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2 Executive summary

Goat producers in the Enrekang District, South Sulawesi, Indonesia identified a need to increase their capacity to produce more goats (and therefore increase their incomes and their economic security) but recognised their limitations in terms of knowledge and skills in goat husbandry, management and marketing.

The project identified that an iodine deficiency (goitre) existed in the diet of the goats. At the same time it was apparent that there was a need for goat producers to be able to regularly weigh their animals for breeding, husbandry and marketing purposes.

Iodine in Povidon solution, when applied to the skin of goats was found to quickly overcome goitre problems. Thus farmers involved with the project (and those from neighbouring villages) have increased knowledge and skills of: solution to the problem of goitre in their goats, as well as improved feeding other than Gliracidia, and capacity to better manage and market their goats. With the involvement of goat farmers a practical, cheap and accurate tool was developed for estimating the liveweight of goats for their specific populations of goats.

A range of survey tools were used to gain a better understanding of the consumer constraints to goat meat consumption in Makassar and the supply chain of goats in Sulawesi and its interconnection with other islands in Indonesia.

This project has identified that there are problems, constraining goat production, for which there are solutions and that goat farmers are willing to be involved in developing new techniques to solve these problems and as such improve the productivity of their animals to produce more protein, as well as improving both the living standards of goat farmers and their animals. To ensure this continues and expands in South Sulawesi it is necessary to have a Provincial and Regency champion for goitre eradication and for continued improvements for goat farmers.

An integrated study of goat production, across Indonesia, identifying local problems and involving local goat farmers in creating solutions will result in significant improvements in goat productivity as well as raising the living standards of many poor Indonesian people. This could include the development of locally calibrated tape measures for estimating liveweights of goats in different locations. This integrated study should also include scientific validation of the Povidon solution for goitre.

The project has identified that there is demand for goat meat, and there is opportunity to improve the supply chain, and that this plus consumer ignorance or misinformation about the benefits of eating goat meat means a better understanding of the supply chain for goat meat, and education of goat meat consumers, across Indonesia should result in greater demand for goat meat and improvements in the supply of goats from farmers to consumers.

3 Background

The Indonesian Government through Central and Provincial Government, and District initiatives (e.g. importations of exotic goat breeds, loans for the purchase of goats, extension activities) has encouraged farmers in Indonesia, and South Sulawesi in particular, to embrace goat production as a means of meeting the need to increase living standards and the increasing demand for animal protein. These initiatives have reached the point where a number of goat farmers in the Enrekang District have progressed from the 'Keeper' (animals kept by families as 'petty cash') type of production system to a 'Producer' (producing animals as their livelihood) type of production system and are now constrained by a lack of husbandry and marketing knowledge and skills. Significant export markets for goat exist within South Sulawesi. Constraints to increased goat production and access to these domestic and export markets could be overcome with refinements to existing goat production, transport and marketing systems, which as well as producing more and bigger, younger animals would also increase incomes for existing goat producers and assist with the development of a viable goat industry within Indonesia.

In the Enrekang District of South Sulawesi the current goat population is believed to be 56,000 goats of which 90% (80%) are cross-bred (typically with Etawah) and about 10% (20%) Kacang goats. Most of these goats are housed for most of their lives in kandang around houses and in the plantations, where they are typically fed 'cut and carried' leafy branches of Gliracidia and sometimes grasses. Gliracidia is widely available because it is used as a legume to increase soil fertility, provide shade and support for estate crops and as source of firewood, however, there is a shortage of easily available grasses in some locations to balance the diet. Some of these housed animals are not given water and this combined with a diet known to cause limitations to growth rates in goats must severely impact on the fertility and growth rates of these animals.

Goat producers in the Enrekang District identified a need to increase their capacity to produce more goats (and therefore increase their incomes and their economic security) but recognised their limitations in terms of knowledge and skills in goat husbandry, management and marketing. They have excellent skills in building kandang and the Indonesian Government through Central and Provincial Government, and District initiatives are supporting villagers to buy small numbers of goats. Currently farmers in South Sulawesi and particularly in Enrekang seem to be facing a sellers market. Goats in Enrekang appear to be bringing a price at least equivalent to the price in Makassar. Consequently, goats are coming in to the southern ports of South Sulawesi from more Southern islands of Indonesia (e.g. Flores) while goats from Enrekang are moving north and ending up in Kalimantan. Most demand seems to be for cultural and religious reasons, with little goat meat sold in local restaurants and meat markets. Some constraints to improvements in marketing of goat and expansion beyond cultural and religious market demands include: consumer attitudes to goat meat, poor and unhygienic marketing and processing facilities, an array of taxes, charges and impediments to trade and a lack of knowledge of the market and supply chain. In addition, currently there does not appear to be any price incentive for improving the condition score of animals. These factors will be investigated in this study.

The project will develop approaches to develop more sustainable systems that integrate goat production with estate plantation crops in Eastern Indonesia and enhance goat productivity and meet market specifications through improved management of feed and reproduction. It will also investigate opportunities for improvements in the goat supply chain and alternatives to the existing chains.

4 Objectives

The aim of the project is to develop understanding and insight of the goat supply chain, in South Sulawesi and identify possible interventions that would improve smallholder and chain profitability. The objectives are to:

1. Improve understanding of existing markets and supply chains and assess alternative markets and supply chains.
2. Improve understanding of the smallholder goat industry and the social, cultural, economic, institutional and resource constraints to its improvement.
3. Identify improvements for on-farm goat production by refining feeding and watering systems, health and breeding management of goats.

Objective 1: Improve understanding of existing markets and supply chains and assess alternative markets and supply chains.

Activity 1: Survey local and export markets and supply chains for goats produced in South Sulawesi Province focusing on the Enrekang District to investigate prices, costs and relationships along the supply chain.

Activity 2: Survey consumers and institutional buyers in Makassar and/or Parepare regarding their perceptions of goat meat, current sources of supply and their projected requirements.

Activity 3: If possible organise 2 or 3 joint meetings with farmers, traders and retailers of goat meat to discuss constraints to the industry & discuss potential solutions.

Objective 2: Improve understanding of the smallholder goat industry and the social, cultural, economic, institutional and resource constraints to its improvement.

Activity 1: Facilitate a series of workshops and participatory research activities with farmer groups from two communities aimed at understanding farmer production and marketing activities and investigating potential improvements.

Activity 2: Towards the end of the project survey a broader range of farming families and local traders to confirm hypotheses about the goat industry identified in the workshops and research activities.

Objective 3: Identify improvements for on-farm goat production by refining feeding and watering systems, health and breeding management of goat on-farm

Activity 1: Identify 'best bet' practical solutions to improve productivity on family farmer enterprises. These family farmer enterprises will have a linkage with local plantation crops, using the cut and carry feeding system.

Activity 2: Train extension staff from AIAT and Dinas, and students from Hasanuddin University in the conduct and monitoring of on-farm evaluation studies and supply chain studies.

5 Methodology

All studies involving animals were conducted in accordance with the guidelines of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes and the University of Queensland Animal Ethics Committee.

The methodology to achieve the objectives of this project were split into three broad sections of adaptive research:

1. Analysing the market chain
2. Socio - economic analysis of smallholder goat industry
3. Goat production

It is important that the initial stages of this project were concentrated on the demand side of the supply chain as the social and capacity elements can act as a 'reality check' to ensure that proposed changes are realistic.

5.1 Analysing the market chain

The first step in evaluating the potential for the goat industry was to describe the marketing chain and develop an understanding for the potential demand and supply of goat products. Data for this activity was collected by a combination of primary and secondary data collection through surveys and industry discussions. Investigations conducted for this included:

Investigation of supply chain from Enrekang

A field trip was conducted to observe and identify the markets and links in the existing trading chain from Enrekang through South and West Sulawesi to Mamuju. Secondary data were obtained from the Animal Husbandry Office and the Agricultural Department (Dinas Pertanian dan Peternakan) of West Sulawesi Province. Semi-structured interviews and Focus Group Discussion (FGD) were used to collect qualitative and quantitative information on small ruminant trading. The respondents were the buyers, collectors and the inter-island goat traders; with one respondent who acted as both the breeder and the trader. Participants were identified through a process of intercepts in markets and snowballing.

A trip was conducted to East Kalimantan to investigate prices, costs and relationships along the supply chain from Mamuju to East Kalimantan to link up with the previous investigation of the chain from Enrekang to Mamuju. Data was obtained from semi-structured interviews with trans-island traders from West Sulawesi and six roadside sellers in Balikpapan and 10 roadside sellers in Samarinda.

