



Australian Government

Australian Centre for
International Agricultural Research

Final report

Small research and development activity

project

Assessing goat production and marketing systems in Laos and market linkages into Vietnam

*project
number*

LPS/2016/027

*date
published*

November 2019

prepared by

Douglas Gray and Stephen Walkden-Brown

*co-authors/
contributors/
collaborators*

Phonepaseuth Phengsavanh
Ian Patrick
Rachelle Hergenhan
Nam Hoang
Ammaly Phengvilaysouk
Michelle Carnegie
Joanne Millar
Nguyễn Hữu Văn

approved by

Werner Stur

*final report
number*

N/A

ISBN

N/A

published by

ACIAR
GPO Box 1571
Canberra ACT 2601
Australia

This publication is published by ACIAR ABN 34 864 955 427. Care is taken to ensure the accuracy of the information contained in this publication. However ACIAR cannot accept responsibility for the accuracy or completeness of the information or opinions contained in the publication. You should make your own enquiries before making decisions concerning your interests.

© Australian Centre for International Agricultural Research (ACIAR) 2019 - This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from ACIAR, GPO Box 1571, Canberra ACT 2601, Australia, aciarc@aciarc.gov.au.

Contents

1	Acknowledgments	7
2	Executive summary	8
3	Introduction	11
4	Objective 1. Review previous ACIAR-funded and related research on goat production and marketing and develop a research framework and methodology for the scoping study	12
4.1	Desktop review and annotated bibliography (full at Appendix 1).....	12
4.2	Development of research framework and methodology	15
4.2.1	<i>Industry Map</i>	<i>16</i>
4.2.2	<i>Other Methodologies</i>	<i>16</i>
4.2.3	<i>Training Manuals</i>	<i>17</i>
4.2.4	<i>Value Chain Visualisation (from Greg Hood post-workshop)</i>	<i>17</i>
4.2.5	<i>Design Issues</i>	<i>18</i>
4.2.6	<i>Joint Activities.</i>	<i>19</i>
4.2.7	<i>Australian Research</i>	<i>19</i>
5	Objective 2. Describe existing goat production and marketing systems estimating existing capacity, constraints to development, and identify innovations or research that will improve efficiency and equity.....	20
5.1	Goat production systems	20
5.1.1	<i>Introduction</i>	<i>20</i>
5.1.2	<i>Historical and Published Information</i>	<i>20</i>
5.1.3	<i>Preliminary Benchmarking.....</i>	<i>27</i>
5.2	Goat marketing systems	32
5.2.1	<i>Introduction</i>	<i>32</i>
5.2.2	<i>Data collected and methodology</i>	<i>33</i>
5.2.3	<i>The value chain to be considered in this study.....</i>	<i>34</i>
5.2.4	<i>Farmer to Laos middle man.....</i>	<i>36</i>
5.2.5	<i>Laos middleman to domestic consumer.....</i>	<i>37</i>
5.2.6	<i>Laos middleman to Vietnamese trader.....</i>	<i>38</i>
5.2.7	<i>Vietnamese trader to slaughterhouse.....</i>	<i>40</i>
5.2.8	<i>Slaughterhouse to Vietnamese consumer.....</i>	<i>41</i>
5.2.9	<i>Summary of price margins.....</i>	<i>41</i>
5.2.10	<i>Present understanding of market size at the Lao Bao border crossing</i>	<i>42</i>
5.2.11	<i>Conclusion</i>	<i>43</i>
5.3	Capacity, constraints and potential innovations along the Goat Market Chains	44

6	Objective 3. Identify researchable issues and opportunities, research capacity and research training needs.....	46
6.1	Researchable issues and opportunities	46
6.2	Research capacity and research training needs.....	46
6.3	UNE Training workshop February 19-March 2, 2108	47
7	Objective 4 (added in Variation 1) develop a Stage 1 and, if required Stage 2, proposal on enhanced Goat Production Systems and Marketing in Laos and Vietnam.....	50
7.1	Visit to Vietnam, November 16-25, 2017	50
7.2	Village agro-forestry goat production systems in Lao PDR	50
7.3	Visit to a large commercial goat farm in Kontum, Vietnam	51
7.4	Planning Workshop Vientiane June 2018	52
8	Conclusions and recommendations	53
8.1	Conclusions.....	54
8.2	Recommendations	55
8.3	References cited in report.....	55
8.4	List of publications produced by project.....	55
9	Appendix 1: Annotated bibliography and narrative review of published and unpublished reports on goat production and marketing in mainland south east Asia with a focus on Laos and Vietnam.....	56
9.1	Introduction	57
	9.1.1 <i>Review scope and purpose.</i>	57
	9.1.2 <i>Past research on goat production in Laos</i>	57
9.2	Brief overview of Laos.....	69
	9.2.1 <i>Geography and climate</i>	69
	9.2.2 <i>Population</i>	69
	9.2.3 <i>Agricultural production in Laos</i>	70
9.3	Goat production in Laos	71
	9.3.1 <i>Trends in goat populations and products worldwide</i>	71
	9.3.2 <i>Trends in goat production in Laos</i>	72
	9.3.3 <i>Areas of production</i>	73
	9.3.4 <i>Production systems</i>	75
	1.1.1 <i>Land use planning and land allocation</i>	83
	9.3.5 <i>Socioeconomic, gender and livelihood aspects of goat production</i>	86
	9.3.6 <i>Support structures for smallholder goat production</i>	95
	9.3.7 <i>Markets for goats and goat products</i>	97
	9.3.8 <i>Summary and conclusions</i>	99

10	Appendix 2. Goat Production and Marketing in South East Asia and the Pacific	112
10.1	Industry Map	112
10.2	Other Methodologies.....	113
10.3	Training Manuals.....	113
10.4	Value Chain Visualisation (from Greg Hood post-workshop)	114
10.5	Design Issues.....	115
10.6	Joint Activities.	115
10.7	Australian Research.....	116
10.8	Next steps for the Laos SRA.....	116
10.9	Next steps for the Pacific SRA.....	117
11	Appendix 3: Description of existing and potential market chains, including mapped information, historic data and potential for expansion based on interviews with key informants and official data when available	118
11.1	Goat market chains in Laos	120
	11.1.1 Introduction	120
11.2	Value chain approach	120
11.3	Goat value chain research in Laos	121
11.4	Partner survey – December 2016 to January 2017	121
11.5	Important market chains in Laos.....	122
11.6	Roles of the different stakeholders; farm to border.....	124
11.7	Smallholder goat system profitability	124
11.8	Goat demand	125
11.9	Goat price.....	127
11.10	Transaction costs.....	128
11.11	References.....	129
12	Appendix 4: Report for partners and selected stakeholders	131
12.1	Overview of the ongoing study.....	131
12.2	Methodology and Planning Workshop	131
12.3	Desktop Study.....	132
12.4	Field Studies and Interviews	132
12.5	Review Workshop	133
12.6	Proposed Next Steps 2017 - 2019.....	135
13	Appendix 5: Key Questions for Field Surveys	136
	13.1.1 Farmer Interviews	136
	13.1.2 TRADER INTERVIEWS.....	139
	13.1.3 Demand and supply trend.....	140
	13.1.4 EXPERT Interview	142

14	Appendix 6 Training Workshop in Armidale	143
15	Appendix 7 Initial Stage 1 and Stage 2 Proposals	147
15.1	Stage 1 Proposal as submitted January 2018	147
15.2	Stage 2 revised proposal submitted December 2018.....	149
16	Appendix 8 Travel Report for trip to Vietnam on SRA LPS 2016/027152	
17	Appendix 9 Village agro-forestry goat production systems in Lao PDR	166
18	Appendix 10. Report on a visit to a very large intensive goat farm in Kontum, Vietnam	170
19	Appendix 11 Planning Workshop, June 18-22,	175

1 Acknowledgments

The Australian, Lao and Vietnam project teams are grateful to the many experts: farmers, traders, processors, retailers, extension workers and researchers consulted during the course of the study, for their time, information and insights into goat production and marketing in the region. Colleagues at the Department of Livestock and Fisheries and the University of Sydney who are implementing two livestock projects in Laos were generous in sharing their data on goat parasitism and control. The staff of the Provincial Agriculture and Fisheries Office and District Agriculture Forestry and Extension Office were essential in the conduct of the field surveys and in hosting the review workshop in Luang Prabang in April 2017. Dr Daovy Kongmanila of the National University of Laos kindly shared the results of her research and the activities of her students. Likewise the Hue University of Agriculture and Forestry are thanked for hosting a study team and for helping to develop the proposal for marketing research in Vietnam. The staff of Burapha and Stora Enso are thanked for their time and openness in sharing their commercial and research plans for agroforestry, interaction that was ably facilitated by Mr Richard Laity of the ASEAN Agroforestry Smallholders Syndicate whose goat farm allowed us to inspect and study a pilot goat enterprise that is integrated with eucalypt plantations. The office and staff of Health Poverty Action in Vientiane and Sepon district provided data and experiences of their work with poor farmers in Savannakhet province that has added greatly to the study. We thank small scale farmers, traders, abattoir owners and restaurateurs who provided useful data and experiences and whose livelihoods we seek to improve by the research proposed as an output of this study. Following the extension of the SRA we are grateful for Dr Nguyễn Hữu Văn from the Hue University of Agriculture and Forestry and Mr Tuan Anh Chung from the National Institute of Animal Science (NIAS) for hosting a very interesting project trip to Vietnam and for ongoing involvement and input into the project since. Since the visit the involvement and ideas of Dr Ngo Thi Kim Cuc from NIAS has been greatly appreciated, as have the contributions of Dr Phonevilay Sinavong from the National Agriculture and Forestry Research Institute (NAFRI) and Dr Joanne Millar of Charles Sturt University. All of these persons attended the project planning workshop held in Vientiane in June 2018. We are grateful also for the wonderful assistance and guidance provided by ACIAR staff in the form of LPS/LS RPMs Werner Stur and Anna Okello and the country managers for Lao PDR, Mrs Dulce Simmanivong and Vietnam, Mrs Nguyễn Thị Thanh An.

2 Executive summary

This report of a small research activity sets the scene, reports on some preliminary research, identifies research priorities and describes a strategy for an extended partnership between Laos, Vietnam and Australia for research on goat production and marketing.

Scoping of previous research and development achievements and assessment of current research on goat systems was undertaken through a search and review of published and 'grey' literature and by the convening of a workshop to review current and past ACIAR investments in goats in Asia. A significant output of that workshop was a plan for a production and marketing survey in Laos and Vietnam and agreement among four ongoing ACIAR projects in Laos, Myanmar, the Pacific and Pakistan to share information and use similar protocols for data collection and analysis.

Initial field surveys on goat production and marketing were undertaken in southern and northern Laos by an experienced team led by NAFRI. The team interviewed farmers, traders and other national and provincial experts. The survey was conducted in 27 villages from 14 districts in 5 provinces: Savannakhet, Khammouane, Houaphan, Oudomxay and Luang Prabang. The survey confirmed key features of goat production such as small herd size (10.3 ± 5.3), the use of goats for sale (94%) rather than home consumption, sale almost exclusively to traders (96.3%), sale mostly to meet a specific expense (eg. school or hospital fees) and the significant proportion of family income provided ($35 \pm 16\%$). On the production side it revealed the predominance of free grazing unrestrained year-round in available forest/bushland (52%) but universal provision of housing at night (100%), the limited use of supplementation with forage (26%) but universal use of salt within the goat house (100%), individual ownership of breeding males (1.13 bucks/family), the very low use of introduced bucks (3.7%), the long period of growth to a sale weight of approx. 20 kg (13.4 months) and the perceived importance of disease as the major constraint (1st ranked by 93% of farmers). Authorities in Laos identified inbreeding in small family herds as a likely significant contributor to the comparatively low growth rates of Lao native goats, and this was identified as an important research question to resolve.

The survey confirmed the high demand for goats in the cities of Laos and from many centres in Vietnam. They also confirmed the lack of inputs to the mainly smallholder farmers who supply the market. During the survey and on subsequent field visits a small number of more commercially oriented farmers were identified. All farmers shared the same constraints of high mortality of young and mature goats with the figures ranging from 10% to 80%, as reported during interviews. Disease signs such as diarrhoea (potentially parasitic) bloat and mouth lesions (presumably Orf) were common. Better definition of the extent and causes of mortality and their control was identified as an important research questions.

Three important market chains from Laos to Vietnam were described:

- **North Eastern:** Houaphanh (Laos) to Thanh Hoa (Vietnam) and Xeun La (Ha Noi, Vietnam) in a north east direction via Route 6.
- **Northern:** Luang Prabang, Oudomxay and Bokeo (Laos) through Xiengkhouang (Laos) to Nghe An (Vietnam) in a south east direction via route 7.
- **Southern:** Savannakhet (Laos) to Quang Tri (Vietnam) via route 9.

Through interviews with farmers, traders, abattoir owners and restaurateurs along these market chains in Laos, and along the southern market chain to Quang Tri and nearby provinces details of the high demand were captured. On average there is a 30% price premium for goats originating in Laos compared with local mostly crossbred Vietnamese goats with a likely, but yet to be confirmed, consumer preference for Lao provenance that has a better taste and an image of being clean and green. It is often sold as 'Lao Mountain Goat'. Average estimated values ascertained for a 20kg male goat along the southern export value chain to Vietnam are \$114 (AUD) at the farm, \$146 on arrival at the slaughterhouse in

Vietnam (with 1 or 2 trader transactions between) and \$163 after slaughter. Farmers are thus capturing approximately 70% of the slaughtered value of the animal. In Vietnam the best cuts of goat meat can retail at over \$20/kg and the cheapest at around \$10/kg. However, sale of goat meat direct to consumers is limited with the vast majority of meat from slaughterhouses going directly to restaurants where considerable additional value adding occurs. Border controls for goat export appeared to be only partly implemented with significant informal movement of goats across the border to escape licence fees. An important need to better define the goat value chains and factors affecting them was identified. Of particular importance is the basis of the premium for Lao type village goats and the extent to which breed improvement programs, particularly using exotic genotypes may compromise this.

The results of the scoping study and surveys were brought together at a review workshop in June 2017 in Luang Prabang. The attendees were the initial participants in the SRA plus research and development leaders from NAFRI, DLF and universities. Significant outputs from the workshop were the setting of research objectives to guide the completion of this small research activity, and agreement that a major research project had the support of the stakeholders represented.

One research objective was to immediately initiate longitudinal studies to obtain more objective data on current goat production and marketing. Two collaborating organisations agreed to take part. One is the ASEAN Agroforestry Smallholders Syndicate (AGFORS) which is spearheading an initiative being supported by the government of Laos and two large agroforestry companies, Burapha and Stora Enso, to integrate livestock and cropping systems in forestry plantations designed to accommodate a rotation of crops and livestock, especially goats. The other is Health Poverty Action (HPA) which implements a project funded by Australia to supply goats and support goat enterprises in Savannakhet. Their data is being provided to the project which, in return, provides analysis and advice on data collection and management. Analysis of data from these sources revealed lower annual mortality rates (12-31%) than recorded in the field survey indicating a likely response to the higher level of management available on these projects. However, measures of kids born per year per breeding doe (1.2-1.4) were approximately 50% of the conventional estimates of 1.7 kids per mature doe every 8 months (2.55 kids/doe/year). This suggests an important need for actual measurement of critical productivity indices rather than relying on survey data. This would also enable benchmarking of enterprise performance against accurate population targets. The initiative to more formally integrate village goats into forestry rotations was also seen as one worthy of support given the importance of the forestry sector in Laos. There are a number of technical and social issues to resolve in such systems and these offer the opportunity for private sector and government engagement to resolve.

With the guidelines provided by the review workshop, potential research partners were investigated. The major partners in Laos with greatest capacity to implement and undertake the research are NAFRI and DLF (and support from PAFO and DAFEO staff) with individual staff and students at NUOL and US likely to make useful contributions. AGFORS and HPA have proven to be energetic and able collaborators. In Vietnam the Hue Agricultural University has assisted greatly with insights and support for the market chain studies and are an appropriate partner especially for the major Southern market chain, while NIAS is well equipped to address marketing issues in the north of Vietnam. Both institutions were visited in November 2017. At NAFRI, HUAF and NIAS there are market chain specialists who will complement the existing UNE capacity. Burapha and Stora Enso have their own extension staff who will have technical support from AGFORS.

To consolidate these research concepts and to build relationships among the teams, 6 members of the current team (5 from Laos and 1 from Vietnam) attended research and partnership training at UNE in February 2018. As a marker of interest and support from non-government agencies AGFORS paid their own way for 2 staff members to attend, and PHA released a staff member on leave to attend. Also attending were 8 counterparts from the

Pacific Project (LPS/2016/021 - Assessment of markets and production constraints to small ruminant farming in the Pacific Island Countries).

A research proposal has emerged which has the strong backing of senior stakeholders in Laos and Vietnam. Collaborators have been identified and have agreed to undertake the detailed design, implement the project and be responsible for the research outputs having the maximum chance to influence farmers, traders, processors and retailers along the market chains in Laos and between Laos and Vietnam.

The major question to have emerged from this SRA is:

How can smallholders and other businesses in Laos increase the quantity and quality of their production to take advantage of the strong market demand for goats in Laos and Vietnam?

Specific research questions are:

1. What are the actual measured levels of productivity in smallholder, large and agroforestry goat production systems in Laos?
2. How can these benchmarks be used to identify technical and social constraints within each farming system and recommended practices that can be readily adopted?
3. What are the opportunities and risks created by the emergence of small commercial goat farms and community agroforestry enterprises involving integration of goats with forestry in Laos
4. Is smallholder production in Laos constrained by inbreeding and what are the opportunities and risks for genetic improvement to increase production and quality?
5. To what extent is goat production and marketing in Laos constrained by mortality and disease, and what "best practice" methods for disease control can be integrated into goat systems?
6. To what extent is goat production in Laos constrained by undernutrition and, how can improved forage production and feeding practices be integrated into goat systems?
7. What are the factors affecting demand and pricing of goats along the value chain in Laos and Vietnam?
8. Is demand for live goats and goat products from Vietnam and Laos likely to change in the foreseeable future and what are the characteristics of the product needed to meet likely future demand?
9. What skills, technologies and practices are needed to enable producers, traders and other players in the goat value chain in Laos and Vietnam to benefit equitably from improved goat production and marketing.
10. What capacity building is required to initiate scaling out of research findings?

A Phase 1 proposal titled "Goat Production Systems and Marketing in Laos and Vietnam" was submitted to ACIAR on 25-1-2018 with revisions in March and May of that year. In June 2018 a detailed planning workshop was held over 4 days in Vientiane and arising from that meeting a Phase 2 document was submitted to ACIAR on 18-9-2018. Following advice from ACIAR in House Review a revised Phase 2 document was submitted on 2-10-2018 with a response to the IHR comments and sent for external review. On 18-12-2018 a revised document accompanied by a response to external reviewers and the IHR was submitted to ACIAR and is currently under consideration at ACIAR. The project has been allocated the project number LS-2017-034.

3 Introduction

Against the background of a worldwide increase in goat numbers and demand for their products, growth has been especially strong in Laos and Vietnam where numbers have trebled in Vietnam and increased in Laos by 60% between 2004 and 2014. Vietnamese traders are travelling deep into Laos to buy goats for sale in Vietnam. In both countries goat enterprises are regarded as strong opportunities for farmers in poor areas to access high value markets on the basis that a) market demand is strong, b) capital investment is low (equivalent to pigs), c) diseases are few, d) they are adaptable to a wide range of feeds, and e) reproductive rate of kids is high. On the negative side the meat can be strongly flavored, kid mortality can be a severe problem if grazing and housing is not well managed, and goats can be destructive to crops, plantations and natural forest.

Both countries have invested in goat production and marketing, for example an ADB-supported government program in northern Laos includes both cattle and goats. Participating districts had to select either cattle or goats as the animal type to be promoted under this project, and at least two districts have selected goats. ADB largely relies on production models developed in a previous ADB project but these were only rudimentary and concentrated largely on fattening. There are strong opportunities to develop business models for goat reproduction that link with the large ADB development project for upscaling. The targets districts are Nalae district in Luang Namtha province and Phonexay and Phoukuon districts, Luang Prabang province

There is also evidence that in some districts on main roads linking cities in Thailand, Laos and Vietnam, for example Hinboon in Khammouane province, and Ed and Xiengkhor districts in Houaphan province buying, possibly breeding, and then selling goats to these population centres is a successful business. These small private enterprises have not been well described and their business models may be instructive for the development of small enterprises in more remote districts and could become connected to them.

This SRA examined the market potential and evaluated opportunities in Laos and to a lesser extent in Vietnam. The overall aim was to developing goat business models for Laos by identifying hotspots of existing enterprise and of high potential for goat breeding to supply young livestock for emerging markets. The research had 4 objectives:

1. Review previous ACIAR-funded and related research on goat production and marketing and develop a detailed research framework and methodology for the scoping study.
2. Describe existing goat production and marketing systems to estimate existing capacity, constraints to development, and identify innovations or research that will improve efficiency and equity.
3. Identify researchable issues and opportunities, research capacity and research training needs.
4. Based on 3, develop a Stage 1 and if required Stage 2 proposal on enhanced Goat Production Systems and Marketing in Laos and Vietnam

4 Objective 1. Review previous ACIAR-funded and related research on goat production and marketing and develop a research framework and methodology for the scoping study

4.1 Desktop review and annotated bibliography (full at Appendix 1)

In the early stages of the SRA a 58-page annotated bibliography and narrative review of published and unpublished reports on goat production and marketing in mainland south east Asia with a focus on Laos and Vietnam was prepared and submitted (Appendix 1).

The purpose of this review was to support the understanding of goat systems in Laos and the likely capacity for further research on goats to be undertaken to improve goat production in northern Laos and the marketing of goats in Laos and Vietnam.

Little or no formal research was undertaken in Laos on goats before the mid 1990s, in part because of lack of research capacity but also because there were very small numbers of goats in the country. The small numbers of goats were restricted to the northern uplands, as was the case in Vietnam. As numbers have increased in both countries, and as both countries have opened up to international research cooperation, there is now a body of documented research on which to base further work. In Laos this has been driven by government agencies: the Department of Livestock and Fisheries (DLF) and the National Agriculture and Forestry Research Institute (NAFRI). They have formed partnerships with their local counterparts in the provinces and districts and with international organisations including the International Center for Tropical Agriculture (CIAT), the International Livestock Research Institute (ILRI), and national agricultural research institutions from countries including Australia and Sweden. Among the livestock research projects, goats have received very little attention. The projects that have looked at goats are summarised in include:

- ACIAR/IFAD TAG 443 Development and Testing of an Integrated Approach to the Control of Gastrointestinal Parasites of Small Ruminants in South and South East Asia
- Governance and Public Administration Reform Livelihoods Strengthening Project (GPARLSP) Background paper on livestock sector in Khamouanne (World Bank)
- ADB Northern Livestock Project based in 5 northern provinces.

On the basis of early research and a design by CIAT and ILRI the Northern Livestock Project was implemented in 5 northern provinces from 2008 to 2015 and a further project has been approved, funded by ADB, IFAD and other agencies. The design phase for the first project generated a number of technical, economic and social studies. From the first project two districts identified goats as a high priority for further development.

As far as we are aware no PhD studies have been undertaken in Australia on goats in Laos. However, arising out of the MEKARN network (Mekong Basin Animal Research Network, see below) a number of students have undertaken PhD studies of goat nutrition at SLU (Swedish University of Agricultural Sciences) in Sweden with graduates now employed in Laos at the NUOL (National University Of Laos) and at NAFRI. Projects and papers arising from MEKARN are outlined. Small projects funded through MEKARN have led to a cohort of staff at Souphanouvong University in Luang Prabang province and Champasack University in Champasack province.

The MEKARN network (Gray and Van Hove 2003) (funded by the Swedish government and implemented by CIPAV in Colombia) has sought to build a research network in SEA around research on smallholder livestock. One of the key institutions that both contributed to

and benefitted from MEKARN is the Goat and Rabbit Research Institute of the National Institute for Animal Husbandry near Hanoi, Vietnam. The local goat in the northern uplands of Vietnam is the same variety as in Laos: the small but prolific *Katjang* goat. While this variety has good potential, the Vietnamese (with French support) have developed a fixed crossbred Bach Thao goat (based on Jamnapari and other breeds) which has been disseminated widely in Vietnam and small herds have been established at the Livestock Research Centre (of NAFRI) in Vientiane, NUOL in Vientiane, and at Souphanouvong University. Much of that research has been published in two international journals, namely *Livestock Research for Rural Development* and *Small Ruminant Research*.

These studies and others from the SEA region have been used to inform the review into goat production in Laos and the potential for further work in this area.

The desktop review revealed strong growth in goat numbers in Vietnam and Laos with growth of the goat market in Vietnam likely to be contributing to the growth in goat numbers in Laos. Within Laos, goat production remains a smallholder mixed farming activity with marked regional variation in importance. Against this background of an increasing national herd there are few data on changes to productivity or offtake of single farms, districts or market chains.

Goat production has formed a component of approximately 10 large international and national projects and a larger number of small projects in Laos since the late 1990s. These project reports and the publications arising from them provide a valuable resource base for any future work. The previous work has often been regionally localised within Laos (Eg ADB Northern projects, ACIAR extension and upland projects, CARE and NAFRI projects), and most projects have a wider livestock or agricultural focus with goats as one component of the system. Exceptions with an exclusive focus on goats/small ruminants include the small CARE Australia project on village goat banks in Laos, The 2004 ADB PPTA 4287 Northern Laos goat production study, the 2006 APHCA/ILRI Asia regional goat production and marketing workshop and the 1999-2005 ACIAR TAG443 project on integrated control of parasites in small ruminants in S and SE Asia. Most emphasis has been on production systems and/or constraints with most projects having a component on extension/adoption methods and one (ACIAR livestock extension project 2007-11) having a specific focus in this area. There is a dearth of detailed marketing information in the literature and with several reports calling for improved understanding and utilisation of markets (eg. 2006 GPARLSP project, 2006 APHCA/ILRI workshop).

While some projects have reported significant improvements in the amount and efficiency of goat production in the targeted areas, it was found in the 2007-2014 ADB Northern Region LDP that uptake of improved practices and returns on investment were lower for goats than other livestock sectors. This is consistent with the current perception of those working with goats in Laos that the production systems have not evolved substantially in response to the market opportunity. To alter this represents both an opportunity and a significant challenge.

It is clear from the review that significant constraints to improved goat production and marketing in Laos remain despite the moderate research effort over the last two decades. These can be broadly categorised as shown in Table 1:

Table 1. A framework for considering constraints to improved goat production and marketing in Laos

Category	Problem	Available knowledge and likely solutions	Prospects for achieving change
Production - Technical	Poor health/high mortality	High. Major problems and their causes well understood. Solutions can draw from beyond Laos.	Moderate-High. Challenges in accessing information and resources to implement solutions. High impact if limiting mortality.
	Poor nutrition	Moderate to high. Awareness of responses to improved nutrition at farmer level is low. Solutions relatively widely researched.	Moderate. Nutrition is at the base of the production system. Returns for improved growth/reproduction less dramatic than those affecting survival. Some prospects for targeted supplementation?
	Goat genetics	Moderate. Some awareness of inbreeding and research into improved genotypes. Benefits of the latter not clear?	Moderate. Altering traditional breeding practices is likely to be difficult but introduction of improved genotype has precedent if improved genotypes to be markedly superior in the eye of the smallholder.
	Availability of technical information	Moderate. Previous projects and Govt. Agencies have produced goat production manuals. Low availability at smallholder level.	Moderate. Can draw on national and international resources.
	Access to support services	Moderate. Govt. services infrastructure is extensive, but knowledge of front line workers and smallholder access may be limiting	Moderate. Amenable to change with staff training. Opportunities for private sector support?
	Technical capacity – Human resources	Moderate. Significant capacity building in recent years. Research – farmer linkages not well developed.	High. Amenable to ongoing education both nationally and internationally.
Production - Socioeconomic	Smallholder scale of production	Low. Few examples of commercial scale goat production to act as lead innovators	Moderate. Market opportunity is significant and there may be examples of larger scale operations which could prove the case once identified.
	Low level of education and resources of smallholders	Low-moderate. Challenges are well understood, solutions less so.	Low-Moderate. Improvements in education and resources are likely to result in a move out of smallholder goat production.
	Labour intensive/Low return to labour	Low-moderate. Opportunity cost of labour not always considered in smallholder systems.	Moderate. Improvements in efficiency of production will increase returns on labour invested.

Category	Problem	Available knowledge and likely solutions	Prospects for achieving change
Marketing	Demand	Moderate. Market for goats widely acknowledged to be strong and consistent.	High. Broad socioeconomic change in SE Asia is likely to see demand increase.
	Price	Moderate. Information on price understood mostly at a local scale.	Moderate-High. Value chain analysis will reveal pricing patterns and change along the value chain in different regions
	Access	Moderate. Ability to market goats not identified as a major constraint. Sold direct to customer or trader. Not highly organised.	Moderate. Value chain analysis would reveal if current marketing arrangements provide optimal returns to smallholders.
	Market knowledge	Low. Market information identified in several reports as lacking.	High. Market specific research likely to result in significantly improved understanding

4.2 Development of research framework and methodology

A two-day workshop took place at UNE on Tuesday 8 and Wednesday 9 November 2016, followed by a one-day planning session on 10 November for two new small research activities in Laos and the Pacific: *Assessing goat production and marketing systems in northern Laos and northwest Vietnam* (LPS/2016/027) and *Assessment of Markets and Production Constraints to Small Ruminant Farming in the Pacific* (LPS/2016/021).

A full report and program of the workshop is appended (Appendix 2)

The objectives of the workshop were to

- Share information among past, ongoing and planned research projects in Asia and the Pacific, funded by ACIAR and others. This was achieved through formal presentations and informal discussions.
- Review methodologies for the identification of, and engagement with, goat market chains. A number of training guides were identified and discussed following presentations by two experienced practitioners.
- Develop a simple framework for the documentation and comparison of goat production and marketing systems, including constraints and opportunities within and across countries. This will be an ongoing task facilitated by simple mechanisms for sharing protocols, reports and flagging future joint activities.

A list of participants and their email addresses is appended. The four projects, scientists and timelines are described in Table 2

Table 2. The four small research activities embraced by the workshop.

Title and PN	Staff and Institutions		Timeline
	Australia	Partner Country	
Assessing goat production and marketing systems in northern Laos and northwest Vietnam (LPS/2016/027)	D. Gray (UNE) S. Walkden-Brown (UNE) I. Patrick (UNE) R. Hergenhan (UNE) N. Hoang (UNE) M. Carnegie (UNE)	P. Phengsavanh (NAFRI)* A. Phonvisay (PAFO)*	Oct 16 – Sep 17
Assessment of Markets and Production Constraints to Small Ruminant Farming in the Pacific (LPS/2016/021).	F. Cowley (UNE) M. Carnegie (UNE) G. Smith (UNE) S. Walkden-Brown (UNE) P. Manuelli (consultant) M. Knox (consultant)	I. Puana (SPC)	Oct 16 – Mar 18
Pakistan	D. McGill (UM)		
Myanmar	A. Campbell (UM) E. Glanville (UM) J. Hanks (UM)		

4.2.1 Industry Map

A consensus emerged from the working groups that an initial ‘industry map’ is the most useful device for understanding the bigger picture and to developing criteria and selecting value chains for further research and development. In the case of the Lao project this will involve capture of the main internal production areas in all provinces of the country with a focus on the northern provinces of Luang Prabang and Huaphanh and the central provinces of Khammouane and Savannakhet where smallholder goat production is relatively common. Internal trade and exports to Vietnam will be assessed through interviews with provincial staff, traders and farmers. The protocols for these interviews will be shared among the four projects. The extent to which demand in Vietnam needs to be better understood will be assessed as the mapping progresses. Interviews will take place in December with an initial map available by the end of January. Common presentation of the maps will be developed.

4.2.2 Other Methodologies

As the workshop progressed it became increasingly clear that a common set of principles could be applied across all 4 projects but that tools needed to be adapted to circumstances when they were confronted and better understood. This applied to the initial mapping criteria development, depth and ‘width’ of the value chains to be studied and the number required to reach the objectives of each project. The projects share the same overall objective; to identify problems/issues that are amenable to further research, especially through the type of partnerships that can be supported by ACIAR.

There are many value chain studies on livestock published and these have compiled in the *ACIAR Goat Group* document folder. Resources for value chain analysis (VCA) methods are detailed in the next section.

It was agreed to develop a set of common parameters to be estimated across the projects for the “on farm” components of the studies. For example for mortality (age classes), reproductive rate (kids borne per litter and per year), productivity indices (turnoff rate in terms of animals, weight and income per breeding female or other resource unit), description of ill-health (as syndromes), numbers animals traded. An initial list of parameters has been described as part of the GLORIA demographic model.

Commcare was discussed as a useful project mobile acquired data tool for the design, implementation and interpretation of survey data. Although it has high initial investment in resources for training and capital expenditure time it can be tested for a full project and set up to collect and process data consistently across projects.

4.2.3 Training Manuals

Many resources are available to learn the principles of VCA and how these are applied to agricultural systems. The tools need to be adapted and developed as new studies progress. The three titles that were mentioned during the workshop are in Table 3 with commentary on their relevance to the forthcoming small research activities.

Table 3. Four VCA Training Resources

	Title and Source	Most relevant feature	Least relevant features
1	'Goat Value Chain Toolkit' ¹	Is exclusively about goat systems.	Considers multiple products from goats: milk, meat and fibre, which create much complexity.
2	A guide to value-chain analysis and development for overseas development assistance projects ²	Recent and closely aligned to practices in ACIAR projects written by Australian practitioners.	Only fruit and vegetable case studies
3	Making value chains work better for the poor: a toolbox for practitioners of value chain analysis ³	Very practical and focussed at household level	a bit broad
4	A value chain approach to animal diseases risk management (FAO) ⁴	Detailed multi animal and product	Multiple commodity, focussed on identifying weaknesses in VC specifically with regard to livestock disease risk

4.2.4 Value Chain Visualisation (from Greg Hood post-workshop)

The document 'Goat Value Chain Toolkit' is useful, but presentation of value chain analyses could consider a standardised and informative presentation of the quantitative components of the analysis. Figure 9 from that document looks like this:



¹ http://www.iga-goatworld.com/uploads/6/1/6/2/6162024/scaling-up_successful_practices-part05.pdf

² <http://aciarc.gov.au/publication/mn178>

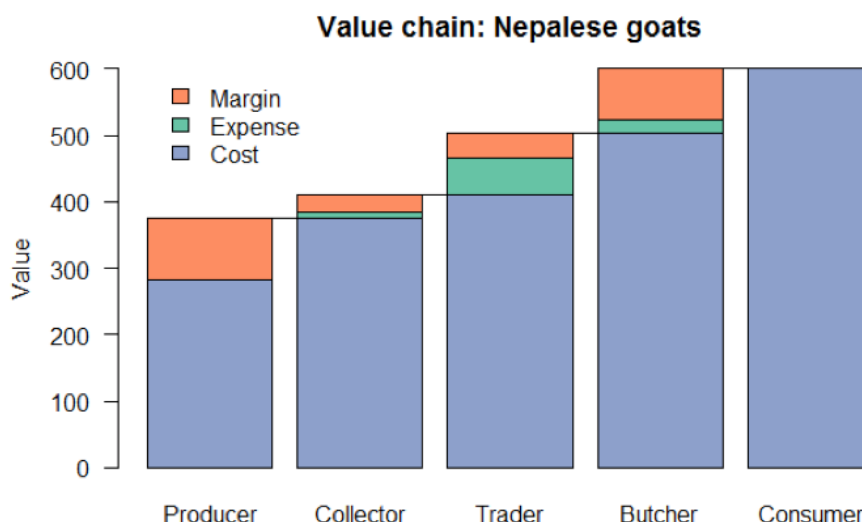
³ <http://aciarc.gov.au/publication/cop019>

⁴ <http://www.fao.org/docrep/014/i2198e/i2198e00.htm>

The numbers are informative but the colours are not informative and the symbols have no relation to the values of (cost, expense, margin).

The information could be presented better via a customised⁵ bar chart, a 'Value Chain Plot'.

With this presentation, it is immediately clear how the total value at one level of the chain feeds in as an expense to the next level. We can also see the relative sizes of the margins, expenses and cost at each level.



4.2.5 Design Issues

The value of institutional flocks was discussed and where they are available they can enable the type of formal experimentation which provides both local data for an intervention and builds capacity and confidence among the researchers and extension workers involved.

The relative emphasis on working with smallholders and / or with emerging commercial enterprises was discussed. The historical emphasis of ACIAR and other agencies on 'poor smallholders' has diminished with the recognition that all sectors need to be understood and the complexity of the relationships among all producers and the value chain accounted for as we look at the industry 10-20 years down the track.

Gender should be considered as part of socioeconomic evaluation but there is a need for the foreseeable future to report separately on issues of gender equity and new opportunities for women and youth for ACIAR and other agencies. A recurring question was: are teams set up to do this properly?

Capacity building needs to be planned and recognised as important for the start of the SRA through to project completion and reporting.

⁵ Greg has provided the code used to generate the chart. The full document is in the AGG Dropbox folder (Hood, 2016)

4.2.6 Joint Activities.

It was agreed to share information initiated by the Lao group and 'maintained' by Rachelle Hergenhan for research publications, planning documents and progress reports of common interest and usefulness.

The LPS program will initiate a 3-monthly update (similar to the TADEP Update form the PNG projects with Lachlan Dennis requesting 'dot points' from each project to compile into an email for the interest of all projects and immediate stakeholders.

These initiatives should encourage inter-personal and inter-project communications by regular means and will enable easy access of new participants to the research.

4.2.7 Australian Research

While not essential for any single ACIAR project we agreed that were significant advantages to research projects having both Australian and overseas activities, with appropriate justification. The Australian research provides opportunities for more students to become involved. One research opportunity that arose was to determine appropriate dewormer rates for goats in Australia and PCs, with a desktop study that included interaction with manufacturers and researchers. This can easily be cast as part of the input value chain shared by all goat producers as there are common suppliers and an international market for dewormers suitable (or unofficially deemed suitable) for goats. An additional and possibly controversial activity is to measure amount of active ingredient in commercially available products (dewormers, antibiotics, etc) in the PC input markets.

WormBoss is a web-based extension resource for Australian sheep and goat producers which could be expanded with a 'plug-in for PC use. This component could be jointly implemented across the projects.

Exports of goats and goat meat to Asia are substantial and increasing and are likely to have increasing impacts on supply and demand in Vietnam and Malaysia. Little is known about these impacts or their potential to stimulate of demand for animal from Laos and Myanmar. Over the past 20 years the Australian goat meat industry has experienced strong growth, largely underpinned by the sale of goats derived from rangeland or extensive production systems. Australia is the world leader in goat meat exports, with around 95% of Australian goat meat sent offshore and accounting for around 50% of the global goat meat trade. Goat meat shipments increased 10% year-on-year, to 35,780 tonnes– the highest on record. This came from the slaughter of 2.14 million goats. In addition, Australia exported almost 89,000 live goats in 2014 mostly to Malaysia.

5 Objective 2. Describe existing goat production and marketing systems estimating existing capacity, constraints to development, and identify innovations or research that will improve efficiency and equity

5.1 Goat production systems

5.1.1 Introduction

This section encompasses historical data from early research in Laos, field survey data for the current project (LPS/2016/027) in 3 provinces and longitudinal data collected over 12 months in two projects: an expanding commercial goat farm in Vientiane Province and several poor villages in Sepon District in Savannakhet. It raises the need and framework for collecting data to derive benchmarks against which production systems can be assessed from small scale farmers with a few goats, to larger scale enterprises with larger numbers and better recording facilities.

5.1.2 Historical and Published Information

Trends in goat production in Laos

Goats thrive in Laos under extensive conditions with minimal management and have high potential for further development^{6,7}. Numbers historically have been low but have increased rapidly in the last two decades. Goat numbers have increased dramatically in Laos and Vietnam based on small and some larger enterprises⁸. Numbers increased in Laos from 170,600 to 481,000 between 2004 and 2014, an increase of 182%. At the last Agricultural Census in 2010/11 goat numbers were 215,600⁹ so numbers have more than doubled in a 3-year period indicating rapid growth of the goat population. All production of goats in Laos is for meat and with most animals either consumed locally or sold to the cities or to Vietnamese traders as live animals. There are no recorded export volumes for goats or their products in Laos¹⁰. Over the same period numbers increased in Vietnam from 1.02 million to 1.6 million⁸.

Much of the increase has been opportunistic with animals bought from remote districts, sold by traders on transport routes in Laos, or taken into Vietnam to the larger centres. This trade was described in detail during the development of a large livestock development project¹¹.

⁶ APHCA 2006. *Goats-undervalued assets in Asia, Proceedings of the APHCA-ILRI Regional Workshop on Goat Production Systems and Markets, Luang Prabang, Lao PDR, October 24 - 25 2006*

⁷ Stür, W. and Gray, G.D. 2014. *Livestock in smallholder farming rice systems of Mainland South East Asia. In 'Trajectories of rice-farming households in mainland South-East Asia.'* (Ed. R Cramb.) ACIAR Monograph No. 177. Australian Centre for International Agricultural Research: Canberra

⁸ FAOSTAT 2016. *Food and agriculture data. Available at <<http://www.fao.org/faostat/en/#home>>*

⁹ MAF 2014. *Lao PDR Lao Census of Agriculture 2010/11: Analysis of Selected Themes, Vientiane, October 2014. Ministry of Agriculture and Forestry, Government of the Lao People's Democratic Republic*

¹⁰ FAOSTAT 2017. *Food and Agriculture data. Available at <<http://www.fao.org/faostat/en/#data>>*

¹¹ ADB 2014a. *Northern Smallholder Livestock Commercialization Project: Project Administration Manual. Project Number 47300-002 Available at <<http://www.adb.org/projects/documents/northern-smallholder-livestock-commercialization-project-pam>>*

Goats are a part of a renewed government investment, also supported by the Asian Development Bank in Northern Laos, focussed on some poorly resourced and remote districts¹¹. Small livestock development is a high priority for NAFRI, the national agency responsible for livestock research for development.

Goat enterprises are regarded as strong opportunities for farmers in poor areas to access high value markets on the basis that a) market demand is strong, b) capital investment is low (equivalent to pigs), c) diseases are few, d) they are adaptable to a wide range of feeds, and e) turn-off rate of kids is high with kidding approximately three times in two years with a good frequency of twins. On the negative side the meat can be strongly flavoured, mortality of kids can be high if grazing and housing is not well managed and goats can be destructive to crops, plantations and natural forest. The challenges for successful R4D have been documented and relate in part to the low 'social' and educational status of small ruminant raisers in many countries and in part to the difficulty of managing goats of mixed farming systems¹².

Published results on production are limited. Gray (2004)¹³ reported that the inter-litter interval (time between litters of an individual female) among goats in 5 northern provinces was 7 months based on single in-depth interviews with farmers and village extension workers. Windsor et al. (2018)¹⁴ have reported highly variable body weights; 33 ± 20 kg of mature female goats among smallholder and small commercial goat raisers in Luang Prabang and Vientiane provinces in the course of a study on internal parasitism.

Areas of production

Table 4 shows the number of goats produced in each province in Laos in 2010/11 while Figure provides a visual summary of the distribution of goats across districts. It is clear from this map that much of the goat keeping is occurring in the Northern and Central areas of Laos with more limited production in the South and this is confirmed in Table 5 which shows the North and Central regions to have 32% and 54% of the goat population respectively.

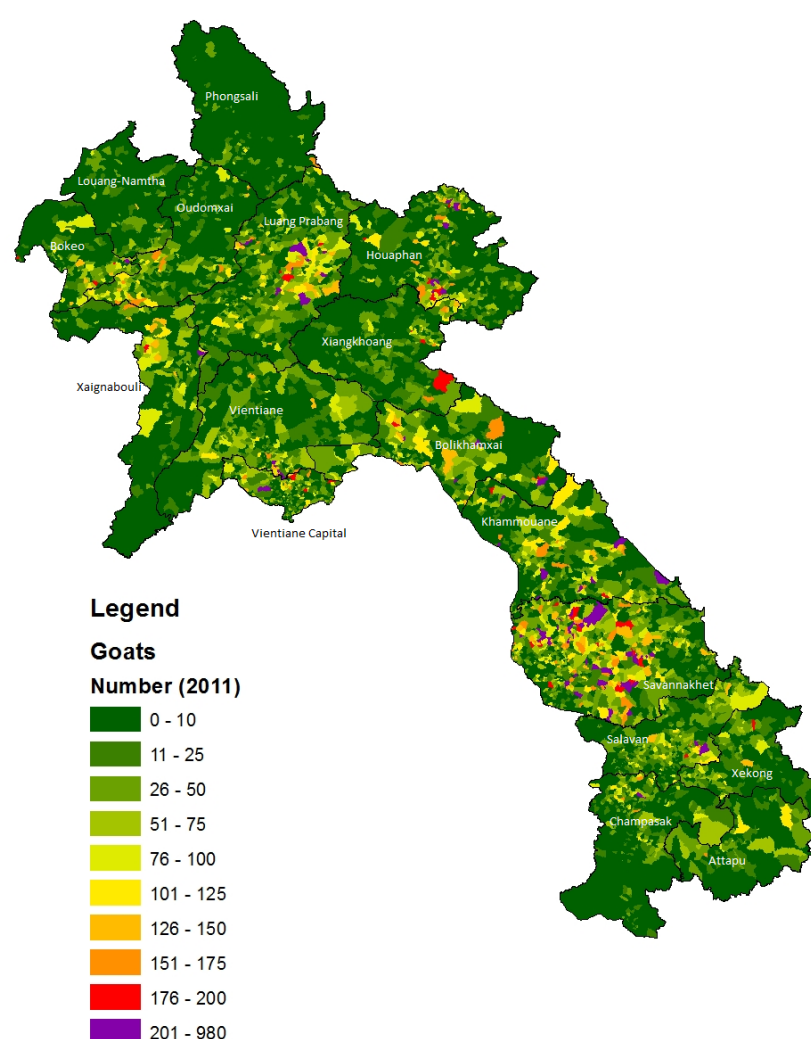
Table 4: Distribution of goats in Laos by province⁹

Province	Goat numbers	Province	Goat numbers
Attapeu	3 243	Phonsaly	2 363
Bokeo	5 643	Salavan	14 570
Bolikhamxai	12 494	Savannakhet	56 466
Champasak	8 264	Vientiane	11 069
Houaphan	16 636	Vientiane Capital	11 760
Khammouane	16 076	Xaignabouly	7 180
Louangnamtha	3 344	Xekong	4 588
Louangphabang	22 713	Xiengkhouang	8 066
Oudomxai	10 722	Total	215 197

¹² Dubeuf, J-P., Bendapudi, R., Bhandari, D., Capote, J., Carrasco-Sanchez, R., Daskiran, I., Guimaraes, V., Iniguez, L., Koluman-Darcan, N., Peacock, C., Rota, A., Richkowsky, B., and Sepe, L. 2014. Scaling up successful practices for pro-poor development projects involving goats: First outputs of a comparative study. *Small Ruminant Research* 121, 146-156.

¹³ Gray, G.D. 2004. *Constraint, Opportunities and Interventions for Goat Production in Laos. Participatory Livestock Development Project ADB PPTA 4287-LAO, Report of the Smallholder Development Specialist, International Livestock Research Institute (ILRI).*

¹⁴ Windsor, P.A., S. Nampanya, V. Putthanac, K., Keonamc, K., Johnson, R.D. Bush, S. and Khounsy 2018. The endoparasitism challenge in developing countries as goat raising develops from smallholder to commercial production systems: A study from Laos. *Veterinary Parasitology* 251 95-100



Data Source: Lao Agricultural Census (2011)

J.C.Newby (CIAT)

Figure 1: Map of goat distribution in Laos, by village (Newby 2017)**Table 5:** Distribution of goat population by region and growth in goat population from 1998/99 to 2010/11 in each region⁹.

Region	Population ('000) in 2010/11 (% of total)	% change between 1998/99 and 2010/11	Growth per annum (%)
North	68.9 (32%)	36.5	2.62
Central	116.0 (54%)	233.6	10.55
South	30.7 (14%)	298.5	12.22
Total	215.6	128.3	7.12

The number of goats kept per household varies widely. In the northern provinces, the number of goats per goat rearing household ranges from 2.2 to 3.4 with 2 to 16% of livestock rearing households raising goats. However, in the central province of Khammouane the number of goats per household is 12 to 16¹⁵ much higher than in the North, but only around

¹⁵ Kounnavongsa, B., Phengvichith, V. and Preston, T.R. 2008. Existing goat production systems in Khammouane province Lao. Masters Thesis University of Agriculture Uppsala

1% of farmers raise goats¹⁶. It is unclear why there is such a big difference in the number of goats per goat raising household. On average across the whole of Lao PDR, 6% of farming households raise goats and there was a 73% increase in the number of households raising goats from 1998/99 to 2010/11 (MAF 2014). The estimate of Kounnavongsa *et al.* (2010)¹⁵ for the number of goats/household is much higher than that indicated in the 2010/11 Agricultural Census as outlined in Table 6.

Table 6: Herd size as a percentage of farm households with goats and average goats/household by region (MAF 2014)

Region	% farm households with goats			Mean number of goats/household
	<5 head	5-9 head	>10 head	
North	66	23	11	4.6
Central	50	32	18	6.0
South	65	22	12	4.8
Total	59	27	14	5.3

Data requirements: Productivity and Offtake

All livestock-raising enterprises are complex, requiring capital investments, costs and income that can be separated by many months or years, ongoing input costs and exposure to risk. The success of the enterprise will depend on many external factors including the technical capacity extension staff and the strength of demand. An overall scheme of interacting elements is in Figure 2. which if fully costed would require complex data collection and analysis over an extended period. (Greg Hood, *Armidale workshop, November 2016*)

On-farm productivity & offtake

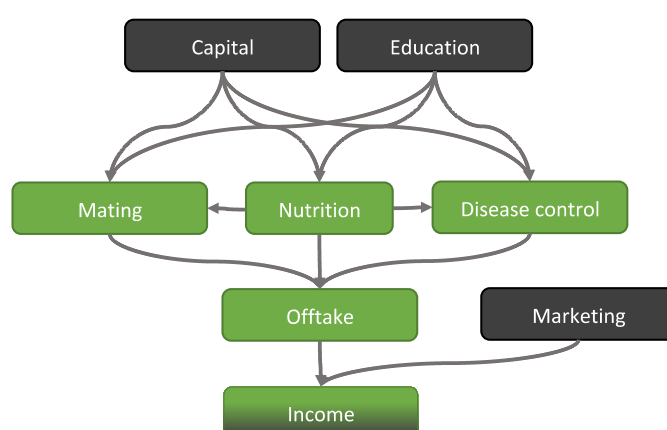


Figure 2. Large-scale Scope of inputs and outputs from a livestock system

¹⁶ Gray, G.D. 2006. *GPARLSP Background Paper on the Livestock Sector in Khammouane Province*. World Bank.

A list of the items that need to be considered for a gross margin analysis are in Table 7.

Table 7. Sample list of income of expenditure items required for a gross margin analysis of a goat enterprise.

Operating Costs	Culled does Buck Service Labour Concentrated Feed Veterinary Medicines Replacement Does Land rental Light and Water
Outputs	No. or weight of animals sold Price per whole animal or per kg Liveweight

In addition, to account for the period between purchase of animal or other inputs and selling of product there needs to be a discounting factor applied to the budget.

Clearly not all such information is currently available in Laos for any productions system, although some could become available from a new research project). A reduced set of data is required in the first instance to make realistic estimates of the productivity and profitability of the enterprise.

Offtake is the a simple measurement for benchmarking and recording change the productivity of the enterprise. The number or offspring or their weight sold / per breeding female/ unit of time, is an expression of the efficiency of the systems. The data required for this simple calculation is surprising difficult to obtain. Most farmers do not keep written records and their memory is challenged when interviewed. What they can recall is when animals are sold and the price, and when animals die. These were the data collected during the field surveys, along with general information about the productions systems and possible causes of death. Price and trader data is reported separately in the Market Chain report.

Survey Results

On the basis of the historical information and through discussions with provincial staff and traders a survey was implemented in southern and northern Laos to identify the most important market chains leading to Vietnam (and other domestic centres). Production and marketing information was collected. Production data are presented in this section.

