Australian Government

Australian Centre for International Agricultural Research

Final report

Small research and development activity

project	**Smallholder goat value chains in Pakistan; challenges and research opportunities**
project number	LPS/2016/096
date published	10 September 2020
prepared by	Rebecca Doyle, Jenny Turton, Angus Campbell
co-authors/ contributors/ collaborators	McGill DM, Arif, S, Zia, A, Hussain, A, Woodruff, ME, Jabbar A, Wajid RM, Aziz A, Afzal A, Hayat K, Majeed S, Kumbher MA, Ullah H and Warriach, HM
approved by	Dr Anna Okello
final report number	FR2020-022
ISBN	978-1-922345-66-0
published by	ACIAR GPO Box 1571 Canberra ACT 2601 Australia

Contents

Acknowledgments

The Australian and Pakistan project teams are grateful to the University of Veterinary and Animal Science at Lahore for the ongoing support of the SRA and for their generosity in hosting the background and final workshops. We are also grateful for the tremendous cooperation of local government authorities throughout the provinces of Punjab and Sindh. We are especially thankful to the Punjab Livestock and Dairy Development Department and the Sindh Livestock and Fisheries Department who helped organise meetings with their own staff, farmers, venues and involved important local stakeholders when required. Without the willing cooperation of the farmers, traders, processors, butchers, exporters and other value chain participants involved, it would not have been possible to establish the understanding of goat and sheep value chain systems in Punjab and Sindh. We are truly grateful for their contributions, both in sharing such a wealth of information as well as their valuable time. We would also like to thank the participants in the two SRA workshops who travelled from a range of organisations from all around the country, providing insights into their research and their local small ruminant value chain systems. We look forward to ongoing collaboration with these individuals and organisations. We are also thankful for expert input on socioeconomic aspects of farming systems from Dr Jane Dyson (University of Melbourne) and on value chains from Dr Tony Dunne (adjunct Associate Professor at the University of Queensland).

List of Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AUSABBA	Australian Assistance to Agricultural Development in Balochistan Border Areas
AVCCR	Agriculture Value Chain Collaborative Research
CCPP	Contagious Caprine Pleuropneumonia
CWT	Carcase Weight
DFAT	Department of Foreign Affairs and Trade
EVC	Export Value Chain
FAO	Food and Agriculture Organisation of the United Nations
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
HACCP	Hazard Analysis Critical Control Point
HH	Household
HRCs	Institutional consumers (Hotels, Restaurants and Caterers)
KPK	Khyber Pakhtunkhwa
LDDD	Livestock and Dairy Development Department
NARC	National Agricultural Research Centre
NDVC	New Domestic Value Chain
NGOs	Non-governmental Organisations
PAMCO	Punjab Agricultural and Meat Company
PARC	Pakistan Agricultural Research Council
PPR	Peste des Petits Ruminants
PRA	Participatory Rural Appraisal
Rp	Pakistani Rupee
RVC	Religious Value Chain
RVCA	Rapid Value Chain Analysis
SPS	Sanitary and Phyto Sanitary
SRA	Small Research and Development Activity
SRRP	Small Ruminant Research Program
TDVC	Traditional Domestic Value Chain
UAE	United Arab Emirates
USD	US Dollars
UVAS	University of Veterinary and Animal Science
VA	Veterinary Assistant
VCA	Value Chain Analysis
VO	Veterinary Officer

Executive summary

The Agriculture Value Chain Collaborative Research program (AVCCR) is a research-for-development program in the Punjab and Sindh provinces of Pakistan, which focuses on enhancing selected agricultural value chains for the ultimate benefit of the rural poor, particularly women. *Smallholder Goat Value Chains in Pakistan: Challenges & Research Opportunities* is a small research activity (SRA) within the SRA program. The aim of the SRA was to describe goat (and sheep) production systems in Punjab and Sindh and identify constraints and opportunities throughout small ruminant value chains that could be addressed to benefit the rural poor, especially women.

The SRA involved: (1) a literature review and stakeholder workshop; (2) participatory rural appraisals of goat and sheep farming systems in villages in Punjab and Sindh; (3) a rapid value chain analysis to describe goat and sheep meat value chains; (4) participatory appraisals with veterinary officers and assistants of key issues facing goat and sheep farmers, and delivery of animal health services to small ruminant value chains; and (5) a workshop to present and ground-truth SRA findings to key sector stakeholders.

The SRA reinforced that mutton (meat from small ruminants) is highly valued and in high demand across a variety of interlinked value chains in Pakistan. Good trading networks potentially link small farmers with value chains, although different value chain actors do not always seem aware of their potential options and benefits. Poor quantity, quality and supply consistency of animals from farms is the major restriction in many value chains, limiting profitability and expansion of important emerging markets. Smallholders could capitalise on this market demand and interconnection between value chains if these restrictions could be overcome. However, current extension and other services for small ruminant farmers are often limited, may lack a strong evidence base and their impact may be reduced by limited coordination or consistency. Women and children play a critical role in goat/sheep farming, and they should be included in activities to improve on-farm productivity and profitability. However, the impact of increasing animal numbers and management methods on these groups needs to be considered.

The rapid value chain analysis principally covered trade and consumption of meat, offal, skins and carcase by-products. It identified four interlinked value chains in Pakistan: a 'Traditional Domestic' value chain supplying traditional wet markets; a 'New Domestic' value chain (higher-end consumers buying chilled meat in supermarkets and speciality butcher shops); an 'Export' value chain (exporting chilled carcases by air); and a 'Religious' value chain in which animals are purchased for sacrifice during festivals such as Eid-ul-Adha and for other religious observances. Wool & milk production are also important in some areas: wool in western Pakistan (although this is outside this project's focus area) and milk for home consumption and/or sale in different areas, especially Sindh.

The first three value chains directly compete for a similar product—an animal up to 12-18 months old of ~8-12 kg carcase weight. It is unclear what proportion of traded animals meet the preferred market specifications, or how well different value chain actors understand pressure on prices in recent years, threatening the sustainability of different value chains (especially export), and individual traders and butchers. Low and inconsistent supply of animals for sale by farmers, competition between chains, and some provincial government policies restricting meat supply or distorting prices appear to be key underlying reasons for the price increases. The Religious value chain is culturally very prominent and comprises about one third of the total annual slaughter volume of small ruminants.

Generally, trading networks appear to operate efficiently over wide geographic areas, with traders and agents sourcing animals over distances of hundreds of kilometres, according to price and availability.

Small ruminants are managed on farms in a variety of ways and in different agroecological environments. Conventionally, it is reported that grazing-based systems are common in less arable areas, whereas stall-fed cut-and-carry systems are mainly found in irrigated areas. Our participatory rural appraisals reflected these distinctions, although both management systems were often found together in the one local area. Stall-feeding farmers often kept small ruminants as a secondary activity, supplementing their main income from dairy animals. Conversely, small ruminants were the main or sole livelihood activity for farmers who predominantly depended on grazing.

A village 'resource score' was calculated to describe access to key resources including water, arable land and different feed sources. The scores showed that small ruminant raising in moderate- and rich-resource villages was an ancillary livelihood activity supplementing income from large ruminant dairy enterprises. In resource-poor villages, small ruminant farming was the main livelihood activity for families that kept them. All the villages visited in Sindh were classified as resource-poor.

Women's roles raising small ruminants chiefly involve feeding and caring for stock, especially young animals. They seldom deliver health care or interact with animal health providers. Men reported chiefly being involved in decision-making and grazing, but women reported they and their children did substantially more day-to-day work with small ruminants than men reported either men or women doing.

It was more difficult to engage with farmers that exclusively owned small ruminants compared to farmers also keeping other livestock. Small ruminant-only households tended to be outside or on the edges of villages, spent longer times away with daily grazing (compared to cut and carry) and/or had a more transhumant lifestyle. Women from these households were almost impossible to contact because it is very difficult for them to move around unaccompanied and they have high daily work demands.

Women and men both identified nutrition and health as the top two issues in small ruminant farming but ranked them differently. Nutrition was the top issue in 'low resource' villages but health was most important as resource availability increased. Nutritional limitations were reported to occur near the start of the summer (April-May), and during winter (Oct-Dec) when growing crops cannot be grazed by animals. Mortality of young stock, of unknown cause, was a critical issue at these times of the year, with 25-80% of young animals dying. Farmers reported receiving poor prices if livestock were sold at times of poor nutrition and growth.

Farmers reported that extension material and support for small ruminant production was practically non-existent in all villages. Similarly, government veterinarians and veterinary assistants identified insufficient extension services as an important constraint to production, despite the government's key role in extension, along with animal health (rank #1) and nutrition (rank #3). Issues were similar in Punjab and Sindh. Parasitism, enterotoxaemia, peste des petits ruminants and contagious caprine pleuropneumonia were reported as key diseases, although diagnostic testing is relatively uncommon. Importantly, although there are large government programs providing free animal health services, medications and vaccines to farmers, intermittent supply of medication means that treatments are inconsistent or are poorly timed, limiting their efficacy and efficiency.

After starting detailed qualitative and quantitative work, it is clear that farmers feed a wide range of feeds to their goats and sheep. This is highly dependent on the season and the resources available to them. Farmers commonly use a supplementation strategy. This means that options to develop feed interventions are available, and farmers have awareness of this practice.