Data was analysed using simple averages and distributions of price and weight data and qualitative analysis of responses.

Surveys of consumers in Makassar

A survey of Makassar consumers had the objectives:

1. To assess the criteria used by Makassar consumers when purchasing meat and in particular attitudes towards goat meat.
2. To investigate levels of consumption, and purchase and consumption patterns for consumers of goat meat.
3. To identify and characterise market segments in the goat market.

Two hypotheses derived from anecdotal evidence and discussions were:

1. Goat is mainly consumed for religious and cultural reasons.
2. There are some negative perceptions held by a large proportion of the population about goat, which include that it can cause hypertension and has an unpleasant smell when cooked and that these factors will affect consumption.

Consumers interviewed came from 14 subdistricts in Makassar with a similar number in each subdistrict. A total of 388 questionnaires were submitted, of which 374 were suitable for analysis. The questionnaire addressed the issues of:

- Purchase characteristics of meat
- Meat usage and occasions used
- Attitudes to goat meat
- Demographics.

Analyses included descriptive statistics; factor and cluster analyses of meat purchase criteria and cross tabulations to identify relationships.

Survey of supermarkets

Supermarkets in Makassar were surveyed to understand their supply chain for goat and their demand. Eight supermarkets were surveyed from throughout Makassar city using an in-depth interview with the manager of the meat section. Data was analysed using simple averages and distributions of price and weight data and qualitative analysis of responses.

Survey of roadside sellers

A survey was conducted of eight permanent and four temporary roadside goat sellers in the two weeks before Idul Adha (Qurban) to collect information on the types and prices of goats being sold. Data was analysed using simple averages and distributions of price and weight data and qualitative analysis of responses.

Survey of mosques

The aim of the survey of mosques was to identify the characteristics goats slaughtered during the Idul Adha in Makassar city. It was conducted during the tasrik days (the day before and two days after Idul Adha) of December 2009. In total 54 mosques were surveyed, two to five from each subdistrict plus the two biggest, Mesjid Raya Makassar and Al Markaz Al Islami. Data was analysed using simple averages and distributions of price and weight data and qualitative analysis of responses.

Interviews with wet market butchers

Two wet market butchers from the Makassar market were interviewed on the 17th February 2009 to identify the source, type and price of their goats and the consumption patterns and prices paid by consumers.

Interview with owner of restaurant selling goat dishes

Very few restaurants in Makassar have goat as part of their menu. One of the three identified was interviewed on the 9th February 2009 to ascertain their method of obtaining goat, prices paid and consumer demand for goat.

Miscellaneous observations

Observations were made throughout our trips of:

- Dishes available in restaurants including goat meat;

- Prices and availability of goat meat in Makassar supermarkets;
- Roadside goat sellers;
- Peoples' perceptions of goat meat; and
- Availability of goat meat in markets.

Stakeholder workshop

A stakeholder workshop was held in December 2009 to: Outline project objectives and preliminary project findings; and involve the industry in identifying opportunities and constraints to improving the productivity and marketing of kambing in Sulsel.

The Workshop officially started at 9:20 and finished at 16:00 with 50 attendees and speakers from the Project team plus Abdul Muas from Dinas Pertenakan discussing policies and strategies for goats; and Pak Husri and Pak Tahir who gave their respective farmer group (Sipakanana and Penanian) view on goat production issues. The issues identified in the workshop included: a perceived lack of Government support, problems with inbreeding and a lack of good goat genetics, problems with gondok and possibly rickets and other diseases, a need to reduce slaughter of betina (breeding females), inconsistent supply (quality and quantity) of goats and goat meat, a negative perception about hypertension and cholesterol from eating goat meat, and more land is required for goat production. The opportunities identified in the workshop included: some more Government support, a large demand for goats from Malaysia and the opportunity to market goats as 'Kentucky kambing'.

5.2 Socio-economic analysis of smallholder goat industry

Two farmer groups were selected for participation in the project after consultation with Dinas – Livestock in Enrekang. The groups were known as the Sipakanana and Penanian groups and are located in the Alla sub-district of Enrekang. The following activities were conducted with these groups:

Initial introductory workshop

The objective of this was to:

- introduce the project and to obtain their commitment, and to take some ownership of the process.
- get commitment from farmers that they would attend the workshops and participate in the Project as required by the Project.
- get farmers to record data for animals that they were willing to include in Project.

Participatory Rural Appraisal of goat farming with project farmer groups

The objectives of this Participatory Rural Appraisal (PRA) were to identify the main problems on goat farming in Enrekang Regency which included their goat raising system, production system and marketing system as well as to analyse the cause of any problems and to develop and provide alternative solutions. The BPTP Sulsel PRA methodology was used.

Local Consensus Data survey of Sipkanana and Penanian groups

The Local Consensus Data (LCD) process was used to obtain detailed information about the economics of typical goat farming in Enrekang Regency from each of the two project groups. This method involved facilitating discussion about a typical farm for their group and developing information on the resources and annual production levels, practices, costs and returns.

Final workshop

A final workshop for the project was conducted at the site of the Sipakanana group in Enrekang District involving 26 farmers from both groups on the 10th June 2010. This workshop outlined the findings of our research on consumer purchasing behaviour, the supply chain for their goats to Kalimantan, treatment of goitre in goats with Povidon solution; and use of a heart-chest girth measurement tape for assessing the live weight of goats. Discussions during the workshop generated the following information:

Goitre – gondok: asked about the 'arrival' of gondok we were told it started about two years earlier and increased such that between 50 and 100% of kids were dying prior to the project in Bolang group – about 90% in Tahirs group! All died within a week of birth. In contrast all kids, mostly twins, are now born alive and all survive. Gondok is gone! On being asked Tahir said in one year his eight goats would normally produce 15 kids i.e. 7 twins and 1 single birth. All does (5 of 8 does had gondok) were now producing normal kids.

Farmers couldn't tell if the seaweed worked as all does got Povidon including the controls once the Povidon treated does had kids that were born without gondok. Even so not all goats offered seaweed ate it and some 'vomitted' after eating it. The seaweed was eaten eventually but not all animals would eat it. There was no problem with applying Povidon. Other farmers not in both project farmer groups are now asking for Povidon – Husri didn't give any but told them to get it from their local hospital. All goats are treated with a 'painting' of Povidon once per month, and thyroid palpation of new born kids indicates that the gondok has 'gone'. Interesting enough also apparently ricketts is no longer a problem.

Supply chain – The discussion indicated that the number of goats per farmers is limited by the amount of capital to purchase goats as currently goats are not their main income source, and because of lack of capital goats are only sold by farmers at Sudu market. Husri made the point he is still a teacher and after retiring will focus on goat farming (he will have a pension to support him while he develops his goat business). Groups do have some capital to allow members to purchase goats (capital needs to be repaid). The challenge is how to raise enough goats to meet the Kalimantan demand. Issues about 'localising' goats to make management easier in one hectare rather than spread across forest (currently for ease of feeding – cut and carry - but involves a lot of walking!).

Husri made the comment that if a farmer owned 15 goats they can be considered medium scale, and with 30 or more goats a large scale goat farmer i.e. their main income source.

Tape measure - When asked whether they would use the tape measure the farmers all agreed - yes! - for negotiation of sale of goats (weigh goats before going to Sudu market) and to monitor the condition/performance of their goats.

When asked about the use of water – yes the goats now get water either on demand (goats screaming) or all the time (as they did previously) and they are now trying new feeds - mostly grasses. Farmers were told that goats will eat a lot of different feeds (e.g. Setaria) – they should try small amounts then increase the quantity if they eat it and it may take several days and ideally they should get about one third to half gliracidia (currently most or all of the goats feed) and half to two thirds grasses.

All goat farmers were given a tape measure for estimating the liveweight of their goats and Ibu's Nurhayu and Yusmasari from BPTP said that BPTP would explore making more tape measures. Ibu Nurhayu was given a copy of the pdf of the tape measure printout.

5.3 Goat production research

The information below was collected from a number of sources during the project. As the marketing and supply chain for goats in and from South Sulawesi is described elsewhere this section of the report will focus on the on-farm management of goats. The majority of the information came from two main sources – the goat farmers and local Enrekang Dinas

staff in a series of meetings and workshops. Meetings/workshops were held to gain information about both the marketing and supply chain of goats within and from South Sulawesi as well as the husbandry and problems associated with the existing husbandry of goats (Table 1).

