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Overcoming technical and market constraints to the emergence of profitable beef enterprises in the north-western highlands of Vietnam

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1 Acknowledgments

We would like to express our thanks to the communities of Long He (Thuận Châu district) and Tà Hộc (Mai Sơn district) in Sơn La Province and the communities of Tỏa Tình, Quài Cang and Quài Nưa (all of Tuần Giáo district) in Điện Biên Province. The positive engagement of local farmers, traders, processors, extension staff and other beef value chain stakeholders and collaborators enabled successful research activities to be undertaken.

We express our gratitude and appreciation to the Department of Agriculture and Rural Development (DARD) in both provinces for their ongoing commitment to the objectives of the project and their continued support for further research. We also thank the Ministry of Agriculture and Rural Development (MARD) and the Vietnamese Government for their support of the project.

Finally we acknowledge the financial support of ACIAR and the valuable contribution of their Australian and in-country staff.

2 Executive summary

The North West Highlands of Vietnam is one of the poorest regions in the country, with approximately 75% of the ethnic minority people, who dominate the region, living in poverty. These higher rates of poverty can in part be attributed to poor access to profitable markets in comparison with other regions of Vietnam, and to various biophysical constraints to agriculture especially long dry winters and remote mountainous terrain. Beef cattle production is an important component of the smallholder farming system and has been identified by the Vietnamese Government and ACIAR as a priority area for further research and development. In order to address the issue of poverty alleviation, the project will work with upland communities in localities recently connected to new market opportunities. This implies involvement of farming families that are in transition from subsistence to market orientation and where both technical and agribusiness research will accelerate the uptake of identified opportunities. The smallholder farming systems of North West Vietnam are characterised by inter-dependent biophysical (i.e. crop, feed, livestock, soil, climate) and human (i.e. culture, labour allocation) factors, further complicated by interactions between the farm and the rest of the economy. Hence, the consequences of management and other changes to the farm system are often complex and counter-intuitive. The aim of this project was to develop, evaluate and implement new technical and market strategies to improve smallholder incomes from beef cattle in the North West Highlands of Vietnam.

The project utilised the Australian resources of the University of Tasmania. Vietnamese collaborating agencies included the National Institute of Animal Sciences (NIAS), Thai Nguyen University of Agriculture and Forestry (TUAF), Centre for Agrarian Systems Research and Development (CASRAD) and Vietnam National University of Agriculture (VNUA). The Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) was also a project collaborator, contributing expertise in economic analysis of livestock systems and value chain methodology. A small, but strategically significant activity was undertaken with Tay Bac University (TBU) to provide engagement and capacity building at the provincial level, and direct involvement with TUAF in conducting on-farm trials. Researchers from each of the institutions were formed into objective teams to build collaborating capacity across institutions. Students from TUAF, TBU and VNUA also participated in research activities throughout the life of the project. The project focussed research activities on beef cattle production systems in two adjoining but contrasting highland provinces; Son La and Dien Bien.

The aims of the project were to be achieved through improving the efficiency and effectiveness of existing beef value chains and the profitability and sustainability of the value chain for smallholder cattle producers; quantifying the biophysical and socio-economic characteristics of the smallholder farming systems involving cattle production, and developing and testing viable management strategies for capitalizing on market opportunities and minimizing the impact of the cold, dry season and other important cattle production constraints.

Over the five years of the project, the research team developed a detailed understanding of the biophysical and socio-economic characteristics of the smallholder farm system involving cattle production, and analysed the cultural impacts of beef value chains on ethnic minorities. The project was then able to implement new forage and feed management systems to address the winter feed gap after conducting specific research on the impact of cold temperature and level of nutrition on cattle performance, forage variety and natural pasture evaluation, and the effect of supplements and processed crop by-products (silage) on productive performance and economic returns from growing cattle.