The objective of the survey was to obtain detailed information on management, productive performance and identify factors with potential to improve performance and reduce goat mortality

The survey was conducted in 27 villages from 14 districts in 5 provinces (Savannakhet, Khammouane, Houaphan, Oudomxay, Luang Prabang

The survey used a semi-structured questionnaire to collect the information from farmers' focus group meetings and individual interview of goat farmers. The key questions for the interviews are appended (Appendix 5)

Table 8. An overall summary of the villages

Variable	Mean
Total family keeping goat in village, %	40.4±26.6
No of goat/family, heads	10.2±5.2
Produce goat for sale, %	93.9±2.1
Family's income of selling goat, %	35.15±9

Table 9. Estimates of productivity

Variable	Mean
Age of buck at 1 st service, month	7 ± 0.6
Age of does at 1 st service, month	6.5 ± 0.8
Weight of buck at 1 st service, kg	14.5 ± 0.8
Weight of does at 1 st service, kg	15 ± 1.2
No of litter/year	3 times / 2years
No of buck, head/family	1.1 ± 0.4
Time keeping buck, year	2.2 ± 0.4
Select kids from own herd for buck, %	100

Table 10. Inputs to goat-raising systems

Input	Mean % of farmers
Supplement forage in rainy season, %	25.9
Offer salt, %	100
Simple pens,	100
De-worming	7
Vaccination	15

Table 11. Constraints to goat-raising systems

Constraint	Reported %	Ranking
Disease	85.2	1
Lack of knowledge	55.5	2
Loss	7-18	3

Table 12. Main Causes of Mortality

Cause of Mortality	Occurrence %	Ranking
Diarrhoea	50.6 ± 28.9	1
Bloat	35.6 ± 37.3	2
Orf	14.4 ± 2 1.9	3
FMD	1.5 ± 7.5	4

Estimates of Mortality

Mortality figures were collected in all villages and households. The time frame of the mortalities was difficult to determine and the figures in Table 10 could best be described as the proportion of kids born that survive to maturity and sale. The range for the 27 villages was 10% to 80% with an unweighted average of 47%. In summary: of the kids that are born, approximately half do not survive to be sold, used as replacement females or as bucks for their own use or for sale.

Table 13. Details of the goat-raising households, village, districts and provinces survey for production and management information, with percentage of goat mortality as reported in farmer interviews. Average mortality was 46% \pm 23% (mean \pm standard deviation).

Province	District	Village	Variable				
			Total families in village	Families keeping goats	Average goats/family	Years of raising goats	Average annual goat mortality %
Savannakhet	Xe Pon	Kalouk	61	41	5.5	2	20
Savannakhet	Xe Pon	Na Bor (farm)	0	0	21	3	20
Savannakhet	Song Khon	Song Khon	195	185	6	10	70
Savannakhet	Phin	Phin	260	182	13	4.5	65
Savannakhet	Phin	Sa Loy	76	50	17	15	70
Khammouane	BouaLaPha	Sop Peng	95	50	4	15	60
Khammouane	BouaLaPha	Kang Ya Loung	36	34	4	3.5	70
Khammouane	SayBouaThong	Ka Sair	22	8	10	2.5	10
Khammouane	SayBouaThong	Na Khong	102	50	6	14	20
Khammouane	HinBoun	MaiNamPaKanh	84	13	5.5	12	75
Houaphan	Add	Na Ha	153	9	10	4.5	80
Houaphan	Add	Na Ngeun	39	16	7.5	3.5	60
Houaphan	Xieng Khor	Loup	50	15	15	10	60
Houaphan	Xieng Khor	PhonThong	128	24	10	12	20
Houaphan	Xieng Khor	Na Kham	87	35	14	25	60
Houaphan	Sam Neua	Long Aeud	80	12	13	25	50
Houaphan	Sam Neua	PhonSaVang	84	9	5	2	85
Oudamxay	Bang	Nam Dor	97	33	6.5	10	30
Oudamxay	Bang	Nam Khong	253	48	7.5	20	50
Oudamxay	Xay	Don Keo (farm)	0	0	24	5	10
Oudamxay	Xay	ViengSar (farm)	0	0	5	3	30
Louangprabang	PakXang	HardSam	69	10	7.5	2.5	20
Louangprabang	PakXang	HardKarAod	54	28	15	10	30
Louangprabang	ViengKham	PhouKeo	64	40	5	20	30
Louangprabang	ViengKham	PhouKang	78	52	8	7.5	60
Louangprabang	NamBak	HouayKong	185	5	15	3	20
Louangprabang	NamBak	MokVad	116	14	15	5.5	60

Conclusion

Goat production has a great potential for Lao farmers, but there are some important technical limitations which farmers cannot easily overcome by themselves. Parasite control, feed, and better housing will need to be considered together to help farmers to improve production and become more market-oriented. We will need to find good entry point for working with farmers that provide quick impacts such as forages and deworming.

5.1.3 Preliminary Benchmarking

Introduction

At the review workshop in Luang Prabang 18-20 June 2017 it was agreed that further surveys based on single visits to farmers would not provide the information required to estimate herd productivity required by the project. It was further agreed that some longitudinal measurements – over several months and years would provide the benchmarking data that would enable change to be detected with the testing and introduction of improved management practice and disease control.

ASEAN Agroforestry Smallholders Syndicate (AGFORS)

AGFORS is currently in the second of the integration of goats to the Burapha farm at Ban Hat Kieng in Vientiane Province. AGFORS is testing the feasibility of livestock enterprises within an agroforestry model. Burapha Agroforestry Co., Ltd (BAFCO) is a Lao/Swedish plantation and wood products manufacturing company, with its own saw mill, processing facilities and plantations. The company (www.buraphawood.com) is one of the world leaders within the concept of agroforestry, since 2005. Seven-year rotation plantation operations are conducted in cooperation with participating villages, with the space between tree rows provided for community agricultural activities. Rice and other crops are grown during the first year of plantation establishment and then livestock can graze during years four through seven. These agroforestry systems in combination with funds for rural development strongly supports the Government goal to eradicate poverty in remote rural areas.

The company is committed to managing and developing the business in a sustainable manner and Burapha is the only company with a Forest Stewardship Certification (FSC). Today Burapha AgroForestry has planted almost 3 000 hectares across more than 20 villages and are in the process of building a plywood mill. Depending on the enabling factors the company plans to develop more than 50,000 ha using a variety of company-communication cooperation models.

The eucalypt forest at AGFORS are planted on a 9m x1m matrix to allow land cultivation between rows. The *Eucalyptus* species are not damaged by goats from planting to maturity. There is a wide variety of seeded, planted and browse species some of which have thrived and others failed. There is a pattern of grazing and browsing that varies throughout the year but differs little from traditional smallholder systems: limited hours of grazing during the days and housing at night. Key differences are a) the larger number of animals b) selection of 'improved' bucks and castration of young males c) differential feeding of lactating does and d) a program of deworming and vaccination.

It was agreed that the project would have access to the data being collected on farm that the project would provide results and suggested modification to the farm over the course of the next 12-18 months.

Health Poverty Action (HPA).

HPA is implementing a project funded by Australia under the Resilient Livelihoods for the Poor Project in Sepon, Sepon District Savannakhet HPA worked with a total of 408 RLP

households from mainly Brou speaking ethnic Mangkong and Tri villages. 372 of the direct beneficiaries from these 408 households, or 91%, were women. The 408 households were divided across two cohorts: Cohort 1 consisting of 212 households living in 12 sub-villages across three village clusters; and Cohort 2 consisting of 196 households living in 13 sub-villages across four village clusters. Cohort 1 households received their productive assets (valued at between 1.8-2.4 million KIP) during September–October 2015, while Cohort 2 households were transferred their assets during March–December 2016. Following asset transfer, each household received the following support until June 2017, in order to help them develop their assets into viable microenterprises:

There has been widespread discussion of the problems encountered during the delivery of the first cohort of ~ 400 goats to their seven clusters of ~25 villages and about 200 households. This is unfortunate as they seem to have met with great success with the second cohort of similar size which were selected, checked and delivered differently.

While there may be opportunity to investigate the proximate causes of the 30% (120 deaths out of 412 purchased) mortality and ongoing morbidity of the adult goats from the first cohort the underlying causes, as described to us by veterinarians Dr Choummala Vanmanivong of HPA and Dr Anne Drew, (volunteer attached to the program from Vets Without Borders) were: a) poor selection of animals from lowland areas, b) poor design of the 'quarantine' area in which housed the animals together, c) inadequate feeding and d) poor health monitoring. These mistakes were avoided in the second cohort with the assistance of NUOL (Dr Daovy Kongmanila) and others. Dr Drew is the fourth in a series of veterinarians who have been attached to the program since it started in mid 2015. There were no deaths in the second cohort.

Each recipient farmer is assessed as 'poor' by HPA guidelines and receive two adults; two females or one male and one female. Training is provided in housing and management with ongoing support from a village facilitator and veterinarians who visit regularly to provide health care to all livestock and gather data from the recipient households.

It was striking to note that this Brou minority village ranks amongst the poorest in Laos by a broad range of criteria, despite being only 5km from a major international highway on a well-formed all-weather side-road.

In Ban Salen Nua there were 19 HH with goats which in field visit in April 2017 of which 11 looked to be prospering. This time of year is their peak kidding time and Dr Choummala believes this is a regular pattern. From the data there are two peaks: in March and September.

Coffee, banana, rubber all feature in the agriculture of the villages and jackfruit leaves are used for some stall feeding. Goats are let out into communal forest land for feeding for 5-6 hours each day.

No individual IDs are kept on the HPA goats beyond the donated animals. Tags were not the best option - some owners removed them to assert their ownership and some wounds became infected. Collars have been used but not all remain. This has implications for future research – how best to identify animals in a longitudinal study?

As with AGFORS it was agreed that the project would have access to the data being collected on farm that the project would provide results and suggest modifications to the projects over the next 12-18 months.

Objectives

The objectives of this initial benchmarking study are (the study is ongoing) to

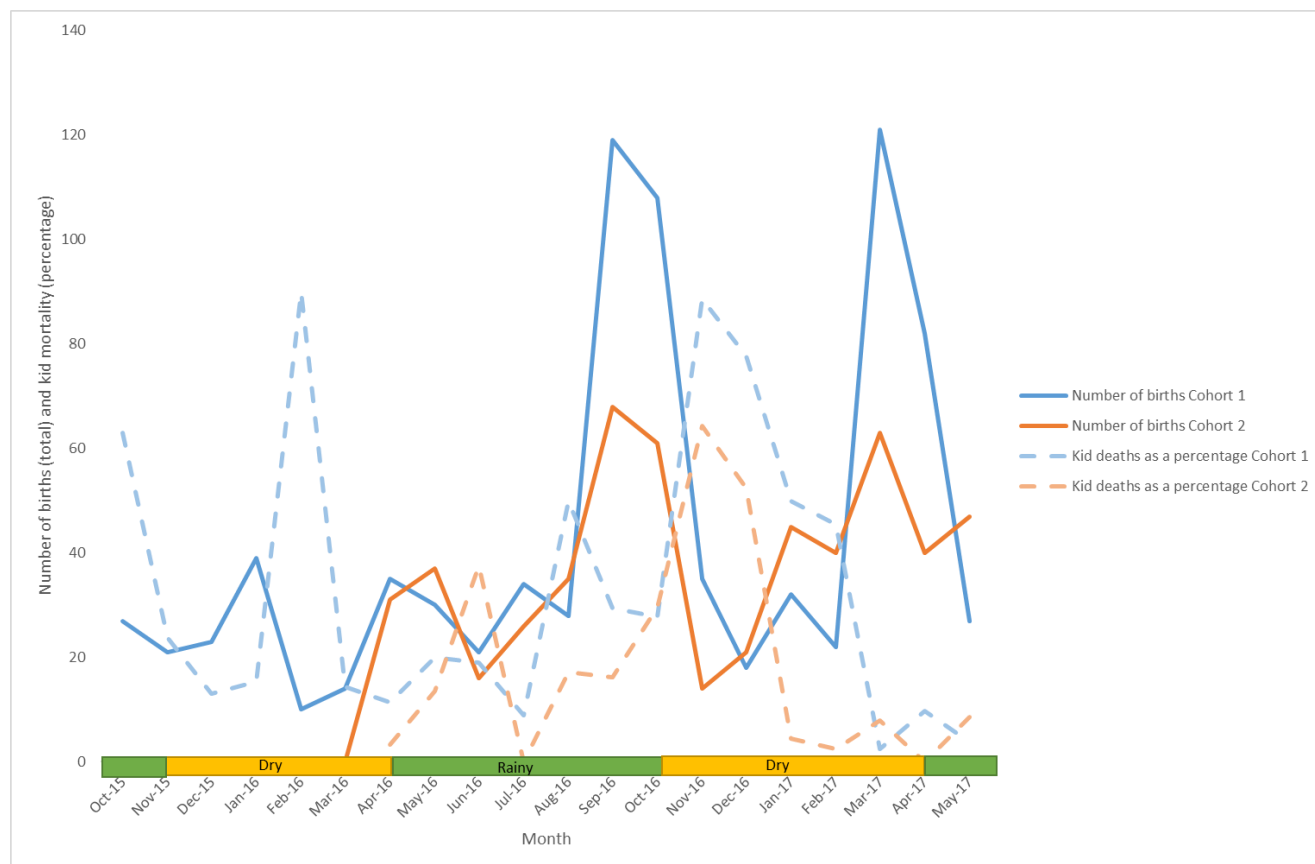
- Develop some basic productivity benchmarks of goat production in Laos based on measured rather than one off survey data

- Assess current recording and measuring methods and make recommendations for future improvement so productivity benchmarks can be easily calculated and monitored over time
- Use these benchmarks and assessments to inform the specific measurements and recording systems to be used for a broader benchmarking project

Table 14: Summary of animal numbers for AGFORS and HPA Cohorts 1 and 2.

	AGFORS	HPA Cohort 1	HPA Cohort 2
Starting date	October 2015	October 2015	March 2016
Starting number	113 nannies	412 adult goats	306 adult goats
Births	213	846	544
Deaths	36	407	105
Sales	53	87	37
Purchases	22	127 (replaced by HPA due to high adult mortality)	0
Closing numbers	259 (75 nannies, 175 kids, 9 bucks)	897*	711*
Closing date (of data presented)	Nov 2017	May 2017	May 2017

*These are the closing numbers at May 2017. Some animals were unaccounted for due to losses other than deaths or sales.

**Figure 3: Births and kid mortality for the HPA goats**

For the HPA goats there are two clear peaks; one towards the end of the rainy season and one towards the end of the dry season. This figure shows that the peak at the end of the rainy season is followed by a peak in the rate of kid mortality. As villages were surveyed on a monthly basis it is likely that neonatal kid mortality is being recorded in the month following the actual birth of that kid hence the delay in the peak. As data was collected on a household basis rather than an individual basis it is difficult to fully ascribe when mortality is occurring in relation to birth. The two peaks are likely to correspond to feed availability and quality at the time of conception. For the peak at the end of the rainy season (Sep/Oct) conception is occurring at the end of the dry/start of the rainy season when feed is either becoming more available from forage or animals are being supplementary fed due to a lack of forage available. This leads to a rising plane of nutrition which can ensure animals are cycling. It would be expected that does kidding towards the end of the dry season would have had adequate feed on offer for normal cycling and therefore conception to occur. The higher kid mortality following the peak of births at the end of the wet season is likely to relate to disease issues due to the management of kids and does at this time. Further interpretation of this data will be possible when the data from June 2017 to the end of the project is available.

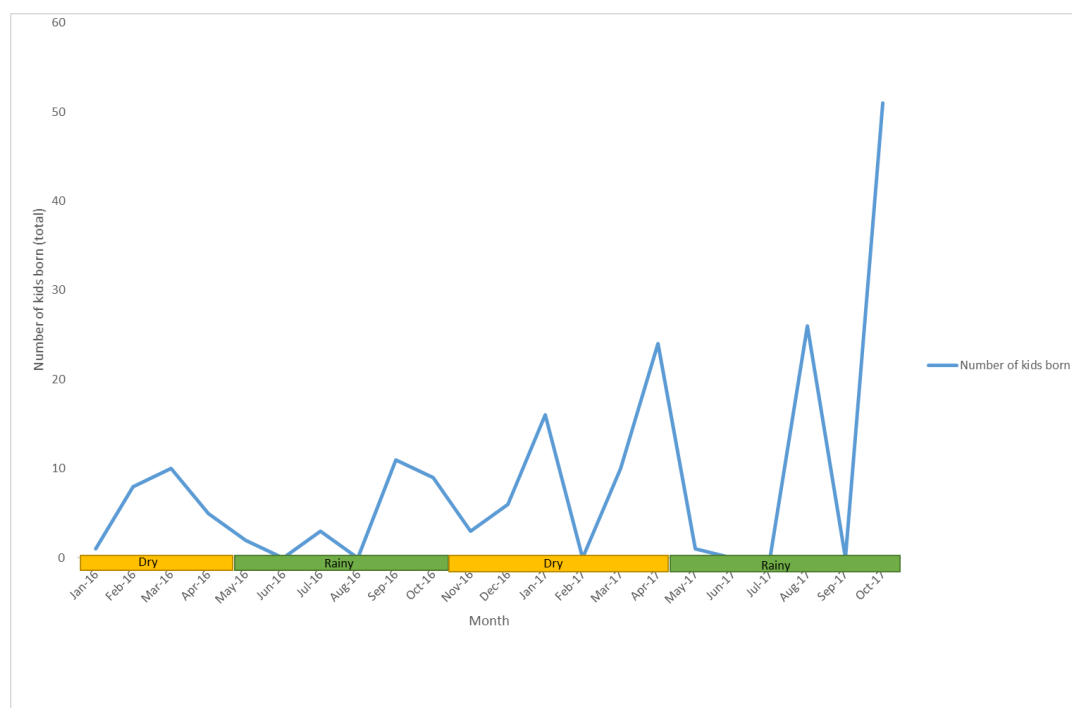


Figure 4. Births and kid mortality for the AGFORS goats

For the AGFORS goats there are clear peaks these are not at regular intervals or in a clearly identified season. The goats on this farm are intensively managed with feed shortages from forage made up by supplementation with commercial cattle feeds. This may be altering the reproductive cycling of the goats affecting when they conceive and therefore give birth. Again, further data over a longer time period may assist in explaining or showing a clear pattern of births. However, as AGFORS is attempting to supply goats to the market year-round it is likely that births will become less seasonal as they attempt to do this. But in saying that if they implemented a controlled breeding program to take advantage of seasonal feed availability then clear kidding patterns will emerge. Neonatal mortality rates for AGFORS are very low so have not been plotted alongside births.

Data Availability and Recommendations

The data received from HPA was in a well summarised and clear format making analysis straightforward. Information on the sex of the animals initially distributed was not included

making calculation of production indices difficult. There were columns in the data file to collect this data but they were not filled out.

Throughout our association with AGFORS recommendations on how to structure the data being kept have been made. Data files have changed significantly with critical information being recorded and kept indefinitely for all animals. Initially, animals were deleted from the Master sheet when sold or if they died but now remain making analysis of the data simpler. Other information has been suggested for inclusion such as parity for each doe and litter size to help inform reproductive indices. The critical parameters for inclusion in herd records are outlined in Table 15. Most of this information is currently collected but maintained in multiple sheets. It is possible to include all this in the Master sheet where it can then be retrieved as needed for the specific analysis. The use of a tool such as Mobile Acquired Data (MAD) would be useful for AGFORS. AGFORS staff already make use of mobile technology to transfer information for inclusion in the database via photos and messages on WhatsApp. A tool that would allow them to input data as they go which is then accessible to the whole team would be ideal. Various apps and software are commercially available to do this however choosing the right one for this situation could be difficult. Some of the apps, although free (Herd) or for a small fee (Goat Book), do not include enough functionality for all the traits that need to be recorded while others do not allow export of data in a useful format for analysis. Some software such as HerdMASTER (Agricultural Breeding and Research Institute) have the functionality to record all the information however are available only for computers rather than mobile devices. Others are very complex with the reports difficult to generate and interpret or have been developed for systems such as beef or wool production with thousands of animals. Software can also come at a significant cost.

The information outlined in Table 15 would be good for our project requirement to developing benchmarks. Other data likely to be collected by AGFORS will include details of the purchaser of goats.

Further analysis of the data from both HPA and AGFORS for the period between May 2017 and November 2017 is in progress. This will allow further development of the seasonal influences on reproductive parameters and whether management interventions/training provided is having any impact on birth and mortality rates.

Table 15: Parameters for inclusion in AGFORS herd records

Parameter	Options
Animal ID	Individual identifier
Tag	Visual tag number (or EID)
Animal Status	Alive, Dead, Sold
Date of Birth	DD/MM/YY
Sex	Male, Female
Breeding status	Nanny, Buck, Kid
Pedigree	Dam, Sire
Birth weight	Kg
Weaning weight	Kg
Weaning date	DD/MM/YY
Sale weight	kg
Sale date	DD/MM/YY
Sale price	Kip/kg
Birth date 1	DD/MM/YY
Litter size 1	Single, Twin or Triplet
Birth date 2	DD/MM/YY
Litter size 2	Single, Twin or Triplet
Birth date 3	DD/MM/YY
Litter size 3	Single, Twin or Triplet
Birth date 4	DD/MM/YY
Litter size 4	Single, Twin or Triplet
Birth date 5	DD/MM/YY
Litter size 5	Single, Twin or Triplet
Birth date 6	DD/MM/YY
Litter size 6	Single, Twin or Triplet
Date of death	DD/MM/YY
Cause of death	Codes will need to be developed for common causes

5.2 Goat marketing systems

5.2.1 Introduction

Goat marketing systems are underdeveloped in Laos and as such there is not a lot of detailed information concerning the market chain actors, the transaction costs and details of goat and goat product flows. Just as production systems are low input, so marketing systems are, for the producers, low effort.

While local markets remain important particularly in rural areas in Laos¹³, increasing goat numbers and an increasing demand from goat restaurants not only in Laos (Provinces of Bolikhamxai, Khammouane and Savannakhet)¹⁷ but also in Vietnam is ensuring that the market chain needs to be better understood and developed.

In provinces such as Khammouane the main purpose of keeping goats is for selling, they are not kept for household consumption¹⁸. There are well organised systems for selling

¹⁷ Pathoummalangsy, K. 2014. *Fattening is an option to improve smallholder goat production in Lao PDR*. Swedish University of Agricultural Sciences.

¹⁸ 2010 Bounthavone Kounnavongsa, Vanthong Phengvichith and Preston, T.R. *Existing goat production systems in Khammouane province Laos*. MSc

cattle and buffalo but the situation or process is not so clear for small livestock such as goats¹³.

A value chain (VC) approach aims to improve market access, efficiency and equity, thereby improving livelihoods of smallholders and other VC participants. Smallholder livelihood improvement cannot be attained in isolation of improving input supply, flow of information, access to alternate markets and a supportive community and institutional environment. Managing development using a VC framework allows researchers to include these economic, social, environmental and institutional factors to be included in the development process. In preparation for this study there have been 3 specific pieces of work undertaken to better understand the goat VC in Laos. These are referred to in this document as Phengsavanh, Patrick and Hoang. This report summaries the results of these studies/consultancies.

5.2.2 Data collected and methodology

In preparation for this study there have been 3 specific pieces of work undertaken to better understand the goat VC in Laos. These are referred to in this document as Phengsavanh, Patrick and Hoang. This report summaries the results of these studies/consultancies.

NAFRI (Led by Dr P. Phengsavanh)

To provide some base information on the goat sector in Laos, the partner team undertook a series of surveys of value chain stakeholders in December 2016 and January 2017. This included 25 village meetings (Table 16), and discussions with 8 middlemen or Laos traders and a Vietnamese trader. The village surveys were focus group discussions where a range of data was collected with regard to:

1. Reasons for keeping goats
2. Goat raising and feeding systems
3. Goat management practices
4. Production and goat health
5. Identification of management problems
6. Goat selling decision-making
7. Future goat enterprise plans and needs

Check list on goat marketing data was used in the data collection included:

1. Market chain of goat
2. Seasonal buy and sell of goat
3. Price of goat and trend in the last five years
4. Number of goat buy and sell, trend in the last five years
5. Expenditure for trading goats

Table 16: Base farmer survey data

Province	No of villages	No. of farmers attended meeting	village households owning goats (%)	Goats/family	Years raising goats	Keep for sale (%)	Keep for consumption (%)	% household income from goats
Savannakhet	5	13	77	13	7	94	6	42
Khammouane	5	13	46	6	9	93	7	41
Houaphanh	7	11	19	11	12	95	5	36
Oudomxay	2	14	23	7	15	95	5	30
Luang Prabang	6	10	26	11	8	94	6	27

The base data illustrated the importance of goats to smallholder farmers with the goats predominantly kept for sale rather than consumption. Between 27% and 42% of household income being provided by goats. While this may seem to indicate that goats are kept for income generation purposes, it is important to note that 23 of the 25 villages (92%) indicated that goats are sold when they need to pay school fees or medical bills, only 9 villages (36%) stated that they sold their goats based on meeting a certain weight target.

The survey confirmed the importance of goats in Savannakhet Province with 77% of households in the 5 surveyed villages owning on average 13 goats per family. Khammouane Province had 46% of households owning goats but only averaging 6 head per household.

Laos Field Visit April 2017 (led by Dr I. Patrick, UNE)

Further information was collected by Dr Ian Patrick in a visit to Savannakhet in 2017. This consisted of interviews with 3 farmers, a restaurant visit and a visit to Lao Bao border crossing to talk to Lao and Vietnamese traders. The specific aim of these interviews was to elicit some basic economic and transaction cost data.

Vietnam Field Visit April 2017 (Led by Dr N. Hoang, UNE)

Dr Nam Hoang collected preliminary data from the Vietnam side of the border. He met appropriate Department of Animal health (DAH) staff as well as traders, middlemen, slaughterhouse owners, restaurateurs and university staff. He visited the Vietnam side of the Lao Bao border as well as the other stakeholders at their places of business.

5.2.3 The value chain to be considered in this study

The Phengsavan survey identified three main production areas in Laos, these were in the provinces of Houaphan, Luang Prabang and Savannakhet. Figures 1 to 3 identify where in these provinces these goats originate and where they end up. The majority of goats in all three market chains are exported to Vietnam, only between 5% and 10% of the goats are consumed domestically. These market chains are referred to as;

- **North Eastern**: Houaphanh (Laos) to Thanh Hoa (Vietnam) and Xeun La (Ha Noi, Vietnam) in a north east direction via Route 6 (Figure 5)
- **Northern**: Luang Prabang, Oudomxay and Bokeo (Laos) through Xiengkhouang (Laos) to Nghe An (Vietnam) in a south east direction via route 7 (Figure 6)
- **Southern**: Savannakhet (Laos) to Quang Tri (Vietnam) (Figure 7)

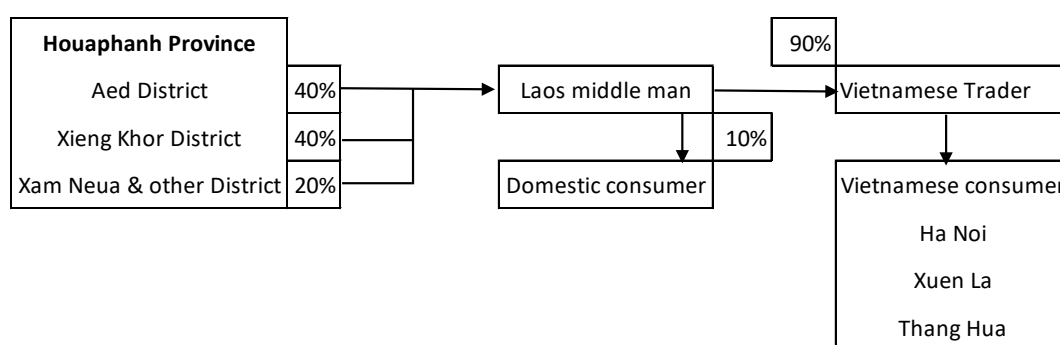


Figure 5: North-Eastern VC: Goat movement from Houaphanh province to Vietnam

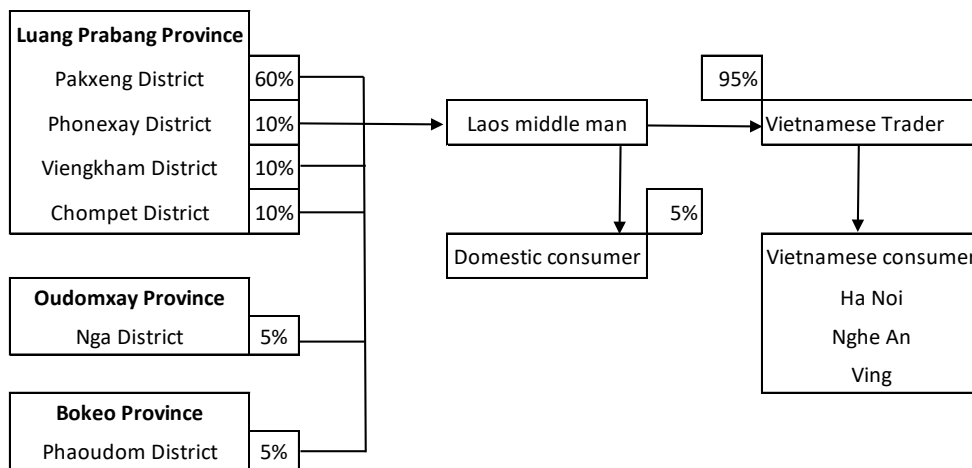


Figure 6: Northern VC: Goat movement from Luang Prabang and other northern provinces to Vietnam

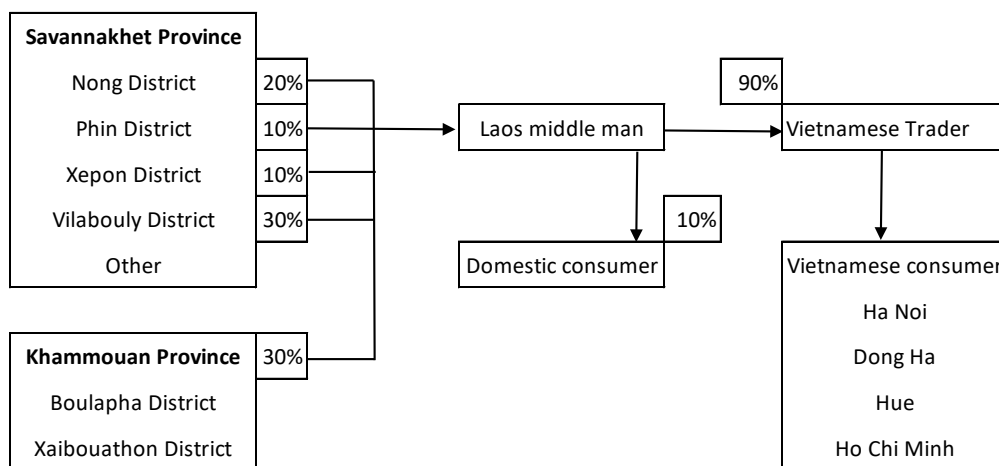


Figure 7: Southern MC: Goat movement from Savannakhet province to Vietnam

Price margins and the value chain

The profitability of goats depends on the availability of adequate grazing areas at low or no cost. Jones and Keoviriyavong (2015)¹⁹ estimated that with access to free grazing areas and with an initial investment of LKP1,400,000 (\$213²⁰), goats could return LKP2,000,000 (\$300) per year. In earlier work Cummins (2005)²¹ estimated that goats had the potential to play an important role in improving smallholder welfare in Northern Laos. This analysis compared a 'without project' scenario of four female goats (mainly free range and with minimal other inputs) with a 'with project' scenario where improved forages and a de-worming program were introduced. The analysis concluded that that would be an increase in annual household financial net revenue of LKP3.6 million (\$550) with the adoption of the new technologies.

The available information and analysis indicates that with or without improved forage technologies, goat breeding and fattening have important economic role to play in smallholder systems in Laos. If payment for grazing country is not required, the main cost is labour.

5.2.4 Farmer to Laos middle man

In the Phengsavanh survey it was estimated that in Savannakhet the on-farm price of young bucks was LAK38,000/kg liveweight (\$5.80). Figure 4 shows the average price of a buck during the years 2012 to 2016. This information is provided by 7 traders in Laos and 1 in Vietnam. While the maximum price has not changed significantly, there seems to have been an increase in the minimum (hence average) price during this time. It is not clear at this stage what the real drivers are for this decrease in variability, however, greater market specifications demanded by Vietnamese traders, increasing demand and improving production systems in Laos may be important.

There are a range of opinions and estimates of price provided by different farms and traders in the 3 market chains being considered in this study. In Luang Prabang one farmer sold 20 goats in 2017, the average price for these was \$5.32/kg for females and \$6.08/kg for males. Traders in this province require goats over 20kg and were purchasing on a liveweight rather than a per head basis. The management system included free grazing for approximately 4 hours/day in the dry season and 6 hours/day in the wet season. At other times the goats were kept in a shed constructed from local timber which cost the farmer \$300 to build. There were no routine treatments or vaccinations.

In further discussion with stakeholders in Vientiane it was suggested that a general premium did exist for Laos goats being exported to Vietnam. AGFORS estimated that Laos goats being sold in the local market averaged USD5 (AUD6.33)/kg liveweight, while the same type of goat going into Vietnam would average USD6 (AUD7.60)/kg. The Thai improved goats being exported to Vietnam averaged about USD4 (AUD5.06)/kg. In Savannakhet the farmers usually sell per head rather than per kilogram liveweight. Sale price estimates provided by farmers in the Patrick study (2017) were;

Farmer 1: \$122 for a 20kg male, \$106 for a female

¹⁹ Jones M. and S. Keoviriyavong (2015), *Report on Market Analysis for Micro-Enterprise Options. Social Production and Sustainable Livelihoods, Vientiane, Lao PDR*

²⁰ Exchange rates used are February 2018:

\$1=LKP6,580 (Lao Kip)

\$1=VND17,900 (Vietnamese Dong)

\$1=US\$0.79 (US Dollar)

²¹ Cummins (2005), *Economic and Financial Analysis of Livestock Enterprise in North Lao PDR report prepared for the Participatory Livestock Development Project, Asian Development Bank, Manila (unpublished)*

Farmer 2: \$158 for a 20kg male

Farmer 3: \$106 for a 20kg male

In the Hoang study a Vietnamese trader stated that they were able to make a higher profit if they bought direct from the Laos farmer. They could buy direct for \$85 per 20kg buck. The Phengsavanh survey in Savannakhet estimated that in 2016 the price of a 20kg male purchased from the farmer was \$122.

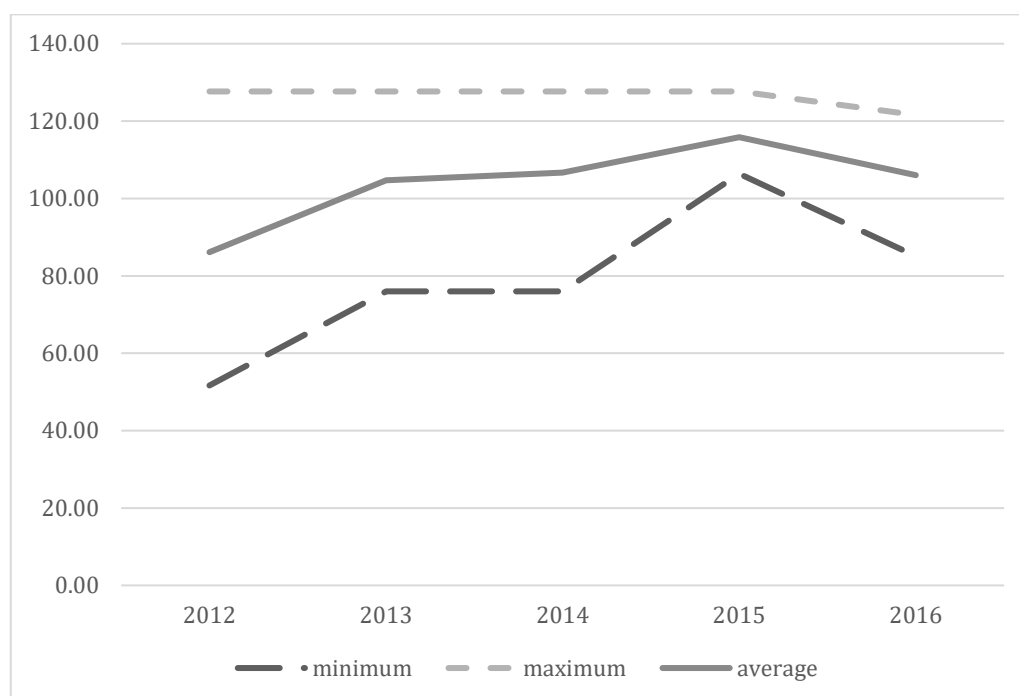


Figure 8: Price range for goats at farm gate 2012-2016 (\$/20kg buck) (Phengsavanh, 2016)

5.2.5 Laos middleman to domestic consumer

APHCA (2006)²² found that in Laos, there is generally a constant demand for goat meat throughout the year and prices, therefore tend to be stable. Livestock can be sold at any time even if animals are in poor condition.

The Lao market for goat is relatively small as goat meat is still not popular with the Lao consumer. The Lao people only consume goat meat during festivals such as New Year and other religious or local occasions. Some farmers will slaughter goats to serve their community after they have been supported in planting or harvesting rice.

There are between 30-40 outlets serving goat meat in Vientiane and only 2 to 4 small restaurants in each of the large provincial towns in Laos. In these they specialize in BBQ meat, soup and salad. Each of these small restaurants slaughter only 1 or 2 goats per day. These restaurants buy the goat from the local middle man or purchase direct from the farm. The restaurant profit ranges between \$45 and \$75 per goat. At one restaurant visited in Vientiane, the Vietnamese owner would only purchase Laos goats as she believed that was what the customer was demanding.

²² APHCA (2006). Goats-undervalued assets in Asia, *Proceedings of the APHCA-ILRI Regional Workshop on Goat Production Systems and Markets, Luang Prabang, Lao PDR, October 24 - 25 2006*

5.2.6 Laos middleman to Vietnamese trader

It appears that increasing demand from Vietnam at particular times of the year may be encouraging Laos producers to target specific goat types and selling times. The Phengsavanh survey identified that Vietnamese traders bought more goats between December and February (Figure 9) with demand at other times of the year fairly constant. To support this the survey also showed that the Lao middlemen in most provinces sourced greater numbers of goats in these months.

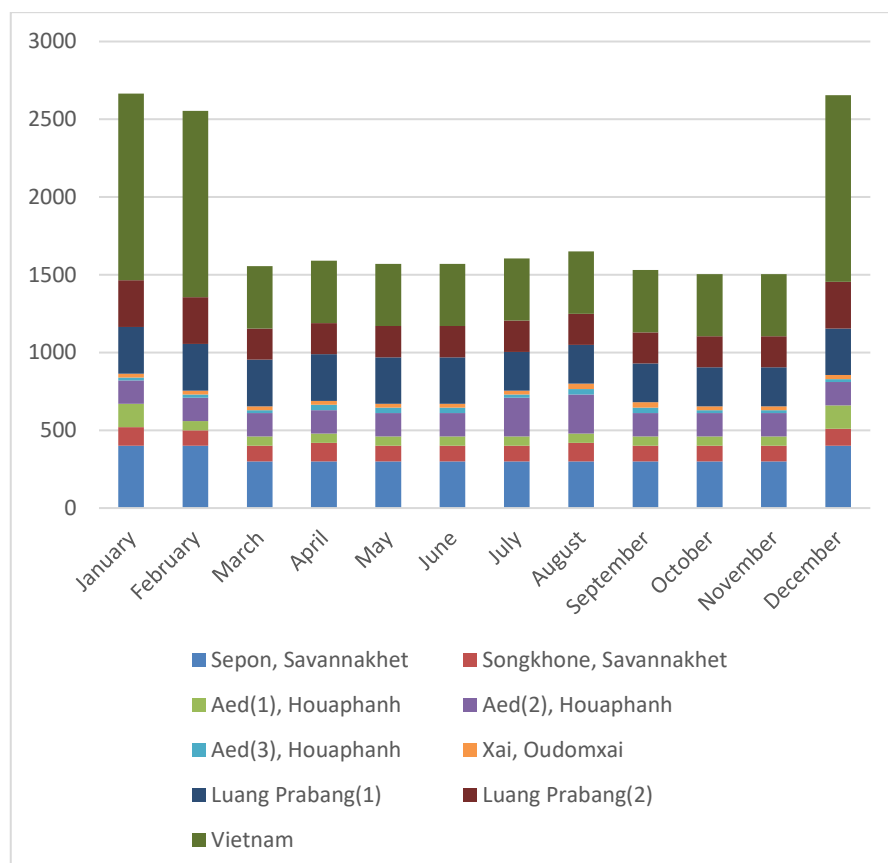


Figure 9. Number of goats traded by 8 Laos middlemen and a Vietnamese trader per year (Phengsavanh survey, 2017)

The Laos trader responds directly to a request from the Vietnamese trader and is responsible for ensuring all the export paperwork and for delivering stock to the Vietnamese trader at the border (Table 17). They usually deliver their consignment direct to the Vietnamese trader, but some middlemen may have their own holding yard/depot where they aggregate stock. They may occasionally sell direct to a restaurant in Laos, but restaurants usually purchase direct from the farmer.

If a Laos trader wants to sell to a Vietnamese trader through the Lao Bao border (Southern market chain) he/she must pay the following transaction costs (Patrick, 2017):

1. **Health Certificate.** This is obtained within the district of origin. The health certificate is checked by DAFO staff and if not in order the Lao middle man will be required by DAFO to leave the animals in their holding yard and return to the district for the appropriate certificate. There is no formal fee for leaving the stock in these yards, but the owner does have to pay feeding costs. This lack of appropriate paper work occurs approximately once a week. The cost of obtaining a health certificate is \$1.50/head.

2. *Certificate of origin*. Purchased at the point of origin. This is important as agricultural products in the neighbouring province to a Vietnam border crossing, in this case Savannakhet, do not have to pay import taxes on entering Vietnam. The cost of obtaining a certificate of origin ranges from \$3.00 and \$7.60/head depending on the province.
3. *Export license*. Licenses to export goats must be purchased from companies accredited by the government to issue them. The annual cost that a Laos trading company (e.g. Ketsana) has to pay the Government to be a licensor depends on the size of the quota purchased. The cost ranges from \$1,500 to \$2,300 per year. At the Lao Bao border crossing Ketsana will charge the trader \$2.30 to use the port near the official crossing and \$1.50/goat if crossing via the road (\$0.45 is the license fee, the remainder covers Ketsana operating costs). As the trader nears the border they will advise the export licensing company, at this border Ketsana, of their intention to export. They will then meet the fee collector and arrange payment. Before purchasing stock for export and picking up from farms/villages the trader must have a copy of the Ketsana license.

Therefore, depending on the province of origin and the means of crossing the border, the Laos trader must incur transaction costs of between \$6.00 and \$11.40 per goat to cross the border and deliver to the Vietnamese trader. This does not include transport costs. While this is simpler for the Vietnamese trader, they have stated that if they purchase goats from the Laos trader they must pay about \$7.00/kg, if they were to purchase direct from the farmer they could make a higher profit.

Table 17: Transaction costs paid by traders to export goats from 2 provinces in Laos

Province	LAK	\$ AUD
Luang Prabang Province		
Animal trading license - trading company per	10,000,000	1,519.76
Trading fee - Laos trader per consignment	50,000	7.60
Health certificate - Laos trader per goat	5,000	0.76
Export fee - Laos trader per consignment	500,000	75.99
Fuel and food - Laos trader per consignment	1,450,000	220.36
Houaphanh Province		
Health certificate - Laos trader per goat	10,000	1.52
Fuel and food - Laos trader per consignment	100,000	15.20
Payment to agent	10,000	1.52
Savannakhet Province		
Animal trading license - trading company per	15,000,000	2,279.64
Trading fee - Laos trader per consignment	50,000	7.60
Health certificate - Laos trader per goat	5,000	0.76
Export fee - Laos trader per consignment	120,000	18.24

Figure 10 provides estimates of the prices received by Laos traders from goats they have purchased from the Laos farmers. Clearly these prices mirror the prices the traders pay the farmers.

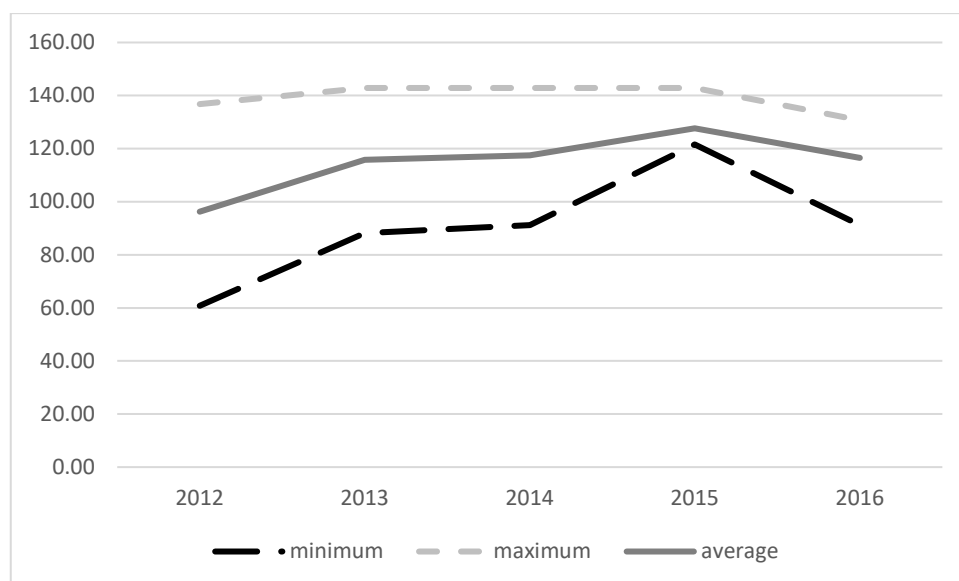


Figure 10: Price range for goats sold by Lao trader 2012-2016 (\$/20kg buck) (Phengsavanh, 2016)

Figure 11 provides the margins (\$/kg liveweight) that the Laos traders are able to attain. Once the transaction costs are taken into account, it is clear that profits for the Laos trader are potentially very small. With transaction costs plus transport ranging from \$6.00 to \$11.40 and price margins ranging between \$10.13 and 11.82/head (Figure 11).

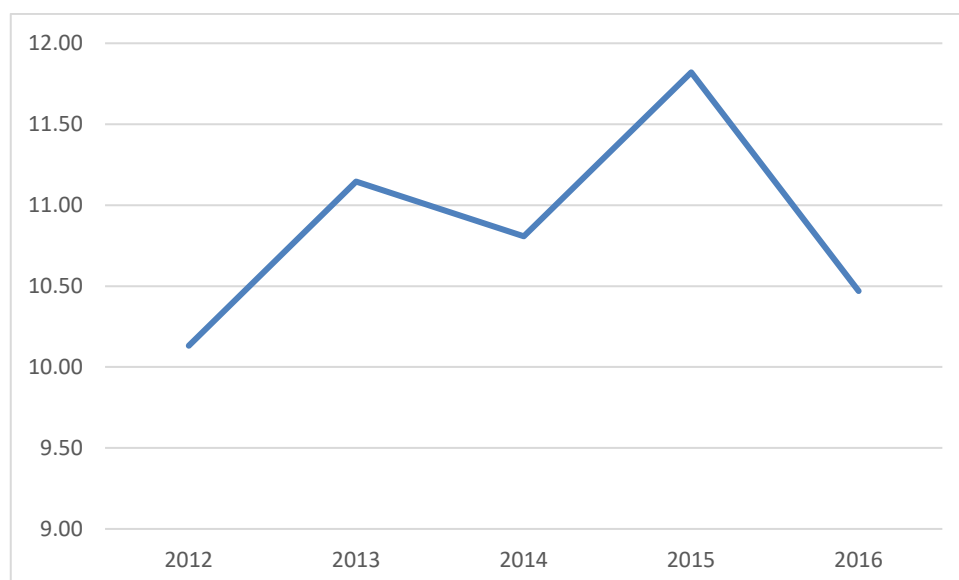


Figure 11: Price margin for goats sold by Lao trader 2012-2016 (\$/20kg buck) (Phengsavanh, 2016)

5.2.7 Vietnamese trader to slaughterhouse

The slaughterhouse purchases goats from the trader, they on-sell meat cuts to restaurants and other retailers. Unlike 20 years ago there is little sale to consumers via wet markets. It seems that it is the slaughterhouse owners that have most influence over goat price. The prices offered by them to the traders and hence down to the farmers will reflect the market equilibrium for any particular day. It is expected that approximately 90% of goat products pass through these slaughterhouses. More information is needed

regarding the number and role of these slaughterhouses in influencing smallholder profitability in Laos.

Slaughterhouses will pay between \$6.70 to \$7.50/kg liveweight for male mountain goats depending on the quality of the individual goat (Hoang, slaughterhouse in Hue). This is significantly higher than the price of the De Lai (mixed breed, Vietnamese or Thai goat) which is sold for \$4.40/kg in Khe Sahn or \$3.40 in Cam Lo. This equates to a 20kg liveweight price of between \$67 and \$90 per male De Lai goat compared to \$134 and \$152 for the mountain goat.

5.2.8 Slaughterhouse to Vietnamese consumer

Information from a visit to a specialist goat abattoir in Hue and discussions with the owner, Mr Bac revealed the following:

- The abattoir currently slaughters about 20 goats per day, 7 days a week with an annual total of around 7,000 goats.
- It is one of 3 goat abattoirs in Hue and specialises in high priced 'grass goats'. The other abattoirs deal in lower quality goats. The owner pays around \$6.15 per kg liveweight for high quality and around \$5.00 for lower quality goats.
- Demand has been steadily increasing over time, but shows seasonal variation with peak times in the 'Wedding Season', the lead up to the Tet festival and during the winter when goat is often used as a meat in a hot pot.
- As goat restaurants only open in the afternoon and evening goats are slaughtered in the morning and are able to supply fresh meat every day.
- This slaughterhouse typically holds 350 goats at any one time (500 maximum). The time from purchase to slaughter ranges from 5 days in the peak season to up to 30 days. Goats are generally grazed during this time with supplements not usually supplied.

The Lao goat, also referred to in Vietnam as a 'mountain' goat, 'local' goat or 'grass' goat receives a significant premium in the Vietnamese restaurant trade. The most expensive cut is approximately \$28/kg. Other cuts will range from \$10/kg. Most goat products go direct to the restaurants. Restaurants understand the importance of using this premium product but will often mix it with cheaper products if they feel they can maintain the required quality.

The Vietnamese consumer is a major stakeholder in the industry, there needs to be a better understanding of the consumers' knowledge of 'grass' or 'mountain' goat and the link with Laos. There also needs to be a better understanding of the expected future demand for this premium product.

Even in Vietnam goats have been purchased direct from the farm by a restaurant who then arranges slaughter, or by middlemen or abattoirs who on-sell to abattoirs. The former generally results in the highest price to the farmer.

5.2.9 Summary of price margins

The summary (Figure 8) is a simplification of the price structure between the different stakeholders in Savannakhet province in Laos to Hue City and Quang Tri, Quang Binh and Ha Tinh Provinces in Central Vietnam. If demand increases this area could expand to Da Nang and Nghe An.

In Laos, farmers have the option of selling direct to restaurants which requires transporting the goats to the restaurant with no guarantee of purchase. If not wanted by the restaurant they will return to the farm. A higher price is available to the farmer but it requires more time. The Laos trader simplifies the process for both the Laos farmer and the Vietnamese trader and is responsible for transaction costs between those

stakeholders. The Vietnamese trader can make higher profits by purchasing direct from the farmer but once again there are higher transport and other transaction costs incurred. Restaurants in Laos will purchase goats rather than cuts or a carcass while in Vietnam the large slaughterhouses purchase from traders and sell to consumers predominantly via restaurants.