Table 1. Sequence of meetings and workshops where information was sourced about the husbandry and problems associated with the existing husbandry of goats in Enrekang, leading up to the trials to solve the iodine deficiency problem.

Date/location	Purpose and outcomes	Attendees – Project team plus:
12/13 th February 2009 Bambapuang Villa, Enrekang	Initial meeting with Enrekang Dinas staff to discuss goat farmer problems and canvas their interest in a trial to help find solutions to these problems	Pak Yunus Abbas, Kepala Dinas; Pak Junwar, Dinas Veterinarian; Pak Anawar, Dinas Peternakan, Pak Mazuki, Dinas marketing, Pak Arsil Bagenda, Dinas secretary
13 th February 2009 Enrekang	Initial meeting with local goat farmers to discuss their problems and canvas their interest in a trial to test some solutions to their problems	40 goat farmers plus several Dinas staff
4 th and 5 th April 2009 Alla, Enrekang Regency	Participatory Rural Appraisal activities were undertaken to identify problems (and solutions) related to the raising, production and marketing systems of goats.	Two farmer groups plus ACIAR team represented by BPTP and Unhas teams as well as a representative from Dinas Peternakan Enrekang
17-19 July 2009 Enrekang	To get commitment of the two farmer groups (Sipakanana and Penanian) and Dinas Peternakan regarding their readiness to participate in the research program – identified that there may be fewer than desirable goats in trial.	21 farmers from the Sipakanana group, much fewer from the Penanian group plus A. Nurhayu and Yusmasari from BPTP; Mawardi A. Asja, Arman and Alim Yamin from UNHAS
18 th August 2009 Bolang, Enrekang	Workshop for BPTP team and Enrekang Dinas team - outlined the project and discussed what was to be achieved i.e. use of iodine treatments to overcome goitre and measurements required for project, in particular measurements of goat chest girth, height and body length to derive an estimate of liveweight.	Nasrullah (BPTP), Junwar (Dinas), Asmuddin (Hasanuddin), Peter, Roy, Yusma, Ayu, Ardi, Alim and staff from Dinas (25-30)
19 th August 2009 Bolang, Enrekang	Workshop for Sipakanana farmers to train them in the use of iodine treatments to overcome goitre and measurements required for project, in particular measurements of goat chest girth, height and body length to derive an estimate of liveweight. Start trial plus discussion of other goat issues.	Sipakanana farmers

Date/location	Purpose and outcomes	Attendees – Project team plus:
19 th August 2009 Sudu, Enrekang	Workshop for Penanian farmers to train them in the use of iodine treatments to overcome goitre and measurements required for project, in particular measurements of goat chest girth, height and body length to derive an estimate of liveweight. Start trial plus discussion of other goat issues.	Penanian farmers
27-29 th September 2009 Enrekang	Team members visited the two farmer groups to assist with the measurement of the trial goats' chest girth, height and body length to derive an estimate of liveweight.	Sipakanana and Penanian farmers
23-24 th October 2009 Enrekang	Team members visited the two farmer groups to assist with the measurement of the trial goats' chest girth, height and body length to derive an estimate of liveweight.	Sipakanana and Penanian farmers
1 st December 2009 BPTP Makassar	South Sulawesi Kambing Industry Workshop at BPTP Makassar, to outline project objectives and preliminary project findings; to involve the industry in identifying opportunities and constraints to improving the productivity and marketing of kambing in Sulsel.	Representatives from Dinas Enrekang, Peternakan and Perdagangan, BPTP, University of Hasanuddin; Sipakanana and Penanian farmers; goat traders
9 th June 2010 Enrekang	Team members visited Dinas Enrekang staff and gave workshop presentation to staff on outcomes of project. Gave tape measures to them all and asked how we could help them – where to now?	Director of Dinas Enrekang Dr Junus plus Dinas staff
10 th June 2010 Bolang, Enrekang	Team members visited the two farmer groups both at Bolang to thank them for their contribution, tell and ask them about the outcomes of the project and give them all a tape measure and asked how we could help them now?	Sipakanana and Penanian farmers

At Susunan Pengurus Koperasi Sipakanana, Bolang Selatan, Bolang, Alla on 13th February 2009 where there were about 40 farmers present with a number of Dinas staff. The outcome of this meeting was that farmers agreed to form two groups: the Sipakanana group, Kec. Alla, Desa: Bolang lead by Pak Husri and the Penanian group lead by Pak Tahir and each group would have about 30 members per group. Dinas staff agreed to assist with any further meetings and trials. Issues raised by farmers at this meeting are summarised in Table 2.

Table 2. Issues raised by farmers at Koperasi Sipakanana, Bolang on 13th February 2009.

Topic/issue	Comments/information	Speaker
Overall management	Still using traditional methods, want to improve production	Pak Salih - farmer group secretary
Costs	How to improve production without incurring high costs?	Pak Salih - farmer group secretary
Goitre/gondok	Does have weakness during birth, leading to weakness after birth - 50 kids born but affected with enlarged thyroids and only 2 alive.	Pak Hasbullah – young farmers group
Goats getting smaller	After 30 years of raising goats the quality of animals decreasing – getting smaller – suspects inbreeding; solution used is to borrow bucks.	Pak Husri - head farmer of Bolang group
Cultural issue	Belief that if goats are already bitten by dog it is free of disease – not sure if relationship true – people don't want to eat those goats because dogs are not clean	Pak Hasbullah – young farmers group
Price received for goats	Farmers are happy with price getting now, but if possible to improve	Pak Hasbullah – young farmers group
Problem with bigger goats	Peranakan Etawa cross have is problem when getting bigger – about 40 kg body weight more susceptible to disease: mastitis, diarrhoea, type of paralysis; however Dinas has told him there is a Middle East market for goats >40kg.	Pak Tahir – head Penanian group
Feed and capital	Population of goats is less than feed available; problem is also lack of capital to expand.	Pak Ibrahim Bacho – extension officer for Bolang village
Breeds of goats	Quality of breeds available is good enough because can get twins or triplets - farmers prefer twins because less risk of death; however aware that farmers not good yet in raising goats and they also need to improve data management.	Pak Haji Dua

At the 17-19 July 2009 meeting in Enrekang there was an agreement that tentative participants, venues and schedules for the August workshop activities were as follows:

Participants	Number of participants (approx.)	Date	Venue
Dinas	15-20	August, 18 2009	BPT/Poskeswan Cakke.
Sipakanana farmer group	≥ 21	August, 19 2009	Sanggar Tani Sipakanana
Penanian farmer group	≥ 20	August, 20 2009	Sanggar Tani Pennanian

Meeting with Enrekang Dinas - Bambapuang Villa on 12th February 2009. The main outcomes from that meeting were that a recent problem: i.e. a disease of goats that can't be identified causes mortality in greater than 25% up to 100% of young animals. They had received an official request from the Malaysian government for supply of goats but can't meet Malaysian government specifications. Dinas staff see one big problem is that many farmers have goats as an additional job, not as their main job.

To identify issues by farmers Participatory Rural Appraisal activities were held with the two farmer groups in April 2009. The full report of the PRA is given in Appendix 1 *Participatory Rural Appraisal (PRA) on Goat Farming in Enrekang Regency, South Sulawesi*. At the PRA for the Sipakanana group, lead by Pak Husri, there were 35 farmers present, while for the Penanian group, lead by Pak Tahir, there were 20 farmers present.

A number of issues were identified and these are listed below in no particular order:

- Gondok and rickets - deficiency of minerals iodine, calcium and possibly phosphorous (and possibly others once these are rectified)
- Water not readily available to all goats
- Quantity and quality of feed fed to goats could be improved
- Manure quality can be improved to make it more valuable
- Inbreeding of goats is considered to be a big problem

The issues identified by farmers with the costs of possible interventions given in Table 3 (needed help to overcome issues) and Table 4 (farmers believed they already had solutions to their goat issues).

Table 3. Issues identified by farmers with the costs of possible interventions given.