Capacity building was a major achievement of the project with farmers, extension staff and researchers developing a range of skills in value chain analysis and marketing, accounting, farm management and recording, evaluation and management of fresh forage production,

crop by-product utilisation for winter feeding and animal husbandry (winter shelters). The project was also instrumental in introducing an experimental value chain from the farmer to a supermarket in Hà Nội, including labelling and marketing. Finally, mapping of existing policy and regulatory framework governing the Beef Cattle Value Chain in the North-West Highlands of Vietnam was conducted, with recommendations provided through a policy brief for future research initiatives and interventions.

The project was not completed without challenges throughout the five years. However, these challenges presented opportunities. These included the need to strengthen coordination with the Departments of Agriculture and Rural Development in remote provinces in capacity building and expand the application of technological advances in forage production, treatment of by-products, feeding management and fattening beef cattle. There is also an opportunity to integrate beef cattle production with cropping systems and improve linkages between beef cattle supply and the consumer, with a focus on a market-oriented, more intensive beef production, and downstream interventions (i.e. food safety and certification). The project revealed a continuing and clearly demonstrated need for innovative agricultural research and development to improve smallholder livelihoods in remote regions in NW Vietnam where there is a high level of poverty among many of the communities and ethnic minority groups. There is also an opportunity to address low farmer literacy through research informing school curricula in new and innovative approaches to address local beef production limitations.

Ultimately, a consistent supply of beef products is required to satisfy consumer demand and emerging food safety protocols within the context of increased competition for land resources whilst improving the profitability of smallholder beef production.

3 Background

Vietnam in general, has experienced significant economic growth in the last 10 to 15 years with the value of livestock output (excluding poultry) alone increasing from USD 375 M to USD 513 M between 2005 and 2013. Between 1990 and 2001 and concomitant with economic growth, the production of beef cattle in Vietnam had increased from 3.1 to 3.9 million head. By 2013, the number had further increased to 5.2 million head (Vietnam Statistics Office, 2014). However, this increase in supply has not been enough to satisfy local demand as reports from the U.S. Meat Export Federation (www.USMEF.org) have indicated that beef consumption per capita in Vietnam increased from 2.5 kg in 2002 to 4.0 kg in 2007. The value of frozen imported beef increased from USD 17 million in 2009 to USD 53 million by 2013, whilst the value of imported fresh beef increased from USD 3.5 million in 2009 to USD 6.7 million by 2013. The value of live cattle imports from countries such as Australia, New Zealand and Thailand increased from USD 4 million in 2009 to USD 20 million by 2012 and to USD 79.5 million in 2013 (Duong, 2014).

However, the income of people in some regions of Vietnam such as the North West highlands has remained below the international poverty line and are continuing to fall behind in agricultural development compared with those in lowland regions. These higher rates of poverty within communities dominated by ethnic minorities can in part, be attributed to poor access to profitable markets in comparison with other regions of Vietnam, but also to various biophysical constraints to agriculture especially long dry winters and remote mountainous terrain. Ironically, the highland areas also currently support a significant proportion of the total beef cattle population of Vietnam in small holder farming systems.

A scoping mission undertaken in June 2009, by the project proponents, and a report by van de Fliert in 2008 (ACIAR Project No CP/2007/123), found that the main constraint to cattle production in these highland regions was the availability and quality of feed, particularly during the cold, dry winter season. This situation causes under-nutrition of animals, increased susceptibility to cold stress and increased mortality. According to Mr. Nguyen Thanh Son, Vice Director of Livestock Production, Ministry of Agriculture and Rural Development, the national mortality rate of cattle and buffalo attributable to cold-stress was 5% in 2008. Most of the deaths, 44,951 or 87% of the total, were in northern mountainous areas and 40 -50 % of these were calves. Khounsy *et al.* (2012) reported that during 5 days of March 2011, in Laos provinces adjacent northern Vietnam, an extreme cold event contributed to some communities losing up to 80% of their cattle. In Xieng Khouang province alone there were 4,600 cattle deaths.

