a kidding rate of 120 per cent, rather than 150 per cent.[15] Underlying assumptions and production parameters used for each of those applications are summarised in Table 25. The results are presented in Table 26.

[15] These kidding/lambing rates were chosen as they were referred to as “benchmarks” by Cowley et al. (2019).

Figure 7. Production parameters, the representative GOAT farm, Baseline, Kidding rate@150%

General Herd Information: Goats

Does	Quantity	Unit	Price/unit	Production parameters (in %)
Herd Size (Total Number of Does)	50	head/year	$ 250.00	
Does Years of Use/Culling rate	7	Years		14%
Does Culled and Sold Per Year	7	head/year		
Doe Deaths Per Year	1	head/year		2%
Culled Doe Live Weight (25-30Kg)	25	Kg/head	$ 7.00	
Replacement Does Required	8	head/year		
Replacement Does -- Retained from own farm	8	head/year		100%
Replacement Does -- Purchased from Off Farm	0	head/year		0%
Kiddinging Rate				150%

Bucks	Quantity	Unit	Price/unit	
No. of Females Serviced by a Buck (F:M ratio)	25	head		
Bucks Needed	2	head/year	$ 450	4%
Buck Year of Use	3	years		
Buck Deaths	0	head/year		0%
Bucks Culled and Sold Per Year	0	head/year		0%
Culled Bucks Live Weight (40-45Kg)	40	Kg/head	$ 10.00	
Replacement Bucks Required	0	head/year		
Replacement Bucks -- Purchased Off Farm	0	head/year		100%
Replacement Bucks -- Retained from own farm	0	head/year		0%

Kids	Quantity	Unit	Price/unit	
Kids Born	75	head/year		
Kids Birth Weight (Male) (2.8-3.0Kg)		Kg/head		
Kids Birth Weight (Female) (2.2-2.4Kg)		Kg/head		
Kid Deaths (Pre-Weaning)	8	head/year		10%
Kids Weaned	68	head/year		
Lost to theft/dog attacks/etc	0	head/year		0%
Kids Remaining upon Weaning	68	head/year		
Weaner Live Weight (Male) (12-18Kg)		Kg/head		3 months
Weaner Live Weight (Female) (12-15Kg)		Kg/head		3 months
Weaner Live Weight (Male) (25-30Kg)		Kg/head		6 months
Weaner Live Weight (Female) (18-20Kg)		Kg/head		6 months

Growers/Fatteners	Quantity	Unit	Price/unit	
Death Rate (Post-Weaning)	3	head/year		5%
Lost to theft/dog attacks/etc	0	head/year		0%
Total Number of Animals Remaining	64	head/year		
Total live weight of Animals Remaining	1763	Kg/year		
Females retained for Breeding	8	head/year		
Animals avaiable for Sale (Female)	24	head/year		
Males retained for Breeding	0	head/year		
Animals avaiable for Sale (Male)	32	head/year		
Live Weight (Female) (25-28Kg)	25	Kg/head	$ 10.00	9 months
Live Weight (Male) (30-35Kg)	30	Kg/head	$ 10.00	9 months

Sales/Revenues	No. of Head	Price/Kg	Kg/head	Subtotal
Culled Females	7	$ 7.00	25	$ 1,250.00
Culled Males	0	$ 10.00	40	$ -
Growers/finishers (Female)	24	$ 10.00	25	$ 5,979.91
Growers/finishers (Male)	32	$ 10.00	30	$ 9,618.75
Total				$ 16,848.66