Issue	Possible interventions	Cost	Available
Mineral deficiency	Cattle or other species mineral mix	Should be relatively cheap and easy, but involves more time by farmer	Yes?
	Seaweed residue	Should be available and cheap except for transport costs	Yes
	Drench with KI	Requires specialised equipment and experience	Yes
	Purchase iodine crystals from Apotek (chemist), grind and add to salt	Should be cheap but involves grinding up crystals and needs carrier (e.g. salt) to give to goats	Yes
	Betadine Povidon Iodine	Should be relatively cheap and easy	Yes
Multiple births that die	Overcome mineral deficiency and better feeding	Mineral mix/seaweed and more feed; an understanding that multiple births can survive and be profitable	Yes?
Lack of water	Buckets of water given daily or several times a week, may be necessary with supply of mineral mix	Involves purchase/access to water and containers, but involves significantly more time by farmer and they may choose to use this water for other purposes	Yes
Feed supply	Include rice straw, other leave material (e.g. setaria)	Involves purchase/access to roughages and transport, involves significantly more time by farmer	Seasonal?

Issue	Possible interventions	Cost	Available
	Include other roughages	Involves purchase/access to roughages and transport, involves much more time by farmer	Seasonal?
Manure	Treat with microbes, buy for 15 to 20,000 Rp/L which treats 1 tonne of faeces	Involves purchase of microbes, method of transport of manure; increases price from 500,000 to 900,000 Rp/tonne	Yes
Inbreeding	Collect and use pedigree data	Time to collect, record and use pedigree data, learn selection process	Yes?
	Collect and record production and pedigree data for selection of elite animals	Time to collect, record and use pedigree and production data, learn process of selection	Yes?

Table 4. A number of other issues were identified by farmers where they thought they had solutions that met their needs:

Issue	Possible interventions	Cost	Available
Diarrhoea	Cassava leaves	Cheap	Yes
	Medicine	Expensive	Yes
Feed	Feed gliracidia plus setaria, cocoa leaves and pods, etc	Cheap	Yes
Bloat	Trocar (into rumen and into rectum?)	Cheap?	Yes?
Ectoparasites	Medicine (kerosene?)	Expensive (cheap)	Yes
Endoparasites	Drenches	Expensive	Yes?
	Papaya leaves	Cheap	Yes
Vaccinations	Dinas supply	Free	Dispute about availability

In August 2009 three workshops were held within the Enrekang District. The full details of these workshops and the techniques taught are given in Appendix 1 – *Dinas and farmer workshop process*; and *Standard Operating Procedures*. In brief a workshop was held on the 18th August for Dinas staff to demonstrate the husbandry techniques necessary to be able to participate in the trial to test different iodine treatments plus as education about goat husbandry. These techniques demonstrated were for:

- Handling goats for inspection
- Heart-chest girth, shoulder height, and body length measurements for goats

- Relationship between these measurements and live weight
- Scrotal measurement
- Identifying age in goats by their teeth (type and wear) – most knew about this
- Trimming toe nails to overcome hoof, and lameness problems
- Palpating the throat of a goat to find their thyroid glands to identify the status of gondok-goitre.

At a meeting on the 19th August 2009 with Kepala Dinas Peternakan – Pak Yunus Abbas at his Enrekang office the consensus was that gondok-goitre was the number 1 problem in goats in Enrekang.

On the 19th August 2009 a farmer workshop was held in Bolang with the Sipakanana group. Before starting farmer training in goat handling, measurement of goats and the start of treatments there was an open discussion with the farmers from which the following information was obtained:

- Farmers had used iodised salt in water given to the goats but this didn't appear to be successful; it was pointed out that iodine in water volatilises and the amount of iodine in the salt is too small to be effective.
- Scabies is sometimes a problem
- Kids born had weakness (kids not suckling from their doe) and frequently died – they thought this was due to rickets and gondok
- if triplets were born only 2 suckled and the doe can't support 3 kids
- farmers don't give water every day – only once a week, some farmers say they gave water but goats didn't want to drink
- some goats don't indicate they were about to give birth – sometimes therefore the kids died because farmer hadn't seen signs

During the day the farmers took ownership of the trial by organising follow up to complete measurements on project goats that weren't completed on the day. Farmers made suggestions about processing of sea weed to make it more palatable to the goats.

Observations made of the goats and the Sipakanana goat farmers during the start to the trial were that:

- Most farmers appear to feeding only Gliracidia;
- Different types of grasses, sugar cane and other plants and feed materials were available but didn't appear to be fed to the goats;
- Some farmers had water collecting (44 gallon drums) and water dispensing arrangements to water the goats;
- There were mixed numbers of goats in kandangs of different sizes;
- The ease of access into kandangs and the location of kandangs was extremely variable;
- Some kandangs were made of bamboo and some of cut timber, most had tin roofs and the amount of faeces (baja) under them varied greatly;
- Most of the farmers were with us most of the day;
- It took a long time to get a routine developed to weigh and measure goats and there were issues with weighing equipment – needed to have a pole for weighing already developed;

- Many farmers and project staff don't know appropriate ways to handle goats when working with them;
- Didn't see any obvious signs of illness other than some very enlarged thyroids and some goats with poor coats (indicative of iodine deficiency) except for 1 doe with scabby teats; and
- There were very few young kids seen anywhere!

On the 20th August 2009 a farmer workshop was held in Sudu with the Penanian group. Before starting farmer training in goat handling, measurement of goats and the start of treatments there was an open discussion with the farmers from which the following information was obtained:

- Farmers didn't know about measuring the girth of goats and what the purpose was;
- Most kids were born weak and can't stand – farmers also mentioned scabies;
- Some does after birth are paralysed (possible hypocalcaemia – milk fever);
- Retained afterbirth was problem (either hormonal or hormonal linked to iodine deficiency);
- Many does had swollen, sore nipples, infection - mastitis – explained this is bacterial but gondok could exacerbate through bad skin and increased risk of infection – could paint with Povidon on teats. There was also sometimes yellow milk and blood in the does milk – mastitis – need antibiotics to treat this;
- What to do about poisonous plants – answer: don't feed – nothing else can be done;
- Infection in nails – Solution – trim nails so they don't get to this stage;
- Asked if any feed supplements contained iodine – yes sea weed;
- Bloat problem in wet season – solution: more fibre and balanced diet; and
- Asked for new and good breeds of goats from Java – explained not really necessary – overcome inbreeding first.

Observations made of the goats and the Penanian goat farmers during the start to the trial were that:

- One weaner doe was found with her brother and she was pregnant – hence not included in trial – indicative of inbreeding and ignorance;
- Goats were only fed Gliracidia even though Elephant grass, Setaria, Paspalum and Brachiaria were often present. Some goats ate Elephant grass when provided but other goats were naïve – indicates some may have had access, but many not;
- Vegetables and corn we passed as we walked between kandangs were not being fed to goats but left to rot or dry out in fields;
- Fewer farmers got trained and were involved than other group;
- There appear to have higher levels of gondok based on palpitation and poor coats;
- Vegetables were being irrigated, but no obvious linkages to goats watering – only saw one case where there may have been watering;
- Farmers suggested they could process seaweed and then drench it into the goats;
- Some farmer's goats were not included in trial although had been offered to Pak Tahir; and
- There were very few young kids seen anywhere!

On the 10th June 2010 a farmer workshop was held in Bolang with the Sipakanana and Penanian groups of goat farmers. Ibu Yusma talked about goat meat markets in Makassar; Ibu Ayu talked about the povidon research to overcome gondok; Mawardi talked about the supply chain from Enrekang to Kalimantan; and Dr Asmuddin talked about the development of the tape measure and heart-chest girth, height and body length relationships with liveweight from the data farmers collected from their goats.

Feedback/questions and comments from the farmers included:

- The number of goats per farmers is limited by amount of capital to purchase goats (as goats are not their main job); and currently goats are not their main income source, and because of lack of capital goats are only sold by farmers at Sudu market. Pak Husri made the point he is still a teacher and after retiring will focus on goat farming (he will have a pension to support him while he develops his goat business). Groups do have some capital to allow members to purchase goats (but this capital needs to be repaid).
- The challenge is how to raise enough goats to meet the Kalimantan demand.
- Issues about localising goats to make management easier in one hectare rather than spread across the forest (for ease of cut and carry feeding -- but a lot of walking!).
- Pak Husri made the comment if a farmer owned 15 goats they are considered medium scale, 30 or more goats a large scale goat farmer i.e. their main income source.
- When asked if they were still using Povidon the surprising answer was answer no - as it was all used up and that they need to buy it from the hospital. Access to Povidon was considered a problem. Dr Asmuddin brought 2 liters and gave them to Pak Husri.
- Asked about the 'arrival' of gondok was told it started to be much worse about two years ago and increased such that between 50 and 100% of kids were dying prior to the trial in the Bolang group – about 90% in Tahirs group! All kids died within a week of birth. In contrast all kids are now born alive, mostly twins and survive. Gondok is now gone! On being asked Tahir said in one year his eight goats would normally produce 15 kids i.e. 7 twins and 1 single birth. All does (5 of 8 of his does had gondok) are now having normal kids.
- Farmers couldn't tell if the seaweed worked as all does got Povidon including the controls once the does given Povidon starting having kids without gondok!
- Not all goats offered seaweed ate it and some 'vomitted' after eating it. The seaweed was eaten eventually but not all animals would eat it. Farmers considered there was no problem with applying Povidon.
- Other farmers not in the Sipakanana and Penanian groups are now asking for povidon – Pak Husri didn't give them any but told them to get it from the hospital.
- All goats are treated with Povidon once per month, and palpation of new born kids indicates that the gondok has 'gone'. Interesting enough apparently ricketts has also gone.
- The question was asked about 'goat flu' by farmer that didn't have any goats!?
- When asked whether they would use the tape measure the farmers said yes! - for negotiation of sale of goats (weigh goats before going to Sudu market) and to monitor the condition/performance of their goats (to measure the effectiveness of different diets, and health and reproductive status).
- When asked about the use of water – yes the goats now get water either on demand (goats screaming!) or all the time (as they did previously) and they are now trying new feeds mostly grasses. Farmers were told that goats will eat a lot of different feeds (e.g. Setaria) – they should try small amounts then increase if the goats eat it – may take several days and ideally they should get about one third to half Gliracidia (currently

most or all of the goats feed) and half to two thirds grasses to give a more balanced diet.

- Gave tape measures to the farmers and demonstrated its use on a goat – the Ibu's said that BPTP would explore making more tape measures.

Other issues raised included the belief that the goats are too small for export markets; which is possibly true for the Kacang breed, which are smaller in size but apparently easier to buy, raise and easy to sell; there is little stealing of goats in Sulsel because of the local belief that if you steal goats it is bad luck; farmers should stop the sale of betina – breeding does for meat!

Makassar Kambing Pasar – 11/5/09, 7:30 - 10:00

As the first phase of developing a tape measure to estimate the liveweight of goats we weighed and measured 10 goats at a local Makassar goat market.

5.4 Training of staff from UNHAS, BPTP and Dinas (Enrekang)

In August 2009 three workshops were held within the Enrekang District. The full details of these workshops and the techniques taught are given in Appendix 1 – *Dinas and farmer workshop process*; and *Standard Operating Procedures*; and discussed in some detail in the previous section. In brief workshops were held on the 18-20th August for Dinas staff, then in Bolang with the Sipakanana group, then in Sudu with the Penanian group to demonstrate the husbandry techniques necessary to be able to participate in the trial to test different iodine treatments plus as education about goat husbandry. These techniques demonstrated and then applied were for:

- Handling goats for inspection
- Heart-chest girth, shoulder height, and body length measurements for goats
- Relationship between these measurements and live weight
- Scrotal measurement
- Identifying age in goats by their teeth (type and wear) – most knew about this
- Trimming toe nails to overcome hoof, and lameness problems
- Palpating the throat of a goat to find their thyroid glands to identify the status of gondok-goitre.

Dinas Final workshop

In June 2010, a final workshop was held with the staff from Dinas Peternakan in Enrekang to outline the findings of the project and to discuss the opportunities for the future. The key features discussed at this workshop were:

- Makassar consumers consumption of meat and kambing and their attitudes to kambing
- The features of the goat supply chain in South Sulawesi and in particular from Enrekang, South Sulawesi to East Kalimantan
- How to use Povodine as a solution to iodine deficiency (gonkok) in goats and the possibilities for dissemination of the finding in the future
- The relationship between heart-chest girth, body length and shoulder height, and liveweight in Indonesian goats and the use of the tape measure developed for estimating liveweight from the heart-chest girth measurement.

Local Consensus Data training

A guide for conducting investigations of the economics of goat production using the Local Consensus Data process was developed in August 2009 and trainings and discussions were held with the project staff from BPTP and UNHAS in its use. This process was used because it not only provided an opportunity to train research staff in assessing the economics of goat production using a participatory process, but the participating farmers who were involved in the process gained a better understanding of the returns and costs associated with their goat production. It also provided the farmers with an opportunity to compare their own production with that of their neighbours and enter into a discussion of the elements that drive its profitability.

Consumer survey

The consumer survey was developed in consultation with the staff from the research team. Staff were therefore trained in the development of survey instruments, the selection of survey population, the conduct of a survey, the entry and cleaning of survey data and finally the qualitative and quantitative analysis of survey data. The survey was conducted by students from Hasanuddin University who in turn received some practical training in the conduct of a large-scale consumer survey.

6 Achievements against activities and outputs/milestones

Objective 1: To improve understanding of existing markets and supply chains and assess alternative markets and supply chains.

no.	activity	outputs/ milestones	completion date	comments
1.1	Survey local and export markets and supply chains	Reports written See Appendix	End of project	Paper presented at ISTAP5
1.2	Survey consumers and institutional buyers in Makassar	Report written See Appendix	End of project	Paper presented at ISTAP5
1.3	Meetings with farmers, traders and retailers of goat meat	Trip reports and observational report		

PC = partner country, A = Australia

Objective 2: To improve understanding of the smallholder goat industry and the social, cultural, economic, institutional and resource constraints to its improvement.

no.	activity	outputs/ milestones	completion date	comments
2.1	Workshops and participatory research activities with farmer groups from two communities	Reports and trip notes written See Appendix	End of project	
2.2	Survey a broader range of farming families and local traders to confirm hypotheses	Not specifically undertaken		Considered unnecessary given the nature of problems identified by farmers and the solutions developed.

PC = partner country, A = Australia

Objective 3: To improve understanding of existing markets and supply chains and assess alternative markets and supply chains.

no.	activity	outputs/ milestones	completion date	comments
3.1	Practical solutions to improve productivity	Practical solution to goatre developed and adopted Practical solution to estimating liveweight developed Reports written See Appendix	End of project	Paper presented at ISTAP5

no.	activity	outputs/ milestones	completion date	comments
3.2	Train extension staff from AIAT and Dinas, and students from Hasanuddin University	Surveys designed and conducted by staff and students of consumers and supply chain participants LCD conducted and reported by staff English and Indonesian lessons for staff	End of project	Paper presented at ISTAP5

PC = partner country, A = Australia

7 Key results and discussion

The project identified that there were problems constraining goat production, for which there are solutions and that goat farmers were willing to be involved in developing new techniques to solve these problems and as such improve the productivity of their animals to produce more protein, as well as improving both the living standards of goat farmers and their animals. An example of this was gondok where the farmers knew they had a problem i.e. their goats had iodine deficiency and only needed some assistance to find a solution. Likewise farmers understood that knowledge of the liveweight and growth rates of their animals is critical as decisions about the onset of breeding, weaning, feeding and health management should be made with an understanding of the liveweight of the animals involved. In developed countries there are number of mechanical (e.g. clockface) and electronic weighing systems available for goat producers to purchase but they are costly, and only purchased where large numbers of animals are farmed. These weighing systems are rarely used in (small holder) goat production systems where the farmer may own less than 20 animals and these animals may not be managed as a large flock but as small units. We involved local goat farmers in the measurement of body length, shoulder height and heart-chest girth of their goats, from across a wide range of ages and liveweights, to develop predictive equations for estimating the liveweight of their goats. The process of estimating liveweight from heart-chest girth measurement was embraced by goat farmers as a cheap and effective management tool, partly as they were directly involved in the generation of the relationship, and as a cheap husbandry (and marketing) tool for measuring and thus managing their goats.

As an important criteria to ensure the value of this research i.e. if more goats were produced there was a market for this increased supply - we also explored goat supply chains and goat meat consumption. We surveyed consumers in Makassar and found that consumers rarely bought goat for family, visitors or gifts and most commonly bought goat meat for Kurban and birth ceremonies, mostly from traditional markets and traders/butchers. That is goat meat is consumed for religious ceremonies, but many consumers consider it unhealthy. As part of this research we also found that the most commonly cooked meats were fish/seafood (92%), chicken (91%), beef (41%), goat (19%) and duck (15%). As with the purchase of goat meat traditional markets traders/butchers were the main places for meat purchases and over half of the consumers surveyed never purchased meat in supermarkets. We found that there were no abattoirs processing goats and as such this makes large scale supply of goat meat difficult.

We found that the supply chain of goats produced in Enrekang pass through four main parties, with a range of transport methods, and where feeding and watering of goats along the way is problematic. Interestingly very few, if any, goats produced in Enrekang are consumed in Makassar, with most of its goat meat coming from goats produced as far south as Flores, with the bulk of the (Kacang) goats sourced from the south of South Sulawesi. Goats that originate from Enrekang farmers and traders go to collectors/traders along the chain via Polewali, Majene and Mamuju and thence via ferry to roadside sellers in Balikpapan and Samarinda. Male goats are mainly sold for cultural ceremonies for which they are preferred, while smaller females are sold to roadside warungs, mostly for sate. Prices of 20-30 kg goats in Enrekang fetch about Rp30,000/kg, but sell for about Rp50,000/kg in East Kaltimantan. The length of this chain when combined with the small size of the enterprises involved means it is almost impossible to deliver a large consistent line of animals as would be required to export to other countries such as Malaysia.

To ensure the value of this research continues and expands in South Sulawesi it is necessary to have a Provincial and Regency champion for goitre eradication and for continued improvements for goat farmers.

8 Impacts

8.1 Scientific impacts – now and in 5 years

The scientific practices that have occurred outside the project, because of the findings of the project, include:

We tested the hypothesis that iodine in the Povidon form, when applied to the skin of pregnant goats overcomes severe goitre problems (iodine deficiency) in their offspring. Farmers indicated that goitre had increased in the two years prior to the start of the project to the extent that between 50 and 100% of newborn kids died within a week of birth. The practice of painting Povidon on the skin of goats had not been used previously to overcome iodine deficiency, and was more successful than feeding chaffed seaweed as a source of iodine, as not all goats ate their seaweed supplement. This is listed as a scientific impact as the issue of gondok was not identified in the original project brief and was arguably the most important problem facing goat producers in Enrekang that was solved.

We developed a practical, cheap and accurate tool for estimating the liveweight of the populations of goats studied in the project. The development of a predictive equation based on heart-chest girth to estimate the liveweight of goats is not new. However the involvement of the owners of the goats in the measurements used to develop the predictive equation (as part of the research), and then the manufacture and distribution of a cheap and accurate tape measure was a scientific practice that occurred outside the original project to allow farmers to be able to monitor the liveweight of their animals for breeding, husbandry and marketing purposes. We anticipate that Dinas and BPTP will continue to manufacture the tape measures and this will be a continued project output that will have an ongoing impact by improving goat productivity for other goat producers in South Sulawesi.

To our knowledge, there has been no research into consumer perceptions of goat meat in South East Asia. In particular, we could find none that had been conducted in South East Asian countries with a predominantly Muslim population where consumption of goat has religious and cultural significance. The survey of consumers and other elements of the chains in Makassar has shown that for a large proportion of the population goat meat is consumed for purely cultural and religious reasons and is not perceived as healthy. This is probably true of other consumers in Indonesia and Malaysia and if goat meat is to become a more important part of the diet some of the misconceptions about goat meat need to be addressed through a consumer education program.

The South Sulawesi and Indonesian governments have received enquiries from Muslim countries to supply goat. This study has identified some of the key supply routes for goat in Eastern Indonesia and identifies areas for improvement and the possibilities for export. It appears that the length of this chain when combined with the small size of the enterprises involved means it is almost impossible to deliver a large consistent line of animals that would be required to export to other countries.

8.2 Capacity impacts – now and in 5 years

The capacity-building impacts of individuals in Indonesia that has occurred through their participation in the project and its training elements include:

- Farmers involved with the project and those from neighbouring villages have increased their knowledge and skills to find solutions to their goat goitre problem; they have learnt they can feed feedstuffs other than *Gliracidia*, primarily available grasses, to improve the nutrition of the animals; and they now have greater capacity to better

manage and market their goats (using the tape measure they helped develop).

- Team members from the University of Hasanuddin have been employed by FAO (Sulsel) to conduct biosecurity surveys based on their survey experience and training in this project.
- All team members have developed skills to work with members of an international team (Australia and Indonesia) and with local Indonesian institutions (BPTP, UNHAS, Dinas).
- Team members have developed and improved their skills to present international conference papers and scientific papers (as seen by the four papers presented at ISTAP5 in Yogyakarta during October 2010).
- The participatory methodologies used in this project will be employed by UNHAS and BPTP staff for other research and development purposes.
- The realisation that the infrastructure used to house goats (kandang) is excellent but the understanding of nutritional and water requirements of goats is poor; as is the previously poorly understood problem that inbreeding is the key genetic problem, not the need for imported goat breeds has been an important change in the knowledge and skills of individuals within South Sulawesi.

8.3 Community impacts – now and in 5 years

Unquestionably the success of the Povidon treatment for goitre has been a community impact due to the uptake of information and technology by individual goat farmers not directly involved or collaborating on the project. This can be illustrated by the numbers of goat farmers requesting Povidon from the Sipakanana and Penanian group leaders.

8.3.1 Economic impacts

Evidence of positive economic impacts from the project include:

- The increased survival rates of kids born by at least 50% in the areas affected by goitre where pregnant does are now being treated with Povidon solution.
- The increased returns to goat farmers from goats due to reduced mortality, improved fertility (linked directly and indirectly to Povidon) and improved nutrition.
- The increased bargaining power of farmers due to their increased ability to estimate price per kilogram in negotiations with buyers and this in turn should lead to increases in farmer income. It could also lead to improved efficiency in the market due to a reduction in information asymmetry.
- The potential for improvements in consumer understanding of the benefits of goat meat consumption for their health.

8.3.2 Social impacts

Evidence of positive economic impacts from the project include:

- Potential changes in the power relationship between goat farmers and buyers because of improved ability of farmers to estimate the value of their livestock through use of the tape measures to estimate their animals' liveweights.
- Potential changes in the attitudes by consumers of goat meat who might currently believe there are health risks (hypertension and high cholesterol) rather than health benefits associated with eating goat meat (lean meat, high iron).

8.3.3 Environmental impacts

It is difficult to envisage how this project will lead to changes in how natural resources are managed.

8.4 Communication and dissemination activities

The activities undertaken in the project to disseminate project results and outputs as a backdrop for achieving impacts in the future have been discussed in detail earlier in this report but are listed in brief below:

Participatory Rural Appraisal (PRA) activities on the 4th and 5th April 2009 were undertaken in Enrekang Regency to identify problems and solutions related to the raising, production and marketing systems of goats. These PRA activities were undertaken with two farmer groups plus BPTP and Unhas team members as well as a representatives from Dinas Peternakan Enrekang.

Workshops for BPTP team members and Enrekang Dinas staff, then Sipakanana and Penanian goat farmers were held on the 18th - 20th August 2009 to train them in the use of iodine treatments to overcome goitre, and measurements required for the project, in particular measurements of goat heart-chest girth, height and body length to derive an estimation of liveweight. At these workshops there were also discussions of other goat production issues and their solutions e.g. feeding grasses with *Gliracidia* to goats.

A stakeholder workshop with 50 attendees was held in December 2009 to outline project objectives and project findings; and involve the industry in identifying opportunities and constraints to improving the productivity and marketing of kambing in Sulsel.

A final workshop for the project was conducted at the site of the Sipakanana group in Enrekang District involving 26 farmers from both groups on the 10th June 2010. This workshop outlined the findings of our research on consumer purchasing behaviour, the supply chain for their goats to Kalimantan, treatment of goitre in goats with Povidon; and use of chest-heart girth tape measure for assessing liveweight of goats.

Four papers detailing the results of different aspects of the project were presented at The 5th International Seminar on Tropical Animal Production. "*Community Empowerment and Tropical Animal Industry*", Yogyakarta, Indonesia, 19th to 22nd October 2010 (see *Section 9.2. List of publications produced by project* for more details).

9 Conclusions and recommendations

9.1 Conclusions

The key learning's arising out of the project are listed below:

- Painting Povidon solution on the skin of pregnant does can easily and cheaply eradicate deaths and weakness from goitre in their kids.
- Involvement by farmers in collecting data to develop a tape measure and the production of the tape measure will ensure their understanding and use of it.
- Goat farmers involved in this project have limited understanding of (i) animal breeding principles as seen by the high levels of inbreeding observed; (ii) the principles of good animal nutrition where only Gliracidia is fed but they have shown they are willing to offer other feeds; and (iii) the importance of water for goats.
- Goat meat is mainly consumed for religious and cultural reasons and currently is considered as an inferior meat for general consumption and therefore is not widely consumed outside these situations.
- There are key consumer constraints to increased goat consumption due to confusion about health issues and cooking which in the longer term could be overcome by education.
- The supply chain is complex and there are opportunities for farmers to be involved in shortening the chain and improving their income. For this to occur farmers need to be trained in supply chain principles and practice.
- Goats are a secondary enterprise, but are a valuable source of income and farmers are interested in learning how to increase their income from this source.