While it is used, supplementation may not be very effective. Annual doe/ewe mortality ranges from 0-15%and herd/flock reproductive efficiency is generally low. In 58% of villages surveyed, the average production of 'saleable' offspring was < 1 per breeding female per year, and no villages produced > 1.5 saleable offspring/breeding female/year.

Further research and extension are required to support the development of small ruminant value chains in Pakistan, particularly in the areas of practical nutrition, overcoming ill thrift and mortality in young animals, and improved health management. The greatest emphasis should be on accurately describing how productive potential is lost on farms, testing effective interventions to overcome these losses and empowering women and men farmers to connect with value chains. This process, from participatory research to extension and scale-out with farmers and other stakeholders, needs to occur in ways accessible to women, men and different social groups. This will support sustainable growth of all small ruminant value chains in Pakistan.

1 Introduction

This Small Research and Development Activity (SRA) was part of the DFAT-funded Agriculture Value Chain Collaborative Research program (**AVCCR**) which identified goat meat value chains within Pakistan as a high priority for further research. The overarching goal of this program is ***"that rural poor, particularly women, living in the Punjab and Sindh significantly and equitably benefit from improvements in strategic value chains".*** The AVCCR targets strategic value chains impacting smallholder livelihoods and focuses on social equity and the empowerment of women as fundamentals to development.

In Pakistan, the rising interest of government, improved financing of animal farming, expanding milk and meat processing companies, and growing domestic and foreign demand for livestock products are reshaping the goat meat sector. Goat numbers have increased consistently over the last 20 years. Punjab province is an important contributor to national production, with over one third of the national herd of 66 million (2013-14). Annual production is about 300,000 tonnes, valued at $US148 million (2012). Goat meat ('mutton') is widely consumed and more highly valued than other red meats. Goats are the main species amongst the 9 million head of livestock slaughtered during Eid-ul-Adha, a deeply significant annual Muslim observance.

Smallholder families dominate goat production. The greatest product flow in the goat value chain is from these smallholder farms, through livestock markets, to slaughterhouses, then retail butchers in wet markets; with the remainder going from slaughterhouses to wholesalers for food service or retail. It is thought that average shares of the consumer price of goat meat are: producer 80-85%, contractor/wholesaler 6-8% and retailer 9-12%. These figures warrant verification, and despite the apparent relative value weighting towards the producer, research is needed to identify how smallholders can derive the greatest net income from their participation in the value chain. Major inefficiencies in goat meat value chains include significant on-farm production and animal losses, controlled retail pricing of meat that distorts market function and affects the profitability of different value chain actors, absence of meat grading and pricing according to quality (contributing to the slaughter of sick, old and sub-standard animals), and illegal slaughtering of sick and unhealthy animals. Collectively improving meat quality and on-farm production efficiency, plus better market engagement, may help smallholders participate more profitably in goat value chains, particularly those targeting higher-value products. This approach is consistent with current government policy and addresses the aims of the AVCCR by targeting an industry comprised largely of smallholder producers.

The ***scope*** of this SRA was to more fully describe the goat industry, including production and marketing systems, and identify future research for development needs throughout the value chain that aligns with the core goals of the AVCCR Program.

The ***objectives*** of this research project were to:

1. Map and analyse goat value chains linking smallholder farmers to markets, including the value smallholders derive from them
2. Investigate smallholder farmer perceptions of their engagement with goat value chains and the role that women play both on-farm and post-farm gate
3. Identify research opportunities for improved smallholder goat producer engagement with, and contribution to, specific goat meat value chains

Key ***outputs*** from this project are:

- A review report and rapid value-chain analysis of the goat sector and associated research in Pakistan including value chain maps of goat production in Punjab and Sindh, describing:
    - Current on-farm production

    - Overview of goat marketing: sales of live animals (regional/provincial/ international), slaughter/processing, sale of products
    - Existing and potential private sector links with smallholder farmers
    - The social environment around goat production, including the roles of women in on-farm production
- Detailed participatory appraisals of on-farm goat production, including identification of constraints and opportunities to improve on-farm goat production, in the context of existing markets and supply chains. This included a gender-based breakdown of roles and opportunities for improved goat production within smallholder families
- Important capacity building of local scientists in value chain research, particularly in the overlooked area of small ruminant production
- Clearly identified research gaps around the roles of rural smallholders and women, which are being used to develop a larger research project that will specifically aim to improve smallholder goat enterprise profitability and the livelihoods of the families it supports

Based on priorities, known research gaps and the funding focus, the ***research questions*** that were addressed in this SRA are:

1. What are the predominant goat value chains linking smallholder farmers to markets, and what value do smallholders derive from them?
2. What is the role of women, and their perceived involvement, in goat value chains? How might their role change, or be influenced, in the future, and what would be the effect on women?
3. What different kinds of producers engage with goat value chains (e.g. landless vs. landowning; large/semi-commercial vs. small/opportunistic/nomadic), and what is their perception of this engagement? How important (economically and culturally) is goat production to the livelihoods of these different kinds of smallholder households? What regional nuances exist in engagement with these value chains?
4. What are the challenges and opportunities for improved smallholder goat producer engagement with, and contribution to, specific goat meat value chains? What is the opinion of goat producers of the opportunities to expand or improve their goat enterprises?
5. Are there differences between goats and sheep in the 'goat' meat value chain that would warrant sheep-specific research in the future?

Activities within the SRA included:

1. A review of current goat value chain literature in Pakistan to consolidate the different perspectives relating to the state of the national industry
2. Mapping of existing goat livestock chains in selected districts of Punjab and Sindh to illustrate how their structure and operation impact on livestock producers who participate in these pathways
3. Undertaking a detailed value-chain analysis, including engagement of private sector stakeholders and financial description of the value chains
4. Collecting qualitative participatory data on smallholder small ruminant farming enterprises, including production, husbandry and health, to complement and validate the value chain case studies, and further identify women's involvement in the sector
5. A summary workshop which presented key findings from SRA and discussed future research, including further identification of potential future collaborators

After the first 12 months of the SRA, a 12 month variation was granted to expand on the initial findings of the SRA with several new research activities, and to maintain the momentum until a larger three year project could start. The research activities for the extension aimed to start to address several of the critical findings in the SRA that will contribute to the objectives of the full project: LS-2018-105 Enhancing small ruminant

production to benefit farming families in Sindh and Punjab, Pakistan. The objectives, outputs and activities of the SRA Extension were as follows:

Variation **objectives**

1. Identify and evaluate potential feed interventions
2. Share SRA research results with stakeholders

Variation **outputs**

- Development of the full proposal (LS-2018-105)
- Detailed understanding of feeding and small ruminant management that will inform activities in the full project.
- Survey of Eid-ul-Adha purchasers to understand what traits they look for when purchasing animals in the high value Eid market
- Develop a preliminary selection of promising feed interventions to address the issues of small ruminant growth, survival and turnoff (as identified in the first 12 months of the SRA).

Variation **activities**

1. Identify and evaluate potential feed interventions
    a. Conduct participatory activities to understand how farming families feed and managed young stock and adult animals
    b. Conduct a regional feed survey to identify types of crops, forages and regional feed stuffs in the area and the way they're currently used
    c. Analyse the nutritional composition of these feed options to identify the animal diets and options for improved nutritional management
    d. Trial feed interventions based on information collected from 1-3
    e. Move towards developing a decision support tool for next and end users to identify feed profiles, nutritional gaps, and regional/seasonal specific options to improve animal nutrition

2. Share SRA research results with stakeholders
    a. Publish papers and/or conference presentation of the SRA results from the last 12 months
    b. Hold a workshop to share results and how to use decision support tools, and make plans for the full project

Outcomes from each of the 7 objectives (5 initial objectives and 2 variation objectives) are presented below.

Note: *Throughout this report, the term 'smallholder' is used to describe small-scale farmers who primarily depend on agricultural activities for their livelihoods but who may or may not own land. We use this term to distinguish these farmers from more affluent livestock owners, who also may or may not own land, who raise livestock as a more commercial investment or secondary income-generating activity.*

2 Literature Review – Small Ruminant Production and Value Chains in Pakistan

A review of relevant literature about small ruminant (goat and sheep) production and value chains in Pakistan. The literature consulted included published papers; government and donor organisation documents, reviews and statistics; and some internationally focused published papers setting small ruminant production and value chains in Pakistan in a global context. The objective of the literature review was to understand the current situation around small ruminant production and value chains in Pakistan, to identify previously articulated constraints and opportunities in this sector, and to establish the extent of previous research in key constraint areas to avoid duplication in future AVCCR activities. This section summarises the key issues discussed in the literature review.

The literature review provided a background to small ruminants in Pakistan and characterised small ruminant production systems, with a consideration of social and household factors related to small ruminant farming families. Five major sections consider nutrition and feeding practices, reproduction and breeding practices, health and disease control, livestock policy and industry governance, and small ruminant value chains. Each section included constraints and opportunities within that area.