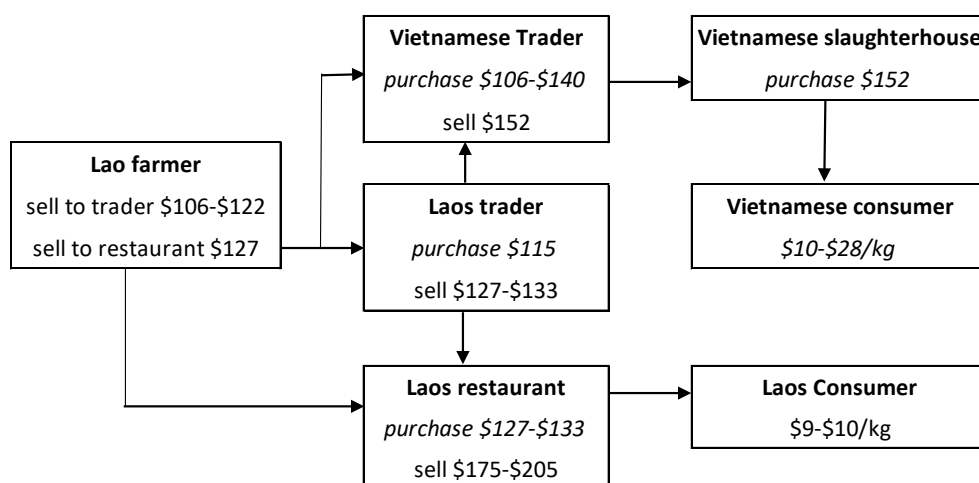


Figure 12: Value chain for a 20kg goat, Savannakhet province, Laos

There needs to be a better understanding of the transaction costs incurred between the different stakeholders in this value chain. While there are some estimates available of the costs incurred in moving goats across the border, more data needs to be collected particularly with regards to transport costs.

5.2.10 Present understanding of market size at the Lao Bao border crossing

Laos side of the border

Various estimates were provided of stock numbers crossing the border at Lao Bao. DAFO staff estimated that on average 20-30 cattle (1 or 2 trucks) crossed the border every day, that is approximately 7,000 to 10,000 per year. Most of these were transit cattle from Thailand. They estimated that between 100-150 goats were exported per week (5,000 to 7,500 per year) but this may be only 40% of the true number crossing the border. There may be a significant proportion of goats (60%) moving informally into Vietnam.

More still needs to be done to better understand the demand for Lao goats in Vietnam and the nature of the Vietnamese market itself. In 2015, it was estimated that there were 15 Vietnamese traders exporting between 200 and 300 goats through the Lao Bao border crossing (Savannakhet Province – Laos, Quang Tri Province, Vietnam) each week (half through the port and half by road).

In discussions held in April 2017 this has decreased to between 30 and 50 goats per week, potentially only 1,500 to 2,500 per year. This reduction has led to there being only a maximum of 5 middlemen left responding to goat purchase orders from Vietnamese traders. While the demand is still high it is becoming difficult to source appropriate goats. One trader stating that she would like to purchase up to 1,000 goats per week but the Lao middlemen could only supply her with 100. It appears that the ability of the Lao farmer to supply the Vietnamese market is decreasing for 3 main reasons:

- (1) Lao farmers still keep goats in the traditional way and don't produce goats to meet market specifications. They will sell goats only when they need cash to pay for children's education, family sickness or daily expenses.
- (2) Farmers are in herd build up phase

- (3) Vietnamese traders are becoming more specific in the type of goat that they demand. The traders now will only purchase male goats that weigh over 20kg.

It is becoming difficult for Lao traders to find the goats that meet this weight requirement. Laos can only supply about 5-10% of the Vietnamese demand, therefore, Vietnam has started importing goats from Thailand.

Vietnam

Officers from the Department of Animal Health (DAH) in Huong Hoa district (which includes Lao Bao) estimated that around 6 trucks per month transport goats from Lao Bao to the nearby provinces of Hue City, Quang Binh and Nghe An. There were on average 50 goats per truck. There were also around 6 trucks per week transporting goats to Dong Ha City and districts within Quang Tri Province. They noted that there are many more goats transported by motorcycle (1 or 2 each time) and these were very difficult to estimate. I was guessed that there may be about 1,200-1,300 goats per month imported from Laos.

A Vietnamese goat trader at Lao Bao said there were about 30 Vietnamese goat traders in Lao Bao and he personally trades about 20 goats per week. He said the total number of Laos goats crossing the border into Vietnam is probably around 300 each day. The major goat slaughterhouse in Hue which specialises in 'grass' goats said that they slaughter 40 'grass goats' per day which means 1,200 goats per month. All their goats are from Laos.

A Vietnamese goat trader and restaurant owner in Cam Lo district (Quang Tri Province) said that 4-5 years ago, he purchased 200 goats every three days through Lao Bao border gate. Now he only purchases 30-40 goats a day for consumption in Quang Tri and other provinces. Collating these numbers, it is estimated that approximately 30,000 goats may be moving through Lao Bao every year. This includes; 1,200/month to Hue, 600/month to Quang Tri and 600/month to Quang Binh and further northern areas. This may also include the goats that are raised locally in the Vietnamese villages near the border. The traders and slaughterhouse owners believe that the number of local (Vietnamese) goat is insignificant.

The Vietnamese traders believe that sourcing appropriate goats in Laos is not easy. They increasingly feel that they need to go and find the goats themselves or order goats from Lao traders in advance. It appears that they are having more difficulty finding goats compared to selling them. The problem is with supply not demand. This is the same perception given by Laos traders.

5.2.11 Conclusion

There is a significant and growing demand for the type of goats being supplied on smallholder farming systems in Laos. The majority of the demand is from restaurants/consumers in Vietnam who believe the flavour of 'mountain' or 'grass' goats is superior to other crossbred goat meat. As the market develops Vietnamese traders, at the behest of the slaughterhouses, are demanding the regular supply of goats that weigh at least 20kg. It seems that Laos producers are struggling to meet the market specifications. Added to this are the small profit margins for both the Laos middlemen and the Vietnamese traders. The initial analysis shows that while a farmer can receive at least \$100/20kg goat, this animal will be bought for \$150 by a Vietnamese slaughterhouse. From this \$50 margin there needs to be significant transaction costs deducted.

The market chain is confused by the lack of formality in the goat trade. While there are some institutional costs which can be incurred, the majority of goats are exported informally into Vietnam. Getting an accurate understanding of the size of the market is difficult.

This initial analysis does highlight the potential for a significant development of the Laos goat industry. It seems that demand in Vietnam will continue to rise, as will demand in the major urban areas in Laos, and this demand can only be met by goats being produced in

low input, free grazing systems. While improvement in market structures and information flow would greatly assist the development of the industry, this must not be accompanied by an increase in transaction costs.

The discussions at the farmer, trader and slaughterhouse levels have identified certain characteristics of the goat production and market systems, however, to take the next step and assist the development of a trade that provides a sustainable, regular supply of appropriate size and quality of goat will require greater understanding of the benefits and costs to all market chain stakeholders.

5.3 Capacity, constraints and potential innovations along the Goat Market Chains

A critical part of the project design, and of the workshops and many discussions conducted for the SRA, has been how to develop a potentially effective impact pathway. Several mechanisms for engaging a wide range of stakeholders across the broad sweep of this project were considered. While the project will have some intensive sites for benchmarking and other investigations of feeds, genetics and parasitism, it is planned to provide a forum for engaging with development partners and businesses along the market chains of interest. This will predominantly be in Laos, taking in the North, North East and Southern corridors, and to some extent in Vietnam. It is recognised that participation will change as some initiatives (for example the ADB Livestock Commercialisation Project) are of uncertain duration, and new government and NGO projects will emerge.

There have been significant advances in the last decade in the theory and practice of extending the benefits of agricultural research to a wide range of beneficiaries. Some of these have been developed within the portfolio of ACIAR projects.

In Laos several new and successful approaches have developed from research and development partnerships. The testing and evaluation of forages with farmers using participatory methods was developed and described in Laos as part of a regional program partly supported by ACIAR²³. A more recent initiative has been to use an 'innovation platform' approach²⁴ to develop and disseminate technologies to a range of farmers and stakeholders: in Savannakhet Province to support outscaling and research for dry direct seeding, in Phin District to improve cattle fattening systems, and in Phontong District for improved post-rice cropping production, focusing on onions.

Several projects²⁵ have attempted to elucidate the most effective methodologies for extending livestock research to farmers with mixed research results but with significant capacity building experience for the PAFO and DAFO staff involved. This capacity has been observed to carry over into other government projects.

One consequence of all these projects has been to develop the skills of central agencies in Laos, especially NAFRI, provincial and district staff, and of Australian collaborators, in the 'participatory' approaches and techniques that are required for any successful impact.

Given the wide potential scope of the proposed project the most appropriate model was agreed to be based on the 'learning alliance' of government and non-government

²³ ACIAR 2003 Monograph 062 *Developing forage technologies with smallholder farmers: how to select the best varieties to offer farmers in southeast Asia*

²⁴ ACIAR Project CSE/2014/086 *Crop-livestock systems platform for capacity building, testing practices, commercialisation and community learning in partnership with PAFO who are also part of the proposed project (the most recent of a series of projects)*

²⁵ ACIAR Project ASEM/2005/124 *Extension approaches to scaling out livestock production in northern Lao PDR*

stakeholders established to support a pig systems project²⁶. This project had a range of technologies (forages) and approaches (village biosecurity) ready to be adopted in the field and which sought to engage along at least local market chains. Many NGOs from throughout Laos participated in the alliance and it operated at a national level (sometimes called a 'Development Alliance') and at a village level (Village Learning Alliance) at different stages of the project.

A 'National Learning Alliance' approach has potential for any new project on the basis that:

1. There are a number of government projects, notably the ADB Northern Commercialisation project which are investing in the improvement of goat production.
2. There are two major private companies Burapha and Stora Enso, supporting goats as part of their commercial community-based operations on a large scale.
3. There are number of NGOs, notably HPA and CARE, using goats as an enterprise for reducing poverty among poor smallholders
4. There is at least one ACIAR project²⁷ (SMCN/2012/075) embarking on new research on feeding goats in smallholder systems.
5. The project is taking a market chain approach which involves restaurants, slaughterhouse and retailers in Laos and Vietnam.

Thus, the impact pathway for the project needs a mechanism that attracts a broad range of stakeholders (not just farmers) and offers information and technologies that will assist them in meeting their objectives.

A key feature of the pig learning alliance (to be emulated by this project) was that initial financial support for participants to attend was gradually withdrawn so that the incentive for participation was the information, contacts and support that the alliance could offer. It needs to be led by a committed and dedicated individual who has a broad knowledge of production and marketing and sympathy for the diverse needs of participants, and the skills to engage and support them throughout the project, not just at alliance meetings.

²⁶ ACIAR Project AH/2004/046 *Forage legumes for supplementing village pigs in Lao PDR*

²⁷ ACIAR Project SMCN/2012/075 *Management practices for profitable crop livestock systems for Cambodia and Lao PDR*

6 Objective 3. Identify researchable issues and opportunities, research capacity and research training needs

6.1 Researchable issues and opportunities

Export of live ruminants is a high priority for MAF, and NAFRI has given high priority to goat production for the improvement of the smallholder sector. Up to 90% of goats produced in Laos are estimated to be exported to Vietnam where demand remains high and Lao goats command a premium. An important **research** question is to better understand the nature and extent of the high demand in Vietnam and Laos in terms of animal size and conformation: taste and texture of meat, other attributes of provenance and perceptions of 'green' and 'clean'. This will require investigation and cooperation in Vietnam.

Mortality of young goats is the most reported but poorly understood constraint on herd productivity and to realising the full potential of the high demand and prices for goats. The capacity for **research** to determine the causes and the testing of practical solutions to reduce mortality has been identified and is available in Laos at the institutions visited and through their collaboration with ACIAR-funded and related projects.

A contributor to mortality, possible inbreeding and lack of genetic improvement is absence of controlled breeding and indiscriminate use of young bucks from within small village herds. There is scope for the initiation and testing, with associated **research**, of a pilot scheme to introduce the use of proven, superior bucks to smallholder systems.

The feed resource available to goats varies with region but goats thrive when allowed to graze and browse widely in previously forested land. Better understanding of the size, carrying capacity and sustainability of this resource is an important **research** question as is the development and evaluation of formal agroforestry systems incorporating goats. Some capacity to investigate the former exists in Laos and preliminary work has been undertaken. For the latter, the presence of companies such as Burapha and Stora Enso which are currently developing sustainable agroforestry models with goats offers an opportunity for research. There is scope for **Australian-interest research** in the area of tools for evaluating animal movement and behaviour and feed resource size and status in forests and scrublands. Current high technology methods are focused on cleared pasture and crop lands.

6.2 Research capacity and research training needs

There is a small number of national, provincial and district staff and farmers with good skills in goat production, goat health and research. There is a lack of appropriate extension material and techniques for goats. Lessons can be drawn from the cattle and pig sectors. Extension approaches developed in Laos by DAEC and others can be used. Adaptation and development of goat-specific material will require some **research** and capacity building. Extension material from previous projects in South East Asia in a web-based format have been supplied to AGFORS and NAFRI to support their current efforts

Potential **partners for research** on goat production and markets were identified: individual households within traditional communities; communities being supported by NGO and government programs; medium sized farmers with larger numbers of animals and a commercial focus; and some larger companies, including Burapha and Stora Enso, which are starting to integrate goat production into eucalypt plantations. There is scope for

collaboration with AGFORS to undertake research on goat production and community engagement in goat-based agroforestry.

Provincial and district **technical capacity** for the support of goat enterprises is strong in Savannakhet, Luang Prabang and Huapanh. NUOL, NAFRI and DLF have researchers with capacity to investigate, interpret and publish results and there is emerging capacity at the University of Savannakhet.

Impact pathways for further investment in research include a) integration with the Northern Smallholder Livestock Commercialization Project (NSLCP) in Huapanh (North East Corridor), b) demonstration of improved herd productivity and associated dissemination of results by district and provincial staff c) assisting HPA and other NGOs to upgrade existing and develop new programs involving goats through a Learning Alliance d) attracting new investors in medium scale goat production e) assisting existing agroforestry businesses to integrate goats into their production systems.

6.3 UNE Training workshop February 19-March 2, 2108

As an interim step in building partnerships and capacity for a system-based approach to goat production and marketing research a two-week training program was convened at UNE in February/March 2018. This workshop was funded primarily by the LPS/2016/021 (Assessment of markets and production constraints to small ruminant farming in the Pacific Island Countries) with a \$20,000 contribution from our project. Six members of the current project team together with 8 counterparts from the Pacific Project. The attendees from our project are detailed below

Name	Gender	Institution	Country	Funding to attend	Action plan
Dr Ammaly Phengvilaysouk	M	NAFRI	Lao PDR	Project/ACIAR	Engagement with Agroforestry
Ms Choummala Vanmanivong	F	HPA	Lao PDR	Project/ACIAR	Reducing kid mortality
Dr Nguyễn Hữu Văn	M	HUAF	Vietnam	Project/ACIAR	Develop association with Kontum intensive farm
Mr Thaixiong Xaikhue	M	AGFORS	Lao PDR	Project/ACIAR	AGFORS farm plan
Mr Richard Laity	M	AGFORS	Lao PDR	AGFORS	AGFORS farm plan
Ms Pankham Silisomchanh	F	AGFORS	Lao PDR	AGFORS	AGFORS Business and communication

Action plans developed at that workshop are integral to the project and are listed in the summary above. Outcomes of the action plans of Drs Phengvilaysouk and Van are provided in Appendices 9 and 10 of this report respectively. The training program is appended (Appendix 6). Members of this project who contributed to the training program were

- Dr Rachelle Hergenhan – Production Systems analysis, review of action plans.
- Dr Ian Patrick – On farm economics: decision tools and extension support
- Prof Steve Walkden-Brown – Project overview, Goat health, parasitology and post mortem examination, review of action plans.
- Prof. Douglas Gray – ACIAR small ruminant programs
- Mr Richard Laity – Agroforestry systems and small ruminants

Feedback from the participants was positive with an overall mean score of 9.03 out of 10 for 30 aspects assessed. A few photos from the program are provided below.



Group shot



On the road to another visit



Group shot – goat farm



How things are done in Australia



Visiting a drug reseller. Thaixong is a Lao PDR veterinarian working for AGFORS



Enjoying some R&R. From L to R Karisha Gounder (Fiji), Nguyễn Hữu Văn (Vietnam), Choummala Vanmanivong (Lao PDR) and Ammalay Phengvilaysouk (Lao PDR).



Boer goat farm visit

7 Objective 4 (added in Variation 1) develop a Stage 1 and, if required Stage 2, proposal on enhanced Goat Production Systems and Marketing in Laos and Vietnam

Stage 1 and Stage 2 proposals were developed and reviewed according to ACIAR guidelines and at the time of finalising this report the Stage 2 proposal had been approved by IHR, sent out for external review and the response to external reviewers was being considered by a small group meeting on Dec 14, 2018. As an aid to future reviews of this project the summaries of the Stage 1 and initial Stage 2 proposals are appended (Appendix 7).

7.1 Visit to Vietnam, November 16-25, 2017

As part of the process of development of a large project proposal on enhanced Goat Production Systems and Marketing in Laos and Vietnam a visit to Vietnam was undertaken by Professor Stephen Walkden-Brown and Dr Nam Hoang to discuss project possibilities with prospective partners, and also to present the SRA project findings at the ACIAR North West Vietnam Research Symposium in Hanoi at the end of the trip. A full report on the visit with photos is appended at Appendix 8 with a summary provided below.

Meetings at HUAF and NIAS confirmed their suitability as partners in a future ACIAR project. A/Prof. Nguyen Huu Van from HUAF was identified as logical participant in the joint ACIAR training program in Armidale in February 2018. Capacity building needs were not clearly identified and need further discussion. Links with one HUAF staff member wishing to undertake a PhD at UNE in Agricultural marketing established. Official sources of information on goats are limited to estimates of the goat population and pricing information. There is a dearth of marketing or value chain information. A basic understanding of the goat production and marketing situation was achieved by visits to institutions, farms and abattoirs coupled with detailed questioning and information exchange. Opportunities for research within the new project were identified and are summarized at item 5 in the appended report. Drs Walkden-Brown and Hoang attended and presented at the ACIAR North West Vietnam Research Symposium in Hanoi at the end of the trip.

7.2 Village agro-forestry goat production systems in Lao PDR

Throughout the SRA, the development of research questions and the full project proposal, research on the emerging possibility of grazing livestock among appropriately planted eucalypt plantations has been discussed and investigated. The ongoing analysis on data from AGFORS is reported elsewhere in this report. The two private companies, Burapha and Stora Enso, have been very cooperative, but this a new partnership which needs to be carefully developed. As part of that process, Lao team members engage with the company staff in their Vientiane headquarters, and their field sites in Vientiane province and Savannakhet. Following the training program in Armidale in Feb-March 2018, Dr Ammaly Phengvilaysouk selected a project to build interaction with the agroforestry section as his main Action Plan arising from the workshop. The objectives of the short study undertaken for this action plan were to:

- Describe and understand current village goat management and production performance in agroforestry system.
- Identify suitable village involved in agroforestry for intensive benchmarking in an upcoming ACIAR project.

- Build partnerships between NAFRI and agroforestry companies, stakeholders and distribute the results.

Results

There was cultivated crop especially rice, and some cassava as inter-cropping with eucalyptus for the first 2 years after tree planting, then eucalyptus plantation only. Farmers are allowed to kept their animal such as cattle, goats in the tree plantation 3-4 years after planting. There are no planted improved forages in the tree plantation. The other main benefit to village is that companies hire farmers labour at \$6/person/day for planting, weeding and fencing the tree plantation.

The system has potential for the creation of temporary job for villages and land renting value allowing villages access to electricity, to extend rice fields, access underground water and build infrastructure such as a dormitory for teacher in the village. The agroforestry company staff are enthusiastic and tree plantations have potential for planting forages to improve goat feed and production.

The villages still manage their goats in the traditional way and the main problems of village goat production remain: slow growth and high kid mortality. Goat production in agroforestry may require fencing and other inputs of material and labour. Company staff and farmers lack of experience and technical skills for inter-cropping forages and eucalyptus, and have had little experience on feed and feeding management, and animal nutrition. Full details are in Appendix 9.

7.3 Visit to a large commercial goat farm in Kontum, Vietnam

On the visit to Vietnam in November 2017 frequent mention was made of a very large intensive goat farm in Kontum province with “several thousand goats”. This farm was not able to be visited during the visit, but another developing fully intensive farm with similar aspirations was visited in Ninh Binh near Hanoi as reported in Appendix 8. While these large, fully intensive (zero grazing) commercial farms are largely predicated on production of goat milk for which there is high demand, both farms also have Boer goats and aspirations to supply goat meat as well as milk. From a project perspective it was felt that it would be worth developing an association with these projects to maintain a watching brief on their developments and success or failure as they may ultimately be part of a process of development of successful larger scale commercial production systems from which Lao PDR can learn.

Following the training program in Armidale in Feb-March 2018, Dr Nguyen Huu Van selected a project to visit and initiate interaction with the large goat farm in Kontum as his main Action Plan arising from the workshop. On behalf of the project he visited the Mang den Dairy Goat farm in Kontum on April 7, 2018. The farm is on 200 ha of land (160 ha of pasture) at 1200 m elevation with 6292 goats (predominantly dairy breeds) and 78 staff. It was established in 2015 and faces very large technical and financial challenges. Nevertheless, the parent company plans to expand to run 10 such farms with 10,000 goats on each, providing a clear idea of the scale of the ambition. A full report on the visit with accompanying photographs is found at Appendix 10.

7.4 Planning Workshop Vientiane June 2018

A significant milestone in the development of the Stage 2 proposal was a planning workshop held in June 2018 in Vientiane. To strengthen the social science aspects of the project (as recommended by IHR) Dr Joanne Millar joined the team. A full description of the workshop is appended (Appendix 11).

The aim of the workshop was to consolidate the results of the scoping study, add recent research findings from Laos and Vietnam and make detailed plans for activities for the four-year project. This workshop was attended by the participants in the study and the project team leaders and scientists from Australia, Laos and Vietnam. The specific objectives were to

1. Prepare detailed workplans and budgets for the full project proposal.
2. Develop relationships amongst senior counterparts in Laos Australia and Vietnam
3. Further engage stakeholders and other potential research partners

The objectives of the workshop were met with the major output being a revision of the scoped and objectives of the project and the addition of substantial detail to the activities required to meet Objectives 1 and 4. All of these were incorporated into the full proposal submitted to ACIAR in September 2018. The list of 21 attendees is below.

Name	Organisation	Country
Phonepaseuth Phengsavanh	NAFRI	Lao PDR
Ammaly Phengvilaysouk	NAFRI	Lao PDR
Phonevilay Sinavong	NAFRI	Lao PDR
Phoukam Viengvilay	NAFRI	Lao PDR
Thangsamay Vorlaphim	NAFRI	Lao PDR
Bounlom Douangngeun	NAHL/DLF	Lao PDR
Souk Phomhaksa	NAHL/DLF	Lao PDR
Thonglai Vanniving	DLF Savannakhet	Lao PDR
Phonesavanh Phomnasone	DLF Savannakhet	Lao PDR
Olavanh	PAFO Savannakhet	Lao PDR
Bounmy Phewankham	SKU Savannakhet	Lao PDR
Sabaiphone Soulinthone	SKU Savannakhet	Lao PDR
Thaixiong Xaikhue	AGFORS	Lao PDR
Luke McWhirter	Burapha	Lao PDR
Nguyễn Hữu Văn	HUAF	Vietnam
Ngo Thi Kim Cuc	NIAS	Vietnam
Chung Tuan Anh	NIAS	Vietnam
Joanne Millar	CSU	Australia
Rachelle Hergenhan	UNE	Australia
Douglas Gray	UNE	Australia
Stephen Walkden-Brown	UNE	Australia

8 Conclusions and recommendations

We conclude that the main conditions for the development of goat production in Laos are as anticipated at the start of the SRA: there are good prospects for increasing both the quantity and quality production, provided that demand remains strong and risk are assessed and mitigated.

The major question to have emerged from this SRA is:

- How can smallholders and other businesses in Laos increase the quantity and quality of their production to take advantage of the strong market demand for goats in Laos and Vietnam?

Specific research questions are:

1. What are the actual measured levels of productivity in smallholder, large and agroforestry goat production systems in Laos?
2. How can these benchmarks be used to identify technical and social constraints within each farming system and recommended practices that can be readily adopted?
3. What are the opportunities and risks created by the emergence of small commercial goat farms and community agroforestry enterprises involving integration of goats with forestry in Laos
4. Is smallholder production in Laos constrained by inbreeding and what are the opportunities and risks for genetic improvement to increase production and quality?
5. To what extent is goat production and marketing in Laos constrained by mortality and disease, and what “best practice” methods for disease control can be integrated into goat systems?
6. To what extent is goat production in Laos constrained by undernutrition and, how can improved forage production and feeding practices be integrated into goat systems?
7. What are the factors affecting demand and pricing of goats along the value chain in Laos and Vietnam?
8. Is demand for live goats and goat products from Vietnam and Laos likely to change in the foreseeable future and what are the characteristics of the product needed to meet likely future demand?
9. What skills, technologies and practices are needed to enable producers, traders and other players in the goat value chain in Laos and Vietnam to benefit equitably from improved goat production and marketing.
10. What capacity building is required to initiate scaling out of research findings?

A research proposal has emerged which has the strong backing of senior stakeholders in Laos and Vietnam, and the collaborators who will undertake the detailed design, implement the project and be responsible for the research output having the maximum chance to influence farmers, traders, processors and retailers along the market chains in Laos and between Laos and Vietnam

At this stage the overall aim of the project is to develop improved sustainable production and marketing systems for goats in Laos and Vietnam to support future expansion and commercialisation of the goat industry in these countries with enhanced opportunities for women.

The broad objectives are to:

1. Directly measure key indicators of goat production systems in Lao PDR to develop benchmarks against which improvements can be assessed.
2. Assessment of major constraints and identification and evaluation of potential solutions
3. Reduce market risk and increase marketing opportunities through improved understanding of the factors affecting demand and pricing of goats in Lao PDR and Vietnam, and of the associated value chains
4. Build capacity for research and development of goat production in Lao PDR and initiate scaling out of project findings

8.1 Conclusions

The core issue is to manage risks and support opportunities associated with very rapid growth in the goat populations of Laos and Vietnam. Goat numbers in Laos in 2017 are estimated at 550,000, from an estimated 190,000 in 2005, a threefold increase. Almost all of this increase has been in small enterprises in rural communities and the majority of product is exported to Vietnam. In Vietnam numbers increased from 1.02 million to 1.6 million between 2011 and 2014. The growth driver is the high demand for goats in Vietnam and for Laos the premium price paid for 'Lao-type' goats, typically > AUD \$6.00/kg live weight, a price premium of 15-25% over other goat breeds. This export trade is at risk on a range of fronts and there are potential environmental risks from unconstrained goat production without intensification of the smallholder production systems. The core opportunity is to develop production systems that can meet this demand in a sustainable fashion and position the sector for a long productive future.

The current priorities for agricultural development in Laos are exported oriented crops (rice, coffee, cassava, sugarcane, maize and timber) plus ruminant production (cattle and goats). Goats, with their high export potential, are a small sector but growing in importance. This was repeatedly expressed in meetings with senior DLF and NAFRI personnel in Laos. Vietnam's current policies on Agricultural Restructuring relating to livestock include developing livestock in two ways: (i) promote large-scale and intensive production in specialized and industrialized areas with high-tech applications; (ii) maintain household livestock production with encouragement to apply technologies and protect biosecurity. Encouraging investment from the private sector is also encouraged. The project is thus a good fit with the priorities of both partner countries.

The proposed project will build on the findings of SRA LPS/2016/027. The desktop review identified that goat production has formed a component of approximately 10 large international and national projects and more small projects in Laos since the late 1990s, but rarely had goats been the sole focus. Field surveys, a study visit to Laos and a workshop on Goat Production and Marketing from June 19-20, 2017 under the SRA have also informed the content of this proposal. In Vietnam there is a long history of goat production research but little on marketing of goats. A significant resource is the 2009 book "New technologies for improving goat production in Vietnam" which is a report of the activities of the Vietnam-Australia Goat Improvement Project (2006-2009). ACIAR has funded several projects on goat production across Asia and the Pacific. Key scientists from these projects attended the SRA planning workshop in November 2016 to share their successes and failures.

New research is needed because of the unprecedented growth in goat production in the region, the attendant risks, the opportunity provided by the high demand in Vietnam, emerging new production systems (eg. integration with forestry) and markets, and the lack of any major current or recent projects focussed on goat production and marketing in Laos.

8.2 Recommendations

It is recommended that further research be supported with the overall aim to develop improved sustainable production and marketing systems for goats in Laos and Vietnam to support future expansion and commercialisation of the goat industry in these countries with enhanced opportunities for women.

The research should take a participatory approach to decision making and implementation of activities in country. Capacity building will be mutual with the early part of the project characterised by the Australian team strengthening their skills and knowledge of working in Laos and Vietnam. The Lao team will be strengthened by training in a systems approach to production in marketing through short courses and visits to Australian research institutions and farms. Both teams will engage in further training in the methodologies of Value Chain Research and in incorporating gender equity into decision-making, development of research teams, implementation of project activities and assessing the potential and actual impacts on communities. All of these elements will be incorporated into a participatory monitoring and evaluation system for

High level benchmarking of production and marketing will occur at a national level with detailed benchmarking of selected key value chains. Production research will be primarily in Laos with transfer of appropriate technologies between countries. Market research will include both countries. The key sources of value in the Vietnam market will be investigated and key risks such as disease, sovereign and market competition will also be monitored/evaluated. Community production systems may present longer term opportunities for marketing and upgrading of key value chains.

A full-time research fellow (RF) should be appointed to manage the project. The person will have a strong Agricultural Systems background and be Australian based but spending significant time in-country. A full-time counterpart should be appointed in Laos, to enhance coordination and achievement of project objectives. References

8.3 References cited in report

All references are included in the appropriate section as footnotes

8.4 List of publications produced by project

- Phengsavanh, P, Phengvilaysouk, A, Viengvilai, P, Gray, D, Patrick, I, Hergenhan, R, Hoang, N, Walkden-Brown, S (2017) Goat production in Laos and market linkages into Vietnam. In 'North West Vietnam Research Symposium 'Mountains of Opportunity'. Hanoi, Vietnam 22-24 November 2017', 22-24 November 2017. (Eds R Dyer, et al) pp. 91-95. (Australian Centre for International Research, Canberra:
- Hoang, N, Phengsavanh, P, Patrick, I, Gray, D, Walkden-Brown, S (2017) Understanding Goat Market Chains between Southeast Laos and Central Vietnam. In 'North West Vietnam Research Symposium 'Mountains of Opportunity'. Hanoi, Vietnam 22-24 November 2017', 22-24 November 2017. (Eds R Dyer, et al) pp. 87-90. (Australian Centre for International Research, Canberra:
- Viengvilai, P, Phengvilaisouk, A, Phengsavanh, P, Walkden-Brown, S, Gray, D (2018) Smallholder goat rearing systems in Lao PDR. *Lao Agriculture and Forestry Journal* (accepted).
- Viengvilai, P, Phengvilaisouk, A, Phengsavanh, P, Patrick, I, Walkden-Brown, S, Gray, D (2018) Study on goat marketing in Lao PDR. *Lao Agriculture and Forestry Journal* (accepted).

9 Appendix 1: Annotated bibliography and narrative review of published and unpublished reports on goat production and marketing in mainland south east Asia with a focus on Laos and Vietnam

Compiled by Rachelle Hergenhan with inputs from Douglas Gray, Ian Patrick, Michelle Carnegie, Phonepaseuth Phengsavanh, and Stephen Walkden-Brown

Contents

1	Introduction.....	57
1.1	Review scope and purpose.....	Error! Bookmark not defined.
1.2	Past research on goat production in Laos	Error! Bookmark not defined.
2	Brief overview of Laos	69
2.1	Geography and climate.....	69
2.2	Population	69
2.3	Agricultural production in Laos.....	70
3	Goat production in Laos	71
3.1	Trends in goat populations and products worldwide.....	71
3.2	Trends in goat production in Laos.....	20
3.3	Areas of production	21
3.4	Production systems.....	75
	3.4.1 Health/disease management.....	76
	3.4.2 Breeding management	80
	3.4.3 Fodder/feeding management	80
	3.4.4 Land use planning and land allocation	83
	3.4.5 Extension for improved production systems.....	84
3.5	Socioeconomic, gender and livelihood aspects of goat production... Error! Bookmark not defined.	
	3.5.1 The multi-functional role of goats	Error! Bookmark not defined.
	3.5.2 Gender roles, ownership and decision making.....	Error! Bookmark not defined.
	3.5.3 Goats, resource poor farmers, landless and women in AR4D projects	Error! Bookmark not defined.
	3.5.4 Goats and groups	Error! Bookmark not defined.
	3.5.5 Rural livelihoods, poverty, gender and small ruminants in Laos.....	Error! Bookmark not defined.
	3.5.6 Summary.....	Error! Bookmark not defined.
3.6	Support structures for smallholder goat production	95
	3.6.1 Province and District.....	95

3.6.2	<i>National</i>	95
3.6.3	<i>Universities</i>	97
3.6.4	<i>Summary</i>	97
3.7	Markets for goats and goat products	97
3.7.1	<i>Goat markets</i>	97
3.7.2	<i>Value chain approach</i>	98
3.7.3	<i>Goat value chain research in Laos</i>	98
4	Summary and conclusions	99
5	Reference list	101

9.1 Introduction

Goats have long been recognised as a potential means of improving the plight of the poor, smallholder farmer in developing countries. As a small ruminant species they are often cheaper to purchase and keep than larger ruminants, such as cattle, and being browsers are able to thrive on vegetation that is often unpalatable to other livestock species. They also have the added advantage of producing multiple products including meat, milk and fibre however this potential is not always realised. Despite these apparent advantages, goat production systems have not necessarily been changing or evolving to significantly improve the position of smallholder livestock producers.

9.1.1 Review scope and purpose.

The purpose of this review is to support the understanding of goat systems in Laos and the likely capacity for further research on goats to be undertaken to improve goat production in northern Laos and the marketing of goats in Laos and Vietnam. The review will be exhaustive, as far as possible, in identifying previous research that has been published and documented, the main findings of the research and the institutions and individuals involved. The main findings and areas of research will be summarised. The review will guide the more detailed evaluation of the research and capacity to be undertaken in the full scoping study. The review will point to some research outside mainland SEA which may shed light on the constraints and opportunities that exist in Laos.

9.1.2 Past research on goat production in Laos

Little or no formal research was undertaken in Laos on goats before the mid 1990s, in part because of lack of research capacity but also because there were very small numbers of goats in the country. The small numbers of goats were restricted to the northern uplands, as was the case in Vietnam. As numbers have increased in both countries, and as both countries have opened up to international research cooperation, there is now a body of documented research on which to base further work. In Laos this has been driven by government agencies: the Department of Livestock and Fisheries (DLF) and the National Agriculture and Forestry Research Institute (NAFRI). They have formed partnerships with their local counterparts in the provinces and districts and with international organisations including the International Center for Tropical Agriculture (CIAT), the International Livestock Research Institute (ILRI), and national agricultural research institutions from countries including Australia and Sweden. Among the livestock research projects, goats

have received very little attention. The projects that have looked at goats are summarised in Table 2 and include:

- ACIAR/IFAD TAG 443 Development and Testing of an Integrated Approach to the Control of Gastrointestinal Parasites of Small Ruminants in South and South East Asia
- Governance and Public Administration Reform Livelihoods Strengthening Project (GPARLSP) Background paper on livestock sector in Khamouanne (World Bank)
- ADB Northern Livestock Project based in 5 northern provinces.

On the basis of early research and a design by CIAT and ILRI the Northern Livestock Project was implemented in 5 northern provinces from 2008 to 2015 and a further project has been approved, funded by ADB, IFAD and other agencies. The design phase for the first project generated a number of technical, economic and social studies. From the first project two districts identified goats as a high priority for further development.

As far as we are aware no PhD studies have been undertaken in Australia on goats in Laos. However arising out of the MEKARN network (Mekong Basin Animal Research Network, see below) a number of students have undertaken PhD studies of goat nutrition at SLU (Swedish University of Agricultural Sciences) in Sweden with graduates now employed in Laos at the NUOL (National University Of Laos) and at NAFRI. Projects and papers arising from MEKARN are outlined in Table 3. Small projects funded through MEKARN have led to a cohort of staff at Souphanouvong University in Luang Prabang province and Champasack University in Champasack province.

The MEKARN network (Gray and Van Hove 2003) (funded by the Swedish government and implemented by CIPAV in Colombia) has sought to build a research network in SEA around research on smallholder livestock. One of the key institutions that both contributed to and benefitted from MEKARN is the Goat and Rabbit Research Institute of the National Institute for Animal Husbandry near Hanoi, Vietnam. The local goat in the northern uplands of Vietnam is the same variety as in Laos: the small but prolific *Katjang* goat. While this variety has good potential, the Vietnamese (with French support) have developed a fixed crossbred Bach Thao goat (based on Jamnapari and other breeds) which has been disseminated widely in Vietnam and small herds have been established at the Livestock Research Centre (of NAFRI) in Vientiane, NUOL in Vientiane, and at Souphanouvong University. Much of that research has been published in two international journals, namely Livestock Research for Rural Development and Small Ruminant Research.

These studies and others from the SEA region have been used to inform this review into goat production in Laos and the potential for further work in this area.

Table 2 Summary of research projects involving goats in Laos (in descending chronological order)

Year	R&D Projects	Organisation/Affiliation	Outcomes
Implementation period 2014 - 2021	ADB Northern Smallholder Livestock Commercialisation Project	Asian Development Bank http://www.adb.org/projects/documents/northern-smallholder-livestock-commercialization-project-pam	<p>Intended impact of this project is: Increased incomes for smallholder livestock producers in the project areas</p> <p>Outcome: Increased livestock sales from sustainable smallholder production in the project areas</p> <p>Outputs: 1. Strengthened capacities of smallholders and other Livestock Value Chain (LVC) actors. 2. LVC infrastructure strengthened. 3. Capacity to access credit improved. 4. Project management enhanced.</p> <p>Based on the outcomes of the Livestock Development Project (ADB 2015), this project identifies districts and priority animal types for those districts. Goats are a priority in some of these districts including Nalae in Luang Namtha and Phoukhoun and Phonexay in Luang Prabang.</p>
2007 – 2014 (preceded the Northern Smallholder Livestock Commercialisation Project)	ADB Northern Region Sustainable Livelihoods through Livestock Development Project	Asian Development Bank/International Fund for Asian Development https://www.adb.org/projects/35297-013/main	<p>Raised livestock productivity and profitability in the 18 districts covered in the project through:</p> <ul style="list-style-type: none"> - Improvement of on farm livestock production technologies - Development of market efficiency and livestock enterprises - Strengthening of participatory extension networks - Effective community-driven development - Strengthening of project implementation management <p>Outcomes for goat production from this project:</p> <ul style="list-style-type: none"> - Average number of goats owned/household increased from 0.51 in 2005 to 1.3 by 2013

Year	R&D Projects	Organisation/Affiliation	Outcomes
			<ul style="list-style-type: none"> - Mortality of goats decreased by 6% from 2005 to 2013 - 75% of the goat population was vaccinated which was the target - Of the 1600 Livestock Producer Groups (LPGs) formed 8% focused on goats with women being most active in these groups along with the poultry groups - The improved practices for goats used during this project led to an increased rate of return compared to traditional practices (IRR 14% vs 24%; EIRR 18% vs 31%) although these returns were the lowest for all livestock species studied - Uptake of goat production not as high as other livestock such as cattle, pigs and poultry despite opportunities
2009??? - 2012	Establish Village Goat Banks, Saysathan district (Sayabouly Province)	CARE Australia https://www.footprintsnetwork.org/project/49/Establish-village-goat-banks-Saysathan-district.aspx	Employment and income for 10% of the population in 6 villages. Technical training and support for goat production
2007 - 2011	Extension approaches to scaling out livestock production in northern Lao PDR (FR2012-04)	Australian Centre for International Agricultural Research (ACIAR) http://aciarc.gov.au/publication/fr2012-04 http://aciarc.gov.au/project/asem/2005/124	<p>Livestock production (including goats) and rural livelihoods can be improved in remote regions if appropriate methods and approaches are used for extension and capacity building including:</p> <ul style="list-style-type: none"> - Training of competent and committed national and provincial staff - Farm training courses and staff visits to farmers to support farmer to farmer learning and to foster increased farmer adoption of techniques or technologies - Use of farmer cross visits and farmer field schools to build skills and information

Year	R&D Projects	Organisation/Affiliation	Outcomes
2001 - 2007	Forages and Livestock Systems Project (FLSP)	International Centre for Tropical Agriculture (CIAT)	This project aimed to facilitate the uptake of forages for livestock production by smallholder farmers in Laos. Within 5 years the number of villages and households using forages and fattening livestock had increased six-fold. There was a 50% reduction in the time required for farmers to get significant benefits from the use of forages in their systems. It also identified that a facilitated learning environment stimulated farmers to adapt forages, livestock housing and management practices to their own systems and that regular follow-up visits and on-the-job mentoring for extension staff provided institutional support.
2006	GPRLSP Background paper on livestock sector	World Bank	<ul style="list-style-type: none"> - Identification of potential benefits to expanded goat production in upland districts (similar to what had already occurred in the Hinboon district) including economic, social and environmental for both the provincial economy and the poorest households and communities. - Identified areas of public sector intervention for success including for goat production access to credit, training of livestock specialists, technical support at district and province. - Recommendation for further study of goat markets and how increased production might affect those markets - How can goat production be used as a coping mechanism for poverty in villages
2006	Goats – undervalued assets in Asia Proceedings of the APHCA-ILRI Regional	Animal Production and Health Commission for Asia and the Pacific (APHCA)	<p>The recommendations from this workshop were:</p> <ol style="list-style-type: none"> 1. There is a widespread need for training in breeding, feeding and health control for goats

Year	R&D Projects	Organisation/Affiliation	Outcomes
2006	Workshop on Goat Production Systems and Markets	International Livestock Research Institute (ILRI) http://cdn.aphca.org/dmdocuments/APHCA%20Publications/ilri - goats_book.pdf	<ol style="list-style-type: none"> 2. There is a need for better understanding of markets for goats and goat products from lowest value (e.g. manure) to highest value (e.g. pharmaceuticals) 3. There are technical issues that can be solved through new research including appropriate species of legumes as feed for goats and the status and possible impact of negative selection in goat populations. 4. There is a good opportunity for networking among the private and public sector in goat dairy production. 5. Training in diagnosis and surveillance for PPR is an urgent priority. 6. Importation of breeds needs to be monitored carefully to ensure the breeds are appropriate and necessary. Contact among suppliers and users of appropriate goat breeds should be stimulated through a knowledge network.
2005	Improving livelihoods in the uplands of the Lao PDR	National Agriculture and Forestry Research Institute, National Agriculture and Forestry Extension Service, National University of Laos http://www.mekonginfo.org/assets/midocs/0001773-environment-improving-livelihoods-in-the-uplands-of-the-lao-pdr.pdf	A sourcebook to facilitate the flow of information between and among workers in the uplands, intended to be a compendium of best practices and lessons learned in upland resource management. Provides field workers and program managers with a range of options to consider when planning activities.
2004	ADB PPTA 4287-LAO Constraints, Opportunities and Interventions for Goat Production in Laos, Participatory Livestock Development Project Goat	Asian Development Bank	<p>Technical</p> <ul style="list-style-type: none"> - Goat production manual was a proposed output but this was not delivered - Identified options for improved productivity including deworming, increased and smarter feeding, housing and sanitation, manure and

Year	R&D Projects	Organisation/Affiliation	Outcomes
	Raising in Northern Lao PDR		compost production, breeder and buck management - Outlined methods and scenarios to facilitate improvement of productivity
1999 - 2005	TAG443 Development and Testing of an Integrated Approach to the Control of Gastrointestinal Parasites of Small Ruminants in South and South East Asia	Australian Centre for International Agricultural Research/IFAD http://aciarc.gov.au/files/node/615/worm_control_a.pdf	In Laos the training workshop provided practical knowledge and techniques on goat production. Goat support in a number of villages. In the project area more generally, technology development for an integrated approach to control of gastrointestinal parasites along with lessons on the development, implementation and monitoring of multi-country projects. Development of software packages for epidemiological modelling – Tropical Worm World and GLORIA (Generalised Livestock Model for Opportunities Risk and Innovation Assessment)
1997	Upland farming systems in Lao PDR – Problems and opportunities for Livestock Proceedings of an International Workshop held in Vientiane, Laos	Australian Centre for International Agricultural Research (ACIAR) http://aciarc.gov.au/files/node/2099/pr87_pdf_10860.pdf	Goats are recognised as economically important animals in the shifting cultivation communities in upland farming systems.

Table 3: Goat specific nutrition projects as part of the Mekong Basin Animal Research Network (MEKARN) including Masters (MSc) and PhD theses and published papers. Access to theses is from the MEKARN website <new.mekarn.org> and the majority of papers are published in the online journal Livestock Research for Rural Development www.lrrd.org.

Year	Title of project or paper
2016	Porsavatdy Phonethep and Preston TR Effect on feed intake, digestibility, N retention and methane emissions in goats of supplementing foliages of cassava (<i>Manihot esculenta</i> Crantz) and <i>Tithonia diversifolia</i> with water spinach (<i>Ipomoea aquatic</i>). LRRD Vol 28, Article 72
2016	Phonevilay Silivong and Preston TR Supplements of water spinach (<i>Ipomoea aquatic</i>) and biochar improved feed intake, digestibility, N retention and growth performance of goats fed <i>Bauhinia auminata</i> as basal diet LRRD Vol 28, Article 92
2015	Phonevilay Silivong and Preston TR Growth performance of goats was improved when a basal diet of foliage of <i>Bauhinia acuminata</i> was supplemented with water spinach and biochar LRRD 27, Article 58
2013	Nguyen Thi Thu Hong and Preston, TR Effect of biodigester effluent on the biomass production of <i>Tithonia diversifolia</i> and the use of the foliage as the basal diet for goats LRRD Vol 25, Article 6
2012	Ngo Hong Chin and Khuc Thi Hue Supplementing <i>Tithonia diversifolia</i> with Guinea grass or tree foliages: effects on feed intake and live weight gain of growing goats. LRRD Vol 18, Article 86
2012	Daovy Kongmanila, Bertilsson, J., Ledin, I. and Ewa Wredle Effect of feeding different levels of foliage from <i>Erythrina variegata</i> on the performance of growing goats Tropical Animal Health Production 44:1659-1665
2012	Bui Phan Thu Hang, Vo Lam and Preston, TR Effects on the performance of growing goats by supplementing ensiled water hyacinth leaves with Melia azedarach foliage LRRD Vol 24, Article 226
2012	Vu Thi Thu Hang, Nguyen Kha Tu, and Chu Duck Tuy The effect of <i>Eupatorium odoratum</i> foliage compared with cassava foliage on growth and intestinal nematode infestation in goats LRRD Vol 24, Article 136
2012	Phonevilay Silivong, Preston, T.R. and Ngo Van Man Feed intake, digestibility and N balance of goats fed Paper mulberry (<i>Broussonetia papyrifera</i>) or Muntingia (<i>Muntingia calabura</i>) foliages supplemented with NPN from potassium nitrate or urea LRRD Vol 24, Article 77

Year	Title of project or paper
2011	Vanthong Phengvichith and Preston, T.R. Effect of feeding processed cassava foliage on growth performance and nematode parasite infestation of local goats in Laos LRRD Vol 23, Article 13
2011	Iv Sophea and Preston, TR Effect of different levels of supplementary potassium nitrate replacing urea on growth rates and methane production in goats fed rice straw, mimosa foliage and water spinach. LRRD Vol 23, Article 71
2010	Bounthavone Kounnavongsa, Vanthong Phengvichith and Preston TR Effects of fresh or sun-dried cassava foliage on growth performance of goats fed basal diets of Gamba grass or sugar cane stalk LRRD Vol 22, Article 202
2009	Daovy Kongmanila and Ledin, I Chemical composition of some tropical foliage species and their intake and digestibility of goats Asian-Australasian Journal of Animal Science 22(6) 803-811
2008	Daovy Kongmanila, Preston TR, Ledin, I Selective behaviour of goats offered different tropical foliages LRRD Vol 20, supplement
2008	Daovy Kongmanila, Preston, TR, and Ledin, I Survey on the utilization of local foliage species for goats in Xaythanee district, Vientiane City LRRD Vol 20, supplement
2008	Pathoummalangsy, K and Preston, TR Effects of supplementation with rumen fermentable carbohydrate and sources of 'bypass' protein on feed intake, digestibility and N retention in growing goats fed a basal diet of foliage of <i>Tithonia diversifolia</i> LRRD Vol 20, supplement
2007	Vanthong Phengvichith and Inger Ledin Effect of feeding different levels of wilted cassava foliage (<i>Manihot esculenta</i> , Crantz) on the performance of growing goats. Small Ruminant Research 71(1):109-116
2007	Vanthong Phengvichith and Inger Ledin, Effect of a diet high in energy and protein on growth, carcass characteristics and parasite resistance in goats. Tropical Animal Health and Production 39(1):59-70
2006	Theng Kouch, Preston, T.R. and Hun Hieak Effect of supplementation with Kapok (<i>Ceiba pentandra</i>) tree foliage and Ivermectin injection on growth rate and parasite eggs in faeces of grazing goats in farmer households LRRD Vol 18, Article 87
2006	Ho Bunyeth and Preston TR Growth performance and parasite infestation of goats given cassava leaf silage, or sun dried cassava leaves, as supplement to grazing in lowland and upland regions of Cambodia LRRD Vol 18, Article 28

Year	Title of project or paper
2005	Luu Huu Manh, Nguyen Nhut Xuan Dung and Tran Phung Ngoi Introduction and evaluation of <i>Moringa oleifera</i> for biomass production and as feed for goats in the Mekong Delta LRRD Vol 17, Article 104
2005	Nguyen Trong Ngu and Inger Ledin Effects of feeding wastes from <i>Brassica</i> species on growth of goats and pesticide/insecticide residues in goat meat Asian-Australasian Journal of Animal Sciences 18: 197
2005	Do Thi Thanh Van, Nguyen Thi Mui, Inger Ledin Effect of method of presentation of different foliages given separately or in mixtures on intake and behaviour of goats Animal Feed Science Technology 118 (1-2): 1-17
2004	Ngo Tien Dung, Nguyen Thi Muiand, Inger Ledin Effect of replacing a commercial concentrate with cassava hay (<i>Manihot esculenta</i> Crantz) on the performance of growing goats Animal Feed Science and Technology 119 (3-4): 271-281
2003	Phoneseuth Phengsavanh Effect of Stylo 184 (<i>Stylosanthes guianensis</i> CIAT 184) and Gamba grass (<i>Andropogon gayanus</i> cv. Kent) in diets for growing goats LRRD Vol 15, Article 71
2003	Theng Kouch, Preston, T.R. and Ly, J. Studies on utilization of trees and shrubs as the sole feedstuff by growing goats; foliage preferences and nutrient utilization. LRRD Vol 15, Article 50
2003	Seng Sokerya and Preston, T.R. Effect of grass or cassava foliage on growth and nematode parasite infestation in goats fed low or high protein diets in confinement. LRRD Vol 15, Article 61
PhD Projects	
2012	Khuc Thi Hue Feeding cassava to sheep: nutrient properties and hydrogen cyanide toxicity. PhD
2012	Davoy Kongmanila <i>Erythrina</i> foliage as an alternative feed for growing goats in Lao PDR. PhD
2009	Seng Sokerya Effects of cassava foliage on nematode infestation in goats in Cambodia. PhD
2006	Do Thi Thanh Van Some animal and feed factors affecting feed intake, behaviour and performance of small ruminants. PhD

Year	Title of project or paper
2004	Vanthong Phengvichith Feeding and forage management systems for smallholder goat production. Improving feed intake of sugarcane foliage in small ruminants: effect of processing and method of presentation of the feed. PhD
MSc projects	
2012	Vo Duy Thanh Effect of NPN source and mangosteen peel (<i>Garcinia mangostana</i>) on methane production in <i>in vitro</i> incubations and on growth performance of Phan Rang sheep in the Mekong delta of Vietnam. MSc
2012	Siton Kongvongxay Effect of foliages rich in bypass protein on apparent digestibility, growth and methane emission in goats. MSc
2012	Phonevilay Silivong Studies on growth performance and methane emissions in goats fed tree foliages. MSc
2010	Iv Sophea Effect of different levels of supplementary potassium nitrate replacing urea on growth rates and methane production in goats fed rice straw and mimosa foliage. MSc
2010	Bounthavone Kounnavongsa, Vanthong Phengvichith and Preston, T.R. Existing goat production systems in Khammouane province Laos. MSc
2008	Bounthavone Kounnavongsa Effects of fresh or sun-dried cassava foliage on growth performance of goats fed basal diets of Gamba grass or sugar cane stalk. MSc
2007	Daovy Kongmanila Utilization of some local foliage species for goats: chemical composition, digestibility and intake characteristics. MSc
2007	Khamparn Pathoummalangsy Effects of supplementation with rumen fermentable carbohydrate and sources of 'bypass' protein on feed intake, digestibility and N retention in growing goats fed a basal diet of foliage of <i>Tithonia diversifolia</i> . MSc
2005	Ho Bunyeth Cassava foliage as supplement for goats fed Paragrass (<i>Brachiaria mutica</i>) in full confinement, or with grazing in semi-confinement. MSc
2005	Sopha Xaypha Goat production in smallholder farming systems in lowland Lao PDR and an evaluation of different forages for growing goats. MSc

Year	Title of project or paper
2003	Theng Kouch Studies on utilization of trees and shrubs as the sole feedstuff by growing goats; foliage preferences and nutrient utilization. MSc
2003	Seng Sokerya Effect of grass or cassava foliage on growth and nematode parasite infestation in goats fed low or high protein diets in confinement. MSc
2003	Phonepaseuth Phengsavanh Lao PDR and the possibility of improving the diet quality by using <i>Stylosanthes guianensis</i> CIAT 184 and <i>Andropogon gayanus</i> cv. Kent. MSc
2003	Phanthavong Vongsamphanh Potential use of local feed resources for ruminants in Lao PDR. MSc

9.2 Brief overview of Laos

9.2.1 Geography and climate

Laos is one of five countries that makes up the Mainland Southeast Asia Region, along with Myanmar, Thailand, Cambodia and Vietnam (Figure 2). It is a land-locked country of 230,800 sq km with only about 4% of this land area being arable (Stür and Gray 2014). Laos can be classified into three main geographical types namely forested mountain regions, upland plateaus and lowland plains. To the North, Laos is dominated by forested mountain regions, rising to a maximum elevation of 2,818 metres at Mount Bia (Zasloff *et al.* 2017). There are large upland plateau regions that form part of the Annamite Chain that stretches from the southeast of Phouane Plateau in Xieng Khouang province to the Boloven Plateau in southern Laos (APPF 2009). The Mekong River, and many of its tributaries, flows through the country with large and small lowland plains areas located along these rivers (APPF 2009) with the most extensive lowlands being along the eastern bank of the Mekong River (Zasloff *et al.* 2017). The lowland plains areas are highly fertile with rice the predominant crop grown in these areas. The majority of the land area in Laos is forest (185 720 sq km) while 23 690 sq km is used for agricultural production.