Based on local findings and the agreed priority 'Improved management and marketing systems for large ruminants and pigs' determined at a stakeholder workshop in Sa Pa, September 2008, this project selected the following specific research priorities:

- Identification of constraints in the livestock supply chains;
- Improved feed availability and integration of appropriate forage varieties into the farming system;
- and improved management of livestock.

van de Fliert (2008) also reported that of the farmers interviewed, cattle was ranked as the most important enterprise after rice, and cattle ranked as having the most potential for improved income generation after small livestock. The farmers believed that with improved feed availability and quality, particularly during the winter season, they could enhance the profitability of their livestock enterprise and improve their livelihoods in a sustainable way.

Le *et al.* (2010) suggested that based on current knowledge and technologies, medium farms (5-9 cattle) had the most potential for future development of beef production in the highland region. Although resources such as experienced livestock farmers, feed availability and labour exist in the region, Le *et al.* (2010) also found that small farms (2 - 4 cattle) were

limited by economic resources (both feed and labour), whilst large farms (> 10 cattle) suffered from limited management knowledge and high feed costs.

The two areas identified by the scoping report for maximum impact from research investment in beef cattle production systems were Sơn La and Điện Biên provinces, two adjoining but contrasting highland provinces. Estimates according to DARD in 2008 for numbers of beef cattle in the provinces of Sơn La and Điện Biên were 180,000 and 30,000 respectively. By 2013, this had increased to 195,600 and 44,400 respectively (Vietnam Statistics Office, 2014).

Of the two provinces, Sơn La appeared to have better market access with potential to supply beef to the rapidly developing market in Hà Nội. Điện Biên is more remote with a beef supply deficit within the province and limited opportunity for farmers to move from subsistence based to market orientated production. It was anticipated that the activities and outcomes of the project would also be of direct relevance to neighbouring highland provinces, particularly Lai Chau which was once a single province with Điện Biên.

A considerable amount of research has been conducted for larger scale cattle production systems on developing options for overcoming the technical issues of low cow-calf productivity in highly seasonal environments with cold winters and hot summers (Bailey 2005, Franzluebbbers and Stuedemann 2006, Rinehart 2006). Strategies included controlled breeding, improved feed availability and quality, improved utilisation of crop residues, preferential feeding of cows and calves at critical times of the year and better housing. However, experience in smallholder farming systems in Indonesia (Lisson *et al.* 2010) and South Central Coastal Vietnam (SMCN 2007/109) has shown that there is typically a range of constraints requiring a combination of carefully selected/designed solutions that take into account the socio-economic and biophysical attributes of the farming system in question. Devendra (2000) suggested that knowledge of availability of total annual feeds, synchronising animal feed requirements to supply, assessment of extent of feed surplus/deficits and existing strategies to cope are pre-requisites to developing improved strategies for feed resource use.

Research specific to the problems associated with smallholder farming systems in the North West highland area of Vietnam has been limited, providing further justification for this project; testing and evaluating documented effective mitigating strategies used in other environments, together with new innovative approaches to address small holder farmer's profitability and sustainability.

4 Objectives

The aim of the project was to develop, evaluate and implement technical and market strategies to improve smallholder incomes from beef cattle in the northwest Highlands of Vietnam

Specific objectives and activities of the project were:

Objective 1: Improve the efficiency and effectiveness of existing beef value chains and the profitability and sustainability of the value chain for smallholder cattle producers:

- 1.1 Undertake value chain diagnosis to identify current economic barriers for smallholder farmer production systems in Sơn La and Điện Biên provinces.
 - Collect historical data and document previous VCA research
 - Observe VC production, marketing and behaviours and conduct stakeholder workshops
 - Design and implement and analyse questionnaires
 - Develop new VC management models
- 1.2 Implement value chain interventions by trialling and evaluating models and materials to extend to smallholder communities and chain participants.
 - Characterise and quantify beef attributes
 - Establish interest groups for capacity building and knowledge dissemination
 - Conduct training workshops
 - Dissemination of new knowledge to farmers, extension agents, policy makers and other key stakeholders