Few references are available that apply specifically to small ruminants, and information often considers small ruminants as part of the broader red meat industry and value chains. Much research has tended to be conducted on research stations rather than on farm and the relevance and applicability is often limited. There is a lack of reliable national statistics regarding small ruminant value chains. Whilst there was a lot of consensus on the key constraints within small ruminant value chains, the variation in smallholder production systems, climate, nutritional inputs, breeds and other variables in different parts of the country makes it difficult to make generalisations of solutions, and these need to be considered in the local context. Existing literature and reports do not clearly report whether research into on-farm solutions to industry issues has then been extended to farmers or scaled out to other parts of the country.

It is clear from this review that small ruminant production is primarily centred on smallholder farming in Pakistan, and that a number of different production systems are utilised, depending largely on local agro-ecological zones. Women play a significant role in small ruminant production, even though this role is often invisible. There is great potential for small ruminant production to be increased due to rapidly increasing demand in both domestic and export markets. Small ruminants for the domestic market are sold through three different channels: the formal sector, informal sector and the Eid-ul-Adha market. There are numerous constraints to increasing small ruminant production and income generation derived from small ruminant value chains, and the majority of these would appear to be related to on farm production, particularly inadequate supply of animals. Some of the most important constraints and opportunities relate to improving animal nutrition (both the quality and quantity of food offered), disease control, and extension services offered to small ruminant farmers. Improving the enabling environment around small ruminant value chains is also required, as is the access of value chain stakeholders to credit. The value chain approach is a critical method of ensuring that inputs and efforts relate to improving consumer value so that all value chain stakeholders can benefit. Some of the constraints require further research to understand them better, whilst for other areas the constraints are clearly defined and practical, relevant interventions are required to address them. This will require political vision and drive, coordination of efforts, networks and relationships between public and private sectors, and adequate funding. It was also clear that production systems, specific constraints, and thus required interventions varied between regions, and thus there is the need to both understand the local situation, and to adapt interventions to address the local constraints.

Sustainability will require adopting affordable and readily available best practice approaches.

3 Background Workshop, December 2016

An introductory stakeholder workshop was held at the University of Veterinary and Animal Science (UVAS) in Lahore on 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, focusing 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. Following is the Executive Summary of the Workshop Report.

Workshop Summary

The Agriculture Value Chain Collaborative Research (AVCCR) Project organized a consultative session at UVAS, Lahore, to understand the existing status of the sheep and goat sectors and associated research in Pakistan. The objective of the meeting was to get an update on goat and sheep research and to seek ideas for future research from participants, in order to improve the efficiency of smallholder farmers by optimising goat production management. Eight researchers from various Pakistani institutions participated in the meeting.

A detailed overview of the project objectives and activities was presented to the participants. The researchers shared their experience and research work on small ruminant production in the areas of breeds, feeding management (including rangelands), reproductive traits of goats, goat genotypes, and an assessment of small ruminant value chains. The participants also highlighted the gaps in goat production systems in Pakistan, as smallholder farmers are not attaining the full production potential of small ruminants. There is a lack of knowledge and capacity building of smallholder farmers for goat production, which needs to be overcome. Technology and information should be transferred to farmers so that they may optimise the production of their goats and sheep.

The meeting concluded with some research questions and challenges for the future to improve goat production in Pakistan, including fodder and rangeland, health issues, goat breeding, marketing, women's involvement in goat production systems and animal husbandry. The new research areas identified by local researchers, although not prioritised, were breed suitability within eco-zones, improvement in rangelands, feedlot fattening, growth rate, husbandry models, identification of breeding seasons, quality bucks, animal transportation and marketing, identification of consumer preferences, animal health in terms of vaccination and deworming for small ruminants, and involvement of women in goat production. The meeting also successfully identified the key experts of small ruminant production from all provinces of Pakistan for future collaboration.

4 Participatory Descriptions of Small Ruminant Farming Systems and Householder Roles

This section provides a summary of the methodology and key results of a participatory activity undertaken with smallholder small ruminant farmers within this SRA to describe their farming systems and better understand household member roles.

Methodology

Participatory rural appraisal (PRA) was used to collect information on environmental, resource and seasonal opportunities as well as the roles of household members around farm activities and the challenges facing small ruminant farming families. A total of 149 women and 144 men participated in the 12 PRAs (24 in total, with women and mens groups held separately). This approach was used to get a rapid in-depth understanding of the farming system, its constraints, and areas for development. To account for the climatic, topographic and seasonal variation in the two provinces, the farmer PRA was conducted across 12 villages (7 in Punjab and 5 in Sindh) selected from a range of agro-ecological zones and based on high numbers of small stock (see Table 1 and Figure 1 for names and locations).

Table 1: **Locations and agro-ecological zones of the 12 villages included in this PRA study**

Province	Agro-ecological zone	District	Village	Map Reference (Figure 5)	Number of female participants	Number of male participants
Punjab	Northern irrigated plain	Jhelum	Pinawal	A	6	9
		Sheikupura	Kalpi Dogran	B	12	7
		Okara	51-3R	C	8	10
		Muzzafargarh	Sanawan	D	13	6
	Sandy Desert	Bhakkar	42-43TDA	E	7	4
	Suleman Piedmont	Rajanpur	Kolti Gul	F	5	11
		Dera Gazi Khan	Basti Muhammad Abad	G	4	11
Sindh	Southern irrigated plain	Shikapur	Qadir Bakhsu	H	15	9
		Sukkur	Goth Kamal Khan	I	14	9
		Dadu	Sawaro	J	8	8
		Badin	Bakhshu Lund	K	21	44
	Indus Delta	Thatta	Haji Leemon	L	36	16

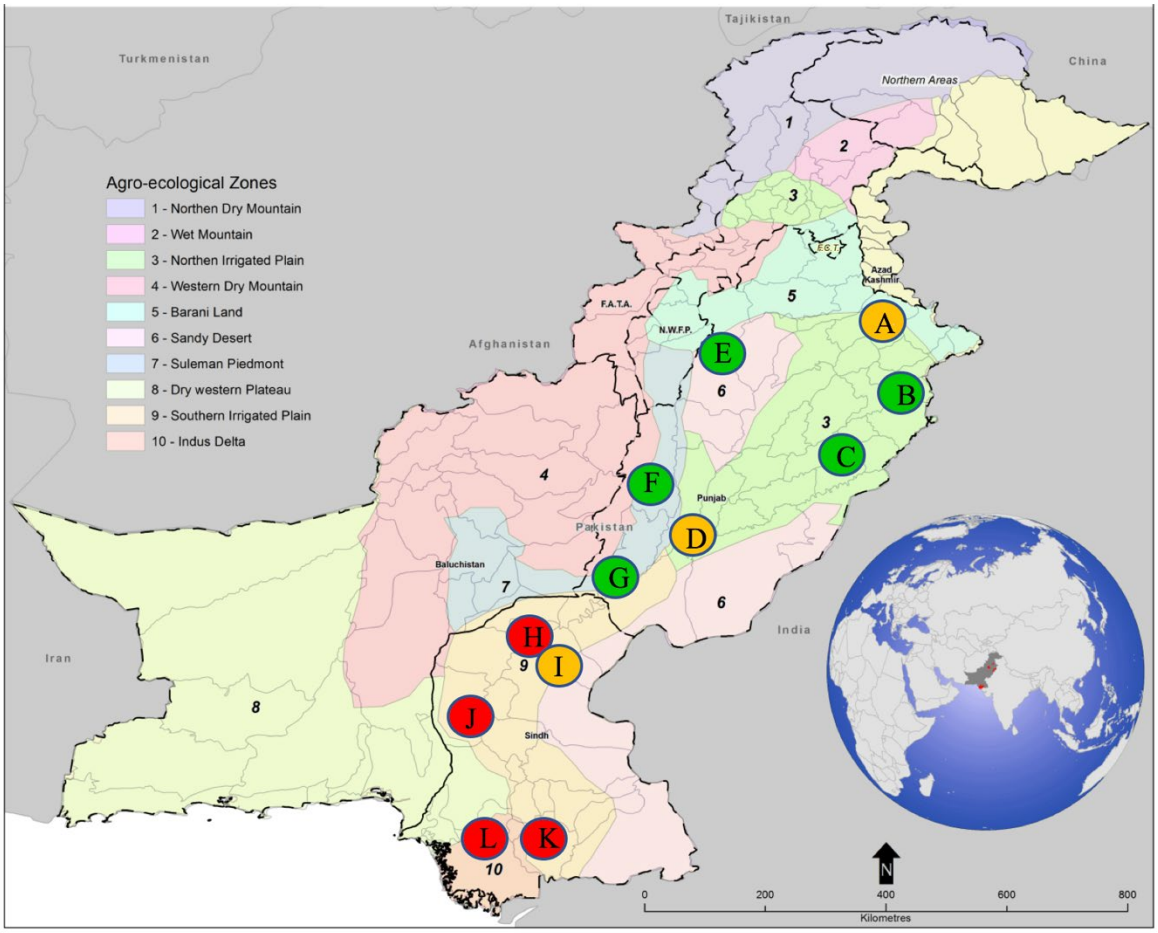

Figure 1: Map of Pakistan showing the different agro-ecological zones (shaded colours) and the location (see Table 1 for A-L reference) of the 12 villages where PRA activities were carried out (map supplied from CSU/SPAN 2017).