The climate of Laos is typical of the region with tropical monsoons consisting of a rainy season from May to October with an average rainfall of 1300 to 2300 mm. The dry season is from November to April. Minimum temperatures range from 16 to 21°C in the cool months to maximums of 32°C in hotter months although the mountain regions provide some variation in temperatures.

9.2.2 Population

The population of Laos is 6.92 million people with 62.4% of the population in rural areas (Zasloff *et al.* 2017). Laos is densely populated with 29.2 people/sq km with a diverse range of ethnic and religious groups (Figure 1). A 2005 census identified 49 different ethnic groups within Laos (APPF 2009).

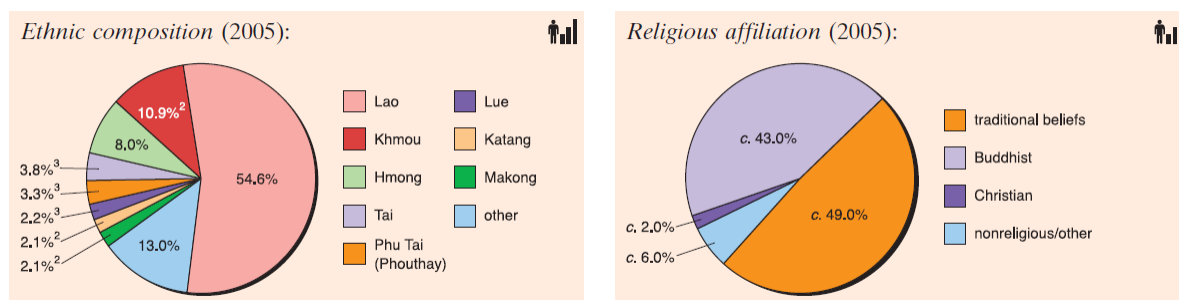


Figure 1. Ethnic and religious composition of the Lao population (Zasloff et al. 2017).



Figure 2: Map of Laos showing each province and relative location to neighbouring countries with Vietnam to the East, China to the North, Myanmar and Thailand to the West and Cambodia to the South (Chamberlain 2006).

9.2.3 Agricultural production in Laos

Of the land area used for agricultural production (23,690 sq km), 64.4% is arable, 7.1% is under permanent crops and 28.5% is pastures or meadows (FAOSTAT 2016). Agriculture, fisheries and forestry make up 26% of the value of GDP in Laos but employs 74% of the labour force as shown in Table 4. The climate and geography of Laos make it suitable for

the production of various field and horticultural crops including rice, sugarcane, bananas, coffee, sweet potatoes and tobacco and a range of livestock are produced including pigs, cattle, water buffalo and to a lesser extent goats and poultry.

Table 4. Structure of gross domestic product and labour force in Laos (Zasloff et al. 2017).

	2012		2015	
	in value KN '000,000	% of total value	labour force ⁵	% of labour force ⁵
Agriculture, forestry, fishing	18,929,400	26.0	2,792,000	74.0
Mining and quarrying	7,286,000	10.0		
Manufacturing	7,456,400	10.3		
Construction	4,886,000	6.7		
Public utilities	3,048,900	4.2		
Transp. and commun.	3,165,500	4.4		
Trade, hotels	13,883,500	19.1	981,000	26.0
Finance, real estate	2,616,900	3.6		
Pub. admin., defense	5,342,900	7.3		
Services	4,207,700	5.8		
Other	1,904,300 ⁶	2.6 ⁶		
TOTAL	72,727,500	100.0	3,773,000	100.0

9.3 Goat production in Laos

9.3.1 Trends in goat populations and products worldwide

Worldwide estimated goat numbers have been increasing with a rising demand for goat products, particularly meat (Devendra 2010; Skapetas and Bampidis 2016). In 2014 the global population of goats was 1.01 billion up from 849 million in 2004 (FAOSTAT 2016) of which approximately 60% were found in Asia (Skapetas and Bampidis 2016). Globally goat meat production was estimated to be 5.5 million tonnes while an estimated 18.3 million tonnes of goat milk was produced in 2014 (FAOSTAT 2016). From 2000 to 2011 goat numbers and meat and milk production rose rapidly in Asia with a 17.6%, 41% and 44.2% increase respectively (Chetroui *et al.* 2013). Since then population and production levels have continued to increase steadily. Much of this production is consumed locally, as despite this increase, there has been very little increase in volumes exported with many Asian countries having no exports of goat products (FAOSTAT 2016). Australia is the largest exporter of goat meat (25-30,000 tonnes/yr) but these exports only equate to 0.1% of estimated consumption (Nunn 2006) indicating very low levels of trade in goat and goat products compared to other livestock commodities.

Goats produce a number of sought after products including meat, milk, fibre, skins and manure. Goat meat tends to be highly valued fetching prices that are usually higher than those received for cattle or other meats. Goat meat can be particularly important for cultural or religious groups who are unable, due to their beliefs or customs, to consume meats such as pork or beef. Goat meat along with other protein sources can be important in meeting the nutritional needs of rural people.

The production and consumption of goat milk varies widely throughout Asia. India, Bangladesh, Pakistan and Turkey produce the highest volumes of goat milk (Skapetas and Bampidis 2016). Goat milk production tends to be limited in South East Asian countries such as Laos and Vietnam, where very little goat milk is produced for human consumption, with most goats being kept for meat production.

Goat fibre (mohair and cashmere) and skins have lesser importance as commodities tending to be a by-product of meat and/or milk production systems. China is the largest producer of skins with a volume of 381 thousand tonnes and makes up 30% of total world production (Skapetas and Bampidis 2016). Production of mohair is estimated to be around 5000 tonnes per year with most coming from South Africa (CFC and FAO 2008). The majority of cashmere production occurs in Central China (IGA 2014). No production is recorded for Laos with the FAO database not even listing goat fibres as an agricultural product although it is listed under traded products (goat hair, coarse) but with very low or no volumes recorded worldwide (FAOSTAT 2016). Goat fibre production is not suited to high rainfall tropical and sub-tropical regions.

Along with these products goats also provide intangible benefits to the farmer such as savings, insurance (Herrero *et al.* 2012), cultural and ceremonial roles and afford the owner some level of prestige (Kosgey *et al.* 2006).

9.3.2 Trends in goat production in Laos

Goats thrive in Laos under extensive conditions with minimal management and have high potential for further development (APHCA 2006; Stür and Gray 2014). Numbers historically have been low but have increased rapidly in the last two decades. Goat numbers have increased dramatically in Laos and Vietnam based on small and some larger enterprises (FAOSTAT 2016). Numbers increased in Laos from 170,600 to 481,000 between 2004 and 2014, an increase of 182%. At the last Agricultural Census in 2010/11 goat numbers were 215, 600 (MAF 2014) so numbers have more than doubled in a 3 year period indicating rapid growth of the goat population. All production of goats in Laos is for meat and with most animals either consumed locally or sold to the cities or to Vietnamese traders as live animals. There is no recorded export volumes for goats or their products in Laos (FAOSTAT 2017). Over the same period numbers increased in Vietnam from 1.02 million to 1.6 million (FAOSTAT 2016).

Much of the increase has been opportunistic with animals bought from remote districts, sold by traders on transport routes in Laos, or taken into Vietnam to the larger centres. This trade was described in detail during the development of a large livestock development project (ADB 2014a). Goats are a part of a renewed government investment, also supported by the Asian Development Bank in Northern Laos, focussed on some poorly resourced and remote districts (ADB 2014a). Small livestock development is a high priority for NAFRI, the national agency responsible for livestock research for development (NAFRI *et al.* 2005). To assist in goat sector development this SRA will describe constraints and opportunities for the emerging goat sector and identify research questions that are appropriate for research based on international partnership between Australia and Lao PDR.

Goat enterprises are regarded as strong opportunities for farmers in poor areas to access high value markets on the basis that a) market demand is strong, b) capital investment is low (equivalent to pigs), c) diseases are few, d) they are adaptable to a wide range of feeds, and e) turn-off rate of kids is high with kidding approximately three times in two years with a good frequency of twins. On the negative side the meat can be strongly flavoured, mortality of kids can be high if grazing and housing is not well managed and goats can be destructive to crops,

plantations and natural forest. The challenges for successful R4D have been documented and relate in part to the low ‘social’ and educational status of small ruminant raisers in many countries and in part to the difficulty of managing goats of mixed farming systems (Dubeuf *et al.* 2014).

9.3.3 Areas of production

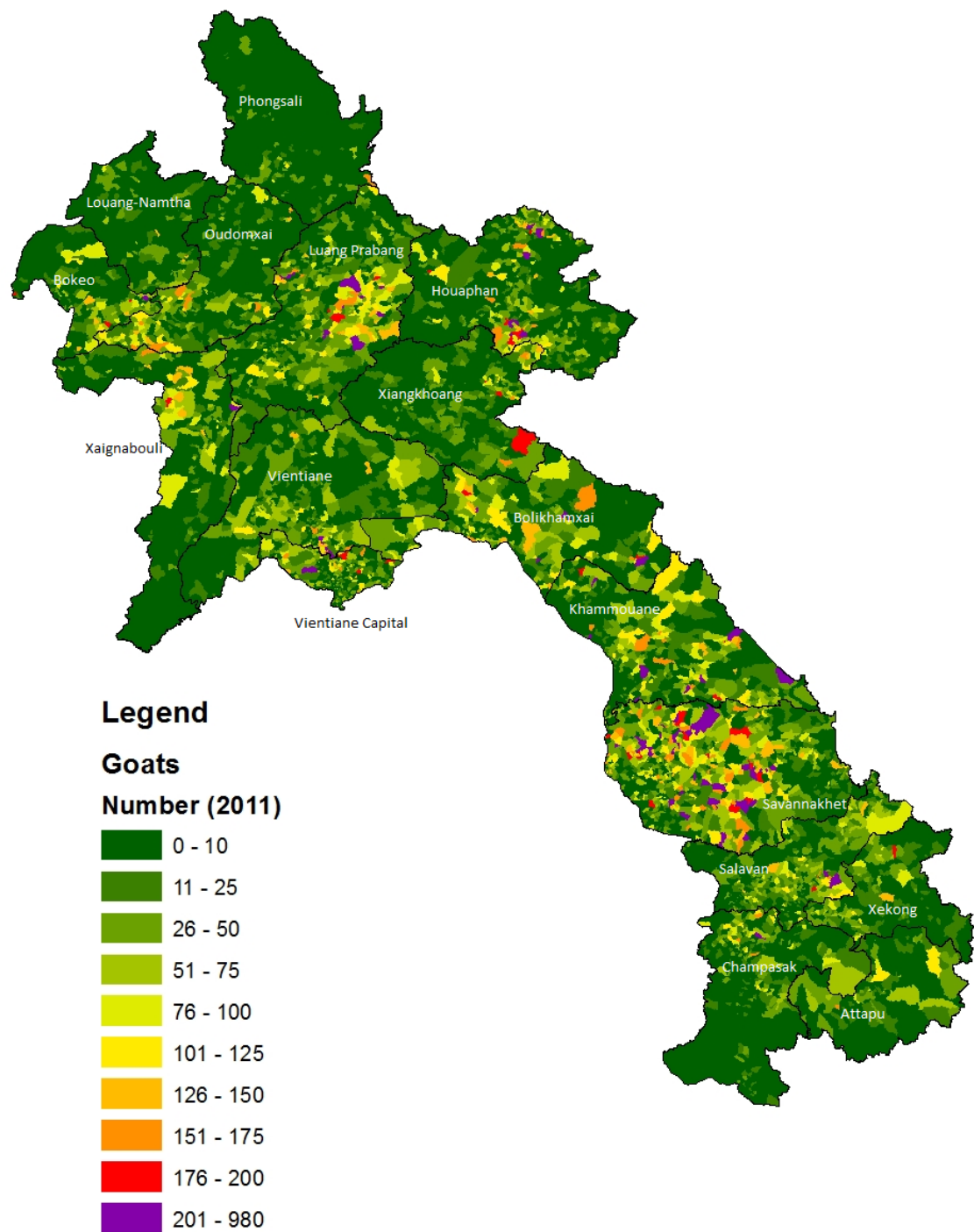
Table shows the number of goats produced in each province in Laos in 2010/11 while **Figure** provides a visual summary of the distribution of goats across districts. It is clear from this map that much of the goat keeping is occurring in the Northern and Central areas of Laos with more limited production in the South and this is confirmed in **Figure 1: Map of goat distribution in Laos, by village** (Newby 2017)

Table which shows the North and Central regions to have 32% and 54% of the goat population respectively.

Table 5: Distribution of goats in Laos by province (MAF 2014)

Province	Goat numbers
Attapeu	3 243
Bokeo	5 643
Bolikhamxai	12 494
Champasak	8 264
Houaphan	16 636
Khammouan	16 076
Louangnamtha	3 344
Louangphabang	22 713
Oudomxai	10 722
Phonsaly	2 363
Salavan	14 570
Savannakhet	56 466
Vientiane	11 069
Vientiane Capital	11 760
Xaignabouly	7 180
Xekong	4 588
Xiengkhouang	8 066
Total	215 197

Number of goats by village in Lao PDR



Data Source: Lao Agricultural Census (2011)

J.C.Newby (CIAT)

Figure 3: Map of goat distribution in Laos (Newby 2017)

Table 6: Distribution of goat population by region and growth in goat population from 1998/99 to 2010/11 in each region (MAF 2014).

Region	Population ('000) in 2010/11 (% of total)	% change between 1998/99 and 2010/11	Growth per annum (%)
North	68.9 (32%)	36.5	2.62
Central	116.0 (54%)	233.6	10.55
South	30.7 (14%)	298.5	12.22
Total	215.6	128.3	7.12

The number of goats kept per household varies widely. In Northern provinces, the number of goats per goat rearing household ranges from 2.2 to 3.4 with 2 to 16% of livestock rearing households raising goats (Gray 2004). However in the central province of Khammouane the number of goats per household is 12 to 16 (Kounnavongsa *et al.* 2010b) much higher than in the North, but only around 1% of farmers raise goats (Gray 2006). It is unclear why there is such a big difference in the number of goats per goat raising household. On average across the whole of Lao PDR, 6% of farming households raise goats and there was a 73% increase in the number of households raising goats from 1998/99 to 2010/11 (MAF 2014). The estimate of Kounnavongsa *et al.* (2010b) for the number of goats/household is much higher than that indicated in the 2010/11 Agricultural Census as outlined in Table .

Table 7: Herd size as a percentage of farm households with goats and average goats/household by region (MAF 2014)

Region	% farm households with goats			Mean number of goats/household
	<5 head	5-9 head	>10 head	
North	66	23	11	4.6
Central	50	32	18	6.0
South	65	22	12	4.8
Total	59	27	14	5.3

9.3.4 Production systems

Goat production in Laos is generally undertaken by smallholder farmers who keep a small number of goats alongside other livestock or crops. In 2012/13, 99% of goats were raised in smallholder systems (Stur and Phengsavanh 2014). Goat production occurs in both upland and lowland farming systems although it tends to be more common in the Northern provinces where food crop production is more difficult due to the mountainous terrain (ADB 2014b). Traditionally, goats were generally allowed to graze freely all year round in small groups in the forest and fallow cropland with goats being restrained or contained at certain times of the year to avoid excessive damage to crops (Phengsavanh 2006). However, goat management practices have been changing due to reductions in land availability and labour and can vary due to community regulations (Phengsavanh 2006) and are also becoming more intensive with the use of forage crops for fodder rather than relying solely on grazing. This is similar to goat production in Vietnam, however, there has been some establishment of goat milk production in Vietnam also (Mui *et al.* 2006). The types of production systems in Laos have been broadly classified into four systems (Phimphachanhvongsod 2001; Xaypha 2005; Phengsavanh 2006) which are described below. The prevalence of each system varies depending on the area. In the north goat production tends to be more free range while in the lowlands more confined systems are used (Gray 2004). In some districts theft has been identified as an issue for goat

production which may be leading to an increase in confinement systems or at least an increase in labour inputs required (Kongmanila *et al.* 2008b).

1. Free-range: Goats graze freely in the forest, fallow land, roadsides and in paddy rice fields after harvest without supervision. They mostly graze on native grasses and any browse found in these areas. Generally no pens, vaccination or supplementation are provided. This system has very low inputs and is also of very low productivity.
2. Semi-rotational grazing: Farmers form groups and graze their goats together but still own them individually. Goats are rotationally grazed in fallow land or communal grazing land. Goats are kept in pens and shelters at night.
3. Semi free-range: During the dry season goats are left to graze. During the wet season goats are contained in certain areas with native grass being cut and carried to feed the goats. Supplements are also provided.
4. Permanent grazing and tethering: An area is fenced in which goats graze permanently. Supplements and water are provided regularly.

Most goat production is from Lao native goats that are morphologically and genetically similar to north Vietnamese native goats (Keonouchanh and Xaypha 2006) and as such are characterised as Kambing-Katjang type native goats. The local breed is considered to be quite fertile and well adapted to the Laos environment. Breeding is generally via natural mating with very little human intervention. Does usually give birth for the first time at around twelve months of age usually to a single kid but often produce twins in the next and subsequent litters (Stur *et al.* 2002). The mature weight of these goats can reach 40kg however the average liveweight is 26.8kg for females and 31.8kg for males in free-ranging systems and 27.3kg and 32.3 kg for females and males respectively in the semi-free ranging systems (Xaypha 2005). It has also been reported that Bach Thao goats from Vietnam have been introduced and kept at the NAFRI Livestock Research Centre for improvement of local goat breeds (Xaypha 2005) however it is unclear what the outcome of this has been.

Goat production in Laos is considered to be low input but also low productivity. Most of the input required is in labour associated with tending the animals or cutting and carrying fodder to the goat house. There are some costs associated with housing and health care but these are generally minimal (Gray 2004). Improvements in production systems, and therefore productivity, through improved management in feeding, breeding, health and housing may help improve livelihoods and sustainability of goat production as has been the case in other livestock species and countries (Stur *et al.* 2013; Stur and Phengsavanh 2014). These management practices will be discussed further in the following sections.

Health/disease management

Internal parasites

Internal parasites, particularly gastrointestinal nematodes, are thought to be one of the most important health issues for goats in Laos (Gray 2004) although Sani *et al.* (2004b) found that there are no reports of epidemiological studies of nematode infections of goats in Lao and that still appears to be the case. In Cambodia and Vietnam, internal parasites of importance to goats include *Haemonchus contortus*, *Trichostrongylus spp.*, *Fasciola sp.* and *Oesophagostomum spp.* (Sani *et al.* 2004b). *Strongyloides papillosus* is also identified in Cambodia and *Moniezia spp.*, *Nematodirus sp.* and *Ostertagia sp.* in Vietnam (Sani *et al.* 2004b). It would be expected that similar species of internal parasites would be important in Laos.

Internal parasites can affect all classes of goats but are particularly important for kids especially after weaning (Phengsavanh 2006). Heavy worm infestations have been reported to cause up to 50% mortality at weaning in kids (Phengsavanh 2004 cited by (Phengsavanh 2006)). These parasites are ingested during grazing of pastures that have been contaminated by faeces containing worm eggs that then develop into infective larvae. Breaking the lifecycle of the parasite prevents infection so management options relate to this.

Liver fluke is another internal parasite that can cause production losses through fasciolosis. Fasciolosis is an endemic disease to most tropical countries and causes mainly chronic systems with few deaths (Gray *et al.* 2008). Although it can be controlled relatively simply, by using a suitable dewormer, reducing the population of snails that are an intermediate host and managing farms and grazing effectively, these management options are often not carried out in developing countries (Gray *et al.* 2008). It is unclear the magnitude of fasciolosis in Laos and therefore production losses due to this parasite.

The IFAD TAG443 project (Sani *et al.* 2004c; Gray 2005) looked closely at options for managing worms in an integrated approach across a number of South and Southeast Asian countries. Although chemical treatment is probably the simplest and most cost effective means of controlling worms, poor smallholder farmers are often not secure enough to make this investment (Gray 2005). This may be because they have higher priorities for cash-in-hand, they are uncertain if their animals will survive or they have little confidence in when and how their animals will be sold and the price they will receive (Gray 2004). It may be more effective to use these treatments in conjunction with other management strategies including grazing management, housing and manure management, genetics and breeding and feeding management (Gray *et al.* 2012). Some of these management strategies, such as improved feeding, would be done to improve productivity however improved resistance to parasites would also be a consequence of these strategies (Gray *et al.* 2012).

In many other developing countries drench resistance has developed (Hood 2004) but it is unclear what the status of drench resistance is for goats in Lao PDR. Ancheta *et al.* (2004) showed via the use of a larval development assay that in smallholder goat and sheep production systems in the Philippines there is resistance to benzimidazole anthelmintics across farms and regions. This tool proved to be useful in assessing drench resistance (Venturina *et al.* 2003) and could be applied across other tropical regions. Lespine *et al.* (2012) have highlighted the need to ensure anthelmintics (and any other therapeutic drugs) are being used in an effective manner for goats. Many chemicals are only registered or tested for use in particular target species such as cattle or sheep, at certain dose rates and routes of administration e.g. oral, topical, subcutaneous. Often these dose rates and routes of administration are ineffective for other target species such as goats leading to little improvement in productivity or increases in resistance to particular chemicals (Lespine *et al.* 2012). For endectocides such as ivermectin, eprinomectin, doramectin and moxidectin there is a clear difference in drug activity in goats compared to other ruminants at similar doses and routes of administration and there is a difference in efficacy according to the nematode species (Lespine *et al.* 2012). For example in goats, a much lower bioavailability of ivermectin (34ng.d/ml vs 94ng.d/ml) and moxidectin (36ng.d/ml vs 98ng.d/ml) were observed when given via oral administration in comparison to sheep given the same dose and subcutaneous administration led to higher plasma concentrations than oral administration (136ng.d/ml compared to 36ng.d/ml for moxidectin) (Escudero *et al.* 1999 and Lespine *et al.* 2005 in (Lespine *et al.* 2012)).

Other options for worm control tested in South East Asia included technologies around grazing compared to confinement, biological control, improved nutrition, sanitation, breeding management and medicinal plants (Sani *et al.* 2004b). Freely grazing goats are at higher risk from parasite infection so grazing and feeding management is essential (Sani *et al.* 2004b). Options may include restricting grazing, to reduced time intervals or

only when the ground is dry, and then supplementing with forages cut and carried back to the goat house. The selection of appropriate forages is also important and is discussed in a later section. Feeding management can reduce exposure of goats to parasites but also improve the growth and productivity of the goats due to higher quality feed being made available. Phengvichith and Ledin (2007a) have shown that goats on a high energy and protein diet have reduced worm burdens compared to goats on a low energy and protein diet. In farmer testing in Vietnam, goats kept in confinement had a 40 – 60% lower faecal egg count (FEC), after a 40 day trial period, than those allowed to graze freely (Sani *et al.* 2004b) although farmers often considered it tedious to confine goats. Rapid rotational grazing was another option tested by farmers in Vietnam where pastures were split into 10 paddocks and goats grazed a different paddock every 3.5 days to prevent re-infection (Alo 2004). The type of forage used may also impact on WEC with Kouch *et al.* (2006) suggesting that Kapok foliage could reduce WEC due to the tannins in this foliage having an anthelmintic effect and cassava foliage is also reported to have a similar effect (Sokerya 2009; Khuc Thi Hue 2012). Sokerya (2009) found that cassava foliage reduced faecal worm egg counts but only did so consistently when ensiled rather than fed fresh and Ho Bunyeth and Preston (2006) found a similar result with ensiled cassava more effective than dried cassava. Phengvichith and Preston (2011) found that wilted, ensiled or dried cassava significantly reduced worm egg counts compared to offering Guinea grass in freely grazing goats confined overnight. Vu Thi Thu Hang *et al.* (2012b) also found that the use of cassava foliage and *Eupatorium odoratum* foliage significantly reduced internal parasite infestations when compared to Guinea grass alone. Levels of infestation were most reduced in groups fed *Eupatorium odoratum* which was attributed to this foliage having double the level of tannins compared to cassava foliage (Vu Thi Thu Hang *et al.* 2012b). There is therefore the option to reduce internal parasite infections through the use of feeding management although the type of feed and how it is offered is important.

Along with grazing management and improved nutrition, the use of medicated urea mineral molasses blocks have also been used for worm control in goats as part of an integrated approach in a number of tropical countries (Knox 1995, 1996; Sani *et al.* 2004c). Manuelli (2004) discussed a number of experiments on goats and sheep in Fiji regarding the efficacy of using blocks medicated with fenbendazole to control worms. Medicated blocks were able to control egg counts compared to when an unmedicated block or no block was offered with goats offered the medicated block only requiring treatment on average 1.9 times over a 36 week period while goats in the other group required 7 to 8 treatments (Manuelli 2004). Medicated blocks are also more effective when offered all the time rather than being offered for a week and then having no access for a 2 or 3 week period. It appears that medicated blocks are effective in controlling worms however other authors suggest that their effectiveness is mainly due to improved productivity from increased nutrition rather than the medication itself (Sani *et al.* 2004a). Getting goats to eat blocks consistently (Alo 2004; Manuelli 2004) can be challenging and in confined situations it may be simpler to drench animals however extensive systems may benefit more from the use of medicated blocks. There is limited information available on the use of medicated mineral blocks in goats in Laos however there is currently a trial being undertaken on Mr Richard Laity's farm, near the National University of Laos, as part of ongoing work to test the efficacy of fenbendazole medicated blocks against important parasites of goat health and production. This work is being funded by the Department of Livestock and Fisheries with the aim of testing this at the village level too.

In Laos, there is generally some degree of housing or shelter provided for goats to be contained at night and in the wet season. However, housing and sanitation may not be well managed to help reduce the spread of internal parasites or other diseases. Norton *et al.* (2009) outline the requirements for effective goat housing including the ability to be kept clean and dry, protected from rain and wind, well ventilated, high ground clearance, adequate flooring, suitable size for the number of goats, feed and water trough placement

for ease of access for both goats and keeper. The high clearance and type of flooring impact on the management of manure. The flooring needs to allow manure and urine to pass through but not be wide enough to allow goat's legs to pass through. High clearance allows manure to be removed so goats are not exposed to parasites in the faeces. In Vietnam, a study that compared 9 goat farms where manure was disposed of daily compared to traditional practices found after a 6 month trial period that FEC was 20% lower and bodyweight gains 20% higher than traditional practices (Sani *et al.* 2004b). Effects were much higher in the first 1 – 2 months after the start of the trial with a reduction in infections of 80% and a reduction in mortality rate from 23% to 12% (Gray 2004). Confining goats in a well-constructed goat house also allows for the collection of manure for composting or use as a fertiliser on crops, gardens or forages to be used for improved goat feeding (Gray 2004; Sani *et al.* 2004c; Norton *et al.* 2009).

Provision of housing also allows for easier management of breeding animals to restrict breeding to desired times. In terms of parasite management this means that better offspring with improved resistance to parasites can be produced along with benefits in timing chemical treatments or other interventions for worm control (Gray 2004). The introduction of superior bucks could also be considered if breeding animals can be managed more closely although the use of introduced breeds needs to be done carefully to ensure they are actually suited to the conditions (Baker and Gray 2004).

Other diseases

Other diseases important to goat production include Orf (contagious ecthyma) which often occurs and causes weight loss, with mortality being unlikely (Phengsavanh 2006). It can be controlled by vaccinating which is recommended as most animals become affected (Norton *et al.* 2009). Diseases such as PPR and goat pox are not currently a problem in Laos however this may change as populations increase and a few cases have been reported in Huaphan province (S. Phengsavanh pers. comm.).

Vaccination of livestock has been promoted and provided by the Northern Livestock Development project where, for goats, vaccination rates during the project improved to 75% of the goat population (ADB 2015), however it is unclear which diseases goats were being vaccinated against. For this project, vaccinations were provided free of charge but upon cessation of the project vaccination wasn't continued by farmers despite farmers understanding the benefit of vaccination (Stur and Phengsavanh 2014). This is in part due to the supply of vaccines and difficulty of farmers, particularly those long distances from markets, being able to access and afford the vaccines (Stur and Phengsavanh 2014).

An international workshop on Animal biosecurity in the Mekong (Adams *et al.* 2012) identified various diseases of importance in the Mekong region. Those listed as relevant to goats included goat pox and foot and mouth disease although goat pox was not considered an issue in Lao PDR (McFarlane 2012) however it is in Vietnam so trade between the two countries may affect this. FMD was considered to be an emerging disease for multiple species in Lao PDR although goats were not mentioned specifically. In other countries in the region, FMD is a problem in goats with a specific example given of Burma. Here goats have a high level of exposure but it was also stated that they are rarely implicated in outbreaks of FMD in the region and therefore there needs to be work done to determine if this is due to a failure to recognise infected animals or whether goats really do play a minor role in outbreaks (Cocks *et al.* 2012). As the trade of goats between countries increases there is a higher risk of introduction and spread of diseases and therefore biosecurity is of high importance. An improvement in farmers' knowledge of the spread of diseases and how to prevent diseases will assist in the development of sustainable bio-security measures which will then impact on market access for livestock products (Stur and Phengsavanh 2014).

Breeding management

Goat breeding is generally uncontrolled with does and bucks running together throughout the year as is the case in many other developing countries producing goats (IGA 2014). This means that does are kidding at any time during the year with high levels of inbreeding due to limited selection for breeding. Bucks are often kept for many years meaning the risk of inbreeding is also further increased and the rate of genetic gain slowed by long generation intervals. As goats are often kept as living “banks”, to be sold when cash is required, superior animals may be inadvertently sold as they are bigger and will fetch a better price than a younger or smaller animal (Nimbkar 2006).

Controlling breeding to a restricted time of the year and between selected animals may provide a number of benefits as identified by (Gray 2004) including:

1. Kids being born at times most suited to the farmer, when feed is increasing and labour is available
2. Reduction of inbreeding by introducing new or borrowed males, decreasing birth defects and increasing production and resistance to parasites
3. Better offspring with higher growth rates due to selection of superior breeding animals
4. Labour required for caring for offspring is concentrated at a particular time
5. More offspring available for sale when prices are highest although this may be difficult to identify
6. Parasite control measures of young animals can be synchronised

However, controlling breeding may be difficult for the smallholder farmer as there may be costs associated with it such as for increased labour (Kosgey *et al.* 2006), fencing and housing. Gray *et al.* (2012) in their analysis of technologies suitable for smallholder development pathways outlined the benefit of improved housing to maximise improvements in breeder and buck management. Controlling breeding also requires investment of time and management effort for success.

Kosgey *et al.* (2006) have reviewed breeding programmes in the tropics to highlight aspects that determine their success or failure. There appears to be more success with breeding programmes involving indigenous breeds as compared to exotic breeds which often fail as these breeds are unsuited to the tropical conditions resulting in little improvement and high losses. There are many types of genetic improvement programmes which won't be discussed here however a challenge in developing countries is how to effectively involve farmers at the village level and how to record such flocks and monitor progress (Kosgey *et al.* 2006). This can be very difficult with smallholder farmers where record keeping is minimal and breeding poorly controlled. In Vietnam, good Bach Thao bucks, an adapted native breed were introduced to farmers on focus farms which improved production through increased growth rates and reduced mortality (TAGAR 2002 in Kosgey *et al.* (2006)). This breed has reportedly (Xaypha 2005) been introduced to Laos however it is unclear what the impact of this has been and whether they are widely used.

Fodder/feeding management

Feed shortages at various times during the year have been recognised as one of the major constraints to goat production, and more generally livestock production, in Laos (Phengsavanh 2003; Phengsavanh and Ledin 2003; Phengsavanh *et al.* 2004; Xaypha 2005; Kounnavongsa 2008; Kounnavongsa *et al.* 2010b; Kongmanila 2012). Feed shortages can occur in the dry season when there is limited growth and quality of native forages and in the wet season when animals are confined to prevent damage to crops (Kongmanila 2012). Farmers report that goat growth rates tend to be higher in the dry season as they can go out and browse whereas in the wet season they tend not to browse

(S. Phengsavanh pers. comm.). As such there have been various projects and studies that have looked at methods of supplementing goat diets in periods of shortages through the use of forages, fodder and tree legumes to not only fill any feed gap but to improve the productivity of goats.

During the Forages for Smallholder Project (FSP) (Stur *et al.* 1995; Horne and Stur 1999) a number of species of forages and fodder trees were identified that were well adapted to Laos environmental conditions and could be used for feeding livestock. The following Forage and Livestock Systems Project (FLSP), established by CIAT in 2000, aimed to improve the uptake of forage use by upland farmers by building the capacity of national, provincial and district government staff (Phengsavanh *et al.* 2004; Millar and Connell 2010). Subsequent studies as part of the MEKARN network have then looked more specifically at some of these varieties and how they benefit goat production (Table 3).

The forage and tree legumes identified in the FSP are outlined in **Table 8** but it was emphasised that the choice of forage or fodder crop needed to be specific to each individual farmers' situation (Horne and Stur 1999). These have been used in experiments to test the effectiveness of including in the diet of goats on feed intake, body weight gain and growth rates. Other species have also been identified that may be beneficial to use in goat production including cassava foliage (Kounnavongsa 2008) and root, *Erythrina subumbrans* foliage (Vivasane and Preston 2016), *Bauhinia acuminta* (Silivong and Preston 2016) and *Moringa oleifera* (Luu Huu Manh *et al.* 2005) and *Tithonia diversifolia* in Vietnam (Nguyen Thi Thu Hong and Preston 2013). Some of these forages such as cassava has also been used to improve growth rates in cattle in Lao (Phanthavong *et al.* 2016). A survey by Kongmanila *et al.* (2008b) outlined a range of local forages that were used in Xaythanee district, Vientiane City to feed goats including guava, *Leucaena*, *Erythrina*, jackfruit, starfruit among others but these were not necessarily the most nutritive (Kongmanila and Ledin 2009). Although these trees and shrubs are generally palatable to goats they may not be highly digestible so various supplements such as water spinach (Kongmanila and Ledin 2009), biochar (Silivong and Preston 2016) or other foliages such as *Mimosa pigra*, *Sesbania sesban* or Mulberry (Pathoummalangsy and Preston 2008; Ngo Hon Chin and Khuc Thi Hue 2012; Silivong *et al.* 2012; Nguyen Thi Thu Hong and Preston 2013) have been suggested to improve digestibility and N retention and therefore production.

Table 8: Forages and fodder trees well adapted to Laos (Horne and Stur 1999; Xaypha 2005).

Forages	Fodder trees
Andropogon gayanus cv. Kent Brachiaria brizantha spp.	Caliandra calothyrsus cv. Besakih Gliricidia sepium (Retalhuleu and Belen Rives)
Brachiaria decumbens cv. Baselisk Panicum maximum TD 58 Setaria sphacelata cv. Solander Brachiaria Hybrid Mulato Stylosanthes guianensis CIAT 184	Leucaena leucocephala K636

Phengsavanh and Ledin (2003) found that increasing the proportion of Stylo 184 (0, 20, 30 and 40% of the diet) in a diet based on Gamba grass improved dry matter intake and resulted in higher growth rates of 70g/d compared to only 27g/d when no Stylo 184 was included. It was concluded that this is due to the higher crude protein levels in the diets containing Stylo 184 resulting in improved rumen conditions and therefore digestibility of the diet. Another study (Phengvichith and Ledin 2007b) that including wilted cassava foliage to a basal diet of Gamba grass also improved growth rates. Other studies have found that it is the level of bypass protein that improves growth rates and that the foliage of some trees and shrubs assist with this through the presence of condensed tannins which bind to protein thereby reducing degradation of protein in the rumen (Kongmanila and Ledin 2009; Kongvongxay 2012). However, the actual performance of the goats depends on the type of supplementation used and whether it is able to increase the amino acids absorbed by the animals (Pathoummalangsy and Preston 2008).

Erythrina variegata has been identified as a potential tree legume that could be used for supplementation of goat diets (Allard 2010; Kongmanila *et al.* 2012) and is able to replace up to 60% of the crude protein normally derived from soybean meal without any negative effects on growth rate (Kongmanila *et al.* 2012). Use of this foliage would be a cheaper source of protein thereby providing the ability to improve smallholder goat production without the need to purchase expensive supplements. Tien Dung *et al.* (2005) found that replacing commercial concentrates with cassava hay led to improved growth rates but only at low levels of replacement. At higher levels growth rates decreased.

Early work from the MEKARN project found that the way forages and foliage is offered to goats affects feed intake and therefore growth rates (Kouch *et al.* 2003; Phengvichith 2004; Do Thi Thanh Van *et al.* 2005). These studies found that hanging foliages from the wall or pen resulted in the highest intakes when compared with chopping the foliage or stripping the leaves off and placing in a trough. The type of foliage offered also affected intake and when foliages of jackfruit, *Flemingia macrophylla* and *Acacia mangium* were mixed together jackfruit was selectively eaten first regardless of how it was offered (Do Thi Thanh Van *et al.* 2005). Goats also ate more dry matter in a shorter period of time when feed was offered hanging from the roof of the enclosure (Kouch *et al.* 2003). These feeding preferences indicate that the choice of feed and method of presentation of feed is important to consider for making productivity gains.

Some of the research being conducted on feeding and fodder management is now moving beyond production benefits to also include consideration of environmental impacts through measures of methane emissions from both eructed gas and decomposition of faeces (Sopheha and Preston 2011; Kongvongxay 2012; Silivong 2012; Porsavatdy *et al.* 2016). When comparing two different forages, cassava and *Tithonia* it was found that diets based on cassava produced 50% less methane than those based on *Tithonia* (Porsavatdy *et al.* 2016) but feeding water spinach as part of these diets increased

methane emissions. Other authors have found that supplementing basal diets of *Bauhinia acuminata* with water spinach decreases methane emissions (Silivong and Preston 2015). The effect of supplementation to reduce methane emissions appears to depend on the content of the basal diet so supplementation should be considered carefully although it usually results in production benefits such as improved growth rates.

As outlined here and in *Table 3* there is a large body of work, predominately carried out as part of MEKARN, on different forages and supplements that can be used to improve goat production. A survey by Stur *et al.* (2006) found that 10% of farmers used forages for goat production. Since this survey there has been further studies on forages suitable for goat production however it is unclear if the uptake of the use of forages has improved.

1.1.1 Land use planning and land allocation

Traditional ways to farm goats by allowing them to graze freely in common 'forest land' and bringing them home daily for security is under threat from increased intensification of agriculture, relocation of more distant villages to be close to services, and the use of traditional and public lands for large scale production of rubber, timber, maize and other crops. Changes in the law have been accompanied by changes in land use with variable relationships between the two: old and new laws are not always adhered to closely and there can be conflict between modern law legislated through the national parliament and traditional laws and practices of the many ethnic groups in Laos. International protocols and opportunities have increasing influence particularly REDD+ (Sirivath 2010). In a recent report (LIWG 2012) the political and social consequences of changing land use are highlighted as the uplands in particular change from the predominant and ancient practice of shifting agriculture based on community law and the modern market-based agriculture based on a formal national legal framework.

Historically land has not been a scarce commodity in Lao PDR with communities, including lowland Lao, have been able to move to new locations and pioneer new land according to their own energies. Traditionally, land ownership depended on recognition of prior use of the land indicated by improvements such as clearing of upland areas and development of paddies. New laws such as the Land Law and the Forest Law (2008) intend to reduce conflict and promote land management as all land belongs to the State but is 'leased' to farmers for their long-term use. Government programs have been instituted to give effect to the Land Law including the Land Use Planning and Land Administration (LUPLA). Village Relocation, Program and the Shifting Cultivation Reduction Programs. The implementation of LUPLA focused on the reduction of shifting cultivation, rather than being a mechanism for effective land use and management: it has been a means to counteract the negatives of shifting cultivation (principally erosion and air quality) rather than to promote profitable intensification.

For traditional goat production the key factor affecting land use in most areas remains the availability of land and traditional rights. The initial area of forages on which intensification is likely to be based, and needed to demonstrate significant benefits is small, say 100 square meters, and would not disrupt existing land use. Where farmers grow larger areas (0.5 ha or more), there has been an associated increase in the sale of cattle for income, and that has led to a reduction of shifting cultivation. The same is likely to be true for goats. As forages are perennials, there is also likely to be an overall reduction in the area of land cultivated by farmers. Intensification of cattle and goat production can lead to reduced reliance on 'upland' forests in a win-win situation: less conflict over resources and more profitable production.

Extension for improved production systems

Section 3.4 described goat production systems in Laos and various constraints on these systems which mean goat production is limited. Some specific strategies for improvements to overcome these constraints have been outlined. However methods for adoption by smallholders of these strategies and technologies has not yet been discussed. A number of authors (Nampanya *et al.* 2010; Kongmanila 2012) identified that smallholder farmers' knowledge of the options for improving livestock production is limited and this needs to be overcome to move towards adoption of improved production practices.

Table 9 outlines various interventions identified by Gray *et al.* (2012) leading to development and therefore improvements in production of smallholder livestock systems. In this paper they were being considered in relation to worm control however these interventions would have other benefits too. For goat production minimal technology is necessary to lead to improvements, with housing and sanitation the main investment required. Figure 4 provides a diagram of the possible development pathway for goats from a completely free-ranging system to a completely confined system with enhancements being made to the system as it moves from left to right. This figure also shows the entry points for goat keepers to improve their goat production and that more gains are made with additional interventions. In determining the entry points for development a participatory approach is required to identify demand and the livelihood needs of smallholder communities (Gray *et al.* 2012) on which to focus which is then more likely to lead to improvements and long term change. Indeed the factors and pathways outlined in Table 9 and Figure 4 were identified as part of a Participatory Livestock Development Project in Laos (Gray 2004; Connell 2005) that aimed to improve livestock production by identifying technical options to improve livestock production but also to include extension methods and activities to achieve this change (Connell 2005).

Table 9 Implementation conditions for goat technology options. The options have been sorted in order of ease for implementation with the simpler recommendations at the top (Gray *et al.* 2012).

Intervention	Inputs required	Minimum level of farmer organisation	Technology prerequisites
Increased and smarter feeding	Forages, tree legumes and other feeds	Individual	None
Housing and sanitation	Hardware to supplement local building materials	Individual	None
De-wormers	Regular supply of de-worming chemicals	Group of farmers	None
Manure and compost production	Simple tools	Individual	Improved housing and sanitation
Breeder and buck management	None	None	Improved housing to maximise benefits and improve handling

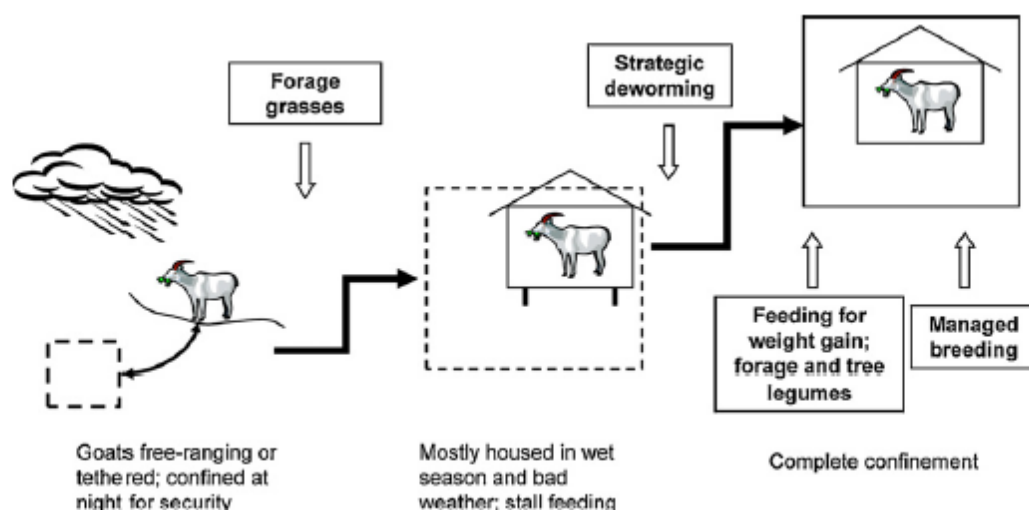


Figure 4: Possible development pathway for goats in which the critical step is the development of a good housing system that keeps goats from grazing close to where they are being kept overnight. An incremental increase in intensity is likely to lead to large losses unless parasite control is effective (Gray *et al.* 2012).

Once entry points for development have been determined and technologies identified to improve these systems scaling out and up of these is required. Millar and Connell (2010) outlined the example of the Forages and Livestock Systems Project (FLSP) that used the need for improved feeding as the entry point to scale out the use of forages to livestock keepers to facilitate them to shift to become livestock producers. The forages were identified in an earlier project, Forages for Smallholders Project (Stur *et al.* 1995), but the FLSP aimed to get smallholder farmers to adapt these forages and practices in their livestock production systems through a facilitated learning environment and regular follow-up visits and mentoring of extension staff to provide institutional support (Millar and Connell 2010). Millar and Photakoun (2008) reported that forages are being used by over 2200 farmers and 200 villages in Northern Lao PDR from a start of 247 farmers in 18 villages at the beginning of the project in 2001 and expansion of the area being used for forage from 5.5ha to 545ha (Millar and Connell 2010). The success of this project is attributed to the use of field tested and proven technologies, fostering of local innovation, competent field staff, effective peer learning and ongoing institutional support (Millar and Connell 2010). Some of the extension methods used were case studies, focus groups, farmer visits, cross visits, study tours, village planning and village learning activities in a bid to move away from workshops as the preferred method of extension. Capacity building was also recognised as important with training workshops, on the job training, mentoring and regular reflection and learning important for developing capacity in extension workers (Millar and Connell 2010; Millar *et al.* 2012).

Although not targeted specifically at goats, the FLSP proved useful for goat producers who did implement the use of forages in their production systems. The methods of extension that were useful in this project could be applied across other technologies, such as worm control and breeding management, that are entry points for goat development pathways (Gray *et al.* 2012). Millar *et al.* (2012) in a project aimed at fostering further farmer adoption of improved livestock production in more remote upland areas of Northern Lao PDR highlighted the need to train and mentor extension staff, the use of cross visits to stimulate farmer learning and action and the need to implement farmer field schools aimed at intensive learning. This project also found that other proven methods of extension could be adapted for use in these situations.

Connell and Case (2017) have developed an Extension Management Strategy aimed at improving the potential of frontline extension service delivery and thereby improving smallholder livelihoods and well-being. This project produced guidelines for implementing

extension interventions related to farmer learning, farmer organization and market engagement but allowed extension staff relative autonomy in the co-design, implementation and refinement of tools to do this (Connell and Case 2017). The case studies used in this project were commercial rice, coffee, organic vegetables and chickens (Connell and Case 2017) however some of the principles and strategies would be applicable across other agricultural products and livestock including goats.

Northern Livestock Commercialisation project (ADB 2014a) which aims to improve productivity of livestock in general and specifically improve goat production in 3 main districts, Nalae in Luang Namtha and Phoukhoun and Phonexay in Luang Prabang, has also identified the need for consideration of gender, ethnic and socioeconomic factors when designing extension strategies which will be discussed further in Section 3.5.

The above projects have all achieved measurable success but there is little evidence that improved production or extension practices extend much beyond the lifetime of the projects that supported them ***unless*** there are follow-up projects. In part this is because the projects lack resources to follow up. In other cases extension staff have dispersed to other tasks when supplementary funds were exhausted. In all projects there was a significant investment in building technical and extension capacity of project participants. That capacity may well be used in later livestock projects or in other areas of agriculture. Investments in capacity building therefore could have long term benefits but identifying these benefits is well beyond the capacity of single fixed-term projects. Anecdotally, collaborating individuals and institutions regard this capacity building highly.

9.3.5 Socioeconomic, gender and livelihood aspects of goat production

The multi-functional role of goats

Goats serve many purposes and functions in the livelihoods of rural people. Devendra and Liang (2012) summarise the products and benefits derived from goats in Asian mixed crop-livestock systems indicating the range of benefits. Under the right conditions, goats can provide an important source of household income to sustain livelihoods. Research studies from around the world show that the main factors influencing farming households to keep livestock, including goats, as a source of income generation are the availability of household resources, including labour, land and capital, as well as access to credit and feed (Udo *et al.* 2011).

Goats may also have a 'non-productive' role in providing household nutrition and food security. They can be a household asset that represents savings that provide financial security and investment which helps to accumulate capital, similar to the formal banking system. The advantage is that goats can be sold off easily when extra income is needed to pay for large household expenditures, for example, in times of emergency such as serious health issues; or for education, weddings and funerals. Along with cow manure, goat manure may be collected and applied to fields as a natural fertiliser for crops.

Table 10 Goat products and their benefits in Asia (Devendra and Liang 2012)

Products	Benefits
Meat (raw, cooked, blood, soup, goat meat extract – “Zeungtang” in Korea)	Cash income and investment
Milk (fresh, sour, yoghurt, butter, cheeses)	Security and insurance
Skins (clothes, shoes, water/grain containers, tents, handicraft, shadow play in Indonesia, thongs etc)	Prestige in ownership
Hair (cashmere, mohair, garments, coarse hair rugs, tents, ropes, wigs, fish lures)	Gifts and loans
Horns	Religious rituals e.g. sacrificial slaughter
Bones (handicraft)	Human nutrition – characteristics of meat and milk
Manure and urine (crops, fish)	Pack transport and draught power
	Draught power
	Medicine
	Control of bush encroachment
	Guiding sheep

Goats can also have an important role in wider society, for example, being used as gifts, in religious rituals and rites of passage. Especially in areas with Muslim communities, goats can play a key role in religious festivities, and the demand, supply and prices of goats can increase several fold during the weeks prior to these events. However, in Indonesia, one study found that farmers did not realise much profit from increased demand at these times, because ‘the small number of animals they keep makes it too difficult to plan the sale of animals with a minimum body weight of 25kg during the period when the prices increase’ (Udo *et al.* 2011).