Objective 2: Quantify the biophysical and socio-economic characteristics of the smallholder farming system involving cattle production:

- 2.1 Review of relevant publications and datasets describing the farming systems of the NW Highlands and their associated constraints.
 - Undertake literature review and collect secondary information and historical data
 - Conduct stakeholder workshop to raise project awareness
- 2.2 Conduct benchmarking activities to characterise the key features of the NW Highland smallholder farming systems and to identify constraints to beef cattle production.
 - Design, implement and analyse benchmarking surveys
 - Implement biophysical monitoring and identify production constraints for beef cattle

Objective 3: Develop and test viable management strategies for capitalizing on market opportunities and minimizing the impact of the cold, dry season and other important cattle production constraints.

- 3.1 Identification and evaluation of the production, social and economic impacts of potential strategies for addressing cattle and market constraints, through conducting workshops and on-farm trials.
 - Conduct potential solution workshops to set on and off farm research priorities
 - Conduct on-farm trials to evaluate best-bet strategies
- 3.2 Conduct off-farm trials to address specific knowledge gaps.

- Conduct off-farm experiments on the effect of cold stress on the performance of beef cattle to identify solutions to improve winter survival rates.
- Conduct off-farm experiments to assess effect of supplements from locally available energy and protein sources and different finishing systems to mitigate identified constraints.

3.3 Undertake extension activities utilising on-farm trials to disseminate project findings to other farmers and stakeholders.

- Facilitate training workshops for farmers and extension staff to ensure dissemination of identified solutions and strategies beyond the immediate study areas.

5 Methodology

5.1 Site Selection

This project was undertaken in the provinces of Sơn La and Điện Biên, in North West Vietnam, using a methodology involving preliminary data, community engagement, research intensive, capacity building and extension and education. Detailed selection criteria for the project areas and site selection report for Sơn La is detailed in the Appendix 11.1.

Sites were selected based on the following criteria (as determined from project team workshop in April 2011), and ranked by level of importance.

1. Accessibility (traffic)
2. Land (0.2-0.5 ha/cattle, for free grazing)
3. Number of cattle/household: 5-10
4. Farmers willing to join
5. Farmers willing to invest
6. Possibility of semi-intensive practice trial in household
7. Local labour availability (by altitude)
8. Local government allowance
9. Possible land for forage planting
10. Farmers willing to fertilize if asked
11. Market accessibility
12. Ethnicity: priority for minorities
13. Altitude difference: Up/low land
14. Breed (local breed dominated)
15. Household has exchanged cattle
16. Good local veterinary services

5.1.1 Sơn La

According to the Provincial Statistic Agency (2010), the total cattle population of Sơn La was 190,000 head, with the three larger districts of Thuận Châu, Sông Mã and Mai Sơn containing 22,800, 29,000 and 20,700 head respectively. Based on the criterion of access, and recommendations from the local government as having the most potential for improvement, the communes of Long He (Thuận Châu district) and Tà Hộc (Mai Sơn district) were selected. Refer to Figure 1.