NOTE: The three coloured circles (red, yellow, green) around the location reference codes specify the resource scoring results from this study (see **Table 1** for names).

To understand the size and type of farmers present, each farmer group was asked to give an approximation of the land they use, the number of animals they owned and whether they were mixed (dairy cattle or buffalo and small ruminants) or primarily small ruminant animals (goats or sheep only). Following this, four activities were undertaken as a part of the PRA: (1) a map of the village, (2) a seasonal calendar of activities associated with small stock production and other agricultural activities, (3) a diary of daily activities specific to small stock, and then (4) participants had the chance to rank what they perceived to be their biggest issues with the production of small stock.

Production systems

Based on responses from the farmers across the 12 districts it was clear that there were two major farming systems with small ruminants; mixed livestock farming systems and small ruminant farming systems.

Mixed livestock farming systems were sedentary households, where the owners had a fixed base with at least an acre of land (generally ranging from three to five acres), and mostly practiced a cut and carry feeding system with animals cared for, mostly by women, within the household walls. These farmers had small stock as a secondary income, with less than ten small ruminants supplementing their main income from dairy animals

(buffalo and/or cattle) or cash crops. These types of systems are mainly found in irrigated areas (Figure 1) and were more common in Punjab province.

Figure 2: Goats being fed within the household walls by one of the women in the family, Kolti Gul, Rajanpur (photo: Anam Afzal)

Sole small ruminant farming systems that were encountered tended to have very little land (less than an acre or landless) and relied on these animals for their primary source of income. Animals were grazed for between four to eight hours on communal lands nearby the village, but if feed is scarce, may have to be grazed more extensively. Some of these small ruminant farmers are transhumant, where flock-owners (ranging from 20 to 50 animals) leave their fixed base, but move with their animals for a part of the year (3 to 6 months) when feed resources are particularly low or unavailable. Tending to the grazing animals was generally undertaken by the men of the household, with the responsibility often passed down to young men/boys if older men were unavailable, whilst the women looked after the young animals in the household. Grazing-based systems are common in less agriculturally productive areas (Figure 3; Figure 1), including mountainous, rain-fed, saline affected and desert areas of Pakistan such as Sindh and southern Punjab.

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. There was a tendency for farmers to have more goats in Punjab and sheep in Sindh, but this was not always the case.

Figure 3: Goats being grazed in a village within district Dadu (Photo taken by Sobia Majeed)

Reasons for keeping small ruminants

Small ruminants are raised by farmers as a means of accumulating a 'living bank' which could be sold when needed and provides an easily accessible source of income throughout the year. Farmers in all of the twelve villages involved in this study reported that they kept small ruminants primarily to sell whole animals for meat purposes with three villages, in wealthier areas with better market access, selling the majority of their animals during the festival of Eid. Two villages (in Punjab) mentioned that they sold goat milk mixed with buffalo milk and another two villages (in Sindh) were the only to mention using and selling wool. In one village (Kolti Gul) an innovation was observed whereby a number of farmers were selling pure bred bucks into a premium market. Understanding these innovations is critical to inform interventions and support mechanisms for other farmers and areas.

We observed another, niche group of small ruminant farmers—entrepreneurial farmers who purchase male sheep or goats to fatten for sale at Eid-ul-Adha. Targeting such specific market opportunities is one potentially valuable approach in which other, financially secure smallholders could invest. However, the required resources and associated risks for these farmers are high, so would likely be applicable to a limited number of small ruminant farmers. It was interesting to note that the benefits of this higher-risk, higher-return strategy were frequently espoused in Pakistan, but there was little discussion of the resources required (i.e., cash to invest in animals and access to suitable livestock), or the financial risk associated with failing to sell desirable animals at the critical time.

Seasonal calendar

Using the outputs from the mapping exercise and the seasonal calendar activity in the PRA, circular seasonal calendars were developed to visualise the key components of the farming system and how they vary and interact throughout the year (Figure 4).

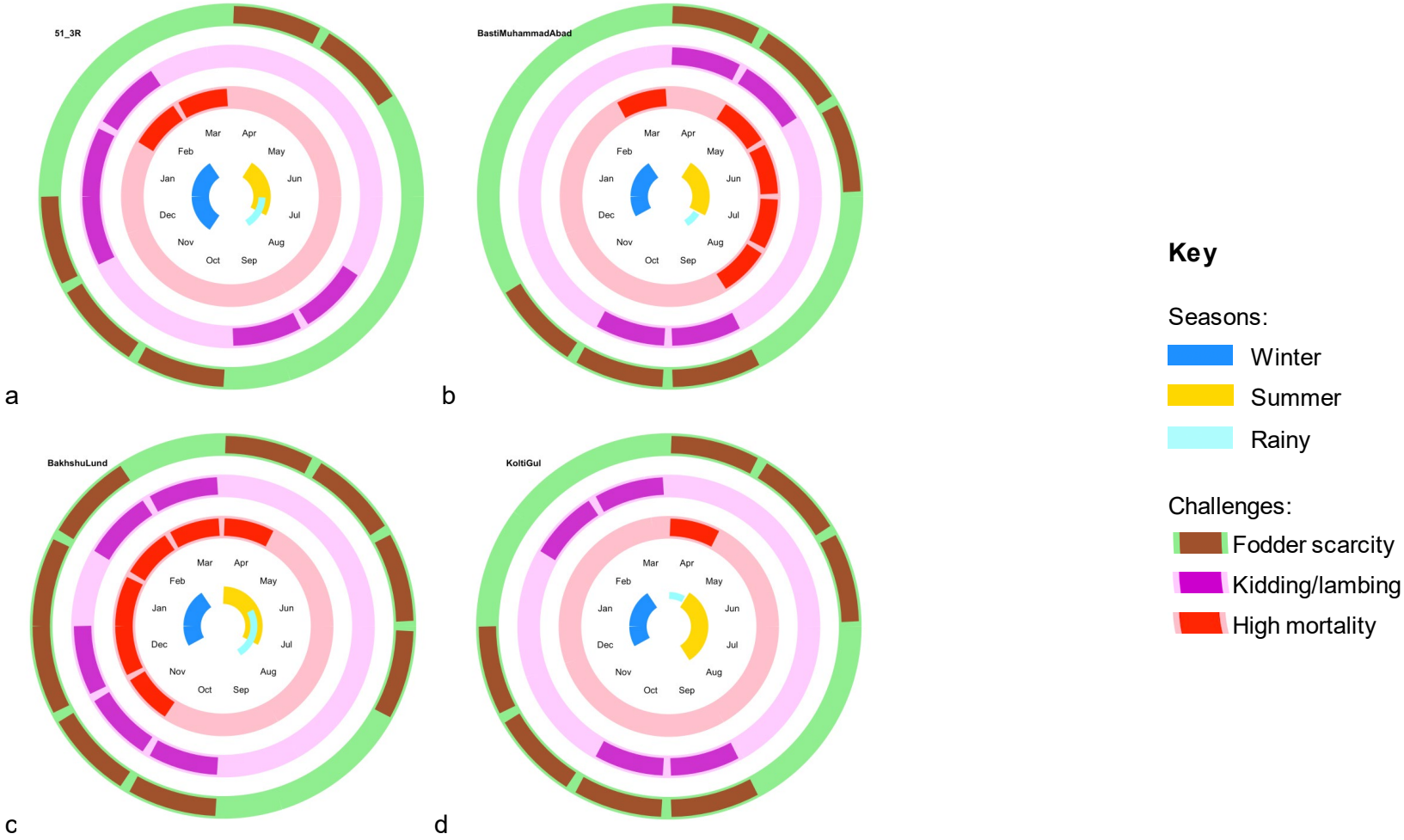

Figure 4: Seasonal calendars of four villages from the PRA with slightly different farming systems; a) 51-3R, b) Basti Muhammad. Abad, c) Baskh Lund and d) Kolti Gul

Based on the PRA results fodder scarcity in small ruminant farming systems occurred at two times of the year. Although this varies from region to region, looking at the calendars in Figure 4, a trend occurs in the months from April to June where summer crops (such as maize, sorghum) aren't yet available for feeding and again, in November to December where winter fodders are still growing and forage plants from the rainy season are lower in quality and quantity. An important observation from Figure 4 is that this feed scarcity period often coincides with the major birthing time of year, which sometimes lead into times of year when mortality spikes occur.

Resource Assessment

It was clear that evaluating villages based on agro-ecological zone alone missed the complexities of production systems within a region, which could be affected by very localised factors. For example, some locations were close to water resources, but had limited access to that water because of poor infrastructure and political complications. To attempt to better classify local small ruminant production, we assigned an overall resource score to each of the 12 locations in the village participatory activity. These overall scores were generated by assigning a binary score to each of eight village-wide resources, following specific group activities and discussion. The resources were: the presence of water suitable for livestock, readily accessible water, majority of farmers having land for cultivation, opportunity for irrigation, year-round grazing, accessible grazing options (e.g stubble/canal banks), free or cheap browse, and easily accessible options to fill the fodder gap. The maximum possible resource score was eight. Villages were classified as belonging to one of three groups: resource-poor (<4), resource-moderate (4-5), and resource-rich (6-8). The 12 villages visited are coloured based on these scores in Figure 1; (1) red – resource poor, (2) yellow – resource-moderate and (3) green – resource-rich. There was a clear difference between the two provinces, with Sindh only having resource-poor villages. 'Moderate' and 'rich' resource villages were those with mixed farming systems (dairy and small ruminants); whereas those that were resource-poor tended to only raise small ruminants.