9.2 Recommendations

The recommendations arising out of the project are listed below:

- For a sustained uptake of the use of Povidon to overcome the problems of iodine deficiency we recommend that a 'Provincial champion' be identified and supported to continue to educate goat farmers and associated government organisations about the solutions identified in this project. This 'Provincial champion' would also be involved in wider development of tape measures for goats in different locations, and overall improvements for goat farmers in South Sulawesi.
- There is a need for scientific validation of the use of Povidon as a cure for goitre in pregnant and other classes of goats as well as further exploration of the use of seaweed as a cure for goitre, given it is rich in iodine and available in South Sulawesi.
- There is a need for a wider consumer survey to verify the findings of the Makassar survey.
- There is a need for an integrated study of goat production, their supply chains and consumer limitations across Indonesia as this project has identified opportunities for making profound improvements for both the productivity of goats as well as both increased supply of animal protein and farmer incomes and economic security.

10 References

10.1 List of publications produced by project

- Natsir, A., Asja, M.A., Nasrullah, Yusmasari, Nurhayu, A., Murray, P.J., and Murray-Prior, R. (2010). *The relationship between heart-chest girth, body length and shoulder height, and liveweight in Indonesian goats*. The 5th International Seminar on Tropical Animal Production. "Community Empowerment and Tropical Animal Industry", Yogyakarta, Indonesia, 19th to 22nd October 2010. pp. 441-445.
- Asja, M.A., Natsir, A., Murray-Prior, R. and Murray, P.J. (2010). *Goat supply from Enrekang, South Sulawesi to East Kalimantan: A long and winding road*. The 5th International Seminar on Tropical Animal Production. "Community Empowerment and Tropical Animal Industry", Yogyakarta, Indonesia, 19th to 22nd October 2010. pp. 725-732.
- Murray-Prior, R., Natsir, A., Asja, M.A., Yusmasari, Nasrullah, Nurhayu, A. and Murray, P.J. (2010). *Goat meat consumption in Makassar, Sulawesi: Important for religious and cultural ceremonies, but many consider it a health risk*. The 5th International Seminar on Tropical Animal Production. "Community Empowerment and Tropical Animal Industry", Yogyakarta, Indonesia, 19th to 22nd October 2010. pp. 733-740.
- Nasrullah, Yusmasari, Nurhayu, A., Natsir, A., Asja, M.A., Murray-Prior, R., and Murray, P.J. (2010). *Factors involved with the purchase of meat by consumers in Makassar, Sulawesi*. The 5th International Seminar on Tropical Animal Production. "Community Empowerment and Tropical Animal Industry", Yogyakarta, Indonesia, 19th to 22nd October 2010. pp. 717-724.
- Nasrullah, Yusmasari, Nurhayu, A., Natsir, A., Asja, M.A., Murray-Prior, R., and Murray, P.J. (2010). *Povodine - a solution to an old iodine deficiency problem. (first draft written when completed to be submitted to Animal Production – Scientific Journal of Farm Animals and Feed Resources in the Tropic)*.

10.2 List of reports produced by project

The reports produced during the project are listed below with the information about the language that the report is written in:

1. Participatory Rural Appraisal (PRA) on Goat Farming in Enrekang Regency, South Sulawesi (written in English, and Indonesian with a Summary in English)
2. Survey of Sapi Slaughter Houses in South Sulawesi Province – (written in English - Ibu Andi Nurhayu & Asmuddin Natsir)
3. Goat and meat consumption by Makassar consumers (written in English - Roy Murray-Prior, Assmudin Natsir, Mawardi Asja, Nasrullah, Yusmasari, Andi Nurhayu, Peter Murray)
4. Local consensus data of typical Enrekang goat farm (written in English - Mawardi A. Asja, Asmuddin Natsir) (includes notes on the process)
5. Masjid survey in Makassar (written in English – Asmuddin)
6. Masjid survey questions (written in English and Indonesia)
7. Survey on Supermarkets in Makassar (written in English - Asmuddin)
8. Report on Field Trip to Kalimantan (written in English, and Indonesian - Mawardi A. Asja)

9. Report on chain appraisal approach for goat marketing from Enrekang to Mamuju (written in English - Mawardi A. Asja)
10. Survey on Restaurants and warungs (written in English)
11. Standard Operating Procedures (for goat husbandry techniques)
12. Dinas and farmer workshop process
13. Report on survey of roadside sellers in Makassar prior to Idul Adha (written in English - Ibu Andi Nurhayu, Ibu Yusamasari *et al.*)
14. Interviews with penjual daging di Makassar mall (Pasar Sentral)
15. Slaughterhouse interview questions (written in Indonesian)
16. Road side survey questions (written in Indonesian)
17. Supply chain survey questions (written in English and Indonesian)

11 Appendixes

11.1 Appendix 1: Goat husbandry

11.1.1 Standard Operating Procedures

General comments

Goats have excellent memories and remember bad experiences. If they are hurt or injured in any of the following procedures they will not want to have that procedure performed again. For example if goats are handled calmly, and the procedure is undertaken efficiently, they will become easier to handle. In contrast if the goats are stressed each time the procedure is undertaken they will become more difficult to handle.

Kids learn from their mothers – they learn what is safe to eat and 'who' they can trust. That is if a doe with kids is handled in any of the procedures below such that she experiences stress her kids will learn that those procedures are stressful and they will remember that later in their lives.

General handling

Goats have 270° vision with binocular vision in front, if their nose is pointing down, and to see the ground and feed in front of them they will put their head down which means if they are moving forward they will slow and often stop to see clearly in front of them. They have a much more flexible spine and neck than sheep and cattle. Goats can jump up onto raised platforms (and over 1 m high fences) and down (out of buildings) as they are adapted to living in and evolved in mountainous areas of the world.

To control a goat place one hand under the chin gently but firmly holding onto the lower jaw and the other hand firmly holding onto the rump. The hand holding the jaw controls the goats forward movement and the hand holding the rump controls the goat from moving backwards. To check a goats teeth stand over the back of the goat facing towards its head with your knees holding its chest – ideally with the animal 'backed' into a corner so it can not go backwards. Hold the lower jaw with one hand while pulling it gently but firmly downwards while the other hand raises the upper lips to expose the front teeth – the incisors.

Tipping a goat to clip their toe nails or examine their testes or udder involves standing on the left side of the goat. With your left hand bend the goats head to the goats right shoulder and with your right hand grasp the goats right flank and lift at the same time push the goat at its left flank with your right knee. The goat should tip and land softly on its left side. Maintain control by holding the head back on the right shoulder there and with your free right hand grasp the front leg and sit the goat up on its rump. If the goat is above 40 kg (depending on your size) it is best to have assistance.

Measurement of heart girth

The goat should stand upright on all four hooves with the back straight ideally on a reasonably flat and level surface. Place the cloth drapers tape around the goats body immediately behind the front leg so that the tape (pita ukur) is perpendicular to the spine (i.e. vertical). Pull tape so that it is held firmly around the body and measure girth in centimeters. Record girth measurement in your record book for this goat on this date.

Measurement of body length

The goat should stand upright on all four hooves with the back straight ideally on a reasonably flat and level surface. Place the cloth drapers tape along the goats body immediately behind the top of the scapula so it is parallel to the spine (i.e. horizontal) to the top of the hip bone. Pull tape so that it is held firmly along the body and measure body length in centimeters. Record body length measurement in your record book for this goat on this date.

Measurement of height at withers

The goat should stand upright on all four hooves with the back straight ideally on a reasonably flat and level surface. Place cloth drapers tape down the goats body parallel to the front leg (i.e. vertically) from the ground next to the front foot to the top of the shoulder. Pull tape so that it is held firmly and measure height length in centimeters. Record the body height measurement in your record book for this goat on this date.

Measurement of liveweight

Remove clockface scales from box and attached bottom and top hooks. Set up clockface scales by hanging a rope or hook over a branch or timber beam and suspending the clockface from the hook or by tying it with the rope. At the start of each day, on the hook hanging from the bottom of the clockface, suspend the 5 kg test weight to confirm that the scales are accurately reading this weight. Adjust scales if necessary. Retest then when accurate weigh the 20 kg test weight to confirm that the scales are accurately reading this weight. Adjust scales if necessary. Retest to ensure the 5 kg and 20 kg test weights are correct. Then:

On the hook hanging from the bottom of the clockface suspend the harness in which the goat to be weighed is held. Check that the clock face is reading 0.0 kg with the harness hanging from the scales (otherwise the harness is included as part of the weight of the goat). Either insert the goat into the weigh harness OR take the weigh harness off the hook, insert goat into harness and lift the goat in the harness and attach the harness to the hook hanging from the bottom of the clockface. Read and record the liveweight (to nearest 0.1 kg).

Remove the goat from the harness OR remove the harness containing the goat and then remove the goat from the harness being careful not to injure or overly stress the goat.

Please note it is possible to weigh kids less than 10 kg by placing them into a plastic or metal bucket (e.g. 20 litre 'paint tin') and suspend the bucket off the bottom clockface hook. It is important to adjust the clockface scales with the empty bucket attached before you start weighing kids (i.e. tare the scales first).

The clockface scales should be checked every 3 goats to ensure they are recording the liveweights of the goats correctly. That is the scales should read 0.0 kg with the empty weigh harness OR weigh bucket attached. At the start of each day the accuracy of the clockface scales should be confirmed by weighing a known weight of material – the 5 kg and 20 kg test weights, then the accuracy of the clockface scales retested every 10 goats. Make sure you record the weight in kilograms to the nearest 0.1 kg in a record book for each goat with a record of each date that goats' weights are recorded. It is useful to have a record book set up so with the goats id, its weight, the date and a comment section is prepared prior to the start of weighing. Comment section is used to record any observations on individual goats – e.g. goat weak, or goat has diarrhoea, goat has injury of left leg. Thus your record book might look like:

Date	Goat id	Liveweight	Comments
21/5/2009	235	23.1	Goat weak with diarrhoea

Aging goats from their teeth

To check a goats teeth stand over the back of the goat facing towards its head with your knees holding its chest – ideally with the animal 'backed' into a corner so it can not go backwards. Hold the lower jaw with one hand while pulling it gently but firmly downwards while the other hand raises the upper lips to expose the incisors.

Goats have no (incisor or canine) teeth at the front of their upper jaw. We can estimate the age of goats by examining the size of the (8) teeth at the front of the lower jaw (these are incisor teeth). When a kid is born they have 8 'kid' teeth and as they get older these kid teeth are replaced by bigger 'adult' teeth. The central/middle 2 kid teeth are replaced first then the teeth on either side of these middle teeth, then the next 2 teeth and finally the outside 2 teeth.

In most goats the 'eruption' of adult teeth corresponds to different ages as shown below:

- 8 kid teeth – birth
- 1-2 adult teeth – 4 to 15 months of age (a 2 tooth goat)
- 3-4 adult teeth 18 – 21 months of age (a 4 tooth goat)
- 5-6 adult teeth 22 – 24 months of age (a 6 tooth goat)
- 7-8 adult teeth 27 – 36 months of age (a full mouth goat)

Age is then estimated by the amount of teeth wear (which is influenced by the type of diet and the amount of soil ingested) then loss of teeth as the goat ages.

Please note there are individual differences between animals, differences between breeds of goats and the diet fed to a goat influences the timing of teeth eruption and teeth wear.

Recording data on new born kids

To determine the breeding value of bucks and does we need to collect the information below. This information is necessary to be able to avoid inbreeding and to select 'elite' animals within populations of goats.

- Record identity of the mother of the kids
- Record number of live kids and still born kids for each mother
- Record distinguishing features of each kid (and put on collar(s)) on the live kids then:
- Record sex of each live and dead kid
- Weigh each live and dead kid and record their weights
- Measure and record heart girth measurement for each kid
- Measure and record body length measurement for each kid
- Measure and record height at withers measurement for each kid
- Record information about general condition of mother and kids e.g. Mother bleating, mother grooming kids, udder extremely enlarged teats swollen, kids suckling normally, kids struggling to breathe, etc.

An example of the data collected is given below:

Date	Doe tag	Kid id	Kid sex	Kid wt	Kid heart girth	Kid length	Comments
21/3/2009	213	451	Male	2.5	25	31	Colour all black

Toe nail trimming

If goats do not stand on hard and rough surfaces their toe nails will not wear. In the absence of a hard and rough surface the toe nails of a goat will continue to grow (faster on a high protein diet) and typically fold inwards often trapping moist dirt and also growing forwards giving the goat the appearance of wearing 'slippers'. The end result of this nail growth is a potential site for infections of the sole of the hoof and deformity of the foot leading to lameness and unwillingness to walk. Toe nail trimming is undertaken as regularly as required (every 2 to 3 months) and requires the use of either professional toe nail clippers or garden secateurs - they need to be sharp and able to easily cut thick hard toe nail. The overgrown toe nail needs to be trimmed to restore the hoof to the correct shape such that the goat is standing on the sole of its hoof.

Applying eartags

Equipment required includes appropriate applicator with correct numbered and coloured eartags plus buckets of water and disinfectant to sterilize applicator.

Ideally adult goats will be held as a group within a race or individually held to allow the procedure to be undertaken with the minimum of stress to the animal. Kids should be held either by hand or within a cradle.

Where plastic eartags are used to identify individual animals ensure, before attempting to insert the eartag, that the eartag is correctly placed in the eartag applicator such that the spike that locks the eartag closed is correctly aligned with the hole in the backing/locking plate and that once attached to the ear that the eartag can be read when facing the animal. The eartag should be inserted in the outside of the ear half way along the length of the ear with the locking spike inserted at least 1 cm from the edge of the ear.

In Queensland males have their eartag in their right ear; females in their left ear.

An alternative to using an eartag is to use numbered appropriately sized collars.

Vaccinations

Equipment required for vaccinating goats (typically for clostridial diseases) includes: the vaccine (should be within expiry date and previously stored in a fridge); vaccinators (clean with no residue in syringe barrel or hose); and spare needles of the appropriate size.

Ideally adult goats will be held as a group within a race or individually held to allow the procedure to be undertaken with the minimum of stress to the animal. Kids should be held either by hand or within a cradle. Kids should be vaccinated separately from does to avoid being smothered in the race.

Ensure that the vaccinators is delivering the correct dose accurately and consistently before starting to vaccinate animals. The dose rate will be given on the vaccine container. The needle is inserted under a pinched fold of skin on the top side of the neck of the animal with the vaccine inserted under the skin (s.c.). The procedure should not take longer than 5 seconds in a correctly restrained animal and should be undertaken such that the animal does not struggle and the needle puncture site should not bleed.

11.2 Appendix 2: Publications

The appendixes offer an opportunity to provide additional information that otherwise might not be reported elsewhere.

1. Participatory Rural Appraisal (PRA) on Goat Farming in Enrekang Regency, South Sulawesi (written in English, and Indonesian with a Summary in English)
2. Survey of Sapi Slaughter Houses in South Sulawesi Province – (written in English - Ibu Andi Nurhayu & Asmuddin Natsir)
3. Goat and meat consumption by Makassar consumers (written in English - Roy Murray-Prior, Assmudin Natsir, Mawardi Asja, Nasrullah, Yusmasari, Andi Nurhayu, Peter Murray)
4. Local consensus data of typical Enrekang goat farm (written in English - Mawardi A. Asja, Asmuddin Natsir) (includes notes on the process)
5. Masjid survey in Makassar (written in English – Asmuddin)
6. Masjid survey questions (written in English and Indonesia)
7. Survey on Supermarkets in Makassar (written in English - Asmuddin)
8. Report on Field Trip to Kalimantan (written in English, and Indonesian - Mawardi A. Asja)
9. Report on chain appraisal approach for goat marketing from Enrekang to Mamuju (written in English - Mawardi A. Asja)
10. Survey on Restaurants and warung (written in English)
11. Standard Operating Procedures (goat husbandry techniques, written in English)
12. Dinas and farmer workshop process (written in English)
13. Report on survey of roadside sellers in Makassar prior to Idul Adha (written in English - Ibu Andi Nurhayu, Ibu Yusamasari *et al.*)
14. Interviews with penjual daging di Makassar mall (Pasar Sentral)
15. Slaughterhouse interview questions (written in Indonesian)
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