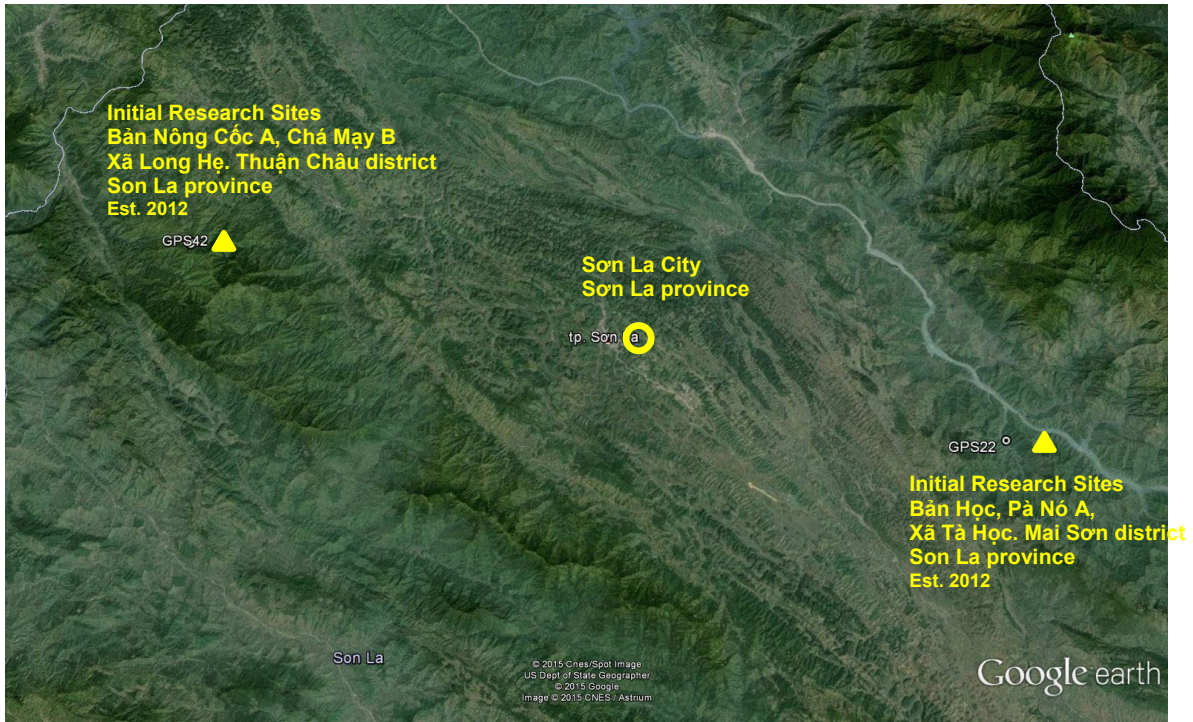


Figure 1 Long He (Thuận Châu) and Tà Học (Mai Sơn) project communes in Sơn La

5.1.2 Điện Biên

Điện Biên Đông and Tuần Giáo districts were selected in Điện Biên province as they had the largest number of cattle (8,300 and 6,300 head respectively). However, due to lack of apparent interest from communal farmers in Điện Biên Đông, two communes in Tuần Giáo were chosen; Tỏa Tình, an upland commune, and Quài Cang, a lowland commune. Refer to Figure 2.