Figure 8. Budget, the representative GOAT farm, Baseline, Kidding rate@150%

Summary Budget (on an annual basis): GOAT		
Revenues		
Animal Sales		
Culled males		$ -
Culled females		$ 1,250
Young Males		$ 9,619
Young Females		$ 5,980
Other Forms of Disposals		
Home consumption		
Give-aways		
Other Revenues		
Manure		
Animal feeds		
Other		
Total Revenues (TR)		**$ 16,849**
Variable Costs		
Total Animal Purchases		$ -
Total Feed Supplement Costs		$ 3,000
Total Health Costs		$ 415
Pasture Maintenance (15%)		$ 260
Machinery/Equipment Maintenance and Repairs (5%)		$ 974
Fencing/Shed Maintenance and Repairs (5%)		$ 1,666
Fuel and Electricity (Operationg costs)		$ 1,200
Hired Casual Labour Costs		$ 300
Family Labour		$ 3,285
Marketing Costs (transport, slaughtering, communication, promotion, etc)		$ 300
Interest Payment on Operating Costs		$ 406
Total Variable Costs (TVC)		**$ 11,806**
Gross Margin (GM) = TR-TVC		**$ 5,043**
Variable Cost of Production/Kg		**$ 7**
Fixed Costs	**Total Fixed/Investment Costs**	**Annualised**
Breeding Stock	$ 13,400	$ -
Land Lease	$ 1,200	$ 1,200
Improved Pasture Establishment	$ 1,731	$ 346
Animal Housing/Shed	$ 11,000	$ 450
Fencing	$ 22,325	$ 2,233
Farm Machinery/Equiment	$ 7,880	$ 713
Overhead - Office/Supplies/Personnel	$ 1,325	$ 225
Interest Payment on Capital Costs	$ -	$ 1,765.82
Total Fixed Costs (TFC)	**58,861**	**$ 5,167**
Total Costs (TC) = TVC + TFC		**$ 16,972**
Net Profit (Loss) = TR -TC		***-$ 124***
Total Cost of Production/Kg		**$ 10**
Market Price/Kg (Live weight)		**From $8 to $12**
Payback period (in years) = TFC/GM		**12**

Table 25. Production parameters and assumptions for farm budgets

	Goat	**Sheep**
Production system	Smallholder; semi-intensive; uncontrolled mating; weaning at 3 months; improved pasture, plus supplementary feeding for different stock classes	Same as goats
Marketing system	V2 (direct sale to consumers)	Same as goats
Breeding stock	Does: 50 head Bucks: 2 head	Ewes: 50 head Rams: 2 head
F/M ratio	25F:1M	Same as goats
Culling rates	Does: 15% (with 7 yrs of service) Bucks: 33% (with 3 yrs of service)	Same as goats
Kidding/lambing rates	Baseline: 150%; Case 1. 120%	Baseline: 150%
Death rates	Does: 2%; Bucks: 0%; Pre-weaning (or < 3 months): 10% Post-weaning (or > 3 months): 5%	Same as goats, except **Lambs lost to dog attacks: 5%**
Replacement of breeding stock	Does: selected from own herd; Bucks: purchased off farm	Same as goats
Farmgate prices (direct marketing)	Culled females: FJ$7/Kg Young animals: FJ$10/kg	Culled females: FJ$7/Kg **Young animals: FJ$8/kg**
Sale weight (at 9 months old)	Adult Female: 25kg/head Adult males: 30kg/head	**Adult Female: 35kg/head** **Adult males: 40kg/head**
Costs of production	TVC = FJ$11,806; TFC = FJ$58,861	Same as goats

Table 26. Comparing results from representative farm budgets, in FJ$

	Representative goat farm, Baseline	**Representative sheep farm, Baseline**	**Representative goat farm, Case 1**
Breeding stock	50 Does, 2 Bucks	50 Ewes, 2 Rams	50 Does, 2 Bucks
Kidding/lambing rates	150%	150%	120%
Total revenues	16,849	18,600	13,322
Total variable costs	11,806	11,806	11,806
Gross margin	**5,043**	**6,794**	**1,516**
Total Fixed costs	58,861	58,861	58,861
Annualised TFC	5,167	5,167	5,167
Profit/loss	(124)	280	(3,651)
Variable CoP/kg	FJ$7/kg	FJ$5/kg	FJ$8/kg
Total CoP/kg[16]	**FJ$10/kg**	**FJ$7/kg**	**FJ$12/kg**
Farmgate price/kg (direct marketing)	FJ$8-12/kg (average FJ$10/kg)	FJ$8-12/kg (average FJ$10/kg)	FJ$8-12/kg (average FJ$10/kg)
Payback period	**12 years**	**9 years**	**39 years**

Source: own analysis

A few observations can be made from Table 26.