Diverse roles within the family

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

Activities

Women reported that they and their children do substantially more day-to-day work with small ruminant husbandry, particularly with the young animals, than the men reported both women and children to do. More research is required to clearly describe the different gender and age roles in small ruminant production and their needs.

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.

Vulnerable groups

There was anecdotal discussion that the people likely to oversee daily small ruminant grazing were young teenagers, children and those with an intellectual disability. Their roles became more important during busy agricultural times such as harvest when other labour was scarce. Household labour availability can be central to the success or failure of any interventions. 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.

Engagement with researchers (and potentially other external agencies)
There were differences in patterns of engagement with the research team between different households and household members. Older women were often more hesitant to contribute to group discussions initially, but then tended to dominate the rest of the activity. As a result, limited information was provided by young women or widows. In villages and households where small ruminants were more commonly a secondary household income source, women from 'grazing' households tended to not participate in the PRA discussions or were absent entirely. The cause of this and the significance of omitting their views from the discussion are not clear and need further investigation.

It was more difficult to engage with farmers that managed only small ruminants compared to mixed farmers. The former farming families tended to live outside or on the outskirts of villages undertook more daily grazing (as opposed to cut and carry) or had a more transhumant lifestyle. This made contacting and engaging the male farmers difficult, but several still took part in our village participatory activities. In contrast, the women from these farming families were almost impossible to engage with because mobility (the opportunity to travel unaccompanied) is limited or non-existent and travelling would impact on their existing work demands. This was a very important observation, as the diversity of these small ruminant farming families requires different recruitment approaches in future research to equitable, representative engagement.

Production limitations identified by smallholder farming families

Figure 5: Issues ranking activity in the women's PRA meeting in Qadir Bakhsu, Shikapur (photo: Rebecca Doyle)

We asked both women and men what they identified to be the most important constraints to improving production of their small ruminants. Along with general discussion on the topic, we asked all participants to rank what they believed to be their top problems for small ruminant production (Figure 5). Four options were presented: health issues, reproduction issues, nutritional issues and 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 to be the major issue affecting small ruminant management, with health a close second. Men's groups ranked health as the major issue and nutrition second.

When looking at the breakdown of activities both genders perform, women play an important role in feeding and caring for livestock, but never deliver health care to the animals, or interact with veterinarians, with these roles being performed by men (**Figure** 6). It is likely that this difference in first and second priorities relates to the relative activities and exposure of both genders. Women also have less direct contact with animal health providers, most of whom are male, which has important implications for how we could advise women to seek animal health advice and provides a clear need for increasing the capacity and availability of female animal health workers. Despite the differences between first and second priority, health and nutrition were considered the two most important constraints by both women and men. Understanding the specific issues behind each topic was the next important step. Other aspects of the village participatory activity helped give context to these broad issues, but more specific research is required.

We also investigated whether resource availability affected the ranked issues reported between villages. Villages with low resource availability considered nutrition to be the most significant issue affecting small ruminant production, and as resource availability increased, the importance of nutrition declined, and health became the most significant issue (**Figure** 7). This result is not a surprising one, as more resources provide more options to feed animals throughout the year. Importantly, these finding highlights that different villages will have different issues that need addressing, influencing the focus of future observational and interventional research. Limited scientific research has been conducted around small ruminant production compared to cattle and buffalo, so preliminary descriptive or fundamental research is still required, particularly including its practical application.

Health was the other key limitation small ruminant farmers experienced. Mortality of young stock was frequently identified by farmers as an important issue, with reported rates of 25-80% per annum. Female and male farmers identified that harsh weather in both the winter and summer periods to be associated with the poorest survival, with 'climate' and 'nutrition' the most common underlying causes. Although both risk periods are preceded by times of limited animal nutrition, the specific causes of mortality at these times were unclear. Farmers reported that they received little to no veterinary support for their small ruminant farming locally. Similarly, there was no extension material or activities available for small ruminant farmers in any villages visited, even when support for large ruminant farming was available.

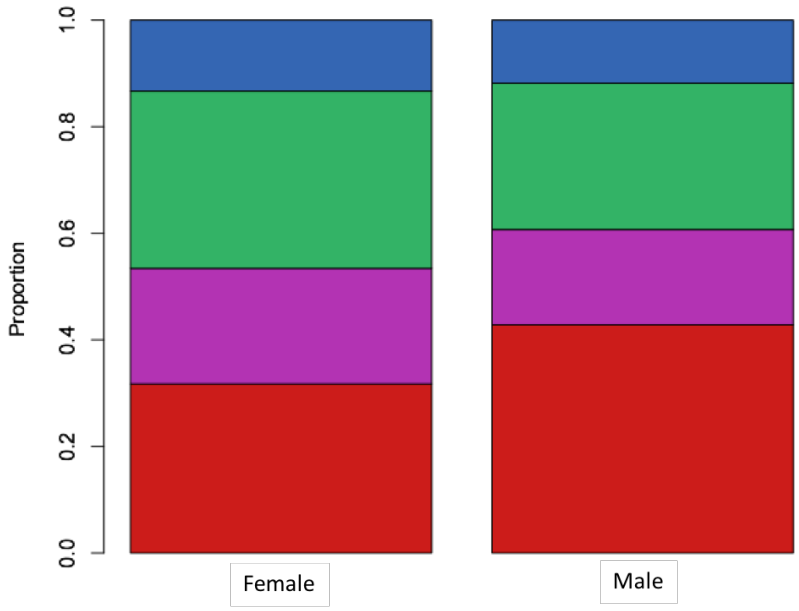

Figure 6: Issues affecting small ruminant production stratified by gender; sales/marketing = blue, nutrition = green, reproduction = pink, health = red

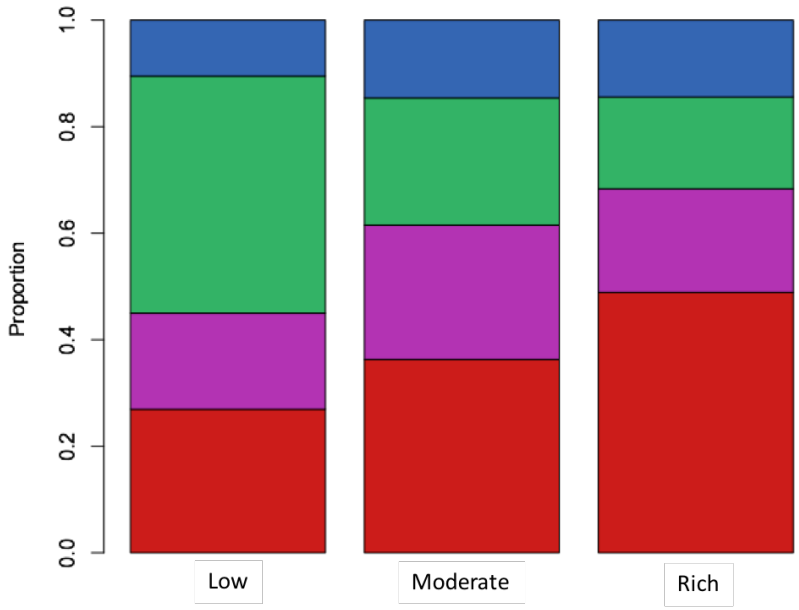

Figure 7: Issues affecting small ruminant production stratified by resource rank; sales/marketing = blue, nutrition = green, reproduction = pink, health = red

Conclusion and future focus

It was clear that poor on-farm production is a major constraint to the entire small ruminant value chain in Pakistan. Key limitations include poor productivity due to inadequate nutrition, health and mortality of young animals. Appropriate research, critically followed by accessible and relevant extension and other support, are required.

As anticipated, all members of small ruminant farming families play different roles in the husbandry and management of these animals. We suggest that future research must specifically engage with each of these groups in different ways. Furthermore, research must not only recognise gender diversity, but also the different roles and needs of

householders of different age, socioeconomic status and ability. Key future issues include:

1. Understanding the roles of different social groups and their opportunities for change
2. How key messages from interventions can be delivered to all relevant groups
3. What impact from future projects would look like for different social groups, and how it could be evaluated

Women and children play a critical role in goat and 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

5 Rapid Value Chain Analysis

A Rapid Value Chain Analysis (RVCA) was undertaken to describe small ruminant value chains in four locations in Punjab (Lahore, Raiwind, Okara, and Mankera) and two locations in Sindh (Karachi and Thatta) provinces, as well as their enabling environment, constraints and opportunities. The locations were chosen to cover areas both close to and further from large urban centres in Punjab and Sindh provinces.