Whether or not goats provide enough cash income to a household, to warrant investing in goat production as an economic enterprise, varies greatly, depending on the grazing system and start-up capital, and particularly in relation to required labour inputs, and the cost, type and availability of labour. Udo *et al.* (2011) conceptualise returns to labour from livestock keeping in terms of a ‘livestock ladder’ whereby the smallest economic benefits are derived from poultry, followed by small ruminants, pigs, fish, local cattle and dairy cattle. In a study in Indonesia, the returns per unit of family labour from sheep or goats were well below the minimum labour wage. The reason for this was high labour demand for daily management (especially feed collection and cleaning sheds). Households with sufficient household labour and no suitable labour alternatives often do not consider the family labour as a production cost (Udo *et al.* 2011). A study of goat husbandry in rural Mexico found that households with family labour were profitable, but households who had to pay for labour to manage their goats were unprofitable compared with the return they could gain from other non-farm activities. However, the milk and meat provided food security, the manure was a valued agricultural input, and as a result it reduced the need to purchase food or inputs (Pinos-Rodríguez *et al.* 2015).

Gender roles, ownership and decision making

Studies from many developing countries show some similarities with respect to the gendered patterns of ownership and care of livestock. Women can and do own livestock, but it is more likely to be small ruminants such as chicken, sheep and goats rather than cattle or buffaloes. One of the reasons put forward for this is women’s domestic role and the greater amount of time they spend close to the family home and surrounds than men, where small ruminants are often kept. If women go to the fields, for example, they will

return early to cook or complete other household tasks (Okali and Sumberg 1985). Small ruminants may also be more likely to be inherited, purchased, or gifted to women than large ruminants.

In terms of small ruminant related tasks, women, men, boys and girls take different roles and responsibilities, and consequently different benefits and potentials accrue for different household members. The situation regarding the allocation of roles in the management of small ruminants is diverse. The various roles of herding, milking, management (grazing and tethering), cutting and carrying grasses, cleaning the goat house, and marketing are undertaken individually or jointly within households, depending on the social and cultural norms in different agro-ecological zones and within different ethnic and religious groups. In Honduras, for example, Sinn *et al.* (1999) found that 'in most houses, more than one person brought the goats to pasture, carried feed and cleaned the goat house'. Generally, in mixed crop-livestock systems, women and girls carry out most of the work related to collecting and carrying livestock feed, bringing water and cleaning pens (Waters-Bayer and Letty 2010). In Indonesia, studies show that women and children take a key role in small ruminant production, with boys contributing more than girls (Valdivia 2001).

Understanding the dynamics of small ruminant ownership is important, as whoever 'owns' the asset may improve the person's bargaining power in controlling the asset and the income derived from it, in this case through products, or sale or slaughter. Kristjanson *et al.* (2014) describe how different rights to livestock may exist within households, for example, to withdraw products such as meat and milk, rights to exploit commercially and decision making rights over animal management or income. In some places, women may not own small ruminants, or have a right to decide when to sell, even if they provide the labour. For example in a review of studies of small ruminants in Peru, Indonesia, Bolivia and Kenya (Valdivia 2001), women herd and milk, but men decide when to sell. Women may participate in the management but not the marketing. But in some cases women do control the income from their own activities, for example, goat milking, and despite not officially owning the animals, they do have a say in whether the animals are kept, sold or slaughtered (Herrero *et al.* 2012).

Goats, resource poor farmers, landless and women in AR4D projects

Goats are deemed to be a low status animal of secondary economic importance (as opposed to cattle and other large animals) in many cultures in Asia and Africa (Peacock 2005). In Asia's mixed crop-livestock systems, the (sometimes overlapping) social categories of women, resource-poor farmers and landless tend to own and/or herd goats (Devendra 2013). The close association of goats with the poor and with poverty and their consequent positioning of lesser relative importance, has led to a neglect of government policy and investments in goat research and development. Fewer AR4D projects have been dedicated to enhancing goat production and marketing, with the majority of resources and attention given to other 'high value' livestock species such as dairy and beef cattle that also favour wealthier, commercial (and often male) farmers (Valdivia 2001; Peacock 2005; Devendra 2013). Furthermore, in many AR4D projects there has been a lack of attention given to targeting of poor households, with project benefits captured by village elites (Peacock 2005). In general, where AR4D projects have failed, it is because of a limited understanding of poor farmers' priorities and resources such as labour, land and capital, which influence their willingness to keep small ruminants (Udo *et al.* 2011).

Despite women being recognised around the world as playing a key role in livestock keeping, and as noted above, especially of goats and other small ruminants, at the same time 'women continue to be overlooked in many livestock-related interventions' (Waters-Bayer and Letty 2010). Because women face greater barriers to access the resources, opportunities and benefits from livestock-related interventions, women-focused activities may be deemed appropriate. In a review of the literature, Waters-Bayer and Letty (2010) argue that the most promising livestock-related interventions for resource-poor women appear to be small-scale, low-external-input income-generating activities involving goats

or other small ruminants, in all three of production, processing and marketing. However, an essential ingredient of success in AR4D interventions, whether it be in crops, fisheries or livestock, is engaging men as well as women, in a manner appropriate to the social and cultural context. This approach maximises the potential for both women and men to benefit through project support, and to support each other, and contribute to household wellbeing and joint decision making.

Gender analysis is considered vital to understand the actual situation of local women, men and children in crop-livestock systems, which is likely to be different in any given context, even within the same country, and therefore cannot be over-generalised. In their review of most promising interventions, Waters-Bayer and Letty (2010) found that projects that focus on analysing and responding to male and female farmer priorities and preferences in the design stage, and involve both women and men in planning and analysing the outcomes of any specific women-focused livestock activities, have a better chance of success. Further, projects that identify the potential different impacts on women, and regularly monitor and mitigate of any unexpected gender impacts during the project implementation, are more likely to equitably benefit the whole household. Differential impacts could be in terms of women's labour inputs, and level of decision making and control over livestock management and any income derived from livestock, vis-à-vis men. Projects with clear strategies to overcome resource constraints, as well as to assist resource-poor farming families to manage and reduce the risks associated with livestock, such as disease, drought, and theft, are more likely to contribute to livelihood improvement in mixed crop-livestock systems.

Goats and groups

Studies show that low-cost investments in small-scale livestock interventions, such as starting with a few chickens or goats, can offer resource-poor farmers, and particularly women, opportunities to increase income. In addition, these types of interventions can be particularly important for women to have a better chance of jointly controlling income and having a say in household expenditure decisions. Informal groups such as work groups, funeral associations, savings and credit associations and so on can be used for such small-scale interventions. In Africa, there has been some success with 'livestock banks', 'whereby groups of five are given 40 female goats or sheep, managed communally with the goats of other groups, and are expected to repay their loan 'in-kind' with interest' (Peacock 2005). de Haan (2001) highlighted the importance of utilising existing social networks when establishing groups for a Heifer International goat husbandry program in Tanzania. The program involved the 'pass-on' system whereby members of groups receive one female goat and pass on three to another member of the group. The more successful groups were those where people already knew each other and had trusting relationships prior to goats being distributed amongst them.

de Vries (2012) evaluated Heifer International's 'passing on the gift' (POG) practice which is part of a broader community development model designed to be implemented in a manner appropriate to the local culture and context, and the type of animal involved. POG involves the original recipient of an animal to pass on at least one female offspring and training in its management to another household, usually within a farming group. Using this approach, Heifer International has enabled almost twice as many indirect beneficiaries as those that have benefited directly (i.e. the original recipients). de Vries' (2012) found that the POG approach as implemented by Heifer International can increase household incomes, but importantly it contributes to livelihood improvement more broadly, through for example, enhanced family dignity and social status. Other important non-monetary benefits include community building through promoting or reinforcing values of giving and sharing; reducing dependence on outside development assistance; and group cohesion.

Budisatria and Udo (2013) evaluated the effectiveness of a goat-based aid program in central Java in Indonesia following a natural disaster. Farmers were organised in groups and each member received goats that were to be repaid over a six-month period. While some groups failed, other succeeded, and this enabled livelihood recovery through increased incomes. The most successful groups were those that had previous experience with goat husbandry, and had access to adequate feed supplies. The study highlighted the need to carefully assess potential beneficiaries according to a set of success criteria, and to adequately prepare them through training and on-going support, including in group management (Budisatria and Udo 2013).

Rural livelihoods, poverty, gender and small ruminants in Laos

Rural livelihood diversification, intensification and market integration

In rural Laos, livelihoods remain highly dependent on agriculture. Rice dominates the agricultural economy, with non-rice crops and livestock playing an important but more minor role. Most of the reproductive age population in rural areas continue to work on own account semi-subsistent farms. However, the non-farm economy, including migrant remittances, is gradually becoming more important (Bouahom *et al.* 2004; Martin and Lorenzen 2016). This is partly related to population growth, and less land available, particularly in lowland rice growing areas, putting pressure on agriculture to meet the livelihood needs of less well-off households (Bouahom *et al.* 2004). A study in southern Laos found that while rural households across all socio-economic groups are diversifying their livelihoods, this is a strategy mainly used by better-off households to advance and accumulate more wealth (Martin and Lorenzen 2016).

Bouahom *et al.*'s (2004) study of rural livelihoods in upland and lowland areas of Laos found that there was large geographic variation in the ability of households to intensify their agriculture, with some having shifted to pursuing mostly non-farm activities for survival. The authors also noted, however, that 'households with limited resources can achieve reasonable standards of living. Households that diversify due to distress can find themselves building progressively better and more resilient livelihoods' (Bouahom *et al.* 2004). In the same study, some less well-off households in rural Laos were observed to support their subsistence activities by intensifying their engagement with the market. The authors suggest that government policy should provide more support to less-well off households to increase their livelihood diversification, particularly in the event that markets are unstable or unreliable.

Specifically, with respect to livestock intensification in the Lao uplands, one study found that managed feed resources and livestock disease prevention measures proved effective in enhancing farmer livelihoods. The household benefits included increased cash incomes, reduced labour time in collecting feed, and freed up labour for other activities such as upland rice, which meant less reliance on purchasing rice for home consumption (Millar and Photakoun 2008). In general, however, animal disease has remained a large and unaddressed problem by animal health extension services in Laos. Another strategy to assist in livestock intensification includes improving financial support (e.g. credit), market structure and facilities (NAFRI *et al.* 2005). However, in their study in the Laos uplands, Millar and Photakoun (2008) observed that 'households with limited labour resources face trade-offs between more intensive livestock raising (with inherent disease risks) and maintaining crop production'. As part of a poverty assessment in upland Laos, Chamberlain (2006) noted that the notion and practice of raising livestock for commercial purposes was relatively new, and had mainly been taken up by farmers from the Hmong ethnic groups. With respect to smallholder livestock systems in Northern Laos, Millar *et al.* (2011) argue that farming households should not become too reliant on external markets and inputs. Rather they should be supported to be self-sustaining, low-risk taking, and oriented to supplying local markets or export markets without short value chains.

Existing disparities and poverty levels and the importance of targeting

As Epprecht *et al.* (2008) note, although inequality in Laos is low relative to international standards, it certainly exists, and with further market integration inequality may worsen if the Laos government does not actively intervene. There are various spatial patterns of uneven development, one of which roughly represents inequality between minority ethnic groups and the majority Lao-Lum from the lowland areas (also referred to as Lao-Tai, based on their linguistic origins). Up to 50 different minority ethnic groups live in more remote, mountainous areas with less road infrastructure, transport, health and education services, and market access. Due to the poor quality and access to education services, years of formal schooling and literacy levels of Lao language amongst minority ethnic groups is lower than the Lao majority, and worse for girls and women, than boys and men (King and van de Walle 2010). In some remote, upland districts, poverty rates can be as high as 70 percent, whereas in other districts that are close to larger urban centres, less than 15 percent of the population are categorised as poor (Epprecht *et al.* 2008). For these reasons, King and van de Walle (2010) argue that tailored poverty-reduction strategies that cater for different groups' specific needs and capabilities are likely to be most successful in addressing multiple sources of disadvantage, such as ethnolinguistic affiliation, as well as gender. This argument also applies to agricultural extension services. The enormous cultural, linguistic and ethnic diversity within Laos means that farmer attitudes to livestock and their interest, preference and ability to intensify livestock production, varies greatly. Because of this, some authors recommend that livestock services to the poor be tailored to suit the needs and preferences of poor farmers, of different ethnic groups, and women farmers (Millar *et al.* 2011).

Socio-economic and livelihood aspects of small and large ruminants

Very little research has been published on small and large ruminants and the different ways in which they contribute to livelihoods in Lao mixed farming systems. For example, with respect to goats, little is known about the ways in which rural households acquire goats and conceptualise or negotiate ownership rights, the relative importance of goats to women or men as an asset, or the types of rights different household members have in relation to goats or other livestock. No studies report on the role of goats in Laos in assisting rural households to cope with shocks, and there is no in depth information in relation to how labour is allocated for goat management between household members. It is unknown whether changing socio-economic conditions lead to changes in gender roles for goat care and management, for example, due to migration of family members or death or illness.

The different productive and non-productive purposes for keeping goats and their contribution to livelihoods (including food security), and preference for different breeds is also largely undocumented. What is reported is that small and large ruminants are generally kept for home consumption or liquidated as of cash on an as needs basis (Stur *et al.* 2002). In upland Lao, large animals such as cattle and buffalo are symbols of wealth and prestige and are only sold for emergencies or for upgrading farm assets (Chamberlain 2006). Households only consume these livestock at ritual sacrifices and where the meat is distributed to kin and neighbours in exchange for ritual prestige. At feasts for important life-cycle events, households may also honourably slaughter small ruminants such as pigs or goats to offer guests as food.

In Laos as in other parts of the world, initial investments in livestock often provide the necessary financial security that then enables households to 'make long-term investments in their farming and livelihood systems (e.g. sending children to high school, planting fruit trees, buying a two-wheel tractor or micro rice mill)' (NAFRI *et al.* 2005). In some cases there may be no reinvestment in replacement animals after selling out (Millar *et al.* 2011). The situation is not the same everywhere, however, as some ethnic groups in upland Lao who traditionally maintain livestock systems appear to continue to maintain them where possible, while taking on new enterprises (Millar and Photakoun 2008).

Gender equality and the status of women in Laos

The enormous ethnic diversity in Laos, which is reflected in different socio-cultural practices and social relations, mean that patterns of gender relations in Laos also differ. However, in general, it can be said that gender relations in Laos are similar to patterns in other Southeast Asian countries, whereby women's status is lesser than men, and women are largely excluded from the public sphere. In a review of the small amount of existing literature on gender relations in Laos, (Khouangvichit 2010) traces the root causes of women's lesser status and the embedding of a patriarchal ideology back to the earliest period of Buddhist religion, which was later reinforced during the period when the country was colonised by Thailand and France. In the years following independence, the Lao Women's Union (LWU), a mass organisation representing Lao women nationwide, with a network of members and a structure reaching to the village level, has encouraged Lao women to be good citizens, good wives and good mothers. For many years the LWU's message has been that women should focus on their husbands and their family, and be passive supporters of men and men's achievements, rather than actively participating in the development process and decision making outside the home (Khouangvichit 2010). Since the early 2000s, the LWU has worked with the Laos government to prioritise gender equality and women's empowerment as important development goals. The government has formulated policies and strategies to achieve this, which are written into Five-year plans of socio-economic development. However, official plans and statements tend to be a long way from realising change on the ground.

Gender and agricultural livelihoods in Laos

There are also very few published studies on gender and agriculture in Laos mixed crop-livestock systems in different agro-ecological zones, with either general information provided or very specific information pertaining to one of many ethnic groups. Relevant information on gender and agricultural livelihoods includes the gendered division of labour of productive and reproductive work, on-farm and off-farm work, access to inputs and productive resources (including land and capital), and household decision making. Rural women tend to provide family labour on family farms, and tend not to have land registered in their own names, which increases their dependence on their husbands. While the majority Lao-Tai ethnic group practices matrilineal inheritance, and in theory women have more control over land, studies show that even when Lao-Tai women inherit land it often still ends up being registered in their husbands name (Vixathep 2011). Both women and men care for cows and buffaloes, but like elsewhere in the developing world, women mainly have responsibility for small ruminants, like pigs and goats, and children are often tasked with watching over grazing goats (FAO/SIDA 2010). Women are rarely considered farmers in their own right, even though they do a large share of farm work (Vixathep 2011).

The most specific information about goat ownership by gender comes from a report titled *National Gender Profile of Agricultural Households: Lao PDR*. The report draws on census data, comparing various demographic, socio-economic and livelihood aspects of male headed households with female headed households, the latter comprising less than 5 percent of all agricultural households at the national level (FAO/SIDA 2010). A limiting factor is that the report does not provide information about the gender dimensions of agricultural livelihoods within male headed households i.e. with married or co-habiting couples. However, data on the average number of different types of livestock per household type reveal important differences, with female headed households having higher goat ownership and lower horse, buffalo, cattle, and pig ownership than male headed households. The difference in goat ownership between the two household types was greatest in southern Laos, with female headed households owning an average of

15.2 goats compared with 3.6 in male headed households (FAO/SIDA 2010). These data indicate that the value of goats in the female headed households may be considerably greater.

A couple of studies report on the respective gender roles in the household and community, and work burden of women and men in Lao farming households. Chithtalath (2006) studied upland agricultural activities in a Moksuk-Tafa ethnic minority community in northern Laos, and reports that while both men and women perform a similar quantity of productive work, in general, women undertake the most burdensome tasks. In general women's working day is longer than that of men, largely because they spend more time on domestic and care work, but much of this work goes unrecognised and is undervalued (GRID 2005). Women's agricultural and non-agricultural decision making in the household has been understudied, but as elsewhere in Southeast Asia, Lao women reportedly take a role in making decisions about day-to-day expenditure. Financial decisions about larger purchases are made either by their husbands, jointly, or under the supervision of husbands, depending on household and socio-cultural factors and patterns of gender relations according to different ethnic groups.

Lao women have limited opportunities to participate in formal community-level decision making, as this is considered the domain of men, and this appears to be a common theme regardless of ethnic group. While it is acceptable for women to take part in community activities or events of a social, cultural or religious nature, they generally do not have opportunities to take up political or administrative leadership roles (GRID 2005). This means women are largely excluded from making significant decisions about community welfare, nor do they participate in decision making structures initiated by government or donor funded projects pertaining to economic development. In an ethnographic study of the Khumu ethnic group in upland northern Laos, the second largest after the majority Lao-Tai, Vixathep (2011) observes that Khumu women have low self-efficacy to make decisions about matters beyond their household roles and day-to-day expenditure.

From the small amount of evidence available, the situation with respect to women's participation in development projects in Laos appears dependent on the development approach of different donors. Despite their different approaches, what two project examples demonstrate in upland Lao as described below, is that women farmers of ethnic minority groups do not routinely, and possibly rarely, have the opportunity to gain the knowledge and skills required to participate in agricultural decision making, and thus this is a central role for projects aiming to improve rural livelihoods.

Vixathep (2011) found that Khumu women did not participate to the same level as men in a development project funded by an overseas non-government agency. The women that did participate were mostly directed toward activities considered to be socially acceptable for women, such as maternal and child health, and micro-credit, rather than being invited to participate in new agricultural-related initiatives. While gender targets appear to have been set for membership of Village Development Committees, targets were not set for particular development activities. By contrast, an ADB (2015) funded project aiming to improve the livelihoods of poor farmers from the ethnic groups of Kmou, Hmong and Akhah also in the northern uplands, specifically targeted women's participation in village-based livestock production groups (LPGs). Gender targets for women trainees in small ruminant training programs for pigs, poultry and goats were set at 70-80 percent. Women were also to be represented equally in village revolving fund and infrastructure fund management; and to constitute 30 percent of all beneficiaries. The above targets were exceeded, and women's participation in the LPGs 'led to networking and knowledge sharing with other women in the village, which helped build confidence among women in taking care of livestock' (ADB 2015). In the final project evaluation, the ADB reports that setting clear and realistic targets that were easy to understand and monitor was a strength of the project. To more effectively increase women's participation and learning, the project recommendations include: allocating enough budget to address women's low literacy;

conducting training in the languages of the ethnic groups rather than Lao language; training women separately from men, and with female trainers; forming women-only LPG's where appropriate, to allow women to overcome inhibitions in taking leadership roles (ADB 2015).

Summary

Goats serve several functions and provide a variety of benefits in smallholder mixed farming systems, which include both monetary and non-monetary. Access to labour, land and capital are significant drivers for uptake of goats as either mainly a subsistence activity, or a commercial activity, or a combination. Women and men, and boys and girls undertake a range of different goat related care and management tasks, which is highly dependent on the social and cultural context, as is the question of who 'owns' goats. Goat ownership may be important for understanding how cash income and other benefits are distributed within households.

In recent decades, goats have been neglected in AR4D projects. Goats are often associated with resource-poor farmers, landless and women, who may derive the most livelihood gains by keeping goats, rather than other small ruminants or large animals. With respect to livestock interventions, women face greater barriers than men to access the resources and opportunities arising from such interventions. Specific gender targeting strategies are needed for raising gender awareness and ensuring women's participation. Interventions focused on any type of livestock should be carefully built around both men's and women's priorities and preferences, with specific measures in place to overcome women's relative disempowerment. Goat groups that target resource-poor farmers and/or women have proved to be successful in many parts of the developing world, with many livelihood benefits that go beyond raising incomes. Many lessons can also be drawn from these experiences to maximise the effective operation and management of such groups.

Over the past two decades Laos has been undergoing rapid macro-economic change which impacts livelihoods at the local level. There is evidence of both livelihood diversification and intensification in Laos. This manifests in different ways depending on the geographic location and the socio-economic status of households. With better infrastructure, market integration is occurring throughout Laos, and provides considerable opportunities for small livestock farmers. The challenge is in providing enough support of the right kind for smallholders to engage in markets while protecting their livelihoods from potential market shocks. Market integration may also deepen already existing inequalities in Laos, making poverty alleviation measures an important development focus in the country. As well, in efforts to improve livelihoods of the poor, suitably tailored strategies are needed, and which meet the different needs of different farmers, particularly with respect to gender and ethnicity.

Very little information exists about how goats contribute to the livelihoods and food security of different kinds of farmers in the different regions of Laos. General information on gender roles related to goats appear to indicate that women and children are mostly responsible for goat management, but this needs to be verified by region and ethnic group. As in other parts of the world, goats are kept for financial security and liquidated when cash is needed for other investments. Some examples exist of intensifying goat production in the uplands, with some success.

In Laos, while the situation is certainly changing, in general women are subordinate to men, and this is more severely felt in rural areas. In mixed crop-livestock systems women provide a large proportion of the labour, as well take the greatest responsibility for household and care work. This double burden, as well as gender norms that determine a limited role for women in the public sphere, presents a barrier to women's access to agricultural knowledge, resources, and participation in agricultural decision making. The

Laos government and donors increasingly focus on assisting women and men in Lao society to overcome these barriers, but there is much more work to be done in this arena.

9.3.6 Support structures for smallholder goat production

Province and District

The goat sector in Laos receives minimal technical support outside the few development projects (government and NGO) which seek to develop goat enterprises. Smallholder farmers with goats fall under the broad umbrella of government support implemented at the district level by the **District Agriculture and Forestry and Extension Office** (DAFEO) and their officers (DAFOs). Typically a district facility comprises 8-14 staff with 2-4 livestock officers. Staff are responsible to the **Provincial Agriculture and Fisheries Offices** (PAFO) which may have a mixture of technical specialists, such as in Xieng Khouang province, with in 2004, Administration, Finance and Planning Section (13 staff), an Agricultural Section (9 staff), a Livestock Section (11 staff), a Forestry Section (23 staff), an Irrigation Section (19 staff) and a Meteorology Section (10 staff). In the Livestock Section, there are two veterinarians with high level technical qualifications and 11 livestock officers, two of whom have high level technical qualifications and the remainder, medium level technical qualifications. More recently there has been a change in approach to train DAFOs as 'generalists', to loosen the boundaries between species and products and systems. In the past there have been issues of training only one extension worker per species in each DAFEO but they are then required to work in a number of villages across species (Stur and Phengsavanh 2014).

In some cases villages have the support of Village Veterinary Workers which have been supported by a wide range of projects with mixed success (Millar and Connell 2010; Millar *et al.* 2012; ADB 2015) and by local suppliers: small independent stores, selling feeds, fertilisers, agricultural chemicals, and machinery. This is contrast to the pig and poultry sectors which in some areas close to the Thai border receive substantial training, supplies and advice from large international companies.

With most frequent exposure to villages, DAFEOs have been allocated responsibilities other than livestock extension including the collation of monthly statistics on livestock, livestock mortalities and other items of interest to government. They are also responsible for collecting local livestock taxes. This can cause conflicts of interest. Monthly livestock reports are collected by village heads and submitted to DAFEO where they are compiled and presented to the district administration office for despatch to PAFO which, in turn, passes the aggregated data to the national head office. The province is responsible for salaries of district staff and for allocating the budget resources to undertake their activities.

The district –based system has been the subject of significant research and support by donors, including ACIAR, and has recently been reviewed in the wider context of global changes in extension methodology by Jones *et al.* (2013) in preparation of a DAFEO-based research projects in two northern provinces.

The PAFO DAFO linkage has been greatly strengthened by the devolution of budget and other matters from the central government to individual provinces. The PAFO receives directives from national DLF but is dependent upon locally allocated operational funds and interprets national directives to make them relevant to districts.

With such wide remits across all of agriculture and forestry it is not surprising that the overall capacity to support goat production is very low.

National

The **Department of Livestock and Fisheries** (DLF) supports the whole livestock sector in its role as a central department of the Ministry of Agriculture and Forestry. Its mandate is to i) develop policies, and support development of livestock and veterinary services, ii) cooperate with relevant agencies in surveying socio-economic conditions and natural

resource endowments and their potential use for livestock and fisheries development, (iii) collecting information (statistics) on animal numbers and incidence of disease outbreaks for use in planning, (iv) run the veterinary laboratory, and (v) be responsible for inspection and quarantine arrangements for livestock and livestock products including imports and exports. With respect to goat production and marketing DLF has overall responsibility for goat health, especially transboundary and epidemic disease control and the management of export and import health standards. DLF also maintain records on the number of Village Veterinary Workers (VVs) trained and who remain active. In 2002-03, there were 8,220 VVs in total - some 31% more than the previous year.

The eight national policies outlined by DLF (Khambounheuang 2014) for promoting livestock production are:

1. Land use for livestock and aquaculture
2. Labourers in livestock sector
3. Finance for prioritised sub-projects
4. Energy
5. Promoting livestock processing
6. Livestock trading
7. Livestock and livestock product transportation
8. Human resource development in the livestock sector

DLF operates a Technical Division, the National Animal Health Center (NAHC and the Animal Vaccine Production Center (AVPC). The NAHC consists of a Veterinary Supplies Unit, an Epidemiological Unit, a Diagnostic Laboratory, a Disease Border Control and Quarantine Unit and a Unit for Other Projects that accommodate a number of internationally funded projects. The AVPC produces vaccines for commercial distribution and biological reagents for testing vaccine effectiveness. The AVPC also has responsibility for quality assurance of veterinary products distributed in Laos. With the reallocation of DLF staff in 2001 to NAFES and NAFRI, its numbers were significantly depleted yet it managed to retain responsibility for animal health and regulatory matters, passing the production, research and extension to the other institutions.

The National Agriculture and Forestry Research Institute (NAFRI) was formed in 1999 as an implementing arm for research activities under MAF with responsibility to carry out technical research activities on agriculture, forestry, meteorology and hydrology. NAFRI operates nine research centres including the Livestock Research centre and one for northern agriculture and forestry. NAFRI is dependant upon external funding sources to carry out its research programs as government budgetary resources are sufficient to meet the wages component of operating expenses. Nevertheless, there has been considerable research activities and through close association with international research institutions such as the International Rice Research Institute, CIAT, and other donors. It has been able to carry out a considerable amount of adaptive research relevant to the conditions found in rural Lao PDR which have been well documented.

The National Agriculture and Forestry Extension Service NAFES was formed in 2001 and renamed the **Department of Agricultural Extension and Cooperatives (DAEC)** in 2012 recruiting much of its staff by direct transfer from DLF. NAFES has eight extension centres for the main agricultural activities of the country including livestock and fisheries, NAFES is the executing agency for a number of significant internationally funded projects and is 'represented' by, but does not financially support, provincial and district extension services including the PAFO and DAFEO staff in the provinces. NAFES implements projects with an extension component and the range of donor funded projects has promoted a wide range of extension approaches. The Lao Extension Approach (LEA) was adopted in 2005 (check dates and progress) arising from cooperation with the Swiss on The Laos Extension for Agriculture Project (LEAP) from which there is a large collection of training

materials on extension, production technologies, study reports, lessons learned, campaigns and other key documents archived online.

Universities

There is emerging capacity at the **National University of Laos (NUOL)**, **Souphanouvong University** and the **Northern Agricultural and Forestry College** in Luang Prabang and **Champasack University** in Champasack for research on goats. The extent to which this capacity (involving PhD and masters training in Thailand, Sweden and Vietnam) has led to improved support services for goat enterprises remains to be evaluated.

Summary

In summary, the goat sector receives little support outside *ad hoc* extension by projects and centrally based technical specialists. This contrasts with more developed segments of the pig and poultry sectors but more in line with the cattle sector which, despite its large size and international importance for trade and disease control, receives only basic extension support. The pathway for public support remains a complex interaction of district, provincial, national and university specialists who, as in many countries including Australia, do not always have the appropriate structures and incentives in place for their technical skills to be applied to best effect. A recent ACIAR project (Connell and Case 2017) in Laos which looked at the development of an Extension Management System and guidelines for extension interventions to utilize the potential of frontline extension service delivery may be useful in guiding how these skills can be applied to improve current extension services. The role of the private sector is minimal and its potential in the goat sector has yet to be assessed. There are enterprises in Thailand and Vietnam which are very successful and can be investigated.

9.3.7 Markets for goats and goat products

Goat markets

As with goat production systems, goat marketing systems are also very underdeveloped in Laos and as such there is not a lot of detailed information concerning the market chain actors, the transaction costs and details of goat and goat product flows. Just as production systems are low input, so marketing systems are, for the producers, low effort. In Laos there is generally a constant demand for goat meat throughout the year and prices, therefore tend to be stable. Livestock can be sold at any time even if animals are in poor condition (Gray 2006).

While local markets remain important particularly in rural areas in Laos (Gray 2006), increasing goat numbers (a 182% increase between 2004 and 2014, (FAOSTAT 2014) and an increasing demand from goat restaurants not only in Laos (Provinces of Bolikhamxai, Khammouam and Savannakhet) (Pathoummalangsy 2014) but also in Vietnam (particularly Ho Chi Minh City) is ensuring that the market chain needs to be better understood and developed. In provinces such as Khammouan the main purpose of keeping goats is for selling, they are not kept for household consumption (Kounnavongsa *et al.* 2010b). There are well organised systems for selling cattle and buffalo and their movements within and between countries have been well described (Kerr *et al.* 2012), but the situation or process is not so clear for small livestock such as goats (Gray 2006) and this is common across many goat producing countries (IGA 2014). Previously goats were purchased by Vietnamese traders on the Lao/Vietnam border but this has been slowed due to Lao government regulation, this has tended to lower the price and make goat more affordable by the Lao consumers (Pathoummalangsy 2014).

Value chain approach

A value chain (VC) approach aims to improve market access, efficiency and equity, thereby improving livelihoods of smallholders and other VC participants. Smallholder livelihood improvement cannot be attained in isolation of improving input supply, flow of information, access to alternate markets and a supportive community and institutional environment. Managing development using a VC framework allows researchers to include these economic, social, environmental and institutional factors to be included in the development process. A value chain development approach is oriented towards:

- Facilitating sustainable impact and inclusive growth interventions;
- Analysing market systems in order to understand the base causes that restrict their ability to improve livelihoods;
- Identifying the causes of the inefficiencies and ensure change in the market system;
- Empowering chain actors to exercise and influence change (particularly women and youth);
- Changes that continue without external support.

Engaging and understanding the roles and priorities of VC participants at all stages of a project will ensure more targeted and more effective research inputs and results. The VC approach is a change, from undertaking research on a system to research being part of the system. Many of these concepts have been developed in the sphere of manufacturing and to a lesser extent in agriculture. Some successes have been achieved in relatively 'simple' product chains such as fruit and vegetable where the pathways from production to consumption are relatively short, further, in most cases there is little processing of the product from harvest to consumption, the production cycle is short (months) and labour costs and other inputs easily quantified.

IFAD has developed the 'Goat Value Chain Toolkit: A guideline for conducting value chain analysis of the goat sub-sector' (IGA and IFAD 2013) which will prove useful to researchers required to understand and develop VCs. There are also more general VC manuals produced which should also assist in this research (M4P 2008; FAO 2011; Collins *et al.* 2015).

Goat value chain research in Laos

There has not been significant work identified that describe the goat VCs in Laos. A student (Khamparn Pathoummalangsy) is undertaking a PhD which has as one of its aims 'to describe the value chains and market of native goats in central Laos', this has not yet been accessed.

There is being work undertaken by other donor organisations to describe and work with goat VCs but neither of these is in Laos. The 'Goats Value Chain for Prosperity (G4P) (USAID 2013) project funded by USAID, is seeking to develop a profitable goat value chain involving goat and milk production, cheese processing and goat milk and cheese advertising and marketing businesses in the Digkale community in South Africa. There is also work being done by ILRI through the 'Small ruminant value chains as platforms for reducing poverty and increasing food security in dryland areas of India and Mozambique' (imGoats; ILRI 2015) project aimed at increasing incomes and food security in a sustainable manner by enhancing pro-poor small ruminant value chains in India and Mozambique.

Other projects that have used the VC approach to understand and improve livestock VCs include:

- Goats in Nepal (IGA 2014)
- Poultry biosecurity in Indonesia (ACIAR, UNE)
- Pig systems in Vietnam (ILRI)
- Pig systems in Nusa Tenggara Timur (NTT), Indonesia (Leslie *et al.* 2011)
- Cattle systems in Cambodia (NW Cambodia and SE Cambodia, ACIAR UNE) (Nam Hoang 2013; Hasnah *et al.* 2016)
- Goats in Ethiopia
- Vegetables in Laos (IFAD)

9.3.8 Summary and conclusions

This review has revealed strong growth in goat numbers in Vietnam and Laos with growth of the goat market in Vietnam likely to be contributing to the growth in goat numbers in Laos. Within Laos, goat production remains a smallholder mixed farming activity with marked regional variation in importance. Against this background of an increasing national herd there are few data on changes to productivity or offtake of single farms, districts or market chains.

Goat production has formed a component of approximately 10 large international and national projects and many more small projects in Laos since the late 1990s. These project reports and the publications arising from them provide a valuable resource base for any future work. The previous work has often been regionally localised within Laos (Eg ADB Northern projects, ACIAR extension and upland projects, CARE and NAFRI projects), and most projects have a wider livestock or agricultural focus with goats as one component of the system. Exceptions with an exclusive focus on goats/small ruminants include the small CARE Australia project on village goat banks in Laos, The 2004 ADB PPTA 4287 Northern Laos goat production study, the 2006 APHCA/ILRI Asia regional goat production and marketing workshop and the 1999-2005 ACIAR TAG443 project on integrated control of parasites in small ruminants in S and SE Asia. Most emphasis has been on production systems and/or constraints with most projects having a component on extension/adoption methods and one (ACIAR livestock extension project 2007-11) having a specific focus in this area. There is a dearth of detailed marketing information in the literature and with several reports calling for improved understanding and utilisation of markets (eg. 2006 GPARLSP project, 2006 APHCA/ILRI workshop).

While some projects have reported significant improvements in the amount and efficiency of goat production in the targeted areas, it was found in the 2007-2014 ADB Northern Region LDP that uptake of improved practices and returns on investment were lower for goats than other livestock sectors. This is consistent with the current perception of those working with goats in Laos that the production systems have not evolved substantially in response to the market opportunity. To alter this represents both an opportunity and a significant challenge.

It is clear from the review that significant constraints to improved goat production and marketing in Laos remain despite the moderate research effort over the last two decades. These can be broadly categorised as shown in Table 10.

Table 10. A framework for considering constraints to improved goat production and marketing in Laos

Category	Problem	Available knowledge and likely solutions	Prospects for achieving change
Production - Technical	Poor health/high mortality	High. Major problems and their causes well understood. Solutions can draw from beyond Laos.	Moderate-High. Challenges in accessing information and resources to implement solutions. High impact if limiting mortality.
	Poor nutrition	Moderate to high. Awareness of responses to improved nutrition at farmer level is low. Solutions relatively widely researched.	Moderate. Nutrition is at the base of the production system. Returns for improved growth/reproduction less dramatic than those affecting survival. Some prospects for targeted supplementation?
	Goat genetics	Moderate. Some awareness of inbreeding and research into improved genotypes. Benefits of the latter not clear?	Moderate. Altering traditional breeding practices is likely to be difficult but introduction of improved genotypes has precedent if improved genotypes to be markedly superior in the eye of the smallholder.
	Availability of technical information	Moderate. Previous projects and Govt. Agencies have produced goat production manuals. Low availability at smallholder level.	Moderate. Can draw on national and international resources.
	Access to support services	Moderate. Govt. services infrastructure is extensive, but knowledge of front line workers and smallholder access may be limiting	Moderate. Amenable to change with staff training. Opportunities for private sector support?
	Technical capacity – Human resources	Moderate. Significant capacity building in recent years. Research – farmer linkages not well developed.	High. Amenable to ongoing education both nationally and internationally.
Production - Socioeconomic	Smallholder scale of production	Low. Few examples of commercial scale goat production to act as lead innovators	Moderate. Market opportunity is significant and there may be examples of larger scale operations which could prove the case once identified.
	Low level of education and	Low-moderate. Challenges are well	Low-Moderate. Improvements in education

Category	Problem	Available knowledge and likely solutions	Prospects for achieving change
	resources of smallholders	understood, solutions less so.	and resources are likely to result in a move out of smallholder goat production.
	Labour intensive/Low return to labour	Low-moderate. Opportunity cost of labour not always considered in smallholder systems.	Moderate. Improvements in efficiency of production will increase returns on labour invested.
Marketing	Demand	Moderate. Market for goats widely acknowledged to be strong and consistent.	High. Broad socioeconomic change in SE Asia is likely to see demand increase.
	Price	Moderate. Information on price understood mostly at a local scale.	Moderate-High. Value chain analysis will reveal pricing patterns and change along the value chain in different regions
	Access	Moderate. Ability to market goats not identified as a major constraint. Sold direct to customer or trader. Not highly organised.	Moderate. Value chain analysis would reveal if current marketing arrangements provide optimal returns to smallholders. Geographical limitations will be harder to overcome.
	Market knowledge	Low. Market information identified in several reports as lacking.	High. Market specific research likely to result in significantly improved understanding

The results of this review, coupled with upcoming country visits and workshops will provide a sound footing for identification and prioritisation of key researchable issues in goat production and marketing in Laos

Reference list

- Adams, L.B., Gray, G.D., Murray, G. 2012. Animal biosecurity in the Mekong: future directions for research and development. Proceedings of a workshop held in Siem Reap, Cambodia, 10 - 13 August 2010. Australian Centre for International Agricultural Research: Canberra.
- ADB 2014a. Northern Smallholder Livestock Commercialization Project: Project Administration Manual. Project Number 47300-002 Available at <http://www.adb.org/projects/documents/northern-smallholder-livestock-commercialization-project-pam>
- ADB 2014b Sector Assessment (Summary): Agriculture, Natural Resources, and Rural Development (Livestock Subsector).

- ADB 2015. Lao People's Democratic Republic: Northern Region Sustainable Livelihoods through Livestock Development Project - Completion Report. Project Number: 35297-013, Asian Development Bank.
- Allard, H. 2010. Goat production in Laos and the potential of using *Erythrina variegata* as a feedstuff Honours thesis, Swedish University of Agricultural Sciences.
- Alo, A.M.P. 2004. Developing and testing integrated approaches to sustainable parasite control in small ruminants with farmers in the Philippines, Vietnam and Indonesia. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, GD Gray, RL Baker) Volume ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Ancheta, P.B., Dumilon, R.A., Venturina, V.M., Cerbito, W.A., Dobson, R.J., Le Jambre, L.F., Villar, E.C. and Gray, G.D. 2004. Efficacy of benzimidazole anthelmintics in goats and sheep in the Philippines using a larval development assay. *Veterinary Parasitology* 120, 107-121.
- APHCA 2006. Goats-undervalued assets in Asia, Proceedings of the APHCA-ILRI Regional Workshop on Goat Production Systems and Markets, Luang Prabang, Lao PDR, October 24 - 25 2006.'
- APPF 2009. About Laos. Available at <<http://www.na.gov.la/appf17/geography.html>> [Accessed 28/02/2017].
- Baker, R.L. and Gray, G.D. 2004. Appropriate breeds and breeding schemes for sheep and goats in the tropics. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, GD Gray, RL Baker) Volume ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Bouahom, B., Douangsavanh, L. and Rigg, J. 2004. Building sustainable livelihoods in Laos: untangling farm from non-farm, progress from distress. *Geoforum* 35, 607-619.
- Budisatria, I.G.S. and Udo, H.M.J. 2013. Goat-based aid programme in Central Java: An effective intervention for the poor and vulnerable? *Small Ruminant Research* 109, 76-83.
- Ho Bunyeth 2005. Cassava foliage as supplement for goats fed Paragrass (*Brachiaria mutica*) in full confinement, or with grazing in semi-confinement. Swedish University of Agricultural Sciences.
- Ho Bunyeth and Preston, T.R. 2006. Growth performance and parasite infestation of goats given cassava leaf silage, or sun-dried cassava leaves, as supplement to grazing in lowland and upland regions of Cambodia. *Livestock Research for Rural Development* 18, 28.
- CFC, FAO 2008 Common Fund for Commodities. Proceedings of the Symposium on Natural Fibres, Rome, 20 October 2008. Common Fund for Commodities 2009: Rome.
- Chamberlain 2006. Participatory Poverty Assessment (2006). Asian Development Bank.
- Chapman, E.C., Bouahom, B. and Hansen, P.K. 1998. Upland Farming Systems in the Lao PDR - Problems and Opportunities for Livestock. ACIAR Proceedings No. 87. Australian Centre for International Agricultural Research: Canberra.
- Chetroui, R., Calin, I., Niculescu, G.C. 2013 Worldwide trends and orientations of raising goats. Munich Personal RePEc Archive Paper No. 53460.
- Ngo Hong Chin and Khuc Thi Hue 2012. Supplementing *Tithonia diversifolia* with Guinea grass or tree foliages: effects on feed intake and live weight gain of growing goats. *Livestock Research for Rural Development* 24, 188.
- Chithtalath, S. 2006. Community development projects and the status of ethnic minority women in the Moksuk-Tafa area, Bokeo province, Laos. *Community Development Journal* 42, 299-316.

- Cocks, P., Robertson, I., Abila, R., Black, P. and Edwards, J. 2012. Foot-and-Mouth-Disease in the Malaysia-Thailand-Burma peninsula: addressing disease at the source. In 'Animal biosecurity in the Mekong: future directions for research and development. Siem Reap, Cambodia, 10 - 13 August 2010'. (Eds LB Adams, GD Gray, G Murray) pp. 104 - 107. Australian Centre for International Agricultural Research: Canberra.
- Collins, R.C., Dent, B. and Bonney, L.B. 2015. A guide to value-chain analysis and development for Overseas Development Assistance projects. Australian Centre for International Agricultural Research, Canberra No. 1447-090X Available at <http://aci-ar.gov.au/files/15500_aciar_chain_analysis_web.pdf>
- Connell, J.G. 2005. Extension approaches for livestock development. International Centre for Tropical Agriculture (CIAT), International Livestock Research Institute (ILRI).
- Connell, J.G. and Case, P. 2017. Enhancing district delivery and management of agriculture extension in Lao PDR. Australian Centre for International Agricultural Research: Canberra.
- de Haan, N. 2001. Of goats and groups - study on social capital in development projects. *Agriculture and Human Values* 18, 71 - 84.
- De Vries, J. 2012. Passing on the gift as an approach to sustainable development programmes. *Development in Practice* 22, 373-384.
- Devendra, C. 2010. Concluding synthesis and the future for sustainable goat production. *Small Ruminant Research* 89, 125-130.
- Devendra, C. 2013. Investments on Pro-poor Development Projects on Goats: Ensuring Success for Improved Livelihoods. *Asian-Australasian Journal of Animal Science* 26, 1 - 18.
- Devendra, C. and Liang, J.B. 2012. Conference summary of dairy goats in Asia: Current status, multifunctional contribution to food security and potential improvements. *Small Ruminant Research* 108, 1-11.
- Dubeuf, J-P., Bendapudi, R., Bhandari, D., Capote, J., Carrasco-Sanchez, R., Daskiran, I., Guimaraes, V., Iniguez, L., Koluman-Darcan, N., Peacock, C., Rota, A., Richkowsky, B., and Sepe, L. 2014. Scaling up successful practices for pro-poor development projects involving goats: First outputs of a comparative study. *Small Ruminant Research* 121, 146-156.
- Epprecht, M., Minot, N., Dewina, R., Messerli, P. and Heinemann, A. 2008 *The Geography of Poverty and Inequality in the Lao PDR*. Swiss National Center of Competence in Research (NCCR) North-South, University of Bern, International Food Policy Research Institute (IFPRI): Bern: Geographica Bernensia.
- FAO 2011. A value chain approach to animal diseases risk management - Technical foundations and practical framework for field application. Rome.
- FAO/SIDA 2010. National Gender Profile of Agricultural Households, 2010. Food and Agriculture Organization of the United Nations and Ministry of Agriculture and Forestry, Vientiane.
- FAOSTAT 2014. Food and Agriculture data. Available at <<http://www.fao.org/faostat/en/#home>>
- FAOSTAT 2016. Food and agriculture data. Available at <<http://www.fao.org/faostat/en/#home>>
- FAOSTAT 2017. Food and Agriculture data. Available at <<http://www.fao.org/faostat/en/#data>>
- Gray, G.D. 2004. Constraint, Opportunities and Interventions for Goat Production in Laos. Participatory Livestock Development Project ADB PPTA 4287-LAO, Report of the Smallholder Development Specialist, International Livestock Research Institute (ILRI).

- Gray, G.D. 2005. Development and Testing of an Integrated Approach to the Control of Gastrointestinal Parasites of Small Ruminants in South and Southeast Asia. International Fund for Agricultural Development (IFAD).
- Gray, G.D. 2006. GPARLSP Background Paper on the Livestock Sector in Khammouane Province. World Bank.
- Gray, G.D., Connell, J.G., Phimphachanhvongsod, V. 2012. Worms in smallholder livestock systems: Technologies and practices that make a difference. *Veterinary Parasitology* 186, 124-131.
- Gray, G.D., Copland, R.S. and Copeman, D.B. 2008. Overcoming liver fluke as a constraint to ruminant production in South-East Asia. Australian Centre for International Agricultural Research, Canberra Available at <<http://aci-ar.gov.au/files/node/9010/MN133%20part%201.pdf>>
- Gray, G.D. and Van Hove, E. 2003. Research Networks for Livestock Development in South East Asia. International Livestock Research Institute (ILRI).
- GRID 2005. Lao PDR Gender Profile. Gender Resource Information and Development Center (GRID).
- Bui Phan Thu Hang, Vo Lam and Preston, T.R. 2012a. Effects on the performance of growing goats by supplementing ensiled water hyacinth leaves with *Melia azadirach* foliage. *Livestock Research for Rural Development* 24, 226.
- Vu Thi Thu Hang, Nguyen Kha Tu and Chu Duc Tuy 2012b. The effect of *Eupatorium odoratum* foliage compared with cassava foliage on growth and intestinal nematode infestation in goats. *Livestock Research for Rural Development* 24, 136.
- Hasnah, P.I. and Smith, R.G.B. 2016. Household-level farming and marketing practices determining body condition score and economic value of cattle in Cambodia. *Livestock Research for Rural Development* 28, 116.
- Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S. and Rufino, M.C. 2012. The roles of livestock in developing countries. *Animal* 7 (Suppl 1), 3-18.
- Nam Hoang 2013. Ho Chi Minh City beef market demand and supply report. ACIAR Project No. AH/2010/046. Australian Centre for International Agricultural Research: Canberra.
- Nguyen Thi Thu Hong and Preston, T.R. 2013. Effect of biodigester effluent on the biomass production of *Tithonia diversifolia* and the use of the foliage as the basal diets for goats. *Livestock Research for Rural Development* 25, 6.
- Hood, G.M. 2004. Anthelmintic resistance in small ruminant parasites: implications for smallholders in Southeast Asia. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, GD Gray, RL Baker) Volume ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Horne, P.M., Stur, W.W. 1999. Developing forage technologies with smallholder farmers - how to select the best varieties to offer farmers in Southeast Asia.
- Khuc Thi Hue 2012. Feeding cassava to sheep: nutrient properties and hydrogen cyanide toxicity. Swedish University of Agricultural Sciences, Uppsala.
- IGA 2014. Scaling-Up Successful Practices on Sustainable Pro-Poor Small Ruminant Development. International Goat Association, Little Rock, Arkansas, USA.

- IGA, IFAD 2013. Goat Value Chain Toolkit: A guideline for conducting value chain analysis of the goat sub-sector. Available at <http://www.iga-goatworld.com/uploads/6/1/6/2/6162024/scaling-up_successful_practices-part05.pdf>
- ILRI 2015. Goat value chains in India and Mozambique. Available at <<https://imgoats.org/>> [Accessed 27/2].
- Jones, M.J., Case, P. and Connell, J.G. 2013. Comparing Developments in Agricultural Extension Services in Lao PDR with Global Trends: A Literature Review. Australian Centre for International Agricultural Research: Canberra.
- Keonouchanh, S. and Xaypha, S. 2006. Goat Production in Lao PDR. In Proceedings of the APHCA-ILRI Regional Workshop on Goat production systems and markets. Luang Prabang, Lao PDR, 24 - 25 October 2006.
- Kerr, J., Sieng, S. and Scoizec, A. 2012. Working with traders to understand livestock movements and spread of animal diseases in Cambodia and Lao PDR. In 'Animal biosecurity in the Mekong: future directions for research and development. Siem Reap, Cambodia, 10 - 13 August 2010'. (Eds LB Adams, GD Gray, G Murray) pp. 59 - 64. Australian Centre for International Agricultural Research: Canberra.
- Khambounheuang, B. 2014. National Policy for Sustainable Livestock Development Lao PDR. Inception Meeting Bangkok, April 7 - 8, 2014.
- Khouangvichit, D. 2010. Socio-economic transformation and gender relations in Lao PDR. PhD thesis, Umea University.
- King, E.M. and van de Walle, D. 2010. Catching up slowly: ethnic and gender inequalities in Lao PDR. The World Bank.
- Knox, M.R. 1995. The use of medicated blocks to control nematode parasites of ruminants. In Proceedings of the Recent Advances in Animal Nutrition Conference 1995. University of New England, Armidale, Australia.
- Knox, M.R. 1996. Integrated Control Programs Using Medicated Blocks. In 'Sustainable Parasite Control in Small Ruminants. Bogor, Indonesia 22-25 April 1996'. (Eds LF Le Jambre, MR Knox) Australian Centre for International Agricultural Research: Canberra.
- Kongmanila, D. 2007 Utilization of some local foliage species for goats: chemical composition, digestibility and intake characteristics. National University of Laos.
- Kongmanila, D. 2012. Erythrina foliage as an alternative feed for growing goats in Lao PDR. Swedish University of Agricultural Sciences, Uppsala.
- Kongmanila, D., Bertilsson, J., Ledin, I., and Wredle, E. 2012. Effect of feeding different levels of foliage from *Erythrina variegata* on the performance of growing goats. *Tropical Animal Health and Production* 44, 1659-65.
- Kongmanila, D. and Ledin, I. 2009. Chemical composition of some tropical foliage species and their intake and digestibility by goats. *Asian-Australasian Journal of Animal Science* 22, 803-811.
- Kongmanila, D., Preston, T.R. and Ledin, I. 2008a. Selective behaviour of goats offered different tropical foliages. *Livestock Research for Rural Development* 20,
- Kongmanila, D., Preston, T.R. and Ledin, I. 2008b. Survey on the utilization of local foliage species for goats in Xaythanee district, Veintiane City. *Livestock Research for Rural Development* 20,
- Kongvongxay, S. 2012. Effect of foliages rich in bypass protein on apparent digestibility, growth and methane emission in goats. Can Tho University, Vietnam.