[16] The variable cost of production of FJ$5/kg for sheep is not far from the FJ$3-5/kg reported by some farmers, which, however, did not account for the costs of family labour or initial capital investments.

GMs and payback periods. All three cases yielded positive gross margins, which means the production should continue, but GM and payback period vary with productivity. For example, when the kidding rate was reduced to 120 per cent from 150 per cent for the goat farm, GM was reduced from FJ$5,043 to FJ$1,546, and it would take 39 years, rather than 12 years, to recoup the initial capital investment cost of FJ$58,861.

Total CoP/kg.[17] They were FJ$7 for sheep, and FJ$10 and FJ$12 for goat farms with kidding rates of 150 per cent and 120 per cent, respectively. Sheep farming had a lower total CoP/kg than goats because sheep are faster growing and producing higher live weight at sale, although total CoP is assumed to be the same. Those figures were comparable with the actual farmgate prices of between FJ$8/kg to FJ$12/kg, as observed/reported during the market survey. That means when SR were sold live directly to consumers (via V2), profits are being made as farmgate prices received by farmers were lower or close to breakeven prices.

These results demonstrate the importance of achieving high productivity through better management and husbandry practices. The next important question is how does the cost of production estimated above compared with imports at the formal markets in Nadi or Suva?

Cost competitiveness. In 2023, the average unit import cost of goat meat was US$4.22/kg (equivalent to FJ$9.49/kg at an exchange rate of 2.25), and US$4.07/kg (equivalent to FJ$9.17/kg) for sheep meat (Table 27).[18] Notice also the differences in unit costs of SR meat imported from Australia and NZ, and Australia appeared to be the lower cost and dominant supplier. Relative prices were FJ$9.39/kg and FJ$11.71 for goat meat, and FJ$7.70/kg and FJ$11.75 for sheep meat. During the market survey, supermarket managers indicated that they could not afford to pay more than FJ$13/kg carcass weight for local products. That means to compete with higher quality/price cuts from NZ, the farmgate price would need to be reduced to FJ$5-6/kg live weight, which was much lower than the average farmgate price of FJ$10/kg live weight.

Table 27. Import volumes and values of SR meat by suppliers, 2023

	Goat meat (HS020450)			
	Volume (in kg)	Value (in 1000 US$)	Unit price (US$/kg)	Unit price (FJ$/kg)
Australia	456,757	1,907.21	4.18	9.39
NZ	18,491	96.24	5.20	11.71
Total	475,248	2,003.45	4.22	9.49
	Sheep meat (HS020442)			
	Volume (in tonnes)	Value (in 1000 US$)	Unit price (US$/kg)	Unit price (FJ$/kg)
Australia	4,277	14,635.69	3.42	7.70
NZ	2,425	12,663.95	5.22	11.75
Total	6,702	27,299.64	4.07	9.17

Source: World Bank (2024a,b)

[17] Total CoP/kg is in effect the minimum sale price that is necessary to cover the CoP and breakeven. The lower the breakeven price, the more able it is to compete, and survive during periods of low market prices.

[18] Given the dynamics of the market, continuing on-farm monitoring and market update are crucial for getting reliable CoP and GM estimates for various production systems and farm size to aid policy makers and value chain players in developing the industry. Therefore, GMA needs to be part of the research and extension effort of MoA.