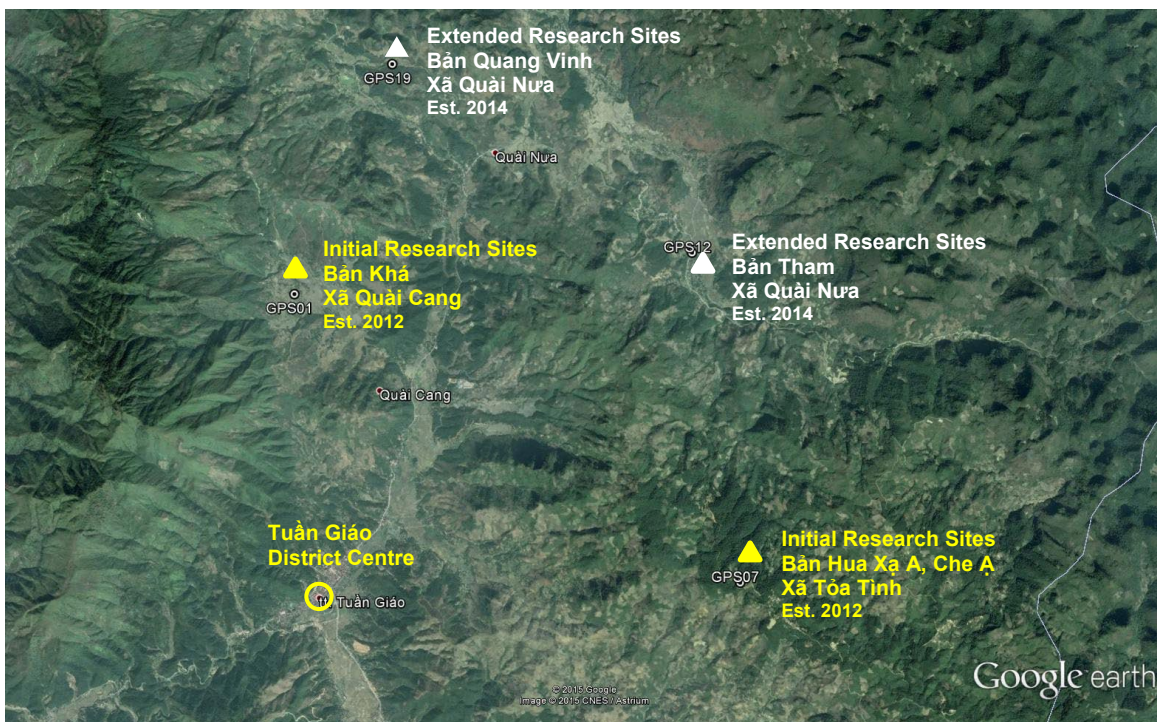


Figure 2 Tỏa Tình and Quài Cang project communes in Tuần Giáo district Điện Biên

5.2 Primary beneficiaries and research partners

The primary beneficiaries of the project were identified as smallholder farmers with beef cattle, commune leaders and local extension staff, the partner researchers and those who participated in field activities. The project endeavoured to establish strong links between the research partners National Institute of Animal Sciences (NIAS), Thai Nguyen University of Agriculture and Forestry (TUAF), Centre of Agrarian Systems Research and Development (CASRAD), Vietnam National University of Agriculture (VNUA) and Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) to ensure a high level of learning and capacity building within the agencies and the education and training sector more widely.

The participation of provincial DARD staff in project activities has been critical to sustaining development and extension activities post-project, because of their linkages and working relationships with Commune Leaders and Animal Health Committees.

A small, but strategically significant activity was undertaken with Tay Bac University in Sơn La province to provide engagement and capacity building at the provincial, district and commune levels and to work closely with TUAF in conducting on-farm trials.

5.3 Preliminary data collection and review

5.3.1 Literature review

In order to address the first objective of the project a review of published literature on production, consumption and value chains of beef cattle in Vietnam was undertaken by Vietnam National University of Agriculture (Pham, 2011). This included an overview of beef value chains in Vietnam and a description of production and consumption of beef in Vietnam, especially in the North and North West region.

The review was structured as follows.

- A summary of legal documents (i.e. policies) related to cattle and beef production
- Beef production and consumption in Vietnam
- The market for beef (including domestic and export market)
- Overview of beef value chains
- Conclusions and implications

A second review was undertaken to address objectives 2 and 3 and provided an overview of beef cattle production; management, environment interaction and performance (Mai et al, 2011). This was a technical review and provided details of cattle distribution, breeds, management, feeding, pasture fodder, crop by-products, performance and potential intervention strategies.

5.3.2 Background information

In order to identify prospects for the development of the commercial orientation of the outputs of this project, CIRAD sourced and analysed the policies and institutions governing the beef cattle value chain in Sơn La (Duteurtre, 2011). Institutions taken into account included public regulators, as well as formal and informal rules governing activities in the value chain, from cattle production to consumption. The work was based on interviews with actors of the value chain, as well as entrepreneurs, civil servants, and policy deciders involved in governing transactions in the value chains. The interviews were conducted in the province of Sơn La from June 2011 to November 2014.

5.4 Community engagement

5.4.1 Research to adoption pathway

The underlying objective of any research for development activity is to establish a research to adoption pathway. This project endeavoured to engage and maintain engagement with all primary and secondary stakeholders in the beef cattle production system in the two study provinces. The main challenge faced by the research team was to establish a level of trust within a cultural context and they did this through two methods; stakeholder workshops and student participation.

5.4.2 Socio-Cