Smallholder Goat Value Chains in Pakistan: Challenges & Research Opportunities

Summary & Interim Report

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ACIAR currently funds a small research activity (SRA) entitled 'Smallholder goat value chains in Pakistan; challenges and research opportunities'. The aim of this SRA was to describe goat (and sheep) production systems, and identify constraints and opportunities throughout the value chain in the Pakistani provinces of Punjab and Sindh. The SRA falls within the mandate of the DFAT-funded Agriculture value chain Collaborative Research (AVCCR) program. The overarching goal of the AVCCR program is *'that rural poor, particularly women, living in the Punjab and Sindh significantly and equitably benefit from improvements in strategic value chains'.*

The experimental work from this SRA involves: (1) a literature review and stakeholder workshop; (2) a farmer participatory activity conducted across 12 villages in Punjab (7 locations) and Sindh (5 locations) to understand how goats are produced in different agro-ecological zones and what issues these farming families experience; (3) a value chain analysis that looked for and described all main value chains in Punjab (4 locations) and Sindh (2 locations); and (4) a participatory animal health activity with veterinary officers and veterinary assistants to understand their perceptions of small ruminant health issues and the services they offer to the small ruminant value chain.

This initial investment indicates that a strong value proposition for research and development of goat value chains, with a particular on-farm focus. To date, the SRA has identified that:

1. Mutton (meat from small ruminants) is highly valued and there is a clear demand for it across a variety of value chains;
2. There are good trading networks linking small holder farmers with the rest of the value chain, with supply from farms being the major restriction across chains;
3. Profitability and expansion of emerging markets (e.g. export) is potentially constrained by limited and/or inconsistent supply;
4. Smallholders could capitalise on this market demand, but that there are barriers that prevent smallholder farmers from increasing supply and improving production;
5. Women and children play a critical role in goat/sheep farming. Supply can be increased by engaging with the whole family, but at the same time, the impact of increasing animal numbers and management methods on these groups needs to be considered.

It is clear that the major constraints exist on-farm rather than further along the value chain. Target issues include ill thrift and mortality of young animals, appropriate nutrition and improved health of stock. To address this research and extension needs to be undertaken. The key to sustainable market supply involves ongoing engagement of women. This provides the opportunity to improve the livelihoods of small ruminant farming families and to empower and benefit women within these families.

Background information

An introductory stakeholder workshop was held in December 2016 to seek expert local opinion on the current state of small ruminant research in Pakistan. In summary, knowledge of constraints and opportunities in certain aspects of small ruminant production, particularly goats, is good, but it would benefit from contextualisation in the wider value chain, to help identify key performance drivers of productivity and profitability for smallholders. Most research to date is very discipline-specific, focussing on particular aspects of small ruminant nutrition or specific diseases. These issues are likely important constraints to small ruminant production, including for smallholders, but their relative importance and methods for efficient implementation by smallholders are lacking. There does not appear to be an awareness of the need for this information to be extended to smallholders in a way that is accessible to them, let alone to different kinds of smallholders, such as women or different ethnic groups.

Small stock, not just goats

The same way that the dairy-beef industry in Pakistan encompasses both cattle and buffalo, the mutton industry in Pakistan is comprised of both goats and sheep. In the SRA, many farms within the village study sites ran mixed herds of goats and sheep, or where there were single species flocks, different farms within the same village had either sheep or goats. This supports work by Afzal and Naqvi (2004) that reported that many small stock flocks are mixed, although single species flocks are also common.

The post-farm value chain analyses identified a broad consumer preference for goat meat (similarly identified by Afzal and Naqvi (2004) and UNIDO (UNIDO, 2011), though this varies considerably across different regions. For example, large areas of Balochistan, with large Afghan ethnic groups, prefers sheep meat. Similarly, sheep are frequently and conspicuously sold along with goats during the major religious festivals of Eid-al-Fitr and Eid-al-Adha. Regardless of preference, the meat from both goats and sheep are marketed under the umbrella term ‘mutton’, so even if there is a consumer preference, it was not clear what they purchase. There was no evidence of wool being used as a product in any of the sheep-producing regions studied, although fibre production is occurring in areas of Balochistan with support from the AusABBA program, and the fibre and skin value chains require further description.

While some health and management issues may well be species-specific, the integrated manner in which they are farmed and marketed indicates that they should not be treated separately.

Diversity in small stock farming families

Small stock are popular among poor rural households, and the vast majority of Pakistani small stock owners are small-scale farmers, and often landless (Teufel et al., 1998; UNIDO, 2011). The adaptability of small stock means that they can be managed in a variety of different systems. Grazing-based systems are common in more difficult terrains, including mountainous, rainfed, saline affected and desert areas of Pakistan, whereas stall-fed cut-and-carry systems are mainly found in irrigated areas (Farooq et al., 2009). As environment was likely to affect production issues, we aimed to conduct our research activities in a variety of agro-ecological zones across Punjab and Sindh (Khan, 2004).

In the SRA, we encountered small stock farmers that had stall-fed animals and those that had grazing farms. Stall-feeding farmers often had small stock as a secondary income, supplementing their main income from dairy animal, whereas grazing farmers tended to focus on small stock alone.

It was clear that evaluating villages based on agro-ecological zone alone missed the complexities of the location specific production system. For example, some locations were close to water resources, but had limited access to that water because of poor infrastructure and political complications. As a result, we assigned an overall resource score to each of the 12 villages that participated in the village participatory activity. These scores were generated using a binary scoring system where the presence or absence of eight resources village-wide were identified following specific group activities and discussion. The resources were: the presence of clean water, readily accessible water, own land for cultivation, opportunity for irrigation, year-round grazing, free or cheap grazing (e.g stubble/canal banks), free or cheap browse, and easily accessible options to fill the fodder gap. This gave a maximum possible resource score of 8, and the resource scores indicated that villages clearly fell into one of three groups: resource poor (<4), moderately resourced (4-5), and resource rich (6-8; Figs 1-3, Table 1).

Fig 1: Night yards for sheep; Haji Leemon, Thatta (resource rank: poor)

Fig 2: Goats grazing stubble; Goth Kamal Khan, Sukkur (resource rank: moderate)

Fig 3: Goats at a mixed livestock farm; 51_3R, Okara (resource rank: rich)

Table 1: Resource ranking of the 12 participatory activity villages

Resource Rank	*Village*	*District*	*Province*	*Clean water*	*Accessible water*	*Land for cultivation*	*Irrigation possible*	*Year-round grazing*	*Accessible grazing*	*Accessible browse*	*Fodder alternatives*	*Total (%)*
Poor	Haji Leemon	Thatta	Sindh	0	0	0	0	0	1	0	0	1 (12.5)
	Bakhshu Lund	Badin	Sindh	0	1	0	0	0	0	0	1	2 (25)
	Qadir Bakhsu	Shikapur	Sindh	0	0	1	0	0	1	1	0	3 (37.5)
	Sawaro	Dadu	Sindh	0	0	1	0	0	1	1	0	3 (37.5)
Moderate	Goth Kamal Khan	Sukkur	Sindh	1	0	1	0	0	1	0	1	4 (50)
	Sanawan	Muzzafargarh	Punjab	0	1	0	1	0	1	0	1	4 (50)
	Pinanwal	Jhelum	Punjab	0	1	0	1	0	1	0	1	4 (50)
Rich	Basti Muhammad Abad	DGKhan	Punjab	1	1	0	1	0	1	1	1	6 (75)
	42_43 TDA	Bhakkar	Punjab	1	1	1	1	0	1	1	1	7 (87.5)
	Kalpi Dogran	Sheikupura	Punjab	1	1	1	1	0	1	1	1	7 (87.5)
	51_3R	Okara	Punjab	1	1	1	1	0	1	1	1	7 (87.5)
	Kolti Gul	Rajanpur	Punjab	1	1	1	1	1	1	1	1	8 (100)

There was a clear difference between the two provinces, with Sindh only having poor-resourced villages. When we grouped the villages according to resources, we clearly identified that those villages that had a moderate to high level of resources available were those that had mixed farming systems (dairy and small ruminants), whereas those that were resource poor largely managed small ruminants (Table 2).

Table 2: Common village livestock farming systems according to the availability of resources

Resource Classification	*Mixed livestock*	*Small ruminants*	*Provinces*
Poor	0	4	Sindh
Moderate	3	0	Sindh (1), Punjab (2)
Rich	4	1	Punjab

Mixed livestock farming systems were sedentary households, where the owners have a fixed base, and can practice either local grazing or cut-and-carry feeding systems. Sole small ruminant farming systems in our SRA tended to be only grazing and sometimes transhumant, where flock-owners have a fixed base, but move with their animals for a part of the year. Sedentary groups were the most common families we encountered in Punjab and Sindh, and transhumant families were commonly present in Sindh and the some more arid parts of Punjab.

We found that it was more difficult to engage with farmers that managed only small stock. These farming families tended to live outside of the village, undertook more daily grazing (as opposed to cut and carry) and had a more transhumant lifestyle. This made accessing the male farmers difficult, but we still had a number participate in our village participatory activity. The women from these farming families were almost impossible to come by because mobility (the opportunity to travel unaccompanied) is limited/non-existent, and travelling would impact on their existing work demands. Understanding the challenges with the diversity of these small stock farming families means that we can apply different recruitment approaches in our experimental work to ensure that we are working with both types of farming families.

One other niche group of small stock farmers also exist. Occasionally, we encountered entrepreneurial farmers that purchased male small stock to fatten for sale at Eid-al-Adha. Exploring these targeted market opportunities is one example that could be valuable for other smallholder farmers in a financially stable position to invest. The required resources, and associated risks, for these farmers is high however, so would likely be applicable to a limited number of small stock farmers.

Market gaps and the role for smallholder farmers

The value chain analysis identified four distinct value chains that are intertwined but warrant individual description:

1. A ‘Traditional Domestic’ value chain supplying traditional wet markets;
2. A ‘New Domestic’ value chain involving higher-end consumers buying chilled meat in supermarkets and speciality butcher shops;

3. An ‘Export’ value chain, exporting chilled carcases by air to shops and consumers, especially expatriate Pakistanis, in the Middle East;
4. A ‘Religious’ value chain in which animals are purchased for sacrifice during festivals such as Eid-al-Adha and for other religious observances

Butcher shop in ‘Traditional domestic’ value chain (VC1) – Okara, Punjab province

The greatest product flow still appears to be to the domestic value chain (70%).

The first three value chains directly compete with each other for a very similar product, namely an animal up to 12-18 months of age of 8-12 kg (and up to ~18 kg) carcase weight. Preferred breeds of animals (and species) vary regionally, as described above, although there appears to be little consumer differentiation of product beyond goat versus sheep at the retail level. In contrast, the religious value chain places very strong preference on older animals (up to ~2 years of age) and larger body weight. Animals are frequently selected visually, with great emphasis on appearance and condition of the animal, and prestige associated with the price paid for the animal. Meat from animals slaughtered in value chain 4 is still consumed, being distributed amongst family, friends and the poor.

Ethnic Afghans trading fat-tailed sheep in a local market outside Karachi, Sindh province

Trading networks appear to operate efficiently over wider geographic areas, with traders and their employees sourcing animals from a variety of areas according to price and availability, and potentially transporting live animals over long distances, and through one or more livestock transactions, to supply large population centres.

Traders in Thattar, Sindh province

It is unclear what proportion of traded animals meet the preferred market specifications described above. An important proportion of animals offered by farmers for sale do not meet specification, either because the household needs money and will try to sell any animal it has available, and/or because farmers believe unwell animals are likely to die and are trying to recoup some value before this occurs. Thus, a proportion of the animals traded and ultimately consumed are in poor condition and/or unwell. They usually find their way into value chain 1 and traditional butchers, who place less emphasis on product quality and food safety than the other value chains.

Value chains 2 and 3 have stronger vertical integration, with large traders often using employees or contractors to source animals from farms, rather than from a series of livestock markets. These value chains have a deliberate emphasis on this oversight along the supply chain. There was a clear increasing demand for modern retail butchers selling chilled, high-quality and safe meat cuts for the income elastic groups of middle and upper class consumers, opening new opportunities for smallholders. Export markets were largely aimed at Pakistani expatriates in the Middle East. There is clear demand for Pakistani mutton, particularly as export markets in the Middle East are driven by factors like competitiveness, consumer preferences, and religious and cultural familiarity (Aw-Hassan et al., 2008). As described above, animals for both value chains 2 and 3 are sourced from the same trading networks in Pakistan as for domestic consumption, then slaughtered in high-quality private facilities and supplied through a well-maintained cold chain to retail stores locally or (via air-freight) in the Middle East.

Advertising material for Foodex International – supplier to value chains 2 & 3 ('New domestic' and 'Export')

It was frequently reported throughout the value chain study that insufficient supply of animals was placing upward pressure on prices, limiting the profitability and sustainability of many trading and butcher operations. This appears to occur for multiple reasons, including low numbers of animals offered for sale by farmers, and various provincial government policies attempting to restrict slaughter of breeding female animals, ostensibly to try to maintain the reproductive potential of the national herd. Government capping of retail meat prices also distorts markets in some districts, although this policy seems to be

enforced very inconsistently in different areas. The export value chain works efficiently but currently its profitability—indeed its ongoing existence—is critically threatened by inadequate supply and rising live animal prices in Pakistan, which makes the product uncompetitive in the Middle East with imports from eastern Africa. Thus, improving the supply of animals from smallholder farms in Pakistan, will support ongoing domestic and export demand and encourage growth in this value chain.

Productivity per unit of small stock is low under the current production systems in Pakistan, and our analysis identified that domestic production does not sufficiently meet domestic demand. Meat consumption is income-elastic, and so there may well be a ceiling in time on the domestic market. The growing value chains 2 and 3 showed a clear opportunity to take up extra supply if it became available.

Other value chain factors also show the potential for improved on-farm production and sustainability to benefit smallholders. The well-established trading networks described above enable animals to be sourced over long distances to meet market demand, and there is a strong trust relationship between farmers and traders/butchers.

The religious sacrifice value chain is a very important separate activity for the small stock market. Very high prices can be obtained at this time of year, but according to our farmer participatory activities, these were rarely targeted. This is likely because there is an outlay of resources to invest in the animals and supplementary feed, which requires access to finance. There is also a greater risk when targeting the Eid-al-Adha market if the tighter market specifications are not met, and so even if producers had access to finance, they may not capitalise on this market option. Those farming families that did, managed to do so very successfully, but there was only a handful of examples of this. When we did encounter them, they were also mixed livestock farmers that lived in resource rich regions.

Sheep for sale for Eid-al-Azha in Lahore municipal livestock market, Punjab province

Animals for sale for religious sacrifice (Sittqa) - Lahore municipal livestock market, Punjab province

All of our SRA findings indicate small stock owners use their stock as an ATM, selling them on an 'as needs' basis to manage their cash flow. This automatically restricts what value chains farmers can sell into. If selling on a needs-basis, they cannot select the price they receive, or the time they sell. Those families that particularly depend on small ruminants for cash flow are those that also live in the resource poor regions, as they have limited to no alternative income from other agricultural products (like milk). Increasing the quantity and quality of goats and/or sheep would potentially give them more flexibility to pursue alternative markets and hold onto some stock so they can meet the more lucrative target markets.

In terms of meeting market requirements and providing options to small holder farmers, there is a clear shortage of small stock. Factors reported in the SRA value chain analysis suggested that the major constraints to the supply of animals existed on farm including nutrition, husbandry and disease issues. From the small number of commercial trials that have been conducted, it has been concluded that current breeds can be grown efficiently, if fed correctly (Khan and Ashfaq, 2010). These animals also have a suitability for fattening under a feedlot system, allowing for specific export and the Eid-al-Adha markets to be targeted in the future. There would be value in this being investigated as an entrepreneurial activity, whereby the smallholder farmers could supply animals and not take on the associated costs and risks. Seasonal, labour and demand related shortages were also reported. It is clear that if small stock producers can increase the number of healthy animals they produce, they can capitalise on all value chain opportunities.

Production limitations identified by smallholder farming families

It has been reported that livestock farming in Pakistan is characterised by poor animal health and growth, which is the result of limited supply of forage, frequent drought and diseases cycles, difficulties in getting health services and vaccination, and difficulties in identifying market opportunities (Farooq et al., 2009). Similarly, production growth can be driven by improved veterinary services, provision of feed subsidies and credit, and increased utilization of alternative feed resources (Aw-Hassan et al., 2008).

We directly asked both women and men what they identified to be the most important constraints to improving production of their small stock. We did this through the use of a participatory approach where in each of the 12 villages we visited, we ran two participatory workshops; one for women and one for men. Along with general discussion on the topic, we asked all participants to rank what they believed to be their top most problems for small stock production. Four options were presented: health issues, reproduction issues, nutritional issues or marketing/sale issues. Each participant was given four stickers and could stick these on any or all of the issues they thought to be most important.

Across all villages, women voted nutrition as the major issue affecting small stock management, with health a close second (Table 3, Fig 4). Men's groups ranked health as the major issue and nutrition second, and when the groups were compared, the differences in rank were statistically significant.

Table 3: Gender differences in ranking issues that affect small stock production

Gender	*Score*	*Health*	*Reproduction*	*Nutrition*	*Marketing*
Women's group	Percentage (Number of responses)	32 (186)	22 (127)	33 (195)	13 (78)
	Rank	2	3	1	4
Men's group	Percentage (Number of responses)	43 (170)	18 (71)	27 (109)	12 (47)
	Rank	1	3	2	4

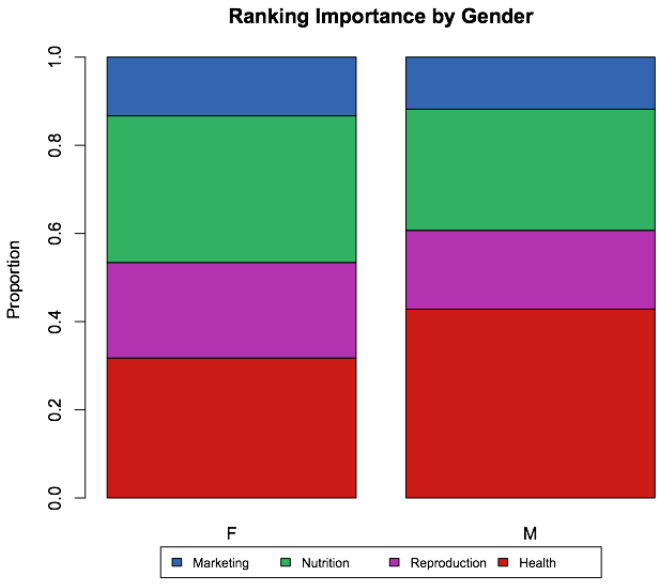

Figure 4: Issues affecting small stock production stratified by gender

When looking at the breakdown of activities both genders perform, women play an important role in feeding and caring for the stock, but never deliver health care to the animals, or interact with veterinarians, with both roles being played by men. It is likely that this difference in first and second priorities relates to the relative activities and exposure of both groups. Women also have less direct contact with animal health providers, most of whom are male, which has important implication for how we could advise women to seek animal health advice and provides a clear need for increasing the capacity/availability of female animal health workers. Despite the differences between first and second priority, there was clear agreement between both group about what was leading to constraints on farm.

Understanding the specific issues behind each topic is one next important step. Other aspects of the village participatory activity helped give context to these broad issues, but more specific research is required.

Villages identified that there were nutritional limitations, particularly around the start of the summer (April-May) and winter (Oct-Dec) as sown fodders grow, that significantly impact on their animals, reducing weight and leading to a reduction in price received from beoparis/butchers. Livestock grazing can also contribute to land degradation, particularly in regions that are arid and experience issues with soil degradation (Aw-Hassan et al., 2008).

We also investigated if resource availability affected the ranked issues reported between villages (Fig 4). Villages with low resource availability considered nutrition to be the most significant issue affecting small ruminant production, and as resource availability increased, this declined and health became the most significant issue. Again, this difference between groups was statistically significant. This result is not a surprising one, as more resources provide more options to feed animals throughout the year. Importantly, this finding highlights that different villages will have different issues that need addressing, influencing the research questions and information conducted.

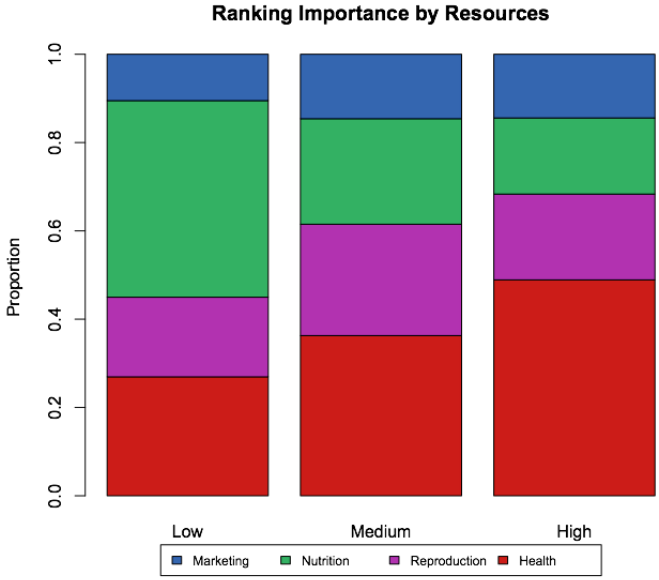

Figure 4: Issues affecting small stock production stratified by resources

Compared to cattle and buffalo, limited scientific research has been conducted around small stock production, so the researchable issues are fundamental in nature. What is known focuses on nutrition and health. Almost all small stock production is conducted with minimum nutrition inputs, and so carcass weights are usually low (Khan and Ashfaq, 2010). According to Tibbo and colleagues (2009), small stock are largely maintained on rangelands, uncultivated wastelands and cultivated fallow lands, and sometimes crop residues, with limited supplementation. Tree leaves can be used as a supplement as well, and this was reported in several of the villages we visited in the SRA.

Mortality of young stock was a core issue in the SRA. Rates of 25-80% mortalities were reported across the villages. Climate and nutrition were reportedly the biggest risks, with female and male farmers identifying winter and summer periods were associated with the highest risk to survival, but the specific causes of mortality are unclear. These two high risk points were also preceded with the critical times of nutritional limitation. It is well

documented that low birthweight neonates have an increased susceptibility to temperature extremes and illness, and so an increased risk to survival (Mourad et al., 2001; Campbell et al., 2009). As the major limitation identified in the value chain analysis was a lack of small stock numbers, targeting these high rates of early losses could critically change the livelihoods of smallholder farmers.

As identified in the participatory activity, health was the other key limitation small stock farmers experienced. Improving the health and management of small stock therefore acts as the third critical component in this project. Veterinary support for small ruminants was also reported to be negligible. Commonly described diseases were FMD, PPR, pox, ticks, lice, enterotoxemia, abortions, and Gid (less common). The prevalence and impact of these diseases were not clear however.

Extension material and support for small stock was non-existent across all villages. All of the research findings and any valuable existing information will be provided to participants in the project. Developed extension materials will be shared with all collaborating organisations, and interested projects and third parties. Again, existing expertise in the AVCCR dairy-beef program will be utilised to enhance the success of small stock extension.

Diverse roles within the family

To contextualise the small holder farming families, we sought to understand the different roles and perceptions women and men had around the management of small stock. In doing this, we identified a variety of different issues.

Activities Women reported that they and their children doing substantially more day-to-day work with small stock husbandry, particularly with the young animals, than the men reported both groups to do (Table 4).

Table 4: Women's and men's perceptions of the activities associated with the daily care of small ruminants and who has responsibility for these roles; number of village groups indicating this response and percentage presented in parentheses

Activity	**Women's perceptions**			**Men's perceptions**		
Responsibility	*Men*	*Women*	*Children*	*Men*	*Women*	*Children*
Birthing	4 (33)	10 (83)		3 (25)	3 (25)	
Breeding				1 (8)	1 (8)	
Care for kids	1 (8)	12 (100)	1 (8)	4 (33)	7 (58)	
Combine grazing	1 (8)		1 (8)	2 (17)	4 (33)	1 (8)
Cutting fodder	6 (50)	9 (75)	4 (33)	2 (17)	1 (8)	
Decision making	12 (100)	7 (58)		11 (92)	7 (58)	
Fodder feeding	1 (8)	7 (58)	1 (8)	1 (8)		
Grazing	5 (42)	6 (50)	8 (67)	2 (17)	4 (33)	
Health	8 (67)	2 (17)		11 (92)		6 (50)
Home remedies		1 (8)		3 (25)		1 (8)
Medication	3 (25)			9 (75)	8 (67)	2 (17)
Milking	2 (17)	5 (42)	1 (8)	2 (17)	1 (8)	
Shed cleaning	2 (17)	10 (83)	2 (17)	1 (8)	7 (58)	
Watering animals	2 (17)	11 (92)	6 (50)	4 (33)	7 (58)	4 (33)

Women are a vital contributor to small stock production (Kristjanson et al., 2010), but these different gender roles in agricultural activities are not well characterised (Tibbo et al., 2009). Not only are the roles women play poorly characterised, they are often not involved in the decision making, nor do they receive the information from extension programs (Kristjanson et al., 2010). This means that the ability to improve the management of these stock, which are often those most susceptible to poor productivity and mortality, is inhibited.

Age Older women were more hesitant to contribute initially, and then would tend to dominate the rest of the discussion. As a result, there was limited information specifically from young women and widows.

Status In households where small ruminants were a secondary source of income, women tended to do less work with livestock. In villages where they were a primary source of income, women and children did a significant amount of work. This also affected literacy rates (as gauged by interaction with the written PRA activities).

Access In villages where small ruminants were more commonly a secondary income, the wives of grazing farmers did not participate, or were not present, for the PRAs. This may be the influence of social status, them living further from the village (and so the study site), or both.

Vulnerable groups There was anecdotal discussion that the people likely to graze small ruminants were young teenagers, children and those with disability (intellectual). Their roles became more important during busy agricultural times (e.g. harvest).

Household labour availability can be central to the success or failure of any interventions (Wangui, 2008). Many interventions aimed at improving livestock production involve modifying husbandry practices around the care of vulnerable animals and/or changing nutritional options and delivery methods, which can directly affect the workload of women and children (Wangui, 2008; Kristjanson et al., 2010).

As anticipated, all members of small stock farming families play different roles in the husbandry and management of these animals. Based on this evidence, the research program will engage with each of these groups in several different ways, with each of these steps focusing on diversity in gender, age, status and ability groups: (1) Understanding the roles they currently play and opportunities for change. (2) Key messages from interventions would be delivered to all relevant groups. (3) Evaluation of the impact of the project would be conducted for all relevant groups.

Animal health services provided to small ruminant farmers by government

Participatory research activities are currently underway to describe the services provided by provincial government Veterinary Officers (VOs) and Veterinary Assistants (VAs) to small ruminant farmers, and the perceptions of VOs and VAs of the constraints to small ruminant production. These findings will be triangulated with the results of the farmer participatory research.

Preliminary outputs have described the diseases and production issues identified as most important to small ruminant production by government staff at a local level. The clinical basis of particular diagnoses appears to be unclear at times, and at times there is limited availability of other methods to confirm suspected diagnoses.

Importantly, although there are large government programs providing free animal health services and medications to farmers, intermittent supply of medication means that treatments are often poorly timed, limiting their efficacy or dramatically reducing the efficiency of these large-scale activities.

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