Fluctuations in import prices are another concern. Changes in farmgate prices for lamb in NZ and Australia in recent years are shown in Figure 9. Not only are there great variations in farmgate lamb prices in a span of 2.5 years, but also changes in cost competitiveness between NZ and Australia. For example, with the exchange rate being one Fiji Dollar (FJD) to 35.6 Pence Sterling (GBX), the farmgate price in Australia had moved between 450 p/kg (equivalent to FJ$12.64/kg) throughout 2022 and 250 p/kg (equivalent to FJ$7.02/kg) towards the end of 2023. The implication for Fiji is that for import substitution policy to have an impact, V3 must be able to compete with the lowest cost suppliers from overseas at least most of the time.

Figure 9. Farmgate lamb prices, carcass weight, in Pence Sterling (GBX), in GB, NZ and Australia

Source: AHDB (2024)

Future Prospects for Developing a Competitive and Profitable Goat/Sheep Industry in Fiji

Based on the on-farm and market research conducted, some issues and opportunities have been identified. In this section, those results are summarised, and their implications for developing a competitive and profitable goat/sheet industry in Fiji are presented.

On the supply side

Several challenges facing the SR farmers were identified in this study. They include:
(1) weather/climate change. Production was said to have increasingly been affected by more frequent droughts and floods, as well as cyclones. The cyclone in 2019 was particularly severe; many farms were badly damaged and in some areas 30-50 per cent of SR were lost. Three years on, some farmers are still trying to recover and rebuild;
(2) theft and dog attacks. Dog attacks on goats and sheep are an enormous issue for the SR sector in Fiji as they cause large numbers of animal deaths. Because of the threat of dog attacks day and night, farmers are always on the lookout, often they stay watching while the animals are grazing. Therefore, in addition to economic losses and time cost, the mental stress that farmers have to endure is immense. Animals lost to dog attacks could be as high as 30 per cent (ACIAR, 2023). No amount of achievable productivity gain could possibly compensate for such heavy losses;
(3) unavailability, poor quality and high costs of major farm inputs, including drenches and other vet medicines, feed ingredients, and fencing materials. The quality of fencing materials appears to be a major concern as they were claimed to last only 2-3 years, exacerbating the threats from dog attacks and the high cost of repairs;

(4) lack of land for expansion or for improving feed supply. Land tenure issues were discussed previously; and
(5) deaths in the wet season.

Interestingly, there was no mention of marketing being an issue. It suggests that demand was indeed high, and prices were good. Severe supply shortages[19], on the other hand, was the major issue identified by traders and retailers in the formal market chain.

On the demand side

During the market survey conducted in October 2022, it was evident that sheep meat imports (lamb chops and others) have a constant presence at the supermarkets and butcher shops, but locally produced goat or sheep meat was very hard to find. Several butchers and supermarkets interviewed claimed that they were unable to source any goats in recent months. For those who could, sales volumes had been reduced (from 4-5 goats/week to 2-3 goats/week) and at significantly higher prices (increased from FJ$6-7/kg to FJ$9-10/kg live weight). In fact, 80 per cent of the supermarkets and butchers visited had not been selling goat meat for over 6 months. Most international hotels/restaurants visited either did not have goat dishes on the menu, or they were unavailable on request.

The reason for the supply shortages was demand/supply imbalances. That is, demand was high because of the lifting of travel restrictions/tourists returning/re-employment after Covid-19 while supply was extremely low because of: (1) drought; (2) farmers holding on to animals, waiting for higher prices at Christmas; (3) more traders entered the market, out competing each other; and (4) destocking during Covid (animals were sold to supplement incomes that were lost due to unemployment, sickness, travel restrictions, etc). Supply shortages being experienced were also caused by long-term issues such as dog attacks, the selling of females and young animals, and low productivity due to worms, poor nutrition, in-breeding, etc. As a result of supply shortages of local goats, one butcher interviewed said that he had no alternative but to turn to imports. As alluded to earlier, goat meat imports increased from 74 tonnes in 2022 to 475 tonnes in 2023, and sheep meat imports, from 4,210 tonnes to 6,700 tonnes.

Import substitution

As mentioned before, over 99 per cent of sheep products were imported through V1. They were said to be relatively cheap, especially trimmings and mutton flaps[20], but of low quality and unhealthy. Concerns about the impacts on health and on foreign reserves have prompted calls from government to replace imports with higher quality local products (Cowley et al., 2019; ACIAR, 2023). A market development project, among others, was initiated by the Ministry of Agriculture to upgrade and expand the aforementioned V3 by linking smallholder farmer clusters to fatteners/traders through some form of production contracts. The outcome of the project is yet to be assessed. However, preliminary analysis just presented suggests that there might not be much profit incentive for either farmers or traders to get involved.

It is clear that the success of the market development project or the like will depend on a range of factors, such as: whether it can compete in this high-end premium market in price, quality and

[19] It is not clear whether the severe shortages observed during the market survey in October 2022, soon after travel restrictions due to Covid-19 were lessened, was an abnormality or not. An update is therefore needed.
[20] Mutton flaps are a staple in the South Pacific, but their high fat content has been linked with the development of obesity problems. In 2000, Fiji banned their import. On July 1, 2020, Tonga banned the import of mutton flaps from New Zealand, claiming their consumption plays a major role in increasing obesity among the population.

consistency in supply, despite the ever-changing competitive landscape; whether farmers can be made better off, both financially and technically, by selling through this channel; whether existing marketing infrastructure, such as processing facilities and cold chain, can support market development and value chain upgrade on a meaningful scale; and whether there is a regulatory framework that ensures food safety and product quality and integrity, including grades and product labelling.

It is true that at the moment Fijian farmers have had a competitive advantage in selling live animals directly to consumers/households, and avoiding the cost of marketing or regulation. However, this situation could change as the market for live animals becomes saturated (Cowley et al., 2019) or declines as a result of urbanisation and other socio-demographic changes leading to more consumers shopping at the supermarket, like most consumers around the world.

The contrast between goat and sheep is apparent. The difficult question for policymakers is: given limited resources, whether it is more cost effective to increase local sheep production to replace imports (ie focusing on import substitution) or to promote and protect the market for local goat? The same question is applicable across the livestock sectors. It seems there are lessons to be learned from examining the reasons underlying the varying degrees of self-sufficiency in different livestock sectors in Fiji.

Conclusions

Gross margin analysis was found to be a useful extension tool for assessing the financial performance of smallholder farms, as well as for demonstrating the impact on cost of production and gross margin of a change in production parameters or farming practices. The results of this paper indicated that in most scenarios, gross margins for small ruminant farming in Fiji were positive even after accounting for opportunity costs of family labour and own capital. The main reason for the positive outcome was the way small ruminants were marketed. That is, live animals were sold directly to households at the farmgate bypassing all intermediaries in the value chain, and therefore marketing margins were accruing to farmers. However, locally produced sheep or goat meat may not be competitive with imports at the formal market in terms of price, quality and consistency in supply given current value chain configuration. Future demand and supply of locally produced live animals is uncertain because of socio-demographical changes that seem to favour imports sold at the formal market.

The major conclusions of the study are: (1) given the dynamics of the market, continuing on-farm monitoring and market update are crucial for obtaining reliable cost of production and gross margin estimates for various production systems and farm size to aid policy makers and value chain players in developing the industry; (2) to compete at the formal market, issues along the vale chain need to be addressed from improving access to land and other farm inputs to improving marketing infrastructure and to building consumer confidence; and (3) continuing targeted government support on research and extension is key to developing a profitable and sustainable small ruminant industry in Fiji.

References

ACIAR (2023), Sheep and goats the focus of livestock productivity challenges. https://www.aciar.gov.au/media-search/blogs/sheep-and-goats-focus-livestock-productivity-challenges.

AHDB (2024), Lamb market update: what's happening in New Zealand? https://ahdb.org.uk/news/lamb-market-update-what-s-happening-in-new-zealand.