Methodology

A total of 112 stakeholders were interviewed, including 26 consumers (15 individuals and 11 restaurant/canteen managers), 21 butchers/retailers, 2 wholesalers, 3 processors (abattoir/exporter), 1 wholesaler/collector of by-products, 50 traders (beopari) (Figure 8) of varying sizes (including contractors and suppliers), and 9 government veterinary staff. Semi-structured interviewing was used in individual discussions and focus group discussions were also held to collect qualitative information about each stakeholder's activities within the value chain. Direct observation was also utilised in livestock markets, processing plants and retail stores, and the individual consumer interviewees were selected at the time of visiting the retail stores. Broad areas discussed for each segment of the value chain were the identity of the stakeholders; core processes in the value chain and key activities; how value changes along the chain; product preferences and prices; key constraints for stakeholders; flow of product, money and information between segments; and the nature of the relationship between segments. Also explored were how the issues differed across regions; what differences there were between goat and sheep value chains; the different kinds of products utilised apart from meat (particularly hides and offal); the types of services feeding into the value chains; and the role of women in the value chains. Some consideration of geographical (routes of animals and products) and temporal (seasonal fluctuations) mapping was incorporated into the RVCA.

Figure 8: Interviewing small ruminant traders at the Lahore livestock market (photo: Angus Campbell)

Figure 9: Traditional butcher in the wet market in Okara (TDVC) (photo: Jenny Turton)

Distinct Small Ruminant Value Chains in Pakistan

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

1. A **Traditional Domestic** value chain (**TDVC**) supplying traditional wet markets;
2. A **New Domestic** value chain (**NDVC**) involving higher-end consumers buying chilled meat in supermarkets and speciality butcher shops;
3. An **Export** value chain (**EVC**) exporting chilled carcases by air to shops and consumers in the Middle East;
4. A **Religious** value chain (**RVC**) in which animals are purchased for sacrifice during festivals such as Eid-ul-Adha and for other religious observances

Approximately 70% of product flow is through the TDVC (Figure 9). The domestic and export value chains (TDVC, NDVC and EVC) directly compete for a very similar product, namely an animal up to 12-18 months of age of 8-12 kg (up to around 18 kg) carcase weight. Preferred breeds of animals (and species) vary regionally, although there appears to be little consumer differentiation of product beyond goat versus sheep at the retail level.

Although its main time of operation is only for six weeks around Eid-ul-Adha, the RVC comprises about one third of the small ruminant meat value chain, consuming about 9 million from a total volume of about 25 million head annually. There is a strong preference in the RVC for slightly older animals (up to around 2 years of age) and heavier body weights. Animals for the RVC are frequently selected visually (Figure 10; Figure 11), with great emphasis on appearance and condition of the animal, and prestige associated with the price paid for the animal. Refer to Figure 15 for an industry map incorporating these 4 value chains.

Figure 10: Sheep for sale at the Lahore livestock market (RVC) (photo: Jenny Turton)

Figure 11: Decorated goat for sale for the RVC at the Lahore livestock market (photo: Jenny Turton)

Trading networks appeared to operate efficiently over wide 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. 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 the TDVC and traditional butchers, who place less emphasis on product quality and food safety than the other value chains.

The NDVC and EVC (Figure 12) 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 consumer preferences and religious and cultural familiarity. Animals for both the NDVC and EVC 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.

Figure 12: Retail store for the NDVC in Karachi (left) and export destinations for the EVC (right) (photos: Jenny Turton)

The post-farm value chain analyses identified a broad consumer preference for goat meat, though this varies considerably across different regions. For example, large areas of Balochistan, with large Afghan ethnic groups, prefer sheep meat. Similarly, sheep are frequently and conspicuously sold along with goats during the major religious festivals of Eid-ul-Fitr and Eid-ul-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 consumers purchase. Small ruminant by-products of hides and offal were utilised, but there was no evidence of wool being used as a product in any of the sheep-producing regions studied. The fibre and skin value chains require further description.

Value Chain Constraints and Opportunities

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 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, and even 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 small ruminant value chains.

Figure 13: Informal small ruminant market outside Karachi (photo: Aijaz Kumbher)

Productivity per animal unit 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 NDVC and EVC showed a clear opportunity to take up extra supply if it became available.

Other value chain factors also demonstrate the potential for improved on-farm production and sustainability to benefit smallholders. The well-established trading networks enable animals to be sourced over long distances to meet market demand (Figure 13 depicts small ruminants from Balochistan which were being sold outside of Karachi), 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 ruminant 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-ul-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 manage to do so very successfully, but there was only a handful of examples of this and they tended to be mixed livestock farmers that lived in resource rich regions.

All of our SRA findings indicate small ruminant owners use their stock as a bank, 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. Increasing the quantity and quality of goats and/or sheep would potentially give them more flexibility to pursue

alternative markets and hold onto some livestock so they can meet the more lucrative target markets.

In terms of meeting market requirements and providing options to smallholder farmers, there is a clear shortage of small ruminants. 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. These animals are also suitable for fattening under a feedlot system, allowing for specific export and the Eid-ul-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 ruminant producers can increase the number of healthy animals they produce, they can capitalise on all value chain opportunities.

Figure 14: Meat consumer in the wet market (TDVC) in Bhakkar District, western Punjab (photo: Jenny Turton)

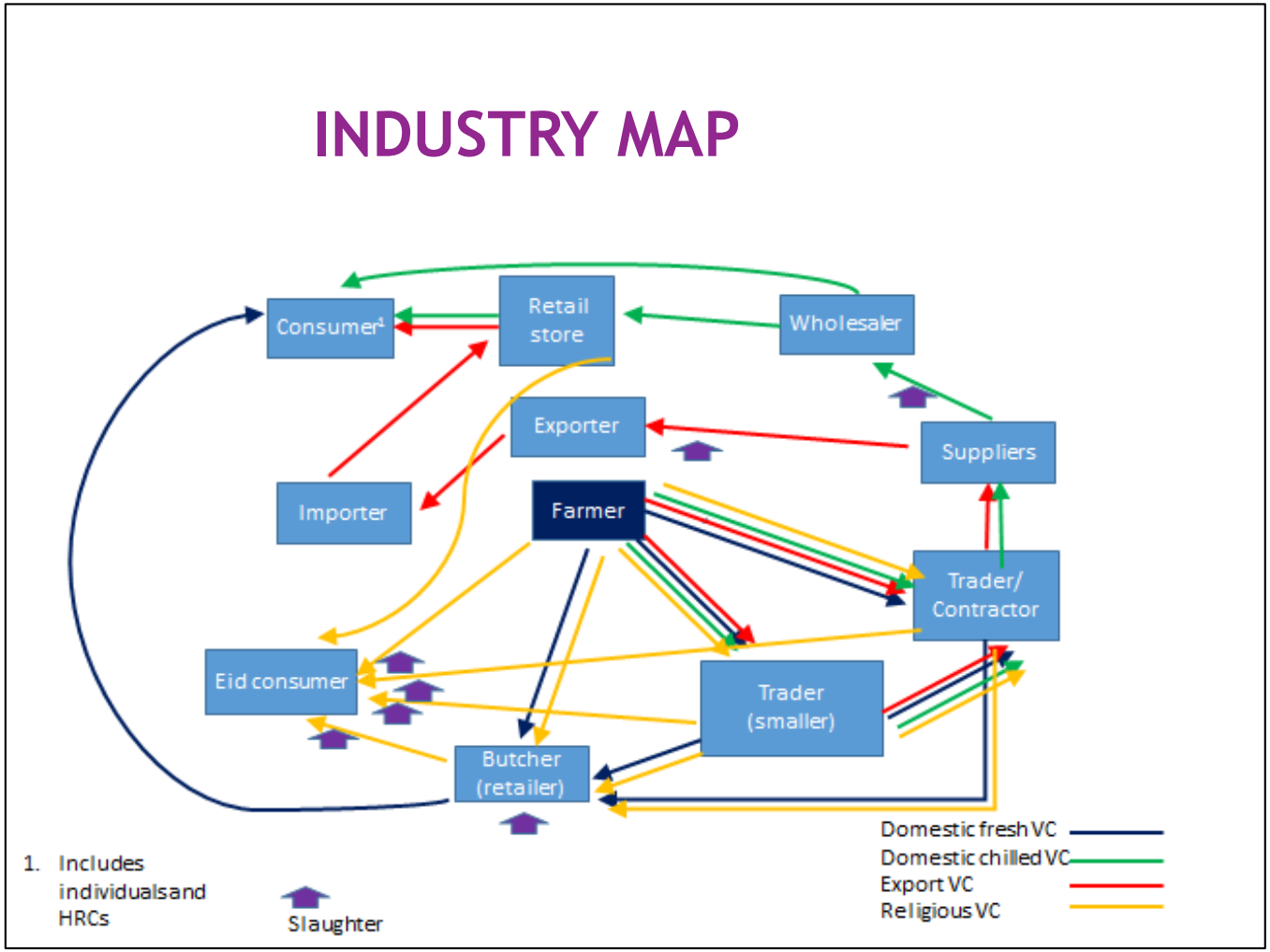

Figure 15: Pakistan goat and sheep meat industry map

6 Participatory Assessment of Animal Health Services Available to Small Ruminant Farmers, and Key Health Challenges

A further major activity for the SRA involved a participatory animal health activity with provincial government Veterinary Officers (VOs) and Veterinary Assistants (VAs) to understand their perceptions of small ruminant health issues and constraints to production, and the animal health services they offer to small ruminant farmers. These findings were triangulated with the results of the farmer participatory research.

This study involved meetings with 172 veterinary healthcare professionals over 10 areas, 5 in Punjab and 5 in Sindh provinces. Of these participants, 87 were Veterinary Officers and 85 were Veterinary Assistants. All of the VAs were men, whereas 76 of the VOs were men, and 11 were women. Participatory activities included ranking and pairwise comparison (Figure 16; Figure 17).

Figure 16: Ranking activity with Veterinary Assistants in Jhelum (photo: Aijaz Kumbher)

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, 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 these interventions are often poorly timed, limiting their efficacy or dramatically reducing the efficiency of these large-scale activities.

Constraints identified in order of importance were health, extension services, nutrition, husbandry/housing, marketing and breed improvement. There were differences in the importance of the constraints between provinces and between VAs and VOs. The five major health constraints listed were PPR (Peste des petits ruminant); Enterotoxaemia;

Parasites; CCPP (Contagious Caprine Pleuropneumonia) and FMD (Foot-and-mouth disease).

Challenges and opportunities included:
• Evidence-based veterinary medicine
• Quality of medicine and vaccines
• Continuing professional development of veterinary healthcare professionals
• Farm economics and entrepreneur skills for farmers
• Education of farmers (extension messages), incorporating a whole family approach
• Policy framework

Figure 17: Ranking activity involving a female Veterinary Officer in Rawalpindi (photo: Aijaz Kumbher)

7 Identify and evaluate potential feed interventions

This is a summary of the 5 activities included under the extension objective.

7.1 Regional feed survey: identification of feeds interventions and management of small ruminants

Participatory interviews have been conducted to *1. evaluate how farming families feed and managed young stock and adult animals*, and *2. to identify types of crops, forages and regional feed stuffs in the area and the way they're currently used*.

Results summary

A total of 51 interviews were conducted in Punjab, and 127 interviews in Sindh.

Small ruminant herd sizes were similar across both provinces, 23 animals on average, and largely consisted of goats. Farmers across Punjab (80%) and Sindh (94%) grazed their herds on grasslands and fed many forms of kitchen waste (80%) year-round. Apart from farmers in Rajanpur, who more commonly reported cut-and-carrying grasses for their herds. It was common across Punjab and Sindh for fodder to be abundant from June-July, two districts had abundant fodder from December-March (Rajanpur and Mirpur Khas). The average age at which young small ruminants joined the herd for grazing was 2.5 months old and varied greatly within each district, from birth to 7 months of age.

Wheat stubbles were used by most farmers in both districts (75%), used the least in Tharparkar. Forages were most commonly cut-and-carried across both provinces (77-79%), except for in Mirpur Khas where farmers more commonly reported grazing their herds on forage crops. Additionally, more farmers in Sindh reported using at least one grazed forage (50%) than in Punjab (12%). It was more common for Punjabi farmers to use concentrates, with 73% feeding cottonseed cake. Crop by-products, such as straw and husks, were also used more in Punjab; where 90% of farmers used at least one type of by-product, than in Sindh where only 17% of farmers used at least one type of by product. Sindh farmers reported using a wider variety of stubbles (21) than Punjab (13). Most Punjabi farmers provided supplementary feed to their young small ruminants (90%); largely forages (44%) such as trees, berseem and lucerne, however, there was limited information collected for Sindh farmers around supplementary feeding for young small ruminants. The only participants who fed concentrates were in Chakwal (n=6) and Tando Allahyar (n=1). It was most common for all family members to be involved in small ruminant management and feeding, more participants in Punjab reported having sole feeding responsibility.

Average mortality rates were similar across the two provinces, with young animal mortality being the highest (Table 2). Key issues for both provinces were fodder shortage, disease and mortality. Most information was gathered around young small ruminant mortality factors, including diseases (52%) such as influenza, viruses, coughs and infections (26%), gastrointestinal symptoms (17%), ticks and paralysis (3%); weather extremes, particularly cold, were the other common reasons behind young animal mortality (31%). Adult small ruminants' mortality was associated most commonly with diseases (19%) such as influenza, fevers, viruses and infections (n=12), gastrointestinal issues (n=8) and paralysis (n=3). Other causes listed included reduced fodder due to drought (n=7), cold weather (n=6) and arsenic poisoning from the water (n=5).

For most participants, agriculture and livestock were their main sources of income (56%), 33% reported themselves or family members being employed as labourers (n=11), in agriculture (n=14) or drivers (n=6) for example, 10 of whom reported that employment was

their main source of income. Family members and women were commonly involved in decision making regarding small ruminant management, however, men usually had control over the household income. Income was used mostly for general household expenses (72%), and agricultural purposes (41%), such as purchasing feed and livestock, followed by emergency situations (20%), ceremonies (20%) such as marriages or Eid

Table 2 Average mortality rates (%) of small ruminants in Punjab and Sindh

	Male goats	Female goats	Young goats	Total goats	Total sheep	Total small ruminants
Punjab	6.2	3.3	13.3	7.2	6.2	8.0
Sindh	3.9	5.5	16.1	9.7	2.0	9.7
Grand Total	4.9	4.6	14.9	8.6	3.8	8.9

7.2 Creep feeding trial

In January 2019 a longitudinal study to assess the value of creep feeding was started. The study was conducted in two districts, district Chakwal from Punjab and district Tando Allahyar from Sindh. This trial addresses activities *4. trial feed interventions based on information collected from the participatory feed analyses*, and *5. start to developing a decision support tool to improve animal nutrition*.

Of the major findings from the SRA, it was clear that poor supply (quantity, quality and consistency) of animals from farms is the major restriction in many value chains. Key factors behind this poor supply were ill thrift and mortality of young animals, and inappropriate nutrition and poor health of adult stock. Creep feeding is a method of providing extra supplement feed is provided to young animals and ensuring that young animals have exclusive access to this feed. The aim of creep feeding is to access the value of providing high value feed (energy and protein) and water to young animals. A successful creep feeding trial was conducted in Myanmar. This work identified that providing high quality supplementary feed (high protein and energy) to young animals dramatically improved survival.

This study has also built the capacity of team members and farming families, collected longitudinal health data from 306 young goats and sheep, and established working relationships with 4 villages that can persist for the next 3 years.

7.3 Share SRA research results with stakeholders

Research outputs

For activity *1. Publish papers and/or conference presentation of the SRA results from the last 12 months* we had 2 conference presentations presented at TropAg, 2019 (Appendices 10.1 and 10.2)

Workshops

In an effort to *2. share results, discuss how to use decision support tools, and make plans for the full project*, we have held a series of workshops in Pakistan.

Capacity building workshop

In June 2018 we held a capacity building workshop at UVAS in Punjab, and SAU in Sindh. The knowledge sharing component of the workshop involved information sharing from the first 12 months of the SRA, the plans for the feed surveys, and research work from Australia.

Presentation titles:

- Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan
- Farmer attitudes, animals and farmer feedback
- Researching & Improving Goat & Sheep Productivity
- Regional feed survey: developing feeding strategies for small ruminants

The technical component of the workshop included

- Livelihoods or profit maps: how to use the tool and why it's of use for smallholder farmers
- Condition scoring goats and sheep: why and how to
- A practical exercise on condition scoring goats at the university farm

Approximately 20 university, government and NGO staff attended the workshops in both Punjab and Sindh.

Inception workshop

In February 2019 we held an inception workshop for the project LS/2018/105 where we showcased results from the SRA. This included the key findings from this report:

1. Mutton (meat from small ruminants) is highly valued and there is a clear demand for it across a variety of interlinked value chains
2. There are good trading networks linking small holder farmers with the rest of the value chain, although different value chain actors do not always seem aware of the options they have for connecting with different value chains
3. Poor supply (quantity, quality and consistency) of animals from farms is the major restriction in many value chains
4. Profitability and expansion of emerging markets (e.g. local supermarkets, export) is potentially constrained by this limited and/or inconsistent supply of animals
5. What currently do carcasses look like? The desired traits are 1 ½ -2 years of age and 15-30 kg CWT, but farmers sell on an 'as needs' basis ("bukri bank") or when animal is sick
5. Women and children play a critical role in goat/sheep farming. Supply can be increased by engaging with the whole family. However, the impact of increasing animal numbers and management methods on these groups needs to be considered.
6. Opportunities for small ruminant production in Pakistan
    - Feeding management and nutrition
    - Adult management and young stock mortality
    - Strong value chains and demands
    - Providing opportunity for all societal groups

Results from the feed survey, including reproductive efficiency data, and the plans for the creep feeding trial were also presented in more detail as this was new information for all of the participants (details of this are in *Identify and evaluate potential feed interventions* above).

8 SRA Concluding Workshop, November 2017

A final workshop for the first part of the project, entitled "Goat and Sheep Production and Supply. ACIAR Project Feedback and Priority Setting Workshop", was held at UVAS in Lahore on November 6th, 2017. Following is the Executive Summary.

Executive Summary

An end of project workshop for the ACIAR/DFAT funded Small Research Activity "Goat Value Chains: Challenges and Opportunities" was held at the University of Veterinary and Animal Sciences (UVAS) in Lahore on Monday 6th November 2017. The objectives of this workshop were to:
1. Share research findings from 2017 SRA activities with key industry stakeholders
2. Validate research findings through small group discussions
3. Obtain participant input into what future research should be conducted through small group discussions
4. Identify key future research and development partners

A total of 29 external participants attended the workshop, with an additional 11 participants from the University of Melbourne and UVAS project team. These represented a range of value chain stakeholders and service providers for the small ruminant industry (academic/research institutions; government/policy making; national and international NGOs; processors; retailers; famers). They also represented the different geographic locations of Pakistan (Punjab, Sindh, Balochistan, and KPK).

5 key issues areas had been identified by the project from the field work conducted over the past year. These were:
1. Growth and mortality of young sheep and goats
2. Nutrition and husbandry of adult sheep and goats
3. Options for selling animals
4. Animals meeting market specifications
5. Knowledge and services to farming families

Small group discussions validated the importance of these 5 key issues, and no gaps in topic areas were identified. The rich small group discussions enabled input around the importance of the issue; background factors contributing to this issue; information gaps around this issue; future activities to address the issue; and expected outputs and impacts of these future activities. A follow up activity was to prioritise these five key issues, and the order of importance allocated to them was 1. Knowledge and services for farmers (32%), 2. Nutrition and husbandry of adult sheep and goats (20%); 3. An equal ranking of Growth and mortality of young sheep and goats and Options for selling animals (18%), and 4. Animals meeting market specifications (13%).

The discussions from workshop participant engagement was integrated into future research questions and activities which had been developed by the project team, and these were presented to the workshop participants:
1) How can growth and productivity of small ruminants be improved on farm?
a) On-farm studies to identify constraints in more details
b) Test interventions on farm
2) How can information and practices benefit different farming households and family members?
a) Adapting interventions to suit local resources
b) Measuring labour impacts
c) Assessing financial and family benefits
d) Adapting extension material for different groups
3) How can farming families engage with value chains better?
a) Measuring how well interventions enable farmers to meet market specifications

b) Testing new methods to engage with markets
c) Testing new small ruminant systems

Participant engagement was high, and evaluation following the workshop was positive. Some of the aspects participants valued most about the workshop were the range of stakeholders present; the networking opportunity; the group work; participant enthusiasm; and the fact that there was interest in small ruminants in Pakistan.

In conclusion, the workshop was extremely successful in engaging with small ruminant stakeholders in Pakistan and meeting the objectives. Priorities and activities for a future research project were clearly identified and future project partners were identified both at the workshop and through one on one follow up discussion.

Figure 18: Participatory group discussions on small ruminant issues at concluding workshop (photo: David McGill)

9 SRA Conclusions and Recommendations

9.1 Conclusions

There is a strong argument for further research and extension to support the development of small ruminant value chains in Pakistan and increase the benefits smallholders derive from these value chains. The greatest emphasis should be on developing and/or extending practical strategies that increase productivity and efficiency on-farm. These findings have now been included as key actions for the 3 year project *LS/2018/105: Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan*

The key SRA findings were:

1. Mutton (meat from small ruminants) is highly valued and there is a clear demand for it across a variety of interlinked value chains;
2. The vast majority of mutton in Pakistan originates from small- to medium-scale farms, chiefly from poorer households dependent on agriculture for their livelihoods;
3. There are good trading networks linking or potentially linking smallholder farmers with the rest of the value chain, although different value chain actors do not always seem aware of the options they have for connecting with different value chains;
4. Poor supply (quantity, quality and consistency) of animals from farms is the major restriction in many value chains;
5. Profitability and expansion of emerging markets (e.g. export) is potentially constrained by this limited and/or inconsistent supply of animals;
6. Extension and other services for small ruminant farmers are very limited. Where they occur, they are infrequently evidence-based, and government programs may be poorly coordinated or inconsistent, which limits their impact;
7. Smallholders could capitalise on high market demand, but there are barriers that prevent smallholder farmers from increasing supply and improving production;
8. Women and children play a critical role in goat and sheep farming. Supply can be increased by engaging with the whole family. However, the impact of increasing animal numbers and management methods on these groups needs to be considered.
9. A wide range of feeds are used by farmers, including supplementation. This means that options to develop feed interventions are available, and farmers have awareness of this practice.
10. While it is used, supplementation may not be very effective. Annual doe/ewe mortality ranges from 0-15%and herd/flock reproductive efficiency is generally low. In 58% of villages surveyed, the average production of ‘saleable’ offspring was < 1 per breeding female per year, and no villages produced > 1.5 saleable offspring/breeding female/year.

9.2 Recommendations

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 livestock, backed by practical, evidence-based extension and engagement programs for farmers and other value chain actors. This will support sustainable growth of all small ruminant value chains in Pakistan. Engagement of women is critical, as it provides the opportunity to improve the livelihoods of small ruminant

farming families and to empower and benefit women within these families. Crucially, this must be done in a culturally respectful way for all members of the family.

This has formed the basis of the objectives and activities for the project LS/2018/105: Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan

Project objectives

1. Develop and test improved production practices to increase growth and off take of small ruminants
2. Create opportunities for women and their families to derive more benefits from small ruminant production and marketing
3. Develop and test strategies for supporting small ruminant farming families to assess market opportunities and attain market specifications

Significant activities and outputs

- Identifying and acting on the key health and welfare issues and improving the survival and growth of young and adult small ruminants;
- Identify current breed potential: how best practice management affects growth, production and health of goats and sheep
- Trialing strategies for better participation for men and women in small ruminant value chains;
- Trialing ways to share opportunities and technical knowledge with families raising small ruminants in in landed and landless situations

10 Appendices

10.1 Appendix 1: Understanding the impact of on-farm wastage on productivity and livelihoods of smallholder goats farmers in Punjab and Sindh, Pakistan

Angus J. D. Campbell, Shumaila Arif, Muhummad Atta ul Zia, Abdul Hussain Memon, and Rebecca E. Doyle

TropAg Conference, Brisbane 2019

Reproductive efficiency is an important driver of productivity in small ruminant farming systems worldwide that is affected by both doe/ewe reproduction and offspring survival. These measures were evaluated through interviews gathering stock tally data from 114 smallholder farmers in Pakistan (51 Punjab, 63 Sindh), providing previously unpublished insights into herd demographics and productivity issues that currently constrain farm income and livelihoods.

Breeding does were kept by 73% of households and 24% kept both goats and sheep. Average breeding herd size was 10 does and/or 4 ewes per household, and many households (n=36; 31%) had 5 or fewer breeding females (15 in Punjab and 21 in Sindh). Annual doe/ewe mortality was 0-15%, and four villages reported average doe mortality >14%. Herd/flock reproductive efficiency was generally low. Although two villages reported average birth rates >1.5 kids/doe/year, it was <1 kid/doe/year in 11 villages. Reported kid mortality was often high, ≥ 10% p.a. in 14/24 villages, including 6 villages >20% (maximum 36%). Combining doe/ewe birthing percentages and offspring mortality showed that overall reproductive efficiency was poor. In 58% of villages, average production of 'saleable' offspring was < 1 per breeding female per year and no villages produced > 1.5 saleable offspring/breeding female/year.

Improving overall reproductive success would reduce significant wastage, substantially improve household income from existing livestock holdings, and meet untapped national demand for goat and sheep meat. Current practices and specific interventions to improve breeder reproduction and/or offspring survival are currently being assessed on smallholder farms in Punjab and Sindh.

10.2 Appendix 2: Consumer Preferences for Goats & Sheep in Pakistan's Religious Meat Value Chain

Shumaila Arif, Angus JD Campbell, Tony Dunn, Abdul Hussain Memon, Muhammad Atta ul Zia, Abdul Aziz, Rebecca E Doyle

TropAg Conference, Brisbane 2019

Small ruminants and their meat (mutton) is a highly valued and culturally prominent part of Pakistan's livestock industry. Four interlinked mutton value chains (VC) exit: traditional wet market, new domestic (supermarkets), export, and religious slaughter, and smallholder farmers (SHF) supply all VCs. The religious VC is the largest trading 9 million of the 25 million animals slaughtered annually, and the highest demand is at Eid-al-Adha.

A cross-sectional survey of 53 potential customers was carried out at three mandis just prior to Eid-al-Adha. All customers were male and over half (56%) were aiming to buy only one animal. Preferences were for two-toothed (one year-old) and phenotypically "attractive white" or single coloured animals; 43% of customers had a specific breed in mind. There was a huge variation in willingness to pay from 15,000-60,000 Pakistani Rupees (PKR), but most (62%) were looking to pay between 20,000 to 30,000 PKR (~2.5x prices of traditional domestic VC). The main challenges for purchasing were high prices (56%) and difficulty finding desired animals (45%). Over half of consumers were looking for animals between 21 to 30kg carcass weight, and 96% had a carcass weight in mind. Carcass weights were estimated on visual assessment with liveweights unavailable.

Communicating VC specifications to farmers and extension officers will be a key activity in our project. SHFs supplementary feed select animals for Eid-al-Adha, so understanding VC specifications could lead to better price outcomes and encourage more strategic selection and investment in preparing animals for sale.