- Kosgey, I.S., Baker, R.L., Udo, H.M.J. and Van Arendonk, J.A.M. 2006. Successes and failures of small ruminant breeding programmes in the tropics: a review. *Small Ruminant Research* 61, 13-28.
- Kouch, T. 2003. Studies on utilization of trees and shrubs as the sole feedstuff by growing goats; foliage preferences and nutrient utilization. Master of Science thesis, University of Tropical Agriculture Foundation, Royal University of Agriculture.
- Kouch, T., Preston, T.R. and Hieak, H. 2006. Effect of supplementation with Kapok (*Ceiba pentandra*) tree foliage and ivermectin injection on growth rate and parasite eggs in faeces of grazing goats in farmer households. *Livestock Research for Rural Development* 18, 87.
- Kouch, T., Preston, T.R. and Ly, J. 2003. Studies on utilization of trees and shrubs as the sole feedstuff by growing goats; foliage preferences and nutrient utilization. *Livestock Research for Rural Development* 15, 50.
- Kounnavongsa, B. 2008. Effects of fresh or sun-dried cassava foliage on the growth performance of goats fed basal diets of Gamba grass or sugar cane stalk. Swedish University of Agricultural Sciences, Uppsala.
- Kounnavongsa, B., Phengvichith, V. and Preston, T.R. 2010a. Effects of fresh or sun-dried cassava foliage on growth performance of goats fed basal diets of Gamba grass or sugar cane stalk. *Livestock Research for Rural Development* 22, 202.
- Kounnavongsa, B., Phengvichith, V. and Preston, T.R. 2010b. Existing goat production systems in Khammouane province Lao.
- Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., Baltenweck, I., Grace, D. and MacMillan, S. 2014. *Livestock and Women's Livelihoods*. 209-233.
- Leslie, E., Geong, M. and Toribio, J. 2011. *Livestock Movement and Manging Disease in Eastern Indonesia and Eastern Australia*. ACIAR Project Report AH/2006/156. Australian Centre for International Agricultural Research: Canberra.
- Lespine, A., Chartier, C., Hoste, H. and Alvinerie, M. 2012. Endectocides in goats: Pharmacology, efficacy and use conditions in the context of anthelmintics resistance. *Small Ruminant Research* 103, 10-17.
- M4P 2008. *Making value chains work better for the poor: A toolbox for practitioners of Value Chain Analysis, Version 3*. UK Department for International Development (DFID). Agricultural Development International: Phnom Penh, Cambodia.
- MAF 2014. *Lao PDR Lao Census of Agriculture 2010/11: Analysis of Selected Themes*, Vientiane, October 2014. Ministry of Agriculture and Forestry, Government of the Lao People's Democratic Republic.
- Luu Huu Manh, Nguyen Nhut Xuan Dung, and Tran Phung Ngoi 2005. Introduction and evaluation of *Moringa oleifera* for biomass production and as feed for goats in the Mekong Delta. *Livestock Research for Rural Development* 17, 104.
- Manueli, P. 2004. Worm control for small ruminants in Fiji. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, RL Baker, GD Gray) Australian Centre for International Agricultural Research: Canberra.
- Martin, S.M. and Lorenzen, K. 2016. Livelihood Diversification in Rural Laos. *World Development* 83, 231-243.

- McFarlane, R. 2012. A multiregion perspective on human and animal emerging infectious diseases. In 'Animal biosecurity in the Mekong: future directions for research and development. Siem Reap, Cambodia, 10 - 13 August 2010'. (Eds LB Adams, GD Gray, G Murray) pp. 30 - 38. Australian Centre for International Agricultural Research: Canberra.
- Millar, J. and Connell, J.G. 2010. Strategies for scaling out impacts from agricultural systems change: the case of forages and livestock production in Laos. *Agriculture and Human Values* 27, 213 - 225.
- Millar, J. and Photakoun, V. 2008). Livestock development and poverty alleviation: revolution or evolution for upland livelihoods in Lao PDR? *International Journal of Agricultural Sustainability* 6, 89-102.
- Millar, J., Sengdala, B. and Stelling, A. 2011. The role of livestock in changing Upland livelihoods in Northern Lao PDR: Facilitating farmer learning according to ethnicity and gender. *Journal of Mekong Societies* 7, 55-71.
- Millar, J., Stelling, A., Sengdala, B. and Photakoun, V. 2012. Extension approaches to scaling out livestock production in Northern Lao PDR. Australian Centre for International Agricultural Research: Canberra.
- Mui, N.T., Hang, D.L. and Binh, D.V. 2006. Goat raising in Vietnam. In Proceedings of the APHCA-ILRI Regional Workshop on Goat production systems and markets, Luang Prabang, Lao PDR, 24 - 25 October 2006.
- NAFRI, NAFES and NUOL 2005. Improving Livelihoods in the Uplands of the Lao PDR- A Sourcebook. National Agriculture and Forestry Research Institute, National Agriculture and Forestry Extension Service and National University of Lao PDR Available at <<http://www.mekonginfo.org/assets/midocs/0001773-environment-improving-livelihoods-in-the-uplands-of-the-lao-pdr.pdf>>.
- Nampanya, S., Rast, L., Khounsy, S. and Windsor, P.A. 2010. Assessment of farmer knowledge of large ruminant health and production in developing village-level biosecurity in northern Lao PDR. *Transboundary and Emerging Diseases* 57, 420-9.
- Newby, J.C. 2017. Number of goats by village in Lao PDR. International Centre for Tropical Agriculture (CIAT)
- Nguyen Tron Ngu and Ledin, I. 2005. Effects of feeding wastes from Brassica species on growth of goats and pesticide/insecticide residues in goat meat. *Asian-Australasian Journal of Animal Science* 18, 197-202.
- Nimbkar, C. 2006. Options for genetic improvement of goats by smallholders. In Proceedings of the APHCA-ILRI Regional Workshop on Goat production systems and markets. Luang Prabang, Lao PDR, 24 - 25 October 2006.
- Norton, B.W., Mui, N.T. and Binh, D.V. 2009. New Technologies for Improving Goat Production in Vietnam. School of Animal Studies, University of Queensland, Queensland, Australia.
- Nunn, M. 2006. Goat Production Systems and Trade in Australia. In Proceedings of the APHCA-ILRI Regional Workshop on Goat production systems and markets. Luang Prabang, Lao PDR, 24 - 25 October 2006.
- Okali, C. and Sumberg, J.E. 1985. Sheep and Goats, Men and Women: Household Relations and Small Ruminant Development in Southwest Nigeria. *Agricultural Systems* 18, 39 - 59.

- Pathoummalangsy, K. 2007. Effects of supplementation with rumen fermentable carbohydrate and sources of 'bypass' protein on feed intake, digestibility and N retention in growing goats fed a basal diet of foliage of *Tithonia diversifolia*. National University of Laos.
- Pathoummalangsy, K. 2014. Fattening is an option to improve smallholder goat production in Lao PDR. Swedish University of Agricultural Sciences.
- Pathoummalangsy, K. and Preston, T.R. 2008. Effects of supplementation with rumen fermentable carbohydrate and sources of 'bypass' protein on feed intake, digestibility and N retention in growing goats fed a basal diet of foliage of *Tithonia diversifolia*. *Livestock Research for Rural Development* 20,
- Peacock, C. 2005. Goats - A pathway out of poverty. *Small Ruminant Research* 60, 179 - 186.
- Phanthavong, V., Preston, T.R., Viengsakoun, N. and Pattaya, N. 2016. Brewers' grain and cassava foliage (*Manihot esculenta* Cranz) as protein sources for local "Yellow" cattle fed cassava pulp-urea as basal diet. *Livestock Research for Rural Development* 28, 196.
- Phengsavanh, P. 2003. Goat production in small holder farming systems in Lao PDR and the possibility of improving the diet quality by using *Stylosanthes guianensis* CIAT 184 and *Andropogon gayanus* cv Kent. Master of Science thesis, Swedish University of Agricultural Sciences.
- Phengsavanh, P. 2006. Goat Production Development in Lao PDR: Potential, Limitations and Approaches of Forage Development. In Proceedings of the APHCA-ILRI Regional Workshop on Goat production systems and markets. Luang Prabang, Lao PDR, 24 - 25 October 2006.
- Phengsavanh, P., Fahrney, K., Phimphachanhvongsod, V. and Varney, K. 2004. Livestock Intensification: forage and livestock technologies for complex upland systems. Proceedings of the workshop on Poverty Reduction and Shifting Cultivation Stabilization in the Uplands of Lao PDR: technologies, approaches and methods for improving upland livelihoods. Luang Phabang, 27-30 January 2004. LRC, NAFRI, Vientiane, Lao PDR.
- Phengsavanh, P. and Ledin, I. 2003. Effect of Stylo 184 (*Stylosanthes guianensis* CIAT 184) and Gamba grass (*Andropogon gayanus* cv. Kent) in diets for growing goats. *Livestock Research for Rural Development* 15, 71.
- Phengvichith, V. 2004. Feeding and forage management systems for smallholder goat production. Improving feed intake of sugarcane and foliage in small ruminants: effect of processing and method of presentation of the feed. PhD thesis, Swedish University of Agricultural Sciences.
- Phengvichith, V. and Ledin, I. 2007a. Effect of a diet high in energy and protein on growth, carcass characteristics and parasite resistance in goats. *Tropical Animal Health and Production* 39, 59-70.
- Phengvichith, V. and Ledin, I. 2007b. Effect of feeding different levels of wilted cassava foliage (*Manihot esculenta*, Crantz) on the performance of growing goats. *Small Ruminant Research* 71, 109-116.
- Phengvichith, V. and Preston, T.R. 2011. Effect of feeding processed cassava foliage on growth performance and nematode parasite infestation of local goats in Laos. *Livestock Research for Rural Development* 23, 13.
- Phimphachanhvongsod, V. 2001. The potential of *Gliricidia sepium* as a feed for goats small holder farming systems in Laos.

- Pinos-Rodríguez, J.M., Gómez-Ruiz, W.J., Aguirre-Rivera, J.R., García-López, J.C. and Álvarez-Fuentes, G. 2015. Profitability of goat production in the Mexico highlands. Outlook on AGRICULTURE 44, 223-233.
- Porsavatdy, P., Preston, T.R. and Leng, R.A. 2016. Effect on feed intake, digestibility, N retention and methane emissions in goats of supplementing foliages of cassava (*Manihot esculenta* Crantz) and *Tithonia diversifolia* with water spinach (*Ipomoea aquatica*). Livestock Research for Rural Development 28, 72.
- Sani, R.A., Adnan, M., Cheah, T.S. and Chandrawathani, P. 2004a. Worm control for small ruminants in Malaysia. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, RL Baker, GD Gray) ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Sani, R.A., Binh, D.V., Ly, N.D., San, S. and Phimpachanhvongsod, V. 2004b. Goat production, parasites and testing of control options in Lao, Cambodia and Vietnam. In 'Worm Control for Small Ruminants in Tropical Asia. (Eds RA Sani, GD Gray, RL Baker) ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Sani, R.A., Gray, G.D. and Baker, R.L. 2004c. Worm Control for Small Ruminants in Tropical Asia. ACIAR Monograph 113. Australian Centre for International Agricultural Research: Canberra.
- Silivong, P. 2012. Studeis on growth performance and methane emissions in goats fed tree foliages. Can Tho University, Vietnam.
- Silivong, P. and Preston, T.R. 2015. Growth performance of goats was improved when a basal diet of foliage of *Bauhinia acuminata* was supplemented with water spinach and biochar Livestock Research for Rural Development 27, 58.
- Silivong, P. and Preston, T.R. 2016. Supplements of water spinach (*Ipomoea aquatica*) and biochar improved feed intake, digestibility, N retention and growth performance of goats fed foliage of *Bauhinia acuminata* as the basal diet. Livestock Research for Rural Development 28, 98.
- Silivong, P., Preston, T.R. and Man, N.V. 2012. Feed intake, digestibility and N balance of goats fed Paper mulberry (*Broussonetia papyrifera*) or Muntingia (*Muntingia calabura*) foliages supplemented with NPN from potassium nitrate or urea. Livestock Research for Rural Development 24, 77.
- Sinn, R., Ketzi, J. and Chen, T. 1999. The role of woman in the sheep and goat sector. Small Ruminant Research 34, 259 - 269.
- Skapetas, B. and Bampidis, V. 2016. Goat production in the World: present situation and trends. Livestock Research for Rural Development 28,
- Sokerya, S. 2003. Effect of grass or cassava foliage on growth and nematode parasite infestation in goats fed low or high protein diets in confinement. Master of Science thesis, University of Tropical Agriculture.
- Sokerya, S. 2009. The effects of cassava foliage (*Manihot esculenta*) on gastrointestinal parasites of small ruminants in Cambodia. Swedish University of Agricultural Science, Uppsala.
- Sokerya, S. and Preston, T.R. 2003. Effect of grass or cassava foliage on growth and nematode parasite infestation in goats fed low or high protein diets in confinement. Livestock Research for Rural Development 15, 61.
- Sophea, I. 2010. Effect of different levels of supplementary potassium nitrate replacing urea on growth rates and methane production in goats fed sugar palm-soaked rice straw and mimosa foliage. Master of Science. Kampong Cham National School of Agriculture: Cambodia.

- Sophea, I. and Preston, T.R. 2011. Effect of different levels of supplementary potassium nitrate replacing urea on growth rates and methane production in goats fed rice straw, mimosa foliage and water spinach. *Livestock Research for Rural Development* 23, 71.
- Stür, W. and Gray, G.D. 2014. Livestock in smallholder farming rice systems of Mainland South East Asia. In 'Trajectories of rice-farming households in mainland South-East Asia.' (Ed. R Cramb.) ACIAR Monograph No. 177. Australian Centre for International Agricultural Research: Canberra.
- Stur, W., Gray, G.D. and Bastin, G. 2002. Review of the Livestock Sector in the Lao People's Democratic Republic. International Livestock Research Institute, Manila, Philippines.
- Stur, W., Khanh, T.T. and Duncan, A. 2013. Transformation of smallholder beef cattle production in Vietnam. *International Journal of Agricultural Sustainability* 11, 4.
- Stur, W. and Phengsavanh, P. 2014. Lessons learnt from the Northern Livestock Development Project (LDP) and Assessment of Livestock Value Chains in northern Lao PDR. IFAD.
- Stur, W., Phengsavanh, P., Gabunada Junior, F.A., Horne, P.M., Khanh, T.T., Phimpachanhvongsod, V., Connell, J.G. and Holman, F.J. 2006. A survey of adoption of improved forages in Southeast Asia. CIAT, Cali, CO.
- Stur, W.W., Horne, P.M., Hacker, J.B. and Kerridge, P.C. 1995. The Forages for Smallholders Project. CIAT, CSIRO and Department of Livestock and Veterinary Services, Ministry of Agriculture and Forestry.
- Vo Duy Thanh 2012. Effect of NPN source and mangosteen peel (*Garcinia mangostana*) on methane production in in vitro incubations and on growth performance of Phan Rang sheep in the Mekong delta of Vietnam. Can Tho University, Can Tho city.
- Tien Dung, N., Thi Mui, N. and Ledin, I. 2005 Effect of replacing a commercial concentrate with cassava hay (*Manihot esculenta* Crantz) on the performance of growing goats. *Animal Feed Science and Technology* 119, 271-281.
- Udo, H.M.J., Aklilu, H.A., Phong, L.T., Bosma, R.H., Budisatria, I.G.S., Patil, B.R., Samdup, T. and Bebe, B.O. 2011. Impact of intensification of different types of livestock production in smallholder crop-livestock systems. *Livestock Science* 139, 22 - 29.
- USAID 2013. The Goats Value Chain for Prosperity (G4P). Available at <<http://www.ranlab.org/the-goats-value-chain-for-prosperity-g4p>> [Accessed 27/02].
- Valdivia, C. 2001. Gender, livestock assets, resource management and food security: Lessons from the SR-CRSP. *Agriculture and Human Values* 18, 27 - 39.
- Do Thi Thanh Van 2006. Some animal and feed factors affecting feed intake, behaviour and performance of small ruminants. Swedish University of Agricultural Sciences.
- Do Thi Thanh Van, Nguyen Thi Mui and Ledin, I. 2005. Tropical foliages: effect of presentation method and species on intake by goats. *Animal Feed Science and Technology* 118, 1-17.
- Venturina, V., Ancheta, P., Eduardo, S., Dobson, R. and Gray, G.D. 2003. Use of a larval development assay to estimate anthelmintic efficacy in goats in smallholder farming systems. *Philippine Journal of Veterinary and Animal Science* 29, 62-70.
- Vivasane, S. and Preston, T.R. 2016. Effect of cassava (*Manihot esculenta* Crantz) and Erythrina (*E. subumbrans*) foliage on growth of goats fed basal diets of banana (*Musa spp*) leaves or Elephant grass (*Pennisetum purpureum*). *Livestock Research for Rural Development* 28,

- Vixathep, K. 2011. Women's Participation in Community Development Projects: The Case of Khmu Women in Laos. Lincoln University.
- Vongsamphanh, P. 2003. Potential use of local feed resources for ruminants in Lao PDR. Master of Science thesis, Swedish University of Agricultural Sciences.
- Waters-Bayer, A. and Letty, B. 2010. Promoting Gender Equality and Empowering Women through Livestock. In 'The Role of Livestock in Developing Communities: Enhancing Multifunctionality.' (Eds F Swanepoel, A Stroebel, S Moyo.) The Technical Centre for Agricultural and Rural Cooperation (CTA), International Livestock Research Institute (ILRI) and University of the Free State: The Netherlands.
- Xaypha, S. 2005. Goat production in smallholder farming systems in lowland Lao PDR and an evaluation of different forages for growing goats. Master of Science.
- Zasloff, J.J., Lafont, P., Osborne, M.E., Dommen, A.J. and Silverstein, J. 2017. Laos. Available at <<https://www.britannica.com/place/Laos>> [Accessed 28/02/2017].

10 Appendix 2. Goat Production and Marketing in South East Asia and the Pacific

A 2 day workshop took place at UNE on Tuesday 8 and Wednesday 9 November 2016, followed by a one day planning session on 10 November for two new small research activities in Laos and the Pacific: *Assessing goat production and marketing systems in northern Laos and northwest Vietnam* (LPS/2016/027) and *Assessment of Markets and Production Constraints to Small Ruminant Farming in the Pacific* (LPS/2016/021). The objectives of the workshop were to

- Share information among past, ongoing and planned research projects in Asia and the Pacific, funded by ACIAR and others. This was achieved through formal presentations and informal discussions.
- Review methodologies for the identification of, and engagement with, goat market chains. A number of training guides were identified and discussed following presentations by two experienced practitioners.
- Develop a simple framework for the documentation and comparison of goat production and marketing systems, including constraints and opportunities within and across countries. This will be an ongoing task facilitated by simple mechanisms for sharing protocols, reports and flagging future joint activities.

A list of participants and their email addresses is appended. The four projects, scientists and timelines are described in Table 1

Table 1 The four small research activities embraced by the workshop.

	Staff and Institutions		
Title and PN	Australia	Partner Country	Timeline
Assessing goat production and marketing systems in northern Laos and northwest Vietnam (LPS/2016/027)	D. Gray (UNE) S. Walkden-Brown (UNE) I. Patrick (UNE) R. Hergenhan (UNE) N. Hoang (UNE) M. Carnegie (UNE)	P. Phengsavanh (NAFRI)* A. Phonvisay (PAFO)*	Oct 16 – Sep 17
Assessment of Markets and Production Constraints to Small Ruminant Farming in the Pacific (LPS/2016/021).	F. Cowley (UNE) M. Carnegie (UNE) G. Smith (UNE) S. Walkden-Brown (UNE) P. Manuelli (consultant) M. Knox (consultant)	I. Puana (SPC)	Oct 16 – Mar 18
Pakistan	D. McGill		
Myanmar	A. Campbell (UM) E. Glanville (UM) J. Hanks (UM)		

10.1 Industry Map

A consensus emerged from the working groups that an initial 'industry map' is the most useful device for understanding the bigger picture and to developing criteria and selecting value chains for further research and development. In the case of the Lao project this will involve capture of the main internal production areas in all provinces of the country with a focus on the northern provinces of Luang Prabang

and Huapanh and the central provinces of Khammouane and Savannakhet where smallholder goat production is relatively common. Internal trade and exports to Vietnam will be assessed through interviews with provincial staff, traders and farmers. The protocols for these interviews will be shared among the four projects. The extent to which demand in Vietnam needs to be better understood will be assessed as the mapping progresses. Interviews will take place in December with an initial map available by the end of January. Common presentation of the maps will be developed.

10.2 Other Methodologies

As the workshop progressed it became increasingly clear that a common set of principles could be applied across all 4 projects but that tools needed to be adapted to circumstances when they were confronted and better understood. This applied to the initial mapping criteria development, depth and 'width' of the value chains to be studied and the number required to reach the objectives of each project. The projects share the same overall objective; to identify problems/issues that are amenable to further research, especially through the type of partnerships that can be supported by ACIAR.

There are many value chain studies on livestock published and these will be compiled in the *ACIAR Goat Group* document folder. Resources for value chain analysis (VCA) methods are detailed in the next section.

It was agreed to develop a set of common parameters to be estimated across the projects for the "on farm" components of the studies. For example for mortality (age classes), reproductive rate (kids borne per litter and per year), productivity indices (turnoff rate in terms of animals, weight and income per breeding female or other resource unit), description of ill-health (as syndromes), numbers animals traded. An initial list of parameters has been described as part of the GLORIA demographic model.

Commcare was discussed as a useful project mobile acquired data tool for the design, implementation and interpretation of survey data. Although it has high initial investment in resources for training and capital expenditure time it can be tested for a full project and set up to collect and process data consistently across projects.

10.3 Training Manuals

Many resources are available to learn the principles of VCA and how these are applied to agricultural systems. The tools need to be adapted and developed as new studies progress. The three titles that were mentioned during the workshop are in Table 1 with commentary on their relevance to the forthcoming small research activities.

Table 1. Four VCA Training Resources

	Title and Source	Most relevant feature	Least relevant features
1	'Goat Value Chain Toolkit' ²⁸	Is exclusively about goat systems.	Considers multiple products from goats: milk, meat and fibre, which create much complexity.
2	A guide to value-chain analysis and development for overseas development assistance projects ²⁹	Recent and closely aligned to practices in ACIAR projects written by Australian practitioners.	Only fruit and vegetable case studies
3	Making value chains work better for the poor: a toolbox for practitioners of value chain analysis ³⁰	Very practical and focussed at household level	a bit broad
4	A value chain approach to animal diseases risk management (FAO) ³¹	Detailed multi animal and product	Multiple commodity, focussed on identifying weaknesses in VC specifically with regard to livestock disease risk

10.4 Value Chain Visualisation (from Greg Hood post-workshop)

The document 'Goat Value Chain Toolkit' is useful, but presentation of value chain analyses could consider a standardised and informative presentation of the quantitative components of the analysis. Figure 9 from that document looks like this:



The numbers are informative but the colours are not informative and the symbols have no relation to the values of (cost, expense, margin).

The information could be presented better via a customised³² bar chart, a 'Value Chain Plot'.

²⁸ http://www.iga-goatworld.com/uploads/6/1/6/2/6162024/scaling-up_successful_practices-part05.pdf

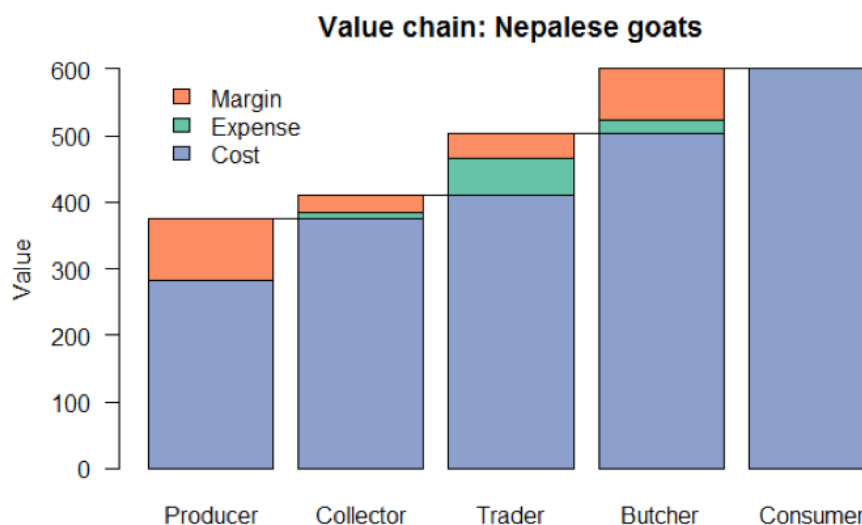
²⁹ <http://aciarc.gov.au/publication/mn178>

³⁰ <http://aciarc.gov.au/publication/cop019>

³¹ <http://www.fao.org/docrep/014/i2198e/i2198e00.htm>

³² Greg has provided the code used to generate the chart. The full document is in the AGG Dropbox folder (Hood, 2016)

With this presentation, it is immediately clear how the total value at one level of the chain feeds in as an expense to the next level. We can also see the relative sizes



of the margins, expenses and cost at each level.

10.5 Design Issues

The value of institutional flocks was discussed and where they are available they can enable the type of formal experimentation which provides both local data for an intervention and builds capacity and confidence among the researchers and extension workers involved.

The relative emphasis on working with smallholders and / or with emerging commercial enterprises was discussed. The historical emphasis of ACIAR and other agencies on 'poor smallholders' has diminished with the recognition that all sectors need to be understood and the complexity of the relationships among all producers and the value chain accounted for as we look at the industry 10-20 years down the track.

Gender should be considered as part as part of socioeconomic evaluation but there is a need for the foreseeable future to report separately on issues of gender equity and new opportunities for women and youth for ACIAR and other agencies. A recurring questions was: are teams set up to do this properly?

Capacity building needs to be planned and recognised as important for the start of the SRA through to project completion and reporting.

10.6 Joint Activities.

It was agreed to share information initiated by the Lao group and 'maintained' by Rachelle Hergenhan for research publications, planning documents and progress reports of common interest and usefulness.

The LPS program will initiate a 3 monthly update (similar to the TADEP Update form the PNG projects with Lachlan Dennis requesting 'dot points' from each

project to compile into an email for the interest of all projects and immediate stakeholders.

These initiatives should encourage inter-personal and inter-project communications by regular means and will enable easy access of new participants to the research.

10.7 Australian Research

While not essential for any single ACIAR project we agreed that were significant advantages to research projects having both Australian and overseas activities, with appropriate justification. The Australian research provides opportunities for more students to become involved. One research opportunity that arose was to determine appropriate dewormer rates for goats in Australia and PCs, with a desktop study that included interaction with manufacturers and researchers. This can easily be cast as part of the input value chain shared by all goat producers as there are common suppliers and an international market for dewormers suitable (or unofficially deemed suitable) for goats. An additional and possibly controversial activity is to measure amount of active ingredient in commercially available products (dewormers, antibiotics, etc) in the PC input markets.

WormBoss is a web-based extension resource for Australian sheep and goat producers which could be expanded with a 'plug-in for PC use. This component could be jointly implemented across the projects.

Exports of goats and goat meat to Asia are substantial and increasing and are likely to have increasing impacts on supply and demand in Vietnam and Malaysia. Little is known about these impacts or their potential to stimulate of demand for animal from Laos and Myanmar. Over the past 20 years the Australian goatmeat industry has experienced strong growth, largely underpinned by the sale of goats derived from rangeland or extensive production systems. Australia is the world leader in goatmeat exports, with around 95% of Australian goatmeat sent offshore and accounting for around 50% of the global goatmeat trade. Goatmeat shipments increased 10% year-on-year, to 35,780 tonnes– the highest on record. This came from the slaughter of 2.14 million goats. In addition, Australia exported almost 89,000 live goats in 2014 mostly to Malaysia.

10.8 Next steps for the Laos SRA

Planning is moving ahead rapidly for the Laos SRA. The following activities have been scoped for the remainder of 2016 and 2017

- Contact other livestock projects in Laos with all or part of this document,
- Initiate industry mapping in December 2016
- Visit by Gray, Walkden-Brown and Patrick to Laos 15- 29 January
- Field Visits to DLF, PAFO ADB, NAFC and trade routes through Luang Prabang and Huapanh to Vietnam border

- Contact livestock market researchers in Vietnam for existing data and possible collaboration.

10.9 Next steps for the Pacific SRA

Significant progress has already been made in establishing key collaborations and contacts for this SRA. The following activities have been planned for the remainder of 2016 and 2017:

- Initial visit to Fiji 28 Nov – 9 Dec to meet with key institutional stakeholders; initiate industry mapping of stakeholders at the upper end of the value chain for participation in future, more detailed VC surveys; describe policy environment; make plans for detailed survey work to follow.
- Identify USP student to undertake a review of literature of sheep and goat research in the Pacific in the last 20 years.
- Collaborate with USP to undertake detailed value chain mapping
- Follow-up visit in early 2016 to train and initiate household surveys on production and livelihoods.
- Prepare concept note for full project ready for May 2017.

11 Appendix 3: Description of existing and potential market chains, including mapped information, historic data and potential for expansion based on interviews with key informants and official data when available

This report is Output 3 from the scoping study Assessing goat production and marketing systems in northern Laos and northwest Vietnam (LPS/2016/027) namely;

Descriptions of existing and potential market chains, including mapped information, historic data and potential for expansion based on interviews with key informants and official data when available (30 April 2017),

as specified in the project document. In consultation with ACIAR the date for delivery was revised to 31 May 2017 to allow for consolidation of information acquired during the field trip between April 19 and April 28 2017. The report is based on consideration of discussions held during the planning workshop in November 2016 among several ACIAR projects with objectives on goat production and marketing (Output 1), the literature review (Output 2) and interviews conducted before, during and after the field trip. Work will continue to acquire further information especially during a planned field trip in Vietnam immediately before the planned overview workshop to be held in Luang Prabang on 19 and 20 June 2017.

The NAFRI team has identified three distinct and active market chains for goats on the basis of field observations and discussions undertaken in December 2016, January 2017 and the April field trip. Fewer goats are consumed in Laos but there is also growing domestic demand. There are three main and separate export market chains:

- The Southern Corridor: goats are sourced in Khammouane and Savannakhet and are transported east on Route 9 to Vietnam.
- The Northern Corridor: goats are sourced in Luang Prabang and Oudamxai and transported south east through Xieng Khouang on Route 7 to Vietnam.
- The North East Corridor: goats sourced in Huaphanh are transported north east by Route 6 to Vietnam

The location of the end-market for goats in Vietnam is based on discussions with Vietnamese traders in Laos. The required detailed interviews in Vietnam will be completed for presentation at the June workshop at which these three market chains of high potential and the following conclusions will be presented for further discussion.

Export of live ruminants is a high priority for MAF, and NAFRI has given high priority to goat production for the improvement of the smallholder sector. Up to 90% of goats produced in Laos are estimated to be exported to Vietnam where demand remains high and Lao goats command a premium. An important **research** question is to better understand the nature and extent of the high demand in Vietnam and Laos in terms of animal size and conformation: taste and texture of meat, other attributes of provenance and perceptions of 'green' and 'clean'. This will require investigation and cooperation in Vietnam.

Mortality of young goats is the most reported but poorly understood constraint on herd productivity and to realising the full potential of the high demand and prices for goats. The capacity for **research** to determine the causes and the testing of practical solutions to reduce mortality has been identified and is available in Laos at the institutions visited and through their collaboration with ACIAR-funded and related projects.

A contributor to mortality, possible inbreeding and lack of genetic improvement is absence of controlled breeding and indiscriminate use of young bucks from within small village herds. There is scope for the initiation and testing, with associated **research**, of a pilot scheme to introduce the use of proven, superior bucks to smallholder systems.

The feed resource available to goats varies with region but goats thrive when allowed to graze and browse widely in previously forested land. Better understanding of the size, carrying capacity and sustainability of this resource is an important **research** question as is the development and evaluation of formal agroforestry systems incorporating goats. Some capacity to investigate the former exists in Laos and preliminary work has been undertaken. For the latter, the presence of companies such as Burapha and Stora Enso which are currently developing sustainable agroforestry models with goats offers an opportunity for research.

There is a small number of national, provincial and district staff and farmers with good skills in goat production, goat health and research. There is a lack of appropriate extension material and techniques for goats. Lessons can be drawn from the cattle and pig sectors. Extension approaches developed in Laos by DAEC and others can be used. Adaptation and development of goat-specific material will require some **research** and capacity building. Extension material from previous projects in South East Asia in a web-based format have been supplied to AGFORS and NAFRI to support their current efforts

Potential **partners for research** on goat production and markets were identified: individual households within traditional communities; communities being supported by NGO and government programs; medium sized farmers with larger numbers of animals and a commercial focus; and some larger companies, including Burapha and Stora Enso, which are starting to integrate goat production into eucalypt plantations. There is scope for collaboration with AGFORS to undertake research on goat production and community engagement in goat-based agroforestry.

Provincial and district **technical capacity** for the support of goat enterprises is strongest in Savannakhet, Luang Prabang and Huapanh. NUOL, NAFRI and DLF have researchers with capacity to investigate, interpret and publish results and there is emerging capacity at the University of Savannakhet.

Impact pathways for further investment in research include a) integration with the Northern Smallholder Livestock Commercialization Project (NSLCP) in Huapanh (North East Corridor), b) demonstration of improved herd productivity and associated dissemination of results by district and provincial staff c) assisting HPA and other NGOs to upgrade existing and develop new programs involving goats through a Learning Alliance d) attracting new investors in medium scale goat production e) assisting existing agroforestry businesses to integrate goats into their production systems.

11.1 Goat market chains in Laos

Phonepaseuth Phengsavanh, Ammaly Phengvilaisouk, Phoukham Viengvilai Phouthone Phonekhampheng, Ian Patrick, Doug Gray and Steve Walkden-Brown

11.1.1 Introduction

Goat marketing systems are underdeveloped in Laos and as such there is not a lot of detailed information concerning the market chain actors, the transaction costs and details of goat and goat product flows. Just as production systems are low input, so marketing systems are, for the producers, low effort. Trade in other livestock have been studied in greater detail (e.g. Zola, 2004, Stur and Phengsavanh 2014) because of their greater numbers and their importance in the transmission of transboundary diseases (e.g. Adams et al 2012).

While local markets remain important particularly in rural areas in Laos (APHCA 2006), increasing goat numbers (a 182% increase between 2004 and 2014, FAOstat 2014) and an increasing demand from goat restaurants not only in Laos (Provinces of Bolikhamxai, Khammouane and Savannakhet) (Pathoummalangsy, 2014) but also in Vietnam is ensuring that the market chain needs to be better understood and developed.

In provinces such as Khammouane the main purpose of keeping goats is for selling, they are not kept for household consumption (Kounnavongsa *et al* 2010). There are well organised systems for selling cattle and buffalo but the situation or process is not so clear for small livestock such as goats (APHCA 2006).

11.2 Value chain approach

A value chain (VC) approach aims to improve market access, efficiency and equity, thereby improving livelihoods of smallholders and other VC participants. Smallholder livelihood improvement cannot be attained in isolation of improving input supply, flow of information, access to alternate markets and a supportive community and institutional environment. Managing development using a VC framework allows researchers to include these economic, social, environmental and institutional factors to be included in the development process. A value chain development approach is oriented towards:

- Facilitating sustainable impact and inclusive growth interventions;
- Analysing market systems in order to understand the base causes that restrict their ability to improve livelihoods;
- Identifying the causes of the inefficiencies and ensure change in the market system;
- Empowering chain actors to exercise and influence change (particularly women and youth);
- Changes that continue without external support.

Engaging and understanding the roles and priorities of VC participants at all stages of a will ensure more targeted and more effective research inputs and results. The VC approach is change, from undertaking research on a system to research being part of the system. Many of these concepts have been developed in the sphere of manufacturing and to a lesser extent in agriculture. Some successes have been achieved in relatively 'simple' product' chains such as fruit and vegetable where the pathways from production to consumption are relatively short. Further, in most cases there is little processing product from harvest to consumption, the production cycle is short (months) and labour costs and other inputs easily quantified.

IFAD has developed the 'Goat Value Chain Toolkit: A guideline for conducting value chain analysis of the goat sub-sector'³³ which will prove useful to researchers required to understand and develop VCs. There are also more general VC manuals produced which should also assist in this research (M4P 2008, Collins *et al* 2016).

11.3 Goat value chain research in Laos

There has been little work published that describe the goat VCs in Laos. In 2004 a study was undertaken by NAFRI to assess the potential for goat production and marketing in Savannakhet province (Phengsavan et al, 2004). A student (Khamparn Pathoummalangsy, staff member at the University of Savannakhet) is undertaking a PhD which has as one of its aims 'to describe the value chains and market of native goats in central Laos', this has not yet been accessed.

There is work being undertaken by other donor organisations to describe and work with goat VCs but neither of these is in Laos. The 'Goats Value Chain for Prosperity (G4P)³⁴ project funded by USAID is seeking to develop a profitable goat value chain involving goat and milk production, cheese processing and goat milk and cheese advertising and marketing businesses in the Digkale community in South Africa. There is also work being done by ILRI through the 'Small ruminant value chains as platforms for reducing poverty and increasing food security in dryland areas of India and Mozambique' (im Goats)³⁵ project aimed at increasing incomes and food security in a sustainable manner by enhancing pro-poor small ruminant value chains in India and Mozambique. Other projects that have use the VC approach to understand and improve livestock VCs include:

- Poultry biosecurity in Indonesia (ACIAR, UNE)
- Pig systems in Vietnam (ILRI)
- Pig systems in Nusa Tenggara Timur (NTT), Indonesia
- Cattle systems in Cambodia (NW Cambodia and SE Cambodia, ACIAR UNE, Muniroth et al 2015)
- Cattle markets in HCMC (Luthi 2011)
- Goats in Ethiopia
- Vegetables in Laos (IFAD)

The following discussion is based on the learnings from the above studies, some particular studies undertaken in Laos (Jones and Keoviriyavong (2015) Cummins (2005), and a survey undertaken by Laos project partners (Phengsavan et al). The team undertook a market chain survey in December 2016 and January 2017 which aimed to describe the market chain and identify the major chain participants. The discussion below is a summary of these findings and additional information gained during the visit to Laos by Gray, Walkden-Brown and Patrick in April 2017.

11.4 Partner survey – December 2016 to January 2017

To provide some base information on the goat sector in Laos, the partner team undertook a series of surveys of value chain stakeholders in December 2016 and January 2017. This included 25 village meetings (Table 1), and discussions with 8 middlemen or Laos traders

³³ http://www.iga-goatworld.com/uploads/6/1/6/2/6162024/scaling-up_successful_practices-part05.pdf

³⁴ <http://www.ranlab.org/the-goats-value-chain-for-prosperity-g4p>

³⁵ <https://imgoats.org/>

and a Vietnamese trader. The village surveys were focus group discussions where a range of data was collected with regard to:

- Reasons for keeping goats
- Goat raising and feeding systems
- Goat management practices
- Production and goat health
- Identification of management problems
- Goat selling decision-making
- Future goat enterprise plans and needs

Table 11: Base farmer survey data

	No. of villages	average no. of farmers attended meeting	village households owning goats (%)	average no. of goats/ family	average no. years raising goats	reason for keeping goats %		% of hhold income from goats
						sale	consumption	
Savannakhet	5	13	77	13	7	94	6	42
Khammouane	5	13	46	6	9	93	7	41
Houaphanh	7	11	19	11	12	95	5	36
Oudamxay	2	14	23	7	15	95	5	30
Luang Prabang	6	10	26	11	8	94	6	27

The base data illustrated the importance of goats to smallholder farmers with the goats predominantly kept for sale rather than consumption and between 27 and 42% of household income being provided by goats. While this may seem to indicate that goats are kept for income generation purposes, it is important to note that 23 of the 25 villages (92%) indicated that goats are sold when they need to pay school fees or medical bills, only 9 villages (36%) stated that they sold their goats based on meeting a certain weight target.

The survey confirmed the importance of goats in Savannakhet Province with 77% of households in the 5 surveyed villages owning on average 13 goats per family. Khammouane Province had 46% of households owning goats but only averaging 6 head per household.

Only general production, health and marketing information was collected during these surveys. The team did identify that most farmers sold to a middleman and on average middlemen passed through villages 13 times per month, searching for goats to purchase. This ranged from 1 visit per month to a total of 28 visits by middlemen in Mok Vad village in Luang Prabang.

The survey provided a good introduction to the role of goats in the smallholder farming systems and will be used as a basis for identifying production, health and market research priorities.

The village production survey was supplemented with detailed individual interviews with 9 goat traders to obtain information on the market chain, buying and selling calendars, demand and supply and price of goats.

11.5 Important market chains in Laos

The survey undertaken by project partners identified three main production areas in Laos, these were mainly in the provinces of Houaphanh, Luang Prabang and Savannakhet. Figures 1 to 3 identify where in these provinces these goats originate and where they end up. The majority of goats in all three market chains are exported to Vietnam. Only between 5% and 10% of the goats are consumed domestically, the remainder moving into Vietnam. All three MCs provide goats to the Ha Noi market. These market chains are referred to as;

- North Eastern MC: Houaphanh (Laos) to Thanh Hoa (Vietnam) and Xeun La (Ha Noi, Vietnam) in a north east direction via Route 6 (Figure 1)
- Northern MC: Luang Prabang, Oudomxay and Bokeo (Laos) through Xiengkhouang (Laos) to Nghe An (Vietnam) in a south east direction via route 7 (Figure 2)
- Southern MC: Savannakhet (Laos) to Quang Tri (Vietnam) (Figure 3)

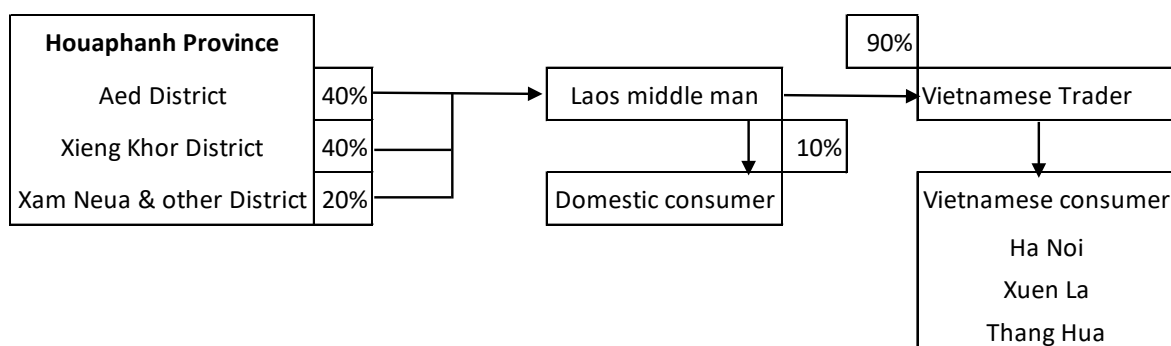


Figure 5: North-Eastern MC: Goat movement from Houaphanh province to Vietnam (Phengsavanh survey, 2017)

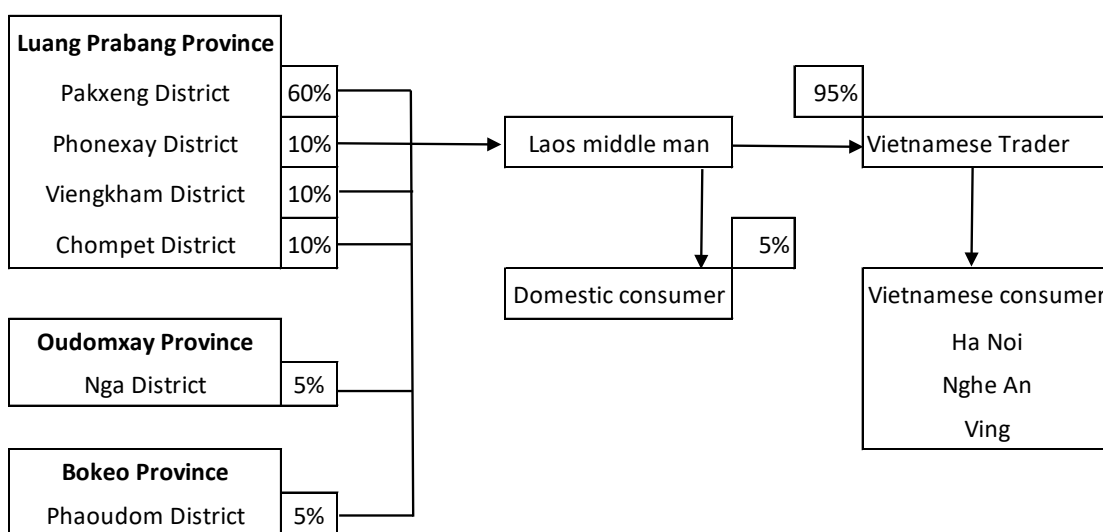


Figure 6: Northern MC: Goat movement from Luang Prabang and other northern provinces to Vietnam (Phengsavanh survey, 2017)

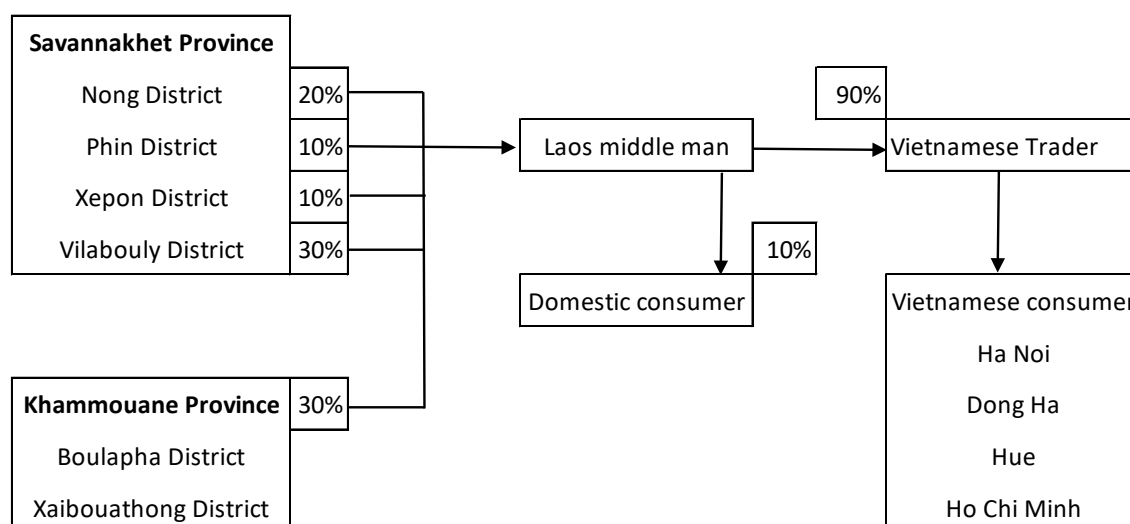


Figure 7: Southern MC: Goat movement from Savannakhet province to Vietnam (Phengsavanh survey, 2017)

11.6 Roles of the different stakeholders; farm to border

Producer: Produces goats, sells to collector or middleman

Collector: Works as an agent for a middleman, purchases from farmer on request from the middleman

Middleman: Could also be referred to as a Lao trader. Purchases from farmer directly or via a collector. Responds directly to a request from the Vietnamese trader and is responsible for ensuring all the export paperwork is in place. Responsible for delivering stock to the Vietnamese trader at the border. Usually delivers directly but some middlemen may have their own holding yard/depot where they aggregate stock. They may occasionally sell direct to a restaurant in Laos, but restaurants usually purchase direct from the farmer.

Vietnamese trader: Orders goats from the Lao middleman and meets them at the border. Usually relies on the middleman to source appropriate stock, but may enter Laos to assist with livestock selection. Trader usually pays for 1 extra kg of goat liveweight to cover weight loss during transport.

License company: Ketsana and other companies purchase annual quotas from the Government to export cattle and goats. In theory companies cannot export more than their official quota. Every goat purchased from a farmer must be purchased by a trader/middleman with a license. Vietnamese traders cannot purchase licenses they must rely on the Lao middleman to provide this service.

11.7 Smallholder goat system profitability

Jones and Keoviriyavong (2015) identified goats as one of the 6 short-listed enterprise options for adoption in 3 Laos provinces (Champasak, Saravan and Savannakhet) through the Laos-Australia Rural Livelihood Program (LARLP). While ranking behind ducks and chickens, goats ranked equal with pigs in their ability to provide welfare and economic benefits to the rural smallholder. It is estimated that for an initial investment of

LKP1,400,000³⁶ goats could return LKP2,000,000 per year. The important criterium was availability of an appropriate, cheap (or free) local feed supply.

In earlier work undertaken as part of the preparation for an ADB Project, Cummins (2005) estimated that goats had the potential to play an important role in improving smallholder welfare in Northern Laos. It was noted that (in 2005) while only 9% of households in the 16 target provinces owned goats, they were becoming more popular. This ADB analysis compared a 'without project' scenario of four female goats mainly free range and with minimal other inputs supplied with a 'with project' scenario where improved forages and a de-worming program. The analysis concluded that that would be an increase in annual household financial net revenue of LKP3.6 million (US\$352) with the adoption of the new technologies.

For those smallholders who previously hadn't owned goats the 'without project' scenario was one hectare of maize. When compared with this alternative the 'with project' goat breeding results in annual net revenue improvements of LKP3.5 million (US\$337). As with other studies while there were some concerns about goat management, resource constraints including access to land did not appear to be a major problem. Alexander et al (2009) identified the importance of improved extension support and market opportunities in improving Laos smallholder livelihoods. This was supported by Epprecht *et al* (2008) who identified the link between rural poverty and market access.

11.8 Goat demand

APHCA (2006) found that in Laos, there is generally a constant demand for goat meat throughout the year and prices, therefore tend to be stable. Livestock can be sold at any time even if animals are in poor condition. While this is generally true for the domestic market it appears that increasing demand from Vietnam at particular times of the year may be encouraging Laos producers to target specific goat types and selling times. The survey identified that the Vietnamese trader bought more goats between December and February (Figure 4) with demand at other times of the year fairly constant. To support this the survey also showed that the Lao middlemen in most provinces sourced greater numbers of goats in these months.

³⁶ The present exchange rate (2017) is approximately US\$1=LKP8,250

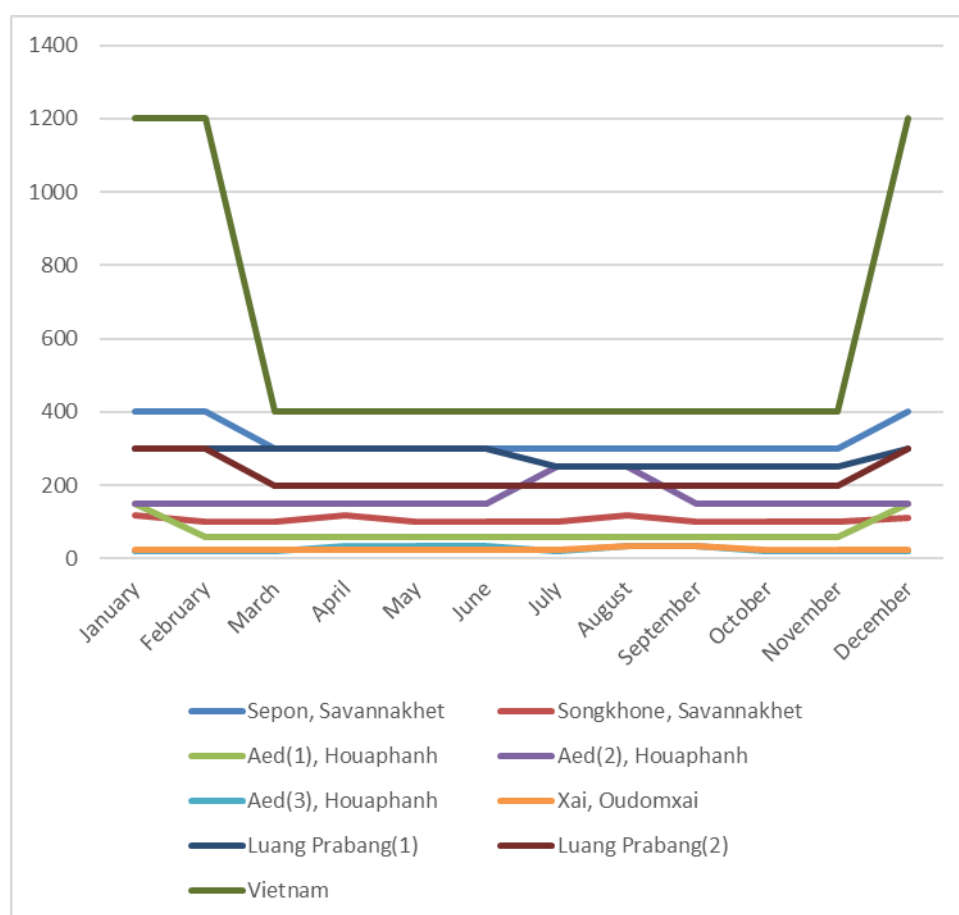


Figure 8: Number of goats traded by 8 Laos middlemen and a Vietnamese trader (Phengsavan survey, 2017)

Domestic market

The Lao (local) market for goat is relatively small as goat meat is still not a popular food for the Lao people. The Lao people only consume goat meat during festival celebrations such as New Year and other traditional events. Some farmers will slaughter goats to serve their community after they have been supported in planting or harvesting rice.

There is wide range of estimates of the numbers small goat restaurants in the large provincial towns in Laos that specialize in BBQ meat, soup and salad., from '2-4' to 'up to 40', numbers that require further investigation. Each of these small restaurants slaughters only 1 or 2 goats per day. These restaurants buy the goat from the local middle man or they purchase direct from the farm. The restaurant profit ranges between LKP300,000 – 500,000 per goat. At one restaurant visited in Vientiane, the Vietnamese owner would only purchase Lao goats as she believed that was what the customer was demanding. She didn't advertise that she supplied Lao goat meat but she was convinced that this was what the consumers preferred.

Vietnam market

The goat industry is driven by the Vietnamese market although this continues to evolve. All the traders and farmers consulted stated that the Vietnamese consumer will pay a premium for 'highland' goats. The belief being that these goats are tastier and more chemical free if raised on natural pasture. The type of goat raised by Laos producers fit into this category.

Various estimates were provided of stock numbers crossing the border. DAFO staff estimated that on average 20-30 cattle (1 or 2 trucks) crossed the border every day, that is approximately 7,000 to 10,000 per year. Most of these were transit cattle from Thailand.

They estimated that between 100-150 goats were exported per week (5,000 to 7,500 per year) but this may be under-estimate of the actual number formally crossing the border. There may also be a significant proportion of goats (60%) moving informally into Vietnam.

More still needs to be done to better quantify and understand the demand for Lao goats in Vietnam and the nature of the Vietnamese market itself. In 2015, it was estimated that there were 15 Vietnamese traders exporting between 200 and 300 goats through the Lao Bao border crossing (Savannakhet Province – Laos, Quang Tri Province, Vietnam) each week (half through the river port and half by road).

In discussions held in April 2017 this has decreased to between 30 and 50 goats per week, potentially only 1,500 to 2,500 per year. This reduction has led to there being only a maximum of 5 middlemen left responding to goat purchase orders from Vietnamese traders. While the demand is still high it is becoming difficult to source appropriate goats. One trader stating that she would like to purchase up to 1,000 goats per week but the Lao middlemen could only supply her with 100. It appears that the ability of the Lao farmer to supply the Vietnamese market is decreasing for 3 main reasons:

- (4) Lao farmers still keep goats in the traditional way and don't produce goats to meet market specifications. They will sell goats only when they need cash to pay for children's education, family sickness or daily expenses.
- (5) Farmers are in herd build up phase
- (6) Vietnamese traders are becoming more specific in the type of goat that they demand. The traders now will only purchase male goats that weigh over 20kg.

It is becoming difficult for Lao traders to find the goats that meet this weight requirement. Laos can only supply about 5-10% of the Vietnamese demand, therefore, Vietnam has started importing goats from Thailand.

11.9 Goat price

Between 2012 and 2016 there appears to be significant variation in price in the different exporting provinces in Laos (Figure 5). While the 2 traders in Savannakhet indicated that goat liveweight price has remained stable, the 3 traders in Houaphanh have provided conflicting estimates. As a general trend the traders estimated that while prices were fairly stable between 2013 and 2015, prices fell in 2016. The Vietnamese trader, who was working through the Lao Bao border crossing in Savannakhet Province, has suggested that prices have grown rapidly between 2012 and 2015 and then stabilised in 2016. Discussions with farmers in Savannakhet Province also provided various pricing scenarios.

Farmer 1: Owned 11 hectares and began 5 years ago with 2 bucks and 18 does. He now has 50 does and 100 goats in total. In 2016 he sold about 70 goats to local NGOs and also sold to Laos middlemen and neighbours. Present prices are about LKP700,000 for a doe and LKP1,000,000 for a 25kg buck. He also owned 45 cattle and 10 sows. Over time the number of sows was declining.

Farmer 2: Grazed his goats on privately owned, unused land. He began 3 years ago with 5 does and now has 14 does and a total of 28 goats. He sells 7 or 8 per year. His main buyers were selling into the Thai market so he quoted sale prices in Thai Baht³⁷. He estimated the value of a 23kg buck was about LKP1,200,000.

Farmer 3: Had 4 hectares allocated to goats (he also had 50 cattle grazing on 35 hectares). Started 4 years ago and now has 20 does and a total of 45 goats. He would like to get to 100 goats but is concerned with the availability of feed and also suffers losses

³⁷ The present exchange rate (2017) is approximately TB\$1=LKP240

due to thieves, being situated on a main road. When he began 4 years ago goats were returning LKP20,000/kg liveweight now they return LKP35,000/kg liveweight. He has no specific traders that he deals with, he will sell when he gets an appropriate offer.

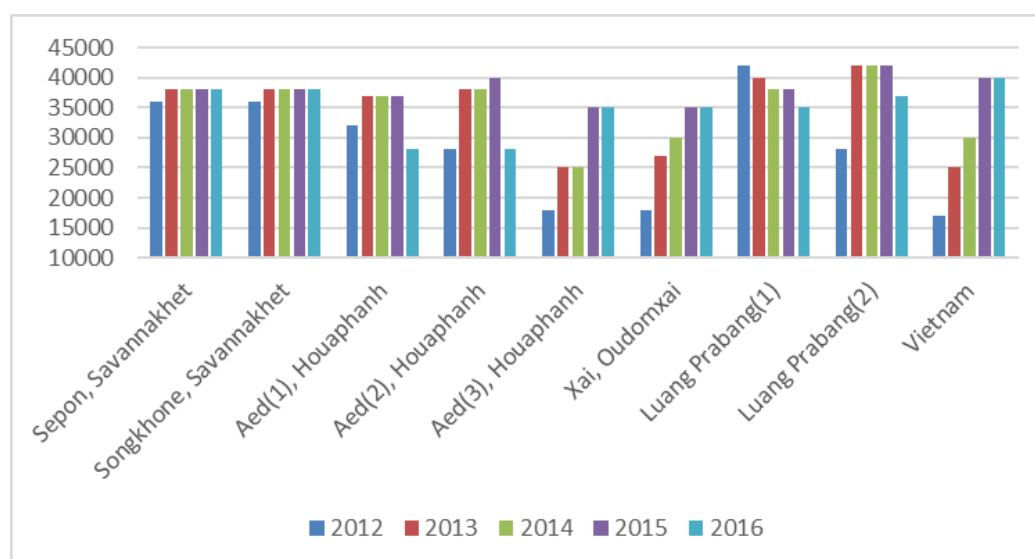


Figure 9: Goat purchase price (KIP/kg liveweight) (Phengsavan survey, 2017)

As mentioned Vietnamese traders are becoming more specific in their demand for Lao goats. The present price for bucks is LKP40,000 to 45,000 per kilogram liveweight and LKP30,000 to 35,000 per kilogram for female goats.

11.10 Transaction costs

The Lao Bao border crossing is a major agricultural export point between Laos and Vietnam. The major livestock types using this crossing are cattle and goats. Pigs are not exported. There are no cattle or goats imported into Laos and only once in the last 3 years has a breeding pig been imported. The exporting process and requirements are similar for cattle and goats. There are no livestock markets on the border, all stock are pre-ordered and arranged and if the paperwork is in order, they pass directly through the border check point. The proper paperwork is;

4. *Health Certificate*. This is obtained within the district of origin. The health certificate is checked by DAFO staff and if not in order the Lao middle man will be required by DAFO to leave the animals in their holding yard and return to the district for the appropriate certificate. There is no formal fee for leaving the stock in these yards, but the owner does have to pay feeding costs. This lack of appropriate paper work occurs approximately once a week. The cost of obtaining a health certificate is LKP10,000
5. *Certificate of origin*. Purchased at the point of origin. This is important as agricultural products in the neighbouring province to a Vietnam border crossing, in this case Savannakhet, do not have to pay import taxes on entering Vietnam. The cost of obtaining a certificate of origin ranges from LKP20,000 to LKP50,000 depending on the province.
6. *Export license*. Licenses to export goats must be purchased from companies accredited by the government to issue them. The annual cost that a Laos trading company (e.g. Ketsana) has to pay the Government to be a licensor depends on the size of the quota purchased. The cost ranges from LKP10million to LKP15million per year. At the Lao Bao border crossing Ketsana will charge the

trader KLP15,000/goat to use the port near the official crossing and KLP10,000/goat if crossing via the road (KLP3,000 is the license fee, the remainder covers Ketsana operating costs). As the trader nears the border they will advise the export licensing company, at this border Ketsana, of their intention to export. They will then meet the fee collector and arrange payment. Before purchasing stock for export and picking up from farms/villages the trader must have a copy of the Ketsana license.

11.11References

- Adams, L.B., Gray, G.D., Murray, G. (2012). *Animal biosecurity in the Mekong: future directions for research and development*. Proceedings of a workshop held in Siem Reap, Cambodia, 10 - 13 August 2010. Australian Centre for International Agricultural Research: Canberra
- Alexander, K., Millar J. and N. Lipscombe (2010), Sustainable development in the uplands of Lao PDR, *Sustainable Development*, 18, 62-70
- APHCA (2006). *Goats-undervalued assets in Asia*, Proceedings of the APHCA-ILRI Regional Workshop on Goat Production Systems and Markets, Luang Prabang, Lao PDR, October 24 - 25 2006.
- Collins R.C., Dent B. and Bonney L.B. 2015. A guide to value-chain analysis and development for Overseas Development Assistance projects. Australian Centre for International Agricultural Research: Canberra, ACT. ACIAR Monograph No. 178
- Cummins (2005), Economic and Financial Analysis of Livestock Enterprise in North Lao PDR report prepared for the Participatory Livestock Development Project, Asian Development Bank, Manila (unpublished)
- Epprecht, M., Minot, N., Dewina, R., Messerli, P. and Heinemann, A. (2008) The Geography of Poverty and Inequality in the Lao PDR. Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, International Food Policy Research Institute (IFPRI): Bern: Geographica Bernensia.
- FAO (2011), A value chain approach to animal diseases risk management - Technical foundations and practical framework for field application. Rome.
- FAOSTAT (2014). Food and Agriculture data. Available at <http://www.fao.org/faostat/en/#home>
- Johns C., Patrick I., Cargill C., Geong M. and J. Ly (2007), Smallholder commercial pig production in NTT – opportunities for better market integration ACIAR/SMAR Research project Final Report SMAR/2007/195
- Jones M. and S. Keoviriyavong (2015), Report on Market Analysis for Micro-Enterprise Options. Social Production and Sustainable Livelihoods, Vientiane, Lao PDR
- Luthi N. (2011), Exploratory survey on the market for beef in Ho Chi Minh City and the market chain for live cattle/buffalo in the Mekong delta. Draft report prepared for ACIAR Project AH/2006/025 Understanding Livestock Movement and the risk of spread of transboundary animal diseases (ULM) Project
- M4P (2008), Making Value Chains Work Better for the Poor: A Toolbook for Practitioners of Value Chain Analysis, Version 3. Making Markets Work Better for the Poor (M4P) Project, UK Department for International Development (DFID). Agricultural Development International: Phnom Penh, Cambodia
- Muniroth S., Patrick I. and G. Smith (2015), Cattle market chain in South-East Cambodia ACIAR Beef4Market Project Report No.3

- Owen J. and S. Owen (2016), Resilient Livelihoods for the Poor Project: Market Study. Social Production and Sustainable Livelihoods, Vientiane, Lao PDR
- Pathoummalangsy, K. (2014) Fattening is an option to improve smallholder goat production in Lao PDR. Swedish University of Agricultural Sciences.
- Phengsavanh, P., Phewankham, B., and Kounnavongsa B., (2004) Study on Goat Production and Market Potential for Smallholder Farming Systems in Savannakhet Province, Lao PDR. NAFRI report for the Livestock and Livelihoods for Smallholders Project, unpublished.
- W. Stur and P. Phengsavanh (2014), Lessons Learnt from the LDP and Assessment of Livestock Value Chains in Northern Lao PDR. Vientiane: International Fund for Agricultural Development.
- Zola, T (2005) Market Analysis for Livestock and Livestock Production. report prepared for the Participatory Livestock Development Project, Asian development Bank, Manila (unpublished)

12 Appendix 4: Report for partners and selected stakeholders

12.1 Overview of the ongoing study

This summary report is from the later stages (Output 4) of a study funded by ACIAR and implemented by NAFRI in Laos and UNE in Australia to assess goat production and marketing systems in Laos and Vietnam. Initially focussed on northern Laos and North West Vietnam it was agreed early in the study to widen the scope to describe all important production areas and export market chains. Constraints and opportunities have been documented for three major market chains with a focus on the trade between the central Lao provinces of Khammouane and Savannakhet and Central Vietnam. Field studies in Vietnam were conducted with the University of Hue.

The potential for goats as a small livestock species to improve livelihoods is well documented but the only two tropical countries that have seen such a dramatic increase in goat numbers in the last decade have been Myanmar and Laos. Although with a wide margin of error, goat numbers in 2017 are estimated at 550,000, from an estimated 190,000 in 2005, a threefold increase. Almost all of this increase has been in small enterprises in rural communities. On average, goat keepers in the surveys and field visits conducted in the current study have kept goats for 2-5 years. Opportunities to capture the reported 'unlimited' demand for Lao goats in Vietnam, the low cost of acquiring goats (compared to cattle) and their ability to feed on 'free' local shrubs and trees are very attractive. On the other hand, there are risks from mis-judging the nature and size of demand in Vietnam; of disease outbreaks and conflicts among neighbours as goat density increases; and of unfavourable impacts on agricultural and conservation lands.

Against this background, the study has built a team with expertise in evaluation of livestock systems and livestock market chains to better understand these goat systems, their interactions with the social and physical environment, and to scope the need for research to increase productivity and manage current and future risks. The team, which is still developing its range of expertise, undertook a process of workshops, desktop reviews, field studies and interviews which have been documented in detail and are summarised here.

12.2 Methodology and Planning Workshop³⁸

ACIAR is currently supporting 4 projects or studies with a major component in goat systems: in Laos, the Pacific, Myanmar and Pakistan. This initial workshop brought participants in all these studies together to share information and agree on appropriate methodologies.

The 2-day workshop was held at UNE on 8-9 November, 2016. It was followed by a one day planning session for two new small research activities in Laos (the current study) and the Pacific. The workshop:

- shared information among past, ongoing and planned research projects in Asia and the Pacific, funded by ACIAR and others. This was achieved through formal presentations and informal discussions.

³⁸ Documented as Output 1 of the study.

- reviewed methodologies for the identification of, and engagement with, goat market chains. A number of training guides were identified and discussed following presentations by two experienced practitioners.
- discussed simple frameworks for the documentation and comparison of goat production and marketing systems, including constraints and opportunities. This will be an ongoing task facilitated by simple mechanisms for sharing protocols, reports and flagging future joint activities.

12.3 Desktop Study³⁹

The purpose of this review of published information was to support the understanding of goat systems in Laos and the likely capacity for further research on goats to be undertaken to improve goat production in Laos and the marketing of goats in Laos and Vietnam. The review was exhaustive, as far as possible, in identifying previous research that has been published and documented, the main findings of the research and the institutions and individuals involved. The main findings and areas of research were summarised to guide the more detailed evaluation of the research and capacity to be undertaken. The review also pointed to research outside mainland SEA which may shed light on the constraints and opportunities that exist in Laos.

12.4 Field Studies and Interviews⁴⁰

The NAFRI team identified three distinct and active market chains for goats on the basis of field observations and discussions undertaken in December 2016, January 2017 and during a joint April field trip with UNE. Fewer goats are consumed in Laos but there is also growing domestic demand. There are three main and separate export market chains:

- The Southern Corridor: goats are sourced in Khammouane and Savannakhet and are transported east on Route 9 to Vietnam across the border at Lao Bao.
- The Northern Corridor: goats are sourced in Luang Prabang and Oudamxai and transported south east through Xieng Khouang on Route 7 to Vietnam.
- The North East Corridor: goats sourced in Huaphanh are transported north east by Route 6 to Vietnam

The location of the end-market for goats in Vietnam is based on discussions with Vietnamese traders in Laos. The required detailed interviews in Vietnam were completed for presentation just before the Review Workshop (see below). These three market chains of high potential and the following initial conclusions were presented at the Review Workshop for further discussion.

Export of live ruminants is a high priority for MAF, and NAFRI has given high priority to goat production for the improvement of the smallholder sector. Depending on location, up to 90% of goats produced in Laos are estimated to be exported to Vietnam where demand remains high and Lao goats command a premium. An important **research** question is to better understand the nature and extent of the high demand in Vietnam and Laos in terms of animal size and conformation: taste and texture of meat, other attributes of provenance and perceptions of 'green' and 'clean'. This will require investigation and cooperation in Vietnam.

Mortality of young goats is the most reported but poorly understood constraint on herd productivity and to realising the full potential of the high demand and prices for goats. The capacity for **research** to determine the causes and the testing of practical solutions to

³⁹ Documented at Output 2 of the study. Available on request

⁴⁰ Documented as Output 3 of the Study. Available on request

reduce mortality has been identified and is available in Laos at the institutions visited and through their collaboration with ACIAR-funded and related projects.

A contributor to mortality, possible inbreeding and lack of genetic improvement is absence of controlled breeding and indiscriminate use of young bucks from within small village herds. There is scope for the initiation and testing, with associated **research**, of a pilot scheme to introduce the use of proven, superior bucks to smallholder systems.

The feed resource available to goats varies with region but goats thrive when allowed to graze and browse widely in previously forested land. Better understanding of the size, carrying capacity and sustainability of this resource is an important **research** question as is the development and evaluation of formal agroforestry systems incorporating goats. Some capacity to investigate the former exists in Laos and preliminary work has been undertaken. For the latter, the presence of companies such as Burapha and Stora Enso which are currently developing sustainable agroforestry models with goats offers an opportunity for research. There is scope for **Australian-interest research** in the area of tools for evaluating animal movement and behaviour and feed resource size and status in forests and scrublands. Current high technology methods are focused on cleared pasture and crop lands.

There is a small number of national, provincial and district staff and farmers with good skills in goat production, goat health and research. There is a lack of appropriate extension material and techniques for goats. Lessons can be drawn from the cattle and pig sectors. Extension approaches developed in Laos by DAEC and others can be used. Adaptation and development of goat-specific material will require some **research** and capacity building. Extension material from previous projects in South East Asia in a web-based format have been supplied to AGFORS and NAFRI to support their current efforts

Potential **partners for research** on goat production and markets were identified: individual households within traditional communities; communities being supported by NGO and government programs; medium sized farmers with larger numbers of animals and a commercial focus; and some larger companies, including Burapha and Stora Enso, which are starting to integrate goat production into eucalypt plantations. There is scope for collaboration with AGFORS to undertake research on goat production and community engagement in goat-based agroforestry.

Provincial and district **technical capacity** for the support of goat enterprises is strong in Savannakhet, Luang Prabang and Huapanh. NUOL, NAFRI and DLF have researchers with capacity to investigate, interpret and publish results and there is emerging capacity at the University of Savannakhet.

Impact pathways for further investment in research include a) integration with the Northern Smallholder Livestock Commercialization Project (NSLCP) in Huapanh (North East Corridor), b) demonstration of improved herd productivity and associated dissemination of results by district and provincial staff c) assisting HPA and other NGOs to upgrade existing and develop new programs involving goats through a Learning Alliance d) attracting new investors in medium scale goat production e) assisting existing agroforestry businesses to integrate goats into their production systems.

12.5 Review Workshop⁴¹

The initial phase of data collection is complete and the purpose of this workshop was to review data, discuss its importance, the need for further data collection, and agree on research priorities and approach. The workshop was attended by the participants in the study, senior members of the participant organizations, and stakeholders with a direct interest in goat production as a commercial opportunity and as a means to promote

⁴¹ A full report of this workshop was submitted to ACIAR. Available on request.

livelihoods of the rural poor. The workshop was held in the offices of PAFO, Luang Prabang on Monday 19 and Tuesday 20 June 2017, followed by a field trip and project meeting on Wednesday 21 June

The workshop presented and discussed:

- Lessons learned from previous goat research and development projects
- National survey of goat production systems
- National goat market chains and their links to Vietnam
- Gender roles and potential impacts in goat-based enterprises
- Links to ongoing livestock R4D projects in Laos and Vietnam
- Existing and new collaboration with NGOs and the private sector
- Collaboration with the Northern Livestock Commercialization Project
- Priorities for MAF, Australian Aid and ACIAR

Workshop presentations were followed by formal and informal discussion, working groups and a final synthesis by the core participants in the study from NAFRI and UNE.

The conclusions and recommendations being developed by this study are in line with Lao and Australian government priorities and expectations. It is recognised that there is substantial expertise in Laos in Australia in livestock R4D and that lessons and findings can be drawn from a very wide range of R4D projects to inform new research on goat production and marketing. The partnership between NAFRI and UNE is appropriate especially with the broadening of the mandate of NAFRI to include rural development (with a change of title to NAFRI) and the depth of experience at UNE in livestock projects (many funded by ACIAR) in South East Asia.

A wide range of expertise will be required, making coordination of institutions, disciplines and experts a high priority for which NAFRI is well equipped and willing to undertake. Areas that will need to be strengthened as the project themes are developed include agroforestry, market chain and gender analysis. Individuals are being identified and will be invited to discuss future participation.

There is some urgency to initiate new research in light of the rapidly increasing numbers of goats and small enterprises entering the market. On current trends the total goat population will double in the next 5 years. While recognising that major funding is not likely to be available until mid-2019, significant planning, training and simple analysis of production systems and market chains can be undertaken in the meantime to ensure that project activities start as soon as project agreements are finalised. Modest additional external funding and in-kind contributions are required to maintain the momentum already created and enhanced by this workshop.

Significant new information was presented at the workshop from a recently-completed short study of the market chain from the Lao-Vietnamese border at Lao Bao in Savannakhet province to consumption in Central Vietnam. There is new evidence of the strong preference of consumers in Vietnamese specialty restaurants for Lao Native goats, for certain dishes where the flavour and texture is distinctive. Prices are high and at the current rate of supply via this route (through Lao Bao) demand can only be met for two provinces in Central Vietnam and Hue City.

Collaborating government institutions present at the workshop included DLF and PAFOs of Luang Prabang, Huapanh and Savannakhet. DLF has an overall responsibility for disease control and there are parallel and highly relevant studies being undertaken on FMD vaccination and the prevalence of zoonotic disease such as brucellosis. DLF is also the implementing agency for the ADB Commercialisation project which will have an increasing focus on goat systems and will work through the PAFO and DAFO in the project area. There are ample opportunities for collaboration in these aspects and, once again, the role of the coordination agency (NAFRI) is vital.

The private sector was represented by three participants from AGFORS with their interest in integrating an enterprise model for smallholder goat production into plantation forestry. AGFORS works closely with three large forestry companies. This private sector network could be of increasing importance to future research if preliminary studies look promising.

It was regretted that Australian funding for the NGO program, of which the Health Poverty Action project in Savannakhet is a part, has been prematurely withdrawn. All workshop participants were deeply impressed by the turnaround in fortunes of the goat program in Sepon and their commitment to the communities of poor farmers where they work. Opportunities to support these villages and use their data to deliver some research outputs will be further investigated.

12.6 Proposed Next Steps 2017 - 2019

Discussions are ongoing within the research team, their supporting institutions and ACIAR to design and implement a research project which address the substantial constraints and minimises the risks associated with the rapid expansion of goat production in Laos. Final steps in the completion of this SRA are:

1. Engage with the collection and analysis of data on goat production systems in the ADB project, AGFORS and HPA to commence detailed benchmarking of these production systems and help develop systematic recording and management of data to facilitate analysis and interpretation at a systems level.
2. Further develop the research partnership through discussion with counterparts in agroforestry, market chain and gender analysis in Laos and Vietnam
3. Present project findings at the ACIAR sponsored "Mountain Research Symposium" on 23-24 November, 2017.
4. Submit a concept note proposal to ACIAR for major project funding from 2019.

Proposed Next Steps 2018 /2019 (% of resources)⁴²

On the basis of what is known now, the scope of interim activities is envisaged as:

- A. Analyse data and assist interpretation of data from AGFORS, HPA and ADB (10%)
- B. Monitor and analyse one domestic and two export market chains (20%)
- C. Assess tools for measuring environmental impacts of goat enterprises (20%). Potential Australian component on methods development.
- D. Conduct training in systems approaches and analysis for livestock production and marketing (40%)
- E. Formulate a full work plan and budget for a 4-year research project to be submitted to ACIAR, and outline for a 10-year research program to guide GOL and other potential investors in the sector (10%)

For further Information on this ongoing study please contact:

Dr Werner Stür, Research Program Manager, ACIAR (Werner.Stur@aciarc.gov.au)

Dr Seuth Phengsavanh, Deputy Director, Livestock Research Centre, NAFRI
(s.phengsavanh@gmail.com)

Professor Steve Walkden-Brown, School of Environmental and Rural Science, UNE
(swalkden@une.edu.au)

⁴² In anticipation of additional funding.

13 Appendix 5: Key Questions for Field Surveys

13.1.1 Farmer Interviews

The overall objective of these interviews is to help with the 'industry map' of goat production, movement and consumption. The initial map will be completed during and after the field work in Luang Prabang between January 16 and 28, 2017.

The interviews are a combination of seeking :

- a) Information and about the production system in the community
- b) information about the price, volume and quality of goats bought and sold.
- c) Opinions on the prospects and problems of goat enterprises.

The record of interview should include the name and location of the person / household being interviewed, with answers to as many questions possible.

The data will be summarized and analyzed by a workshop of the researchers involved in the project.

Production System

What is the goat production system

- How many goat farmers are the village?
- How many goats you have? Other farmers?
- What's the main purpose of keeping goats
- How do you feed your goats
- How do you shelter your goats?
- Are there any health problems and what actions do you take?
- Who in the household is primarily responsible for the management and marketing of goats?
- Do you eat your own animals, what proportion?
- Are there particular costs (eg fencing) required to manage goats
- What's the main difficulty in keeping goats

Selling and buying

1. How farmers buy goats (if they do).

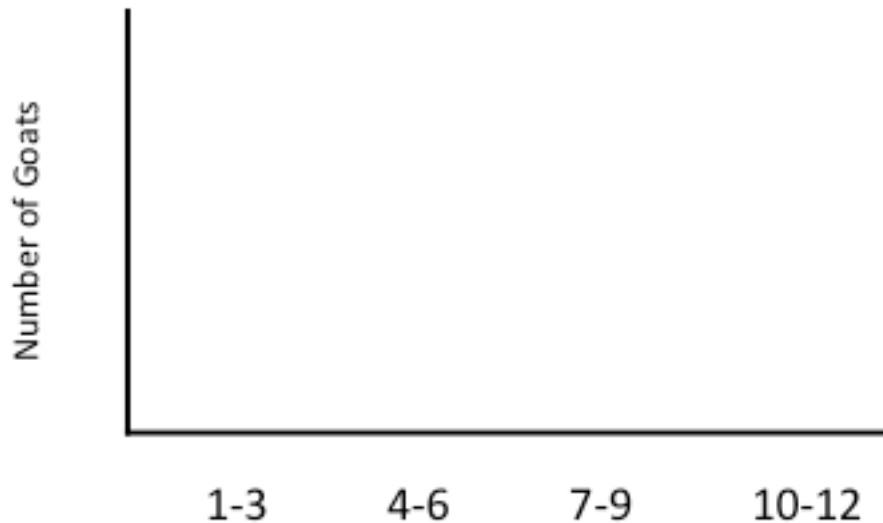
- What type of goats do you buy?
- Where do you buy? Do you have a specific site? If yes, why?
- How many goats do you buy from each site?

2. How farmers sell goats

- What type of goat do they sell?
- Where and to whom do they sell?
- How many goats do they sell to each buyer or market?
- Where is the main market for the farmers? Why?
- Asking about the destination (How far from each market) of each buyer or market
- How do you negotiate a price with the trader

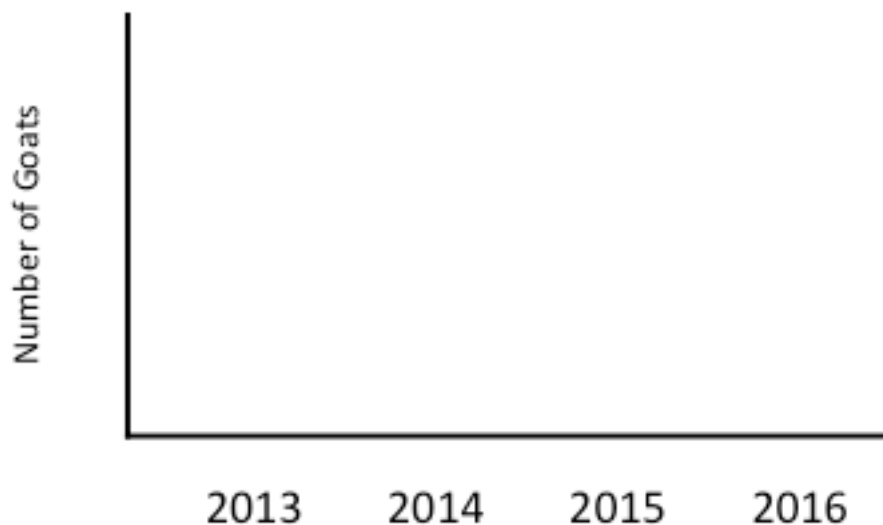
3. Buy and sell calendar

- During which months do you buy and sell goats?

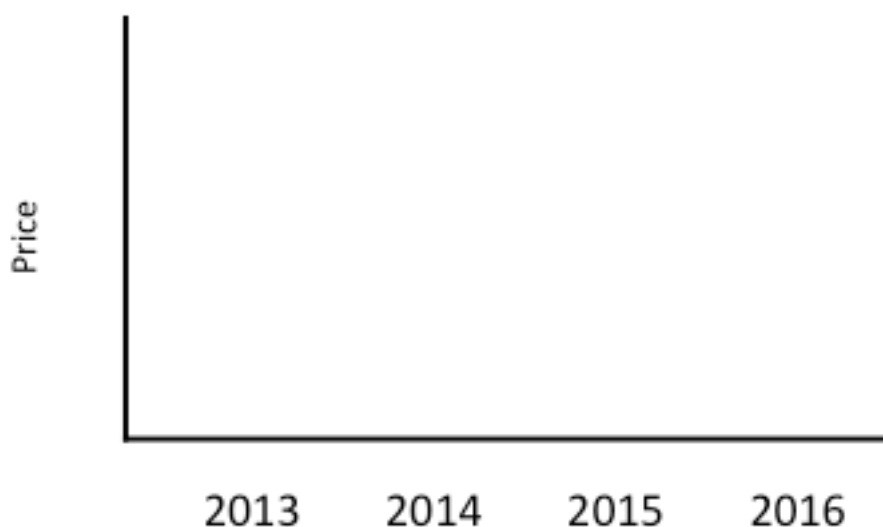


4. Demand and supply trend

- How many animals did you buy / sell in 2016?
- How about the 2015, 14 and 13?
- Was the number of animals the same as other farmers in the area?
- Do you have enough animals for supply? If not, why?



- How do farmers in the market chain link (relationship) with other actors?
- Do they know the volume of buying / selling of other farmers?
- What are the criteria (quality) of buyers / markets?
- Where do they get suitable goats for the markets?
- How do farmers decide about the price if each type of goat?
- How has the price changed in the last few years?



- Price calendar

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
High												
Low												

- What are the factors affecting the price?
- How do farmers pay (by cash, exchange thin for fat etc)
- How long do farmers keep goat between buy and sell? How do farmers keep them?
- How much do farmers pay for one animal?
- How much do farmers sell that animal?
- Do farmers pay for other things? If yes, what and how?

C. Opinions

- Do you want to have more goats in the future. Why?
- Are there any policy, regulation or services for buy and sell animals? If yes, what do you think about those policy or regulation?
- What are the problems in goat marketing and how do you think about the solution?
- What the potential of goat market in the future?

13.1.2 TRADER INTERVIEWS

The procedure is very similar to the once that we use with farmers. To interview traders is help us to understand more about the market and clarify the information that we get from farmers especially about the price, volume and quality.

TRADING BUSINESS

1. Do you have/breed goats yourself?
2. Do you buy and sell kids, goats?
3. How long have you been trading?
4. Is it an important source of income for your household?
5. Are there particular times that you like to buy and sell?
6. What happening with price over the years?
7. Who do you sell goats to?
8. Do you know who the consumers of your goats are, local, Vietnam?
9. Who, where is your competition?
10. Do you work alone or for a bigger company or group of traders?
11. Do you employ other people?
12. Is the number of goats that you buy and sell increasing (12 months) or decreasing
13. How do you make contact with farmers?
14. How do you negotiate price with farmers?
15. What is price based on? Weight? Size? Season?
16. Do you work with collectors/brokers or deal directly with the farmers?
17. How do you organise payment for your customers?
18. Do you slaughter goats?
19. Do you collect goats into a group before selling, do you have collection areas?
20. Do you own a truck / vehicle? If so how many goats can it carry
21. Do you use contract transport?
22. Do you have contracts with farmers and/or slaughterers/retailers
23. Are there any government regulations around your trading operation

1. How traders buy goats

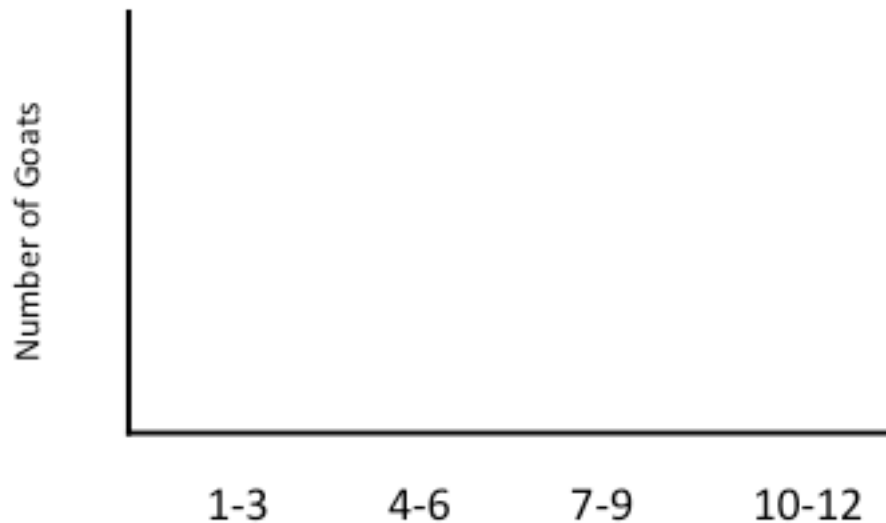
- What type of goat do they buy?
- Where do they buy? Do they have a specific site? If yes, why?
- How many goat do they buy from each sites?

How traders sell goats

- What type of goat do they sell?
- Where and to whom do they sell?
- How many goat do they sell to each buyer or market?
- Where is the main market for the traders? Why?
- Asking about the destination (How far from each market) of each buyer or market

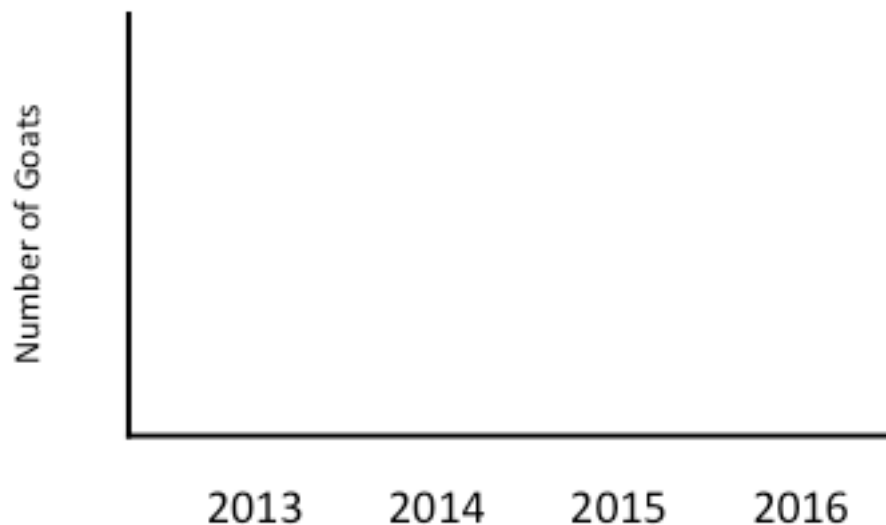
Buy and sell calendar

- Does number of animals that traders buy and sell similar throughout the year?
- If different, how?



13.1.3 Demand and supply trend

- How many animals do traders buy in 2008?
- How about the 2007, 06 and 05?
- Was the number of animals the same as other traders in the area?
- Have traders got enough animals for supply? If not, why?



How many traders in the areas? How many small and big traders?

How do traders in the market chain link (relationship) with other actors?

Do they know the volume of buying / selling of other traders?

What are the criteria (quality) of buyers / markets?

Where do they get suitable goat for the markets?

Price

- How do traders decide about the price if each type of goat? (Draught, breeding or meat)
- Trend of Price

- Price calendar



	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
High												
Low												

- What are the factors affecting the price?
- How do traders pay (by cash, exchange thin to the fat etc)

How long do traders keep goat between buy and sell? How do traders keep them?

Benefit margin

- How much do traders pay for one animal?
- How much do traders sell that animal?
- Do traders pay for other things? If yes, what and how?

Opinions

- Do you want to buy and sell more goats in the future. Why?
- Are there any policy, regulation or services for buy and sell animals? If yes, what do you think about those policy or regulation?
- What are the problems in goat marketing and how do you think about the solution?
- What the potential of goat market in the future?

13.1.4 EXPERT Interview

To interview experts is help us to understand more about the market and clarify the information that we get from farmers especially about the price, volume and quality.

The expert interview will also range more widely to ask

- What are the main constraints to goat production and market development in Laos.
- Where do you think the main opportunities lie?
- Are there any examples of success and failure that can inform ne research and
- What research is needed, if any to stimulate goat-based enterprises? ?

For more detail refer to the trader and farmer interview questions, as required.

14 Appendix 6 Training Workshop in Armidale

Monday, 19 February 2018	WELCOME, COURSE OUTLINE AND CASE STUDIES
Overview about Course objectives	Overview of objectives and structure of the course
Update on ACIAR LPS-2016-021 and follow up project	Share SRA project findings, update on current stage of full project. Link project to course objectives (why training on participatory methods, why work with marginal farmers?)
Update on LPS/2016/027	Share SRA project findings, update on current stage of full project. Link project to course objectives (why training on participatory methods, why work with marginal farmers?)
Participant case studies	Each participants presents Case study. 15 Minutes for each presentation. Time for discussion in the plenum
Tuesday, 20 February 2018	ACTION PLAN AND COMMUNICATION FOR EXTENSION
Action Plan: introduction	Participants are introduced to the Action Plan Methodology. They receive guidelines for the development of their own Action Plans.
Communication and extension	To increase capacity of participants to be extension agents: Content will include communication theory, communication styles, principles of persuasion, facilitation tools and techniques.
Wednesday, 21 February 2018	PARTICIPATORY METHODS IN EXTENSION
Participatory extension: introduction, tools and methods	
Thursday, 22 February 2018	FEEDING SMALL RUMINANTS AND PARTICIPATORY FEED TRIALS
Feeding small ruminants	Enhance the understanding of the course participants on small ruminant feeding requirements, differences between sheep and goats and differences of feeding in the production cycle

Forage and feed resources	Increase the participants' knowledge on forage species and feed resources suitable for small ruminants in Fiji and Samoa. Creating awareness how the participants, in their role as extension officers can educate farmers.
Feeding management and strategies for the Fijian and Samoan context	This session will introduce the tool of on-farm trials. What are the cornerstones needed to test technologies together with farmers in the farm context? How can extension staff initiate, support and implement such trials with farmers in Fiji and Samoa.
On-farm trials	This session will introduce the tool of on-farm trials. What are the cornerstones needed to test technologies together with farmers in the farm context? How can extension staff initiate, support and implement such trials with farmers in Fiji and Samoa.
Friday, 23 February	Production system analysis and Action Plan update
Production System Analysis: theory	Participants will learn how to address production system challenges small ruminant producers face through a systemic analysis of on-farm production systems and how to advise farmers on possible solutions.
Production System Analysis: scenario analysis	Participants will work with example scenarios to apply their newly acquired knowledge on a systemic analysis of on-farm production systems.
Action plan updates and workshop.	Each participant gives a brief update on his/her Action Plan. How has the plan changed during this week? What support is needed?
Saturday, 24 February 2018	Cultural Program
Full day excursion: goat meat producer	Booma Boer Goat Stud (tbc)
Sunday, 25 February 2018	REST AND RECREATION
Monday, 26 February 2018	SMALL RUMINANT HEALTH AND WORM MANAGEMENT

Small Ruminant Health: sheep and goat diseases advice for extension	Participants enhance their knowledge on small ruminant health, basic diagnostics and how to advise farmers to improve animal health at farm level
Practical session: BCS and Faecal sample collection	Participants learn how to determine body condition scores and how to advice farmers based on these results
Tuesday, 27 February 2018	WORKING WITH GENDER APPROACHES AND MARGINALISED GROUPS; ON-FARM ECONOMICS
Gender, marginalised groups and extension	The session discusses the differences between sex and gender. The influence of gender roles will be illustrated and the connex to agricultural and livestock systems established. Gender sensitive extension approaches and tools will be introduced. Participants will also learn how to engage and include farmers from marginalised groups in extension activities.
On-farm economics: decision tools and extension support	This session explores basic principles of on-farm economics and financial planning. Participants will be introduced to tools they can use in their everyday work to support farmer decision making and planning. An overview of the theory, basic budgeting tools and practical examples in interactive group exercises will be included. Participants will contribute with their experience in knowledge to be able to apply the discussed principles in their local contexts.
Wednesday, 28 February 2018	MANAGING CHANGE and farm visit
Managing change: Innovation Platforms	To improve resource allocation and uptake of technology, participants are introduced to the concept of innovation platforms. This will session will provide content on engagement methods with industry to improve planning, research and technical transfer

Farm visit (location tbc)	Participants are required to ask questions relating to: - which role does extension play in your enterprise? - provide examples for good AND bad extension you have experienced? - inquire about breeding, husbandry, feeding, marketing details
Thursday, 1 March 2018	ACTION PLAN WORKSHOP DAY
Action Plan updates and finalisation	Each participant gives a brief update on his/her Action Plan. How has the plan changed during this week? What support is needed for finalisation?
Friday, 2 March 2018	ACTION PLAN RESENTATIONS, WRAP-UP, DEPARTURE FROM ARMIDALE
Synthesis of Learning Outcomes	Participants present final Action Plans, feedback from key trainers and the group
Certificate Award lunch	Course completion certificates are awarded during an organised Buffet lunch.
Departure for Sydney (to catch QF2023)	Travel to Sydney
Saturday, 3 March 2018	REST AND RECREATION
Free day in Sydney to explore the sights, shopping	UNE staff available to offer optional joint morning exploration of sights in central Sydney (e.g. Darling Harbour, Circular Quay, Opera House, Botanical Gardens). Lunch, afternoon free. Possibility for joint dinner if desired
Sunday, 4 March 2018	Departure for Fiji/Samoa/Laos

Action Plans – engage with small ruminant farmers that extension is currently not working with. Use participatory extension methods to work on an issue together with farmers. Should be implemented within 6 months

15 Appendix 7 Initial Stage 1 and Stage 2 Proposals

15.1 Stage 1 Proposal as submitted January 2018

Background and justification

Goat numbers in Laos and Vietnam are increasing rapidly driven mainly by demand from Vietnam. Current smallholder production systems that are free-ranging on communal, often sloping land, are not sustainable. This project will benchmark existing production and markets within a value chain framework. Risks and opportunities will be identified and supported by research to: improve market access; increase adoption of best practice management packages for different production systems; institute benchmarking methodology to assess performance; determine the impacts of inbreeding and parasite infection on productivity; and assist in the development of village agroforestry and more intensified production systems. The project will support processes, structures and systems that enhance opportunities for women along the value chain.

Aim and objectives

The aim of the project is to develop improved sustainable production and marketing systems for goats in Laos and Vietnam to support future expansion and commercialisation of the goat industry in these countries with enhanced opportunities for women.

The objectives are to:

1. Quantify and improve the potential of traditional and emerging production systems in the major market chains in Laos
2. Evaluate the consumption and goat products in the domestic and export markets of Laos and Vietnam.
3. Build capacity for research and development of goat production and marketing through formal and informal training and a National Learning Alliance in Laos.

Significant activities and outputs

To meet these objectives:

- a. Practical methodologies will be developed and used for comparative benchmarking of biological and socio-economic, including gendered, aspects of goats in representative production systems.
- b. The extent of inbreeding depression in village systems and potential for genetic improvement will be assessed as will the contribution of gastrointestinal parasites and anthelmintic resistance to lost productivity and mortality.
- c. Improvements in management informed by the above activities that constitute “best practice” will be implemented and evaluated.
- d. Detailed analysis of the domestic Vientiane and export Savanakheth province-Vietnam market chains will be undertaken to characterise the value chains, and identify constraints, risks and opportunities. Based on this
 - Appropriate (simpler) methodologies for monitoring the major market corridors will be developed
 - These will be applied to the two other main export corridors from Laos to Vietnam (North and North East)

- e. A National Learning Alliance in Laos will be developed involving stakeholders in existing and potential goat projects or investments.
- f. Short term training courses in Laos, Vietnam and Australia will be conducted to build capacity in selected areas of goat production and research methodologies.
- g. Research support will be provided to postgraduate students in Laos/Vietnam undertaking studies in project relevant areas at partner universities or UNE.
- h. Researchable issues will be screened and resources for testing them sought

End of project outcomes

Under Objectives 1 and 3 the project will produce a cadre of systems-based researchers and development partners with far reaching implications for goat and other livestock production systems. More specific outcomes will include:

- a. Improved understanding and uptake of “best practice” and pathways to newer production systems defined.
- b. Adoption of benchmarking against targets as a tool for use by both farmers and advisors.
- c. Improved productivity and profitability of stakeholder production systems
- d. Clarification of the roles of inbreeding and gastrointestinal nematode infection in limiting productivity in village production systems
- e. Understanding of one Laos domestic and three export goat market chains and the attendant constraints, risks and opportunities.
- f. Knowledge and understanding of the factors influencing consumer preferences for goats in Vietnam
- g. Clear messages about market needs and specifications arising from e) and f)
- h. Increased exploitation of market information by project stakeholders to increase profitability, manage risk and for future planning arising from e), f) and g).
- i. A National Learning Alliance in place in Laos continuing to improve knowledge and skills on goat production and marketing and their application
- j. Improved attitudes to gender equity and aspirations by project participants
- k. Increased research and advisory capacity through short term training and postgraduate student support.
- l. Well-developed ideas for ongoing research to meet needs within a 10-year planning cycle

Key partnerships

The key partners in the project are UNE (University of New England) as the implementing agency in Australia, NAFRI (National Agriculture, Forestry and Research Institute) as the lead agency in Laos, and HUAF (Hue University of Agriculture and Forestry) and NIAS (National Institute of Animal Sciences) as the joint agencies in Vietnam.

Project impact pathways and benefits

The impacts arising from the project will be improved socioeconomic conditions for goat farmers, improved production systems with higher offtake and reduced economic and environmental risk coupled with improved prices due to improved market understanding and meeting specifications. The government of Laos (GOL) and its agencies will benefit from improved capacity in research and advisory services and policy in the area of goats improved by detailed understanding of the markets and production systems and by participation in the learning alliance. Consumers in Vietnam will benefit from increasing access to high Lao goats and amongst all the stakeholders there will be an increased

awareness of the importance of gendered social relations and the need for equity along the value chain.

15.2 Stage 2 revised proposal submitted December 2018

Background and justification. Goat numbers in Lao PDR have increased dramatically in recent years although population estimates vary greatly. According to FAOSTAT⁴³ numbers increased more than fivefold between 2000 and 2016 from 30,700 to 157,000. The last Laos Agricultural Census in 2010/11 estimated goat numbers to be 215,600 (MAF, 2014)⁴⁴ while current estimates of the current goat population range up to 550,000⁴⁵. SRA LPS/2016/027 established that this growth is driven primarily by increased demand from Vietnam. Demand in Vietnam is likely a function of both human population growth of 19% in 2000-2016 and more significantly a 228% increase in GDP per capita over the same period⁴⁶.

Research under SRA LPS/2016/027 found that up to 90% of goats produced in some surveyed regions of Lao PDR are exported to Vietnam and on average these goats command a price premium of 30% over Vietnamese crossbred goats⁴⁷. It confirmed the high demand for goats from Vietnam and identified key market and value chains for which there is a lack of detailed information. The project identified a low level of production inputs to the mainly smallholder/village-based farmers who supply the market. High mortality ranging from 10% to 80% was a major constraint and controlling disease was identified by farmers as their most important need. Inbreeding depression was also identified as a major constraint on productivity by Lao counterparts. Estimates of productivity varied widely and a need for systematic performance benchmarking was identified⁴. There is a need to understand the role of goats in smallholder farming systems, including any household risks in changing or expanding goat production, and farmer motivations to do so.

The Government of Lao (GOL) is very aware of the rapid growth in goat population and exports, and its potential to improve livelihoods of the village smallholders who produce the vast bulk of goats in Lao PDR. There is strong GOL support for this proposal as there has been no major research focussed on goat production and marketing in Lao PDR.

Aim and objectives. The overall aim of the project is to enhance income-generating opportunities for goat raising households in Lao PDR through the development of productive, environmentally sustainable, socially acceptable and gender sensitive production systems accessing high-demand markets in Vietnam.

To contribute to this aim, the project has four objectives, to:

5. Directly measure key indicators of goat production systems in Lao PDR to develop benchmarks against which improvements can be assessed.
6. Assessment of major constraints and identification and evaluation of potential solutions
7. Reduce market risk and increase marketing opportunities through improved understanding of the factors affecting demand and pricing of goats in Lao PDR and Vietnam, and of the associated value chains

⁴³ FAOSTAT accessed March 2018.

⁴⁴ MAF 2014. *Lao PDR Census of Agriculture 2010/11*. Ministry of Agriculture and Forestry, Govt of Lao PDR.

⁴⁵ MAF 2017. *Pers. Comm.*, Dr Syseng Khounsly, Deputy DG, Department of Livestock and Fisheries.

⁴⁶ World Bank Databank accessed March 2018.

⁴⁷ *Interim Final Report of SRA LPS/2016/027*, ACIAR

8. Build capacity for research and development of goat production in Lao PDR and initiate scaling out of project findings

Significant activities and outputs.

Objective 1. Comparative benchmarking of biological, socio-economic and gender aspects of goat production systems will be introduced as a tool for improvement.

Objective 2. The extent of inbreeding depression in village systems will be assessed as will the contribution of selected animal health problems to lost productivity and mortality. Improvements in management informed by all the above activities will be evaluated.

Objective 3. Analysis of the domestic Vientiane and three main export market chains to Vietnam will be undertaken to characterise demand/supply and the value chains, and identify constraints, risks and opportunities.

Objective 4. Short term training courses in Laos, Vietnam and Australia will be conducted to build capacity in selected areas of goat production, research methodologies and gender sensitive approaches. Research support will be provided to postgraduate students in Laos/Vietnam undertaking studies in project relevant areas at partner universities or UNE. Scaling out of project findings will be initiated.

End of project outcomes.

- m. Increased use of measurement, recording and assessment against benchmarks as a tool for farmers and advisors.
- n. Improved understanding and uptake of recommended management practices and their social and environmental impacts for smallholder and agroforestry goat production systems.
- o. Improved productivity and profitability of goat production systems.
- p. Clarification of the impact of inbreeding, gastrointestinal nematode infection and other animal health syndromes in limiting productivity in village production systems.
- q. Understanding of Lao domestic and export goat market chains and the attendant constraints, risks and opportunities.
- r. Knowledge and understanding of the factors influencing consumer preferences for goats in Vietnam, particularly those that underpin the premium for Lao goat.
- s. Clear messages about market needs and specifications arising from e) and f)
- t. Increased exploitation of market information by project stakeholders to increase profitability, manage risk and for future planning arising from e), f) and g).
- u. A National Learning Alliance in place in Lao PDR continuing to improve knowledge and skills on goat production and marketing and their application
- v. Improved knowledge and application of gender sensitive approaches by project participants
- w. Increased research and advisory capacity through short term training and postgraduate student support.

Key partnerships. The key partners in the project are the University of New England (UNE) as the implementing agency in Australia, supported by Charles Sturt University (CSU) and The University of Sydney (USyd). In Lao PDR the implementing agency is the National Agriculture and Forestry Research Institute (NAFRI) supported by National Animal Health Laboratory (NAHL), with Hue University of Agriculture and Forestry (HUAF) and the National Institute for Animal Science (NIAS) as the joint agencies in Vietnam.

Project impact pathways and benefits. The project will improve socioeconomic conditions for the modest number of directly participating goat farmers through higher offtake and reduced economic and livelihood risk coupled with improved returns due to

improved market understanding and meeting market specifications. Provision of guidelines and initial scale out will begin spreading these benefits to a wider pool. The GOL and its agencies will benefit from improved capacity in goat research and advisory services and policy. A national learning alliance will be a key mechanism for scaling out of project findings in addition to direct community engagement, meetings with relevant stakeholders and clearly written project reports and documents.

16 Appendix 8 Travel Report for trip to Vietnam on SRA LPS 2016/027

Steve Walkden-Brown and Nam Hoang, November 16-25 2017

Objectives

1. Confirm partner organisations and project leader for Vietnam component of new project.
2. Refine research opportunities for the new project in Vietnam
3. Identify capacity building needs for SRA and longer term
4. Identify official sources of information on goat and agro-forestry industries and land use policy
5. Share results of SRA LPS/2016/027 with other ACIAR researchers in Vietnam and develop contacts with them and with the ACIAR country office.

Activities

- Meeting with collaborating institutions, HUAF and Goat and Rabbit Research Centre (GRRC) (part of National Institute of Animal Science - NIAS) to establish common goals and initial framing of Stage 1 proposal
- Field visits to Vietnamese goat producers and possibly slaughterhouses
- Attend and participate in ACIAR North West Vietnam Research Symposium - Networking
- Discussions with ACIAR country manager on Vietnam policies and emerging shape of the Stage 1 proposal

Executive Summary

Meetings at HUAF and NIAS confirmed suitability as partners in a future ACIAR project. A/Prof. Nguyen Huu Van from HUAF was identified as logical participant in the joint ACIAR training program in Armidale in February 2018. Capacity building needs were not clearly identified and need further discussion. Links with one HUAF staff member wishing to undertake a PhD at UNE in Agricultural marketing established. Official sources of information on goats are limited to estimates of the goat population and pricing information. There is a dearth of marketing or value chain information. A basic understanding of the goat production and marketing situation was achieved by visits to institutions, farms and abattoirs coupled with detailed questioning and information exchange. Opportunities for research within the new project were identified and are summarized at item 5 at the end of this report. Drs Walkden-Brown and Hoang attended and presented at the ACIAR North West Vietnam Research Symposium in Hanoi at the end of the trip.

A daily itinerary can be found at Appendix 1.

Hue University of Agriculture and Forestry (HUAF)

The following attended a meeting and discussions at HUAF on 17/11. Prof Walkden-Brown and Dr Hoang were met and hosted by A/Prof. Nguyen Huu Van, together with A/Prof. Nguyen Xuan Ba.

No	Name	University*	Remarks
1.	A/Prof. Nguyen Xuan Ba	HUAF-FAV	- Animal Science - Leader of ACIAR project LPS/2012/062
2.	A/Prof. Nguyen Huu Van	HUAF-FAV	- Animal Science, Coordinator of ACIAR project LPS/2012/062

No	Name	University*	Remarks
3.	Dr. Dinh Van Dung	HUAF-FAV	- Animal Science - Member of ACIAR project LPS/2012/062
4.	MSc. Tran Thanh Hai**	HUAF-FAV	- Animal Science - Member of ACIAR project LPS/2012/062
5.	MSc. Le Van Nam	HUAF-FAERD	- Rural Economic & Sociology - Member of ACIAR project LPS/2012/062
6.	MSc. Nguyen Thi Bich Thuy	HUAF-FAERD	- Agricultural Economic
7.	MSc. Nguyen Hai Quan**	HUAF-FAV	- Animal Science
8.	Prof. Stephen Walkden-Brown	UNE	- Animal Science, UNE
9.	Dr. Nam Hoang	UNE	- School of Business, UNE

*HUAF: Hue University of Agriculture and Forestry, FAV: Faculty of Animal Science and Veterinary Medicine, FAERD: Faculty of Agricultural Extension and Rural Development

** Australian MSc at UTas on John Allwright Fellowships from ACIAR

The meeting commenced with presentations by A/Prof Van on HUAF and an overview of the goat situation in Vietnam followed by one by Prof Walkden-Brown on background and introduction to the proposed goat project respectively.

HUAF was founded in 1967 and is one of 4 National Agricultural Universities offering a wide range of courses through to PhD level. It has 8 faculties namely

1. Faculty of Basic Sciences
2. Faculty of Agronomy
3. **Faculty of Animal Science & Vet Medicine**
4. Faculty of Forestry
5. Faculty of Rural Engineering & Post-harvest Technology
6. Faculty of Fishery
7. Faculty of Land Management & Agricultural Environment
8. Faculty of Agric. Extension & Rural Development

The Faculty of Animal Science & Vet Medicine has 51 staff (40 academic) in 6 departments and 2 units namely

1. Dept. of Animal Anatomy & Physiology
2. Dept. of Animal Biochemistry and Nutrition
3. Dept. of Animal Genetics and Breeding
4. Dept. of Animal Husbandry
5. Dept. of Veterinary Clinology
6. Dept. of Infectious Diseases & Parasitology
7. Central Laboratory
8. Animal Clinic

Key points about the **current goat situation in Vietnam** included

- Between 1960 and 1990 the goat population was relatively stable at around 400,000
- In 1986 food security was achieved and emphasis on livestock production was increased.
- From 1994 policies to specifically promote goat production were introduced. Funding for NIAS to improve goat genetics. However, there was not great demand for goat meat so the population increases were modest and not sustained.

- In the 2000s there were major increases in investment in ruminant production and rural development. Together with increasing living standards, there was a rise in demand for goat meat and a rapid increase in numbers peaking in 2007. Numbers since then have largely reflected variations in demand/price and are currently 1.9m (Figure 1).
- The population is spread throughout the country but is concentrated in the Northern Midlands and Mountains and the North Central and Central coast areas.
- Most production is smallholder semi-intensive. In agricultural areas there is pressure to reduce grazing and move to fully intensive systems. In hill areas there is also competition for land, esp. by Acacia plantations and reduced grazing land available.
- There is little fully commercial production but quite a good number of farms with 50-100 goats or more and a couple of very big operations with thousands of goats. The latter are new and unproven, and are focused on dairy goat production.
- Current Govt. policy is supportive of increased ruminant production but is not goat specific. While supporting smallholders there is also support for commercialization.
- Differential pricing for different breeds/production systems is recognized but while there are breed improvement programs for Bach Thao and introduced breeds such as the Boer, Barbary, Black Beetal, Jumnapari and European milch breeds there is no national breed improvement program for the local or Co goat.

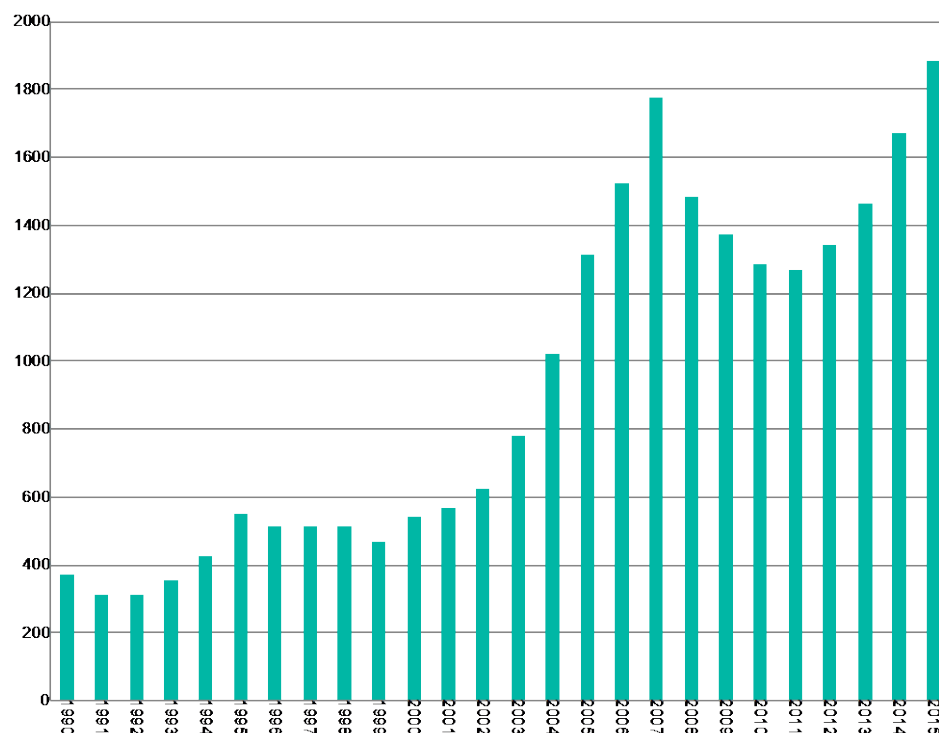


Figure 1. Goat population of Vietnam (thousands) 1990-2015 (NIAS census data)

Regarding the **local goat situation**, the following key points emerged in discussions:

- Production is almost exclusively by smallholders with about 75% from the hill areas and 25% from lowland areas. Land is mostly individually owned and controlled.
- Interestingly, erosion due to goat grazing was not observed or considered a problem, possibly reflecting comparatively low grazing pressures.
- There are a few people with 50-100 goats (more commercial) and one large farm with over 3000 goats kept fully indoors (mostly dairy) in Kon Tum province further south.
- Goat meat cannot be readily purchased in wet markets unlike the situation 20 years or so ago. Goat meat is something that is consumed in restaurants not at home. Virtually

all goats are killed in registered abattoirs followed by sale to restaurants, providing a good point for documentation. It is thought that this applies nationally as well.

- Goats from the farm may be purchased directly by a restaurant who then arranges slaughter, or by middlemen or abattoirs who on-sell to abattoirs. The former generally results in the highest price to the farmer.
- In the hill areas there is grazing under forest, but this is a diminishing resource. There is a lot of acacia forestry plantation and goats occasionally graze amongst the young trees but plant density is high and growth rapid so canopy closure is early with limited availability of feed beneath it.
- At HUAF goat research is focused on expanding the range of forages available for feeding goats, including tree leaves (eg. Jackfruit) and banana stems and use of specific supplements such as molasses urea.

Discussion on **current and future research needs and questions** revealed the following:

- Commercial forestry is reducing the area available for free grazing of goats so research into alternative feedstuffs and production systems is a priority, including fully housed systems. Currently fully housed systems are only seen in the lowland areas. Semi-intensive systems are currently characterized by low productivity and high mortality rates.
- Genetic improvement. As in Laos, it is widely considered that inbreeding depression is at least partly responsible for the apparent low productivity of the local goat as evidenced by small body size and low milk production (300-500 ml/d) considered insufficient to rear twins at high growth rates. While there are breed improvement programs for introduced and other breeds, there are no breed improvement programs for the local goat (which to our eyes looks identical to the Lao local goat).
- Meat quality. Some meat quality work including taste testing has been done at HUAF and there is considerable interest in doing more of this work. Researchable issues in this area discussed included
 - The basis for consumer preferences for different types of goat meat (including imported Australian goat meat).
 - Changes in meat quality associated with long market chain between farm and slaughter.
 - Methods used to reduce “goat taint” in goat meat.
- Marketing and value chain. Documenting the value chain, investigating the basis of pricing differentials within the value chain, why is there an absence of goat meat in wet markets, is “goat taint” an issue, final destination (in the form of restaurant dishes) of goats and goat meat of different quality.
- Animal Health. As in Laos high kid mortality is seen as a problem and orf identified as a particular problem.

Farm and abattoir visits around Hue

On day 2 (18/11) Dr Van escorted Prof Walkden-Brown and Dr Hoang to the Faculty farm 7 km from the university and one of the 4 University farms, the one with goats a greater distance to the north of Hue then 3 smallholder farms and an abattoir (Figure 2).

The HUAF Faculty of Animal Science & Vet Medicine has its own small farm of 1.2 ha, 7 km from the campus. It has a manager and poultry, duck, cattle and goat facilities sufficient to support student projects and small-scale research work. It is managed and operated by the faculty.

The University itself has 4 larger farms under central administration. We visited the one of these farms with goats. It was half an hour or so drive north of Hanoi and managed by Mr Ngo Mau Dzung (MSc) who is director of the farm. It also has a commercial 3000 pig

grower facility and various cropping and forestry aspects. The goat facility comprises a single well-constructed house and 34 semi-intensively managed crossbred goats with a crossbred Boer buck being used for breed improvement. The goat facility is moving towards a fully intensive system to reduce wet-season ill health and restricted grazing issues. Orf is a major health problem. Goats are sold directly to restaurants (high price) or to middlemen/abattoir (lower price).

Visits to smallholder farms with 5-30 goats (Mr Ho, Mr Huan and an unnamed farm in the Huong van commune, near the hydroelectricity dam) resulted in the following main observations:

- The standard of housing was very good. Floors and wall were of sawn timber and in some cases concreting of areas under slats was observed.
- Farm sizes in some locations were very small. Eg 1,500 m² for Mr Ho was typical for his village.
- Animal condition and husbandry levels appeared to be reasonably good. Use of salt, supplementary feeding, forage growing and harvesting were all practiced.
- Replacement of pigs with goats was observed due to low prices of pigs relative to goats, suitability of facilities for conversion to goats and fewer sanitary and odour problems with goats.
- Use of crossbred animals was typical with evidence of Boer and Bach Tao influence. Goats tended to be heterogenous in appearance.
- Sale of goats was not a problem with regular visits from traders seeking goats.



Figure 2. Dr Nguyen Huu Van showing off silage at the HUAF faculty farm (left of left photo) and the goat facility at the main University Farm (Right)

A visit to a specialist goat abattoir in Hue and discussions with the owner, Mr Bac revealed the following:

- The abattoir is licensed has been in business for 18 years and currently slaughters about 20 goats/d, 7 days per week with an annual total of around 6000 goats.
- It is one of 3 goat abattoirs in Hue and specialises in high priced “grass goats”. The other abattoirs deal in lower quality goats. Mr Bac pays around 110,000 dong (AUD 6.25) per kg LWT for high quality goats and around 90,000 dong (AUD 5.12) for lower quality goats.
- Demand has been steadily increasing over time, but shows seasonal variation as well with peak times in the “Wedding Season” (currently), the lead up to the Tet festival and during the “cold season” for hot pot.

- Goat restaurants only open in the afternoon and evening so he is able to slaughter in the morning at a reasonable time and supply fresh meat on the day.
- He has 1000m² of land which is used as grazing for the goats in addition to neighbouring rice land. He typically holds 350 goats at any one time, with 500 as a maximum. Time from purchase to slaughter ranges from 5 days in the peak season to up to 30 days. Goats are not supplemented during holding but purchased jackfruit leaves are used during flood times when the goats cannot graze.
- Reduction of goat taint is achieved by burning the hair on the carcase before dehairing (? check) and sale with skin on.

HUAF linkages with proposed new ACIAR project

The HUAF team was very positive about involvement in the new project. They have strong links with ACIAR through current project LPS 2012/062 (Developing productive, sustainable and profitable smallholder beef enterprises in central Vietnam) and its predecessor projects. A/Prof. Nguyen Huu Van is the Vietnam project coordinator for that project which ends shortly (early 2018). He is identified within HUAF and in discussions as an appropriate leader for Vietnamese activity on the new project. Dr Van accompanied us on the remainder of our trip to Vietnam and during this period he was identified as the most suitable participant for the joint Pacific/Laos goat training program in Armidale in Feb 2018.

A prospective UNE PhD student of Dr Nam Hoang's, Ms Nguyen Thi Bich Thuy, is a staff member at HUAF in the Faculty of Agric. Extension & Rural Development and wishes to undertake a PhD in agricultural commodity marketing with Dr Hoang. She attended some meetings during the visit and may be someone who can be involved in market/value chain research under the project. Her initial approach to Dr Hoang was prior to the visit and unrelated to the ACIAR project.

The visit to HUAF and surrounds was very well organized by Dr Van and he, and Dr Ba, offered exceptional hospitality to us for which we are very grateful. Our visit coincided with the Teacher Day holiday and celebrations in Vietnam and we participated in two major functions associated with this. These were very enjoyable and revealed an aspect of Vietnamese culture that I had been unaware of. It also enabled Dr Hoang and I to meet 3 distinguished UNE Alumni who were staff members of HUAF (Figure 3).



Figure 3. Celebrating Teacher's day at HUAF. At left, on the stage with Drs Van and Ba (either side) with three UNE alumni previously on the HUAF staff. At the right, an example of the celebrations of students and past teachers at the HUAF faculty of Animal Science & Vet Medicine.

Visit to ACIAR office in Hanoi

On 20 Nov we, together with A/Prof Van, visited the ACIAR country office in the Australian Embassy in Hanoi and had a brief meeting with Ms Nguyễn Thị Thanh An the ACIAR

Country Manager. We re-iterated the purpose of our visit to Vietnam and outlined the developing ideas around the new project, for which Ms An was supportive. She drew our attention to the recently approved ACIAR-Vietnam Collaboration Strategy for 2017-2027. Relevant research themes for the new project are “Market Engagement” and “Soil fertility and crop-livestock systems”. Ms An noted that having two separate research partners in Vietnam (eg. HUAF and NIAS) would not pose undue challenges. She noted that some major supermarkets do sell goat meat (frozen?) and that she had recently visited the very large intensive goat farm in Kon Tum mentioned previously. A figure of 10,000 goats at this farm was mentioned. In response to questions from Dr Hoang she acknowledged the demand for goat milk in Vietnam also and felt it could form part of a market study.

National Institute of Animal Sciences (NIAS)

The program for visits to NIAS the affiliated Goat and Rabbit Research Centre (GRRC) and goat farms and businesses near Hanoi was prepared and implemented by Mr Tuan Anh Chung MSc. On 21 November Drs Walkden-Brown, Hoang and Van attended a meeting at the NIAS headquarters at Thuy Phuong, Tu Liem, Hanoi (Figure 4, L). Others in attendance from NIAS were

- Dr Pham Cong Thieu, Vice director, NIAS
- Nguyen Tien Phien BSc. Deputy of Division of Personnel and Administration
- Dr. Ha Minh Tuan, Deputy of Division of Scientific Management and International cooperation
- Ms Le Thu Ha, Division of Scientific Management and International Cooperation
- Tuan Anh Chung Msc., Researcher, Department of Animal Nutrition and Feed
- Dr. Do Thi Thanh Van, Director of GRRC



Figure 4. Meeting at NIAS headquarters (Left) and inspecting hay at the GRRC (Right).

Following a presentation on the history and goals of NIAS Prof Walkden-Brown gave a presentation on the purposes of the visit, the proposed new Laos-Vietnam goat project and background.

Formal Government goat research in Vietnam commenced at NIAS in 1990 and in 1991 the Rabbit Research Centre was renamed the Goat and Rabbit Research Centre. Research has centred mainly on breed introduction and crossbreeding with development of the Bach Tao goat and introductions of Barbary, Beetal and Jumnapari from India (early 1990s) and European milch breeds (Saanen, Alpine) and the Boer goat from the USA (early 2000s). The three main goat rearing systems were reiterated being

- Extensive – grazing without supplementation. Most popular and widespread.
- Semi-intensive – Some supplementation and restricted grazing

- Fully intensive – advocated for imported breeds. They require semi or fully intensive.

The Co local goat is suitable for extensive grazing systems but extension and development in this system is difficult. Because of this confounding of breed with production system, there is a research question relating to whether the price premium for “mountain goats” is due to the goat phenotype/breed, or the production system or area it was raised in. More intensive management systems are thought to be more developed in the central parts of Vietnam than the north.

Milk is seen as an important goat product with significant unmet demand (met with imported goat milk powder) and considerable research effort and expenditure is directed towards milk goats.

Goat and Rabbit Research Centre at Son Tay (NIAS)

We were hosted on this visit by the Director Dr. Do Thi Thanh Van and also accompanied by rabbit researcher Ms. Luyen (MSc) (Figure 4, R and Figure 5).

The Centre occupies 65 ha (including 14 ha for staff housing), with an additional goat facility on 70 ha in Ninh Thuan province in the South. The Son Tay facility has 50 staff (30 research, 20 general with 1 PhD, 1 Master's degree and 20 bachelor degrees). There are close links with Thai Nguyen University and others including HUAF with student and staff training. The Centre has approx. 800 goats and 200 sheep (upgrading to Dorper) with a primary function of supplying breeding stock to farmers. Hundreds of bucks are sold for breeding each year and all breeding stock is priced at USD \$10/kg – significantly higher than the price of goats for eating. Sheep are seen as easier to raise than goats, but with lower reproductive rates, through reduced litter size and longer lambing interval. There is some demand for sheep in central Vietnam but

The feed for 1000 sheep and goats is grown on 24 ha of fodder and cassava with about 10% of feed needs purchased in. Animals are fed *ad lib* forage fed 5 x daily plus 1% of BW concentrate (+ 200g/d in late gestation or + 500g/L milk during lactation) fed in split meals 4 times/d. Concentrate costs 7900 dong if purchased or 7000 if made up at the centre.

Goat milking is 2-3 x /day depending on production and 2 persons manage houses with 60-65 individually housed does (all tasks). Kids are artificially reared. Milk is sold fresh chilled to a processing factory for 35,000 dong/L (AUD \$2.00). Goat produce 300-400L over a 7-month lactation with the best animals producing 600L (average 1.5L/d).

The main activities of the centre appear to be managing the large herd of animals present and producing animals for sale, as well as working on specific projects able to be implemented at the centre.



Figure 5. External (Left) and internal (Right) views of the many large goat sheds at the GRRC.

Farm visits around Son Tay

Visits to smallholder and semi-commercial farms on the afternoon of Nov 21 (Mrs Singh – Dairy, Mr Nguyen van Han, Mr Nguyen van Duc, and a 4th unnamed lady's farm) resulted in the following main observations:

- Mrs Singh manages 65 dairy goats (Saanen) and a number of dairy cows on 4.5 ha of land. She has had dairy goats for 15 years and considers them more profitable than dairy cows and easier to manage. She gets 12,000 dong/L for cow's milk and 35,000 dong/L for goats milk. Goats produce 1.5-2L/day over a 4-month lactation and she sells 40-50L/day to the processor.
- Two of the of the other 3 farms had moved into goats recently due to low pig prices. In two cases the goats were initially gifts from urban children to their rural parents as a cash making enterprise.
- All were multiple enterprise affairs on small areas of land (dairy cattle, pigs, forage, crops)
- One of the 3 was finding the goats difficult to manage especially in wet weather, the other two were very happy with progress. The unhappy lady had lost a goat.
- Animals received a high level of care and attention including a lot of supplemental nutrition and looked in good condition.
- The high price of goats was a major factor in all cases. Purchase price to get into goats was around 120,000 dong/kg LWT (AUD 6.83).
- Goats were easier to manage and more profitable than pigs (2/3)
- Goat management information obtained from the internet (1/3)
- The people showing us around the goats were women in all cases.
- Advertisements for both goat meat (restaurants) and milk were commonplace in the area.

Visit to Ninh Binh on Nov 21

Ninh Binh (city popln. approx. 200,000, Province approx. 1m), is 110 km due south of Hanoi and claims to be the “Goat Capital” of Vietnam. This was certainly borne out by numerous prominent advertisements for goat meat restaurants (Figure 6). Our host for the visit (arranged by Mr Tuan) was Mr Quang Nga, Vice Director of the Dong Giao Plant and Animal Breeding Company (Private company). By his estimate there were more 1000 restaurants selling goat meat dishes in Ninh Binh. This number included many restaurants that sold different meats so not all restaurants are exclusively goat meat. Goat meat is an important part of the tourist trade to Ninh Binh with an estimated 10m tourists visiting the province each year. Most goats are sourced locally from within the province or Vietnam with very few from Laos.



Figure 6. Typical examples of roadside goat advertising around Ninh Binh. Dê Núi is “Mountain Goat” and Thịt Dê is “Goat Meat”.

The Dong Giao company has a large piggery (5000 pigs) with 20 years of history and plans to reduce the scale of this somewhat and expand instead into goat production (mixed dairy and meat) with targets of 1000 dairy goats and 2000 meat goats to be intensively housed by the end of 2018. Currently has 200 goats purchased from GRRC intensively housed with 5 ha of forage. Building of new houses is under way and 100 ha of forage is planned. The company will use Boer and Bach Tao goats for meat and dairy breeds for milk. Accepts the lower price than for “grass goat”, but does not discount the possibility of going into “grass goat” production at some time in the future.

A visit to the new goat production facility (Figure 7) revealed goats purchased a month ago in a large shed with construction still being completed. Goats were being fed elephant grass silage plus concentrate and were in poorer condition than observed on farm visits and at GRRC where condition was excellent. Kidding was just starting.



Figure 7. Visit to the developing goat project of the Dong Giao Plant and Animal Breeding Company in Ninh Binh. Boer goat kids in a group pen (Left) and ongoing construction/finishing of the far end of the large controlled environment goat house.

This was followed by a visit to one of the estimated 40 goat abattoirs in Ninh Binh (Figure 8). The owner, Mr Nguyen Van Cuong, has been doing this for 3 years and kills an average of 15 goats per day. Goats are boned out completely before sale. Carcasses are soaked in calcium carbonate solution (lime) in cold water and dehaired by pulling hairs out with a spoon including the bulb and sebaceous gland. This reduces/removes any goat taint. As in Hue, it was confirmed that purchase of goat meat for home use is rare and difficult to purchase with meat going direct to restaurants.



Figure 8. Goats awaiting slaughter at a goat abattoir in Ninh Binh (Left) and boned, skin-on carcasses with blood, ready for delivery to the restaurant.

Visits to two private farms followed. Mr Phuong van Hiep has 70 goats currently and has had around 100 goats continuously for 10 years and this is a stable number. He feeds them from 0.1 ha of elephant grass fodder with some supplemental grazing (3 x week) on communal land 1 km away and feeding of cracked corn. Breeding bucks are purchased from GRRC and the crossbred goats are sold to traders for 110,000 dong/kg LWT (AUD 6.25). Annual income from goats is around USD 5,000.

Farm 2 was a further example of entrepreneurship, being located by a lovely lake amongst limestone mountains with the farm containing deer (Vietnamese elk), goats, horses and large porcupines, linked to two restaurants. Goats ranged mostly freely with some supplementation. Husbandry levels did not appear high.



Figure 9. Scenes from smallholder and semi-commercial farms. Note the diversity of phenotype amongst the crossbred goats so prevalent in the lowland areas.

ACIAR North West Vietnam Research Symposium

Drs Walkden-Brown, Hoang and Van attended this symposium on Nov 21 and 22, with each presenting a poster on Nov 21 on some of the results of ACIAR SRA LPS/2016/027. The symposium was a significant affair with full proceedings in English and Vietnamese and approximately 300 delegates with real-time translation of presentations. It was an excellent opportunity to find out more about ACIAR policy in general and in Vietnam in particular, learn about research outcomes and meet ACIAR researchers with deep experience of working in Vietnam. Useful discussions were held in particular with Stephen Ives, Jonathon Newby, David McNeil, Dominic Smith and Dr Bui Thi Nga of VNUA (Value Chain specialist).

Of particular value were papers on markets and value chain analysis, food safety and integration of livestock production with crops and/or forestry.

On the afternoon of 22/12 Dr Bui Thi Nga of VNUA hosted a visit of Dr Nam Hoang to her office and university.

Identification of research and collaborative opportunities

The main ideas for discussion and possible inclusion in the new project arising from the visit are

- i) HUAF and NIAS to be the key partner institutions.
- ii) Include Vietnamese collaborators and experts in the Learning Alliance proposed for the new project
- iii) Benchmark goat supply and demand in Vietnam by abattoir survey. The vast majority of goats appear to pass through registered abattoirs.
- iv) Detailed value chain analysis of one or more major value chains from Laos to Vietnam. A northern one should be included given the importance of the north in goat consumption in Vietnam. Identify
 - a. Basis for differential pricing of goats, esp Lao/Mountain goat premium
 - b. Threats to the Laos-Vietnam trade
 - c. Main constraints to efficient marketing, and opportunities for expansion/improvement.
- v) Depending on resource availability consider research in Laos and/or Vietnam and/or Australia into goat meat quality and factors affecting it including
 - a. Goat taint
 - b. Underlying basis for mountain goat premium
 - c. Effects of long interval between purchase and slaughter.
- vi) On a case study basis investigate and document the very large fully intensive goat production systems in place in Kon Tum and that being developed in Ninh Binh.

Appendix 1: Itinerary and Meetings

Date	Activity / Meetings
Thurs 16 Nov:	Depart Armidale 0630 QF2019 to SYD then 1150 VN7022 to HCC (SGN) then 1940 VN1378 to Hue (HUI) arrive 2105 Accommodation: Imperial Hotel, Hue.
Frid 17 Nov:	<ul style="list-style-type: none"> Meeting Dr Nguyễn Hữu Văn Vice-Dean, Faculty of Animal Sciences and Veterinary Medicine, Hue University of Agriculture and Forestry (HUAF) and colleagues. Presentation by SWB and Discussion on phase 1 proposal. Accommodation: Imperial Hotel, Hue.
Sat 18 Nov:	<ul style="list-style-type: none"> Field trips around Hue to look at a Goat production/slaughter house example TBA Accommodation: Imperial Hotel, Hue.
Sun 19 Nov:	<ul style="list-style-type: none"> Concluding meeting with HUAF staff Writing Imperial Hotel, Hue
Mon 20 Nov	Depart Hue 1035 VN1542 to Hanoi (HAN) arrive 1150 <ul style="list-style-type: none"> 4 PM – Visit ACIAR country office. Nguyễn Thị Thanh An. Country Manager. Accommodation: Daewoo Hotel, Hanoi.

Date	Activity / Meetings
Tues 21 Nov	<ul style="list-style-type: none"> • Am - Formal meeting with key people at National Institute of Animal Science (NIAS) and Goat and Rabbit Research Centre (GRRC) • Visit to Goat and Rabbit Research Centre\ • PM. Visit goat farms <p>Accommodation: Daewoo Hotel, Hanoi.</p>
Wed 22 Nov:	<ul style="list-style-type: none"> • Field trips arranged by GRRC to farms and abbatoirs in Ninh Binh. • Evening Registration and welcome function for North West Vietnam Research Symposium “Mountains of Opportunity” <p>Accommodation: Daewoo Hotel, Hanoi.</p>
Thurs 23 Nov:	<ul style="list-style-type: none"> • Attend and participate in ACIAR North West Vietnam Research Symposium • Networking. Meeting with Nguyễn Thị Thanh An, ACIAR Country Manager, Vietnam <p>Accommodation: Daewoo Hotel, Hanoi.</p>
Frid 24 Nov:	<ul style="list-style-type: none"> • Attend and participate in ACIAR North West Vietnam Research Symposium • Networking. Meeting with An from ACIAR office <p>Steve Departs. To HCC 1700 VN0259, then to SYD 2115 VN0773, then Armidale (Sat 25 Nov) 1210pm QF 2022 arriving 1330.</p> <p>Accommodation (Nam only): Daewoo Hotel, Hanoi.</p>
Sat 25 Nov:	<p>Nam Departs</p> <p>To HCC 1700 VN0259, then to SYD 2115 VN0773, then Armidale (Sun 26 Nov) 1210pm QF 2022 arriving 1330.</p>

Professor Stephen Walkden-Brown 22/12/2017

17 Appendix 9 Village agro-forestry goat production systems in Lao PDR

Ammaly Phengvilaysouk, Phoukham Viengvilai and Phonepaseuth Phengsavanh
(LRC, NAFRI)

Introduction

In Laos farmers traditionally raised goats in two main systems:

1. free grazing system-goats were allowed to graze freely all year round and relied on grasses, shrubs and tree occurring naturally in grazing areas.
2. semi-free range system-this system was found in areas have more intensive cropping system.

In general, Goats are allowed to graze or browse freely in the dry season, but are confined, tethered and/or herding in the rainy (cropping) season and goats were kept in simple shelters at night time.

In both systems the growth performance in generally slow: to reach 20 kg of live weight takes around 2 to 2.5 years. Reproductive performance is to have first kidding about 1 year (age at first pregnant about 6-7 months). Average kidding rate is about 2 litters/year, first kidding usually 1 kid, after that commonly 2 kids or occasionally 3 kids, and average litter size was 2.1 kids. Feed supplementation is not common, only some farmers provided feed to goat in the rainy season when cannot grazing. There was no breeding management, buck is selected from within the flock, and mating at younger age about 4-6 months.

The main problems are diarrhea, bloat, Orf and parasite. Diarrhea is the main cause of death in young goat from born to 5 months age. The mortality is high up to 60-70% because lack of knowledge on management and animal health, most farmers were no vaccination and deworming, they treat sick animals by themselves and sometime ask for help from local staffs.

The productivity of local goat is low in smallholder farms, but the demand is high from Vietnam market (i.e. Vietnamese traders at the border of Savannakhet can buy up to 1000 goats/week, but Laos traders can supply about 100 goats/week).

The strategy of Lao government has target to increase forest cover up to 70: by 2020 through afforestation, reforestation and stabilization of shifting cultivation (MAF, 2005). Currently, tree plantation is wide-spread in the country such as teak, rubber and eucalyptus plantation.

Therefore, goat production integrate with agroforestry system may an opportunity for smallholder farm in Laos.

Objectives

- To describe and understand current village goat management and production performance in agroforestry system.
- To identify suitable village involved in agroforestry for intensive benchmarking in an upcoming ACIAR project.
- To building partnerships between NAFRI and agroforestry companies, stakeholders and distribute the results.

Expected outputs

- Improved working relationship between NAFRI, agroforestry companies and villages.

- Understand current village goat management and production performance in agroforestry systems.
- Select suitable villages involved in agroforestry for intensive benchmarking in an upcoming ACIAR project.

Methodology

Step 1:

Consultation with Burapha, Stora Enso companies and AGFORS to review information the villages involved, how they use forest and select the most suitable villages.

Step 2:

Field Study conducted in May and June 2018 of:

- villages in Vientiane province (Hin Ngon village, Hin Herb district and Houy Deau village, Phon Hong district), Burapha.
- villages in Savannakhet province (Kaeng Luang village, Sepon district and Ta Kor village, Nong district), Stora Enso.

The study team was comprised LRC, Burapha, Stora Enso and local staff. Initially, a study team meeting was organized to design the task and discuss an appropriate outline of a check list for the study. The study used farmers' focus group meetings to generate general information on goat production performance and agroforestry systems, the constraints and potentials of goat production.

Staff and Farmers:

LRC, NAFRI: Phonphaseuth, Ammaly, Phoukham.

Burapha company: Visouk, Phonkham, Khamphut.

Stora Enso company: Simmalay, Keo, Bounyang.

PAFO: Bounchanh, Thonglay.

Farmers: about 30 people in 3 villages.

Results

There was cultivated crop especially rice, and some cassava as inter-cropping with eucalyptus for the first 2 years after tree planting, then eucalyptus plantation only. Farmers are allowed to kept their animal such as cattle, goats in the tree plantation 3-4 years after planting. There are no planted improved forages in the tree plantation. The other main benefit to village is that companies hire farmers labour at \$6/person/day for planting, weeding and fencing the tree plantation. Full details are in Table 1.

Table 1. Summary data collection on village goat production in agroforestry systems

	Hin Nhon village Hin Herb district Vientiane province Burapha	KaengLuang village Sapon district Savanakhet province Stora Enso	Ta Kor village Nong district Savanakhet province Stora Enso
General information	<p>-Total 140 HH in the village, 5 HH kept goats.</p> <p>-Farmers were no kept goats in the tree plantation. Goats were allowed to graze freely all year round and relied on grasses, shrubs and tree occurring naturally in grazing areas.</p>	<p>-Total 138 HH in the village and 40 HH for KaengLuang cluster village which 30 HH kept goats (about 100 goats).</p> <p>-Farmers were no kept goats in the tree plantation. Goats were allowed to graze freely all year round and relied on grasses, shrubs and tree occurring naturally in grazing areas.</p>	<p>-About 30 HH kept goats (2-3 goats/HH).</p> <p>-Farmers were no kept goats in the tree plantation. Goats were allowed to graze freely all year round and relied on grasses, shrubs and tree occurring naturally in grazing areas.</p>
Agroforestry systems and policy	<p>-Since 2013, company had land concession 80 ha for eucalyptus plantation.</p> <p>-2014, extend more land concession 50 ha.</p> <p>-Land concession price is \$366/ha/30 years.</p> <p>-Company allows to cultivate rice as inter-cropping in the tree plantation for first 2-3 years.</p> <p>-The other benefit to village, companies rent farmers labor \$6/person/day for planting, weeding and fencing the tree plantation.</p>	<p>-Since 2013, company had land concession 82 ha for eucalyptus plantation.</p> <p>-Land concession price is \$341/ha/50 years.</p> <p>-Land renting value allows villages access to electricity, construct road to village, extend rice field, fish pond, livestock as revolving fund.</p> <p>-Company allow farmers kept their animal or planting forages in the tree plantation, company also will support for land preparation, but farmers response for fencing.</p> <p>-Company allows to cultivate rice as inter-cropping in the tree plantation for first 2-3 years.</p> <p>-The other benefit to village, companies rent farmers labor \$6/person/day for planting, weeding and fencing the tree plantation.</p> <p>-Orf, diarrhea, bloat are the problem on village goat.</p>	<p>-Since 2007, company had land concession 80 ha for eucalyptus plantation.</p> <p>-Land concession price is \$341/ha/50 years.</p> <p>-Land renting value allows villages access to electricity, construct road to village, extend rice field, fish pond, livestock as revolving fund.</p> <p>-Company allow farmers kept their animal or planting forages in the tree plantation, company also will support for land preparation, but farmers response for fencing.</p> <p>-Company allows to cultivate rice as inter-cropping in the tree plantation for first 2-3 years.</p> <p>-The other benefit to village, companies rent farmers labor \$6/person/day for planting, weeding and fencing the tree plantation.</p> <p>-Orf, diarrhea, bloat are the problem on village goat.</p>

Potential

- Company's policy create temporary job for villages and land renting value allows villages access to electricity, extend rice field, underground water and build dormitory for teacher in the village.
- Agroforestry companies staff are enthusiastic and tree plantation has potential for planting forages to improve goat feed and production.

- Build network and working relationship between NAFRI, agroforestry companies and villages

Constraints

- Village goat production in agroforestry are still kept in a traditional way and the main problems of village goat production remain: are slow growth and high kid mortality.
- Goat production in agroforestry is challenging included: 1). Fencing tree plantation (inter-cropping forages and eucalyptus) need more inputs in term of material and labour.
- Company staffs and farmers lack of experience and technical skills in inter-cropping forages and eucalyptus, they had little experience on feed, feeding management and animal nutrition.

18 Appendix 10. Report on a visit to a very large intensive goat farm in Kontum, Vietnam

By **Nguyen Huu Van**, HUAF

Farm visit date: 7th April 2018.

Company: Mang den Pharmacine and Food Joint-stock Company

Farm: Dairy goat farm.

Location: Mang Den commune, Kon Plong district, Kontum province

Establishment of the farm: June 2015

Topography & climate: mountainous, 1200 m high, temperate climate (cool)

Area: total 200 ha.

+Grass land (160 ha): VA06, TD58, stylo, corn

+Farm (40ha): office, houses, feed store & processing, animal houses,...

Personals: 78 people (management staffs, technicians, workers)

Sheds & Goat population (*data in December 2017*)

Sheds	Total in the shed (head)	Breeds	Population/breed (head)
Shed No.1	300	Saanen	94
		Boer	30
		Boer (crossbreed)	176
Shed No.2	400	Saanen	100
		Boer	40
		Boer (crossbreed)	260
Shed No.3	3,898	Saanen	2,430
		Alpine	1,468
Shed No.4	1,596	Saanen	786
		Alpine	810
Shed No.5	98	Bach Thao (Vietnamese breed)	98
Total	6292		6292

Milking parlour : 10 goat/batch.

* However, milk factory is still not build yet, therefore milk is not for selling until end of 2018 when the goat milk factory will be set up in Kontum city (60 km from the farm)

Farm business development plan (according to Mr.Thanh, Director of the farm) :

- Continue to import dairy goat to increase the population to 10,000 at the end of 2018
- Expand production : establishment of total 10 similar farms in the surrounding area (10,000 head/farm) = total 100,000 heads by the year 2025.

VERY AMBITIOUS PLAN I THINK.

Current issues :

- High density of goat in the shed. Need to build more.
- Feed shortage : not enough green forage, they have to buy rice straw very far away
- Sloping land is difficult to cultivate, harvest and transport grass to the farm.
- Long dry season : January – June (6 months)
- High humidity, cold and windy (farm located on top of the hill)
- Water supply
- Huge amount of money investment (imported goat, housing & facilities, land clearance, labour,...) but almost no return after two years and may be the years to come.
- Goat milk consumption market is still a question ? even though goat milk in Ho Chi Minh city is very high (60,000 – 80,000 VND/litre) in comparison with cow milk (20,000 VND/litre)
- Goat diseases (for example Diarrhea in young goat, lung inflammation)

General impression: Great goat farm that I have ever seen. At the initial stage of establishment, they hired two experienced experts who used to be the director of goat and rabbit centre and the grassland specialist of NIAH as advisors. They also hired one dairy goat expert (one from India) as a technician. In addition, an expert from the Netherland also visit occasionally. However, they were on short leave during my visit.

I think this model of goat farm is very excellent but not easy to adop by other people because of unique climate location and huge investment.

Selected photos from the visit are shown below



Topography and soils



Farm in the distance



External view of some sheds



Mr.Thanh (farm director) in the middle



Saanen goats



Alpine goats



Boer goats



Milking parlour



Kid rearing



Kid feeding



Housing style



Different housing style



Rice straw for roughage



Feed mixing

19 Appendix 11 Planning Workshop, June 18-22,

The aim of the workshop was to consolidate the results of the scoping study, add recent research findings from Laos and Vietnam and make detailed plans for activities for the four-year project. This workshop was attended by the participants in the study and the project team leaders and scientists from Australia, Laos and Vietnam. The specific objectives were to

1. Prepare detailed workplans and budgets for the full project proposal.
2. Develop relationships amongst senior counterparts in Laos Australia and Vietnam
3. Further engage stakeholders and other potential research partners

Participants

NAFRI <ul style="list-style-type: none"> • Phonepaseuth Phengsavanh • Ammaly Phengvilaysouk • Phoukham Viengvilai • Phonevilay Sinavong • Phouthone Phonekhampheng 	Savannakhet <ul style="list-style-type: none"> • Khamchanh Konedavong (PAFO) • Tonglai Vanniving (PAFO) • Bounmy Phewankham (SKU) • Sabaiphone Soulinthone (SKU) 	UNE <ul style="list-style-type: none"> • Stephen Walkden-Brown • Douglas Gray • Nam Hoang • Rachelle Hergenhan
Dept. Livestock & Fisheries <ul style="list-style-type: none"> • Bounlom Douangneun • Laphine Phithakthep • Phouth Inthongxai • Souk Phomhaksa 	ACIAR <ul style="list-style-type: none"> • Khampheng Mounmeuangxam 	Charles Sturt University <ul style="list-style-type: none"> • Joanne Millar
University of Sydney <ul style="list-style-type: none"> • Peter Groves 	Burapha/AGFORS <ul style="list-style-type: none"> • Richard Laity • Luke McWhirter 	Vietnam <ul style="list-style-type: none"> • Nguyễn Hữu Văn (HAU) • Ngo Thi Kim Cuc (NIAS) • Chung Tuan Anh (NIAS)

Day 1 - Monday 18 June

Objective: SRA Achievements, lessons learned from past projects and how the new project has been developed. Brief intro to ACIAR and the institutions involved and their processes.

Time	Speaker/Leader	Topic
0830		Coffee and Informal Gathering
Session 1. SRA achievements and lessons		Chair: Dr Vanthong
9.00	Vanthong Phengvichith	Welcome
9.10	Phonepaseuth Phengsavanh	Welcome and Workshop Objectives Introductions
9.25	Steve Walkden-Brown	Overview of ACIAR SRA LPS 2016-027

9.35	Phonepaseuth Phengsavanh	Goat production and production systems in Laos
9.55	Nguyễn Hữu Văn	Goat production and production systems in Vietnam
10.15		BREAK
Session 2. SRA achievements and lessons		Chair: Dr Cuc
10.35	Nam Hoang	Goat pricing, marketing and value chains in Laos and Vietnam
10.55	Rachelle Hergenhan	Data capture and management to provide performance indicators to benchmark against
11.15	Richard Laity	Integration of goats in timber agroforestry – what are the opportunities?
11.35	Ammaly Phengvilaysouk	Report on SRA Training workshop in Australia and post workshop activities
11.45	Doug Gray	Overview of SRA achievements against goals
12.00		LUNCH

Time	Speaker/Leader	Topic
Session 3. New Project – setting the scene		Chair: Dr Seuth
13.30	Steve Walkden-Brown	Proposed new project – rationale, overview and ACIAR feedback to date
13.50	Dulce Simmanivong	ACIAR processes and Laos situation
14.10	Joanne Millar	Social, gender and adoption aspects to consider in all new project activities
14.30		BREAK
Session 4. New Project – setting the scene. Partner institutions		Chair: Dr Gray
14.50	Phonepaseuth Phengsavanh	NAFRI – Overview, capacity and project sign off requirements
15.05	Bounlom Douangngeun	DLF/NAHL – Overview, capacity and project sign off requirements
15.20	Nguyễn Hữu Văn	HUAF – Overview, capacity and project sign off requirements
15.35	Ngo Thi Kim Cuc	NIAS – Overview, capacity and project sign off requirements
15.50	Steve Walkden-Brown	UNE/CSU/USyd – Overview, capacity and project sign off requirements
16.05		END

Day 2 - Tuesday 19 June

Objective: Understanding the new ACIAR project. How will it work and what changes are needed?

Time	Speaker/Leader	Topic
0830		Coffee and Informal Gathering
Session 5. New project Objective 1.		Chair: Dr Walkden-Brown
9.00	Phonepaseuth Phengsavanh /Rachelle Hergenhan	<p>Objective 1. <i>Directly measure performance of goat production systems in Laos to develop benchmarks against which improvements can be assessed.</i></p> <ul style="list-style-type: none"> • Activity 1.1 Select 6 locations for benchmarking that represent the main goat production systems • Activity 1.2 Develop and test data and information capturing methods to benchmark goat health and production and socioeconomic parameters at the selected project locations. (months 1-9). • Activity 1.3 Regular measurement of key goat production, socioeconomic and gender parameters at the selected locations over 15 months (months 9-24). • Activity 1.4 Benchmarking study data analysis and interpretation (Months 12-36).
9.30		Group discussion and questions on Objective 1
10.15		BREAK
Session 6. New project Objective 2.		Chair: Dr Van
10.35	Ammaly Phengvilaysouk /Steve Walkden-Brown	<p>Objective 2. Investigate major constraints on goat productivity identified under SRA LPS/2016/027 and develop and test practical solutions to overcome these constraints</p> <ul style="list-style-type: none"> • Activity 2.1 Determine the importance of inbreeding depression in smallholder production systems (months 12-36). • Activity 2.2 Determine the importance and causes of mortality and disease in Lao goat production systems, identify and test control methods (months 12-48). • Activity 2.3 Improved forage and feeding systems in smallholder and agroforestry production systems (months 12-48).
11.05		Group discussion and questions on Objective 2
12.00		LUNCH

Time	Speaker/Leader	Topic
Session 7. New project Objective 3.		Chair: Dr Millar
13.15	Phonevilay Sinavong/ Nguyễn Hữu Văn/Nam Hoang	<p>Objective 3. <i>Reduce market risk and increase marketing opportunities through improved understanding of the factors affecting demand and pricing of goats in Laos and Vietnam, and of the associated value chains</i></p> <ul style="list-style-type: none"> • Activity 3.1 Desktop review (months 1-9) • Activity 3.2 Market surveys to determine what characterises and is acceptable as Lao goat (months 6-18) • Activity 3.3 Market forecasting (months 18-24) • Activity 3.4 Characterising domestic and export value chains (months 6-24)
13.45		Group discussion and questions on Objective 3
14.30		BREAK
Session 8. New project Objective 4.		Chair: Dr Nam Hoang
14.50	Phonepaseuth Phengsavanh/Joanne Millar/Doug Gray	<p>Objective 4. <i>Build capacity for research and development of goat production in Laos and initiate scaling out of project findings</i></p> <ul style="list-style-type: none"> • Activity 4.1 Learning Alliance (months 6-48): • Activity 4.2 Tactical short course training (months 6-48): • Activity 4.3 Strategic capacity building via postgraduate training, conference attendance and specialist talks (months 6-48) • Activity 4.4 Initial scaling out of project findings to other families in the participating and nearby villages (months 6-48)
15.25		Group discussion and questions on Objective 4
16.00		END

Day 3 - Wednesday 20 June

Objective: Working Groups to finalise workplans and budgets. Aim to find consensus and document activities in detail.

Time	Key participants	Topic
0830		Coffee and Informal Gathering
Session 9. Concurrent group sessions by objective		Facilitator: Doug Gray
9.00	Seuth /Rachelle/ Ammaly/Steve Lanoy/Nam/Van/Cuc/Tuan Seuth/Ammaly/Joanne/Doug	Objective 1 and 2 activities. Benchmarking productivity and constraint investigation and solutions in target enterprises Objective 3 activities. Markets and Value Chains Objective 4 activities. Build Capacity
10.15		BREAK
Session 10. Concurrent group sessions continue		Facilitator: Doug Gray
10.35	Seuth/Rachelle/ Ammaly/Steve Lanoy/Nam/Van/Cuc/Tuan Seuth/Ammaly/Joanne/Doug	Objective 1 and 2 activities. Benchmarking productivity and constraint investigation and solutions in target enterprises Objective 3 activities. Markets and Value Chains Objective 4 activities. Build Capacity
12.00		LUNCH
Session 11. Group Reporting back on changes needed in activities and budgets		Chair: Dr Ammaly
13.15	Objective 1 team	Objective 1 activities. Benchmarking productivity. Final version and budget principles
13.45	Objective 2 team	Objective 2 activities. Constraint investigation and solutions. Final version and budget principles
14.15		BREAK
Session 12. Group Reporting back on changes needed in activities and budgets		Chair: Dr Hergenhan
14.35	Objective 3 team	Objective 3 activities. Markets and Value Chains. Final version and budget principles
15.05	Objective 4 team	Objective 4 activities. Build Capacity. Final version and budget principles
15.40	Steve Walkden-Brown	Synthesis of proposed changes and any perceived issues to resolve
16.00		END

Days 4 and 5 - Thursday 21 June and Friday 22 June

Morning and afternoon	Field Visits and Report Writing as required. Departure of delegates
-----------------------	---------------------------------------------------------------------