APAARI (2021), *Sheep and goats in Fiji and Papua New Guinea – Success story*. Asia Pacific Association of Agricultural Research Institutions, Bangkok, Thailand. xiv + 62 p. https://www.apaari.org/sheep-and-goats-in-fiji-and-papua-new-guinea-a-success-story/.

Asian Development Bank (ADB) (2016), Indigenous peoples planning framework. Prepared by the Water Authority of Fiji and the Ministry of Economy Urban for the Water supply and wastewater management investment program (RRP Fij 49001-002).

Chandra, S., Silva, T. and Hazeem, M. (2023), Field test of creep feed supplementation on lamb performances at Nawaicoba Quarantine Station. Paper presented at the project review meeting of Pasifika Sheep and Goat Improvement Project, Rakiraki, Fiji, 26-29 June.

Cole, S. (2022), Value chain analysis paper: beef, pork and goat meat. Unpublished report for Technical Assistance for the Sustainable Rural Livelihoods (SRL) Programme – EUROPEAID/140795/DH/SER/FJ.

Cowley, F., Smith, G., Roschinsky, R. and Carnegie, M. (2019), Assessment of markets and production constraints to small ruminant farming in the Pacific Island countries. Final paper for LS/2016/021 submitted to ACIAR.

Fiji Meteorological Service (2009), Extreme rainfall and new records in the Fiji Islands, January 2009. https://niwa.co.nz/island-climate-update/island-climate-update-101-february-2009/feature-article

Gertner, D., Dennis, E., Saner, R. and McClure, G. (2021), UNL-meat goat budget tool: an Excel spreadsheet for evaluating the value of potential meat goat production revenue, expenses, and profitability. Department of Agricultural Economics, University of Nebraska-Lincoln.
https://cap.unl.edu/budgets/budget-template-meat-goats-2021-gm-2.pdf

Hill, J.I. (2013), Consumer's preferences for goat meat in the United States: an application of choice-based conjoint analysis. LSU Doctoral Dissertations. 1460. Available on
https://repository.lsu.edu/gradschool_dissertations/1460

Kassam, A.H. van Velthuizen, H.T., Sloane, P.H., Fischer, G.W. and Shah, M.M. (1993), *Agro-ecological land resources assessment for agricultural development planning-a case study of Kenya resources data base and land productivity technical Annex 5 Livestock productivity*. Chapter 5. Characterisation of livestock systems. FAO. https://www.fao.org/4/t0828e/T0828E07.htm#ch5.

Kour, G. (2023), The impact of inefficient control of gastrointestinal nematodes on the production cost of sheep and goats in Fiji. Paper presented at the project review meeting of Pasifika Sheep and Goat Improvement Project, Rakiraki, Fiji, 26-29 June.

Manueli, P. (2022), *Small ruminant husbandry: A training manual for small ruminant farmers and staff of the Ministry of Agriculture*, 3rd edition. Ministry of Agriculture, Suva, Fiji.

Metawi, H.R., Shalaby, N.A., Gabr, A.A., and El- Bassiouny, E.G. (2019), 'Socio-Economic Characteristics of Small Ruminant Smallholders in Four District of Northern Egypt', *Journal of Animal and Poultry Production, Mansoura University*, 10 (5), 115- 119.

Ministry of Agriculture (2014), *Fiji Farm Management Budget Manual 2014*. http://nwcfiji.com/wp-content/uploads/2016/11/Fiji-Farm-Manual-compressed.pdf

Porter, M. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance.* NY: Free Press.

Prasad, D. and Baleiverata, A. (2023), Monitoring productivity of sheep and goat farms in the Western division of Fiji (2022/2023). Paper presented at the project review meeting of Pasifika Sheep and Goat Improvement Project, Rakiraki, Fiji, 26-29 June.

Prasad, R. (2022), Inventory of local feed resources for livestock feeding in Fiji: availability, chemical composition and value chain perspectives. Master of Science thesis, Department of Animal Science, School of Agriculture, University of the South Pacific.

Prasad, R., Diarra, S., Silva, T., Shivani, S. and Baleiverata, A., Tiko, A. and Cowley, F. (2023), Inventory of local feed resources for small ruminant feeding in Fiji: availability, chemical compositions and value chain perspectives. Paper presented at the project review meeting of Pasifika Sheep and Goat Improvement Project, Rakiraki, Fiji, 26-29 June.

Rao. R. and Mala, S. (2023), Characteristics of small ruminant farms in Fiji. Paper presented at the project review meeting of Pasifika Sheep and Goat Improvement Project, Rakiraki, Fiji, 26-29 June.

Schoenian, S. (2015), Tips for improving lambing and kidding percentages management, genetics, and selection. University of Maryland.

Tridge (2024a), Overview of goat meat market in Fiji. https://www.tridge.com/intelligences/goat-meat/FJ

Tridge (2024b), Overview of lamb market in Fiji. https://www.tridge.com/intelligences/lamb/FJ

World Bank (2024a), Fiji fresh, chilled or frozen goat meat imports by country in 2023. https://wits.worldbank.org/trade/comtrade/en/country/FJI/year/2023/tradeflow/Imports/partner/ALL/product/020450

World Bank (2024b), Fiji frozen unboned meat of sheep imports by country in 2023. https://wits.worldbank.org/trade/comtrade/en/country/FJI/year/2023/tradeflow/Imports/partner/ALL/product/020442

World Population Review **(**2024), Lamb Consumption by Country 2024. https://worldpopulationreview.com/country-rankings/lamb-consumption-by-country

Appendix 1. Utilisation of family labour in goat/sheep farming

Table A1.1. Utilisation of family labour in goat/sheep farming in Fiji

Activity	Time spent (in hrs)
Daily routines	
Check/count the number of animals	0.5
Provide water	0.5
Provide feed (copra/molasses/salt/minerals)	0.5
Take animals to the paddocks for grazing	
Collect the droppings and clean the shed	1-2
Patrol/keep watch/checking the fence	1-2
Other (cut and carry fodder/grasses) (only for some farmers)	2
Other (keep watch while the animals are grazing) (only for some farmers)	4
Average/day	**3-5 hours/day**
Occasional/periodical activities	
Drenching	2-3 hours/month (2 people) *12 months
Repair fences	Small repairs, 4 hrs/month; major repairs: one whole day every 2-3 years
Hoof clipping/Tagging/rubbering	1
Provide care during lambing/kidding, and to sick animals	5-6
Buy/sell animals	4 (waiting and negotiating)
Travel to town (eg buy farm inputs, seek information on problems, etc)	4 (once or twice/month)
Pasture maintenance	
Irrigation/watering	
Hand weeding/chemical spray	2-3/every 3 months
Fertiliser	1/every 6 weeks (after planting and before grazing)
Planting grasses	1-1.5 days/2-acre block
Average/year	**180-200 hours**

Appendix 2. Flock structure for goats and sheep, by age, sex and production system in Kenya

Table A2.1. Flock structure for goats, by age, sex and production system, Kenya

Numbers in herd	Input levels		
	Low	Intermediate	High
Breeding does	100	100	100
Kids(under6months)	127	156	187
Replacement yearlings			
- female	19	25	19
- male	2	2	2
Bucks	4	4	4
Total head	252	287	312
Total adult animals	125	131	125
TLU/adult head	0.10	0.11	0.12
TLU	12.5	14.4	15.0

Source: Reproduced from Kassam (1993)

Table A2.2. An example of flock structure for sheep, by age, sex and production system, Kenya

Numbers in herd	Input levels		
	Low	Intermediate	High
Breeding ewes	100	100	100
Lambs (under 6 months)	115	148	178
Replacement yearlings			
- female	19	22	22
- male	2	2	
Rams	4	3	3
Total head	240	275	305
Total adult animals	125	127	127
TLU/adult head	0.10	0.10	0.10
Total TLU	12.5	12.7	12.7

Source: Reproduced from Kassam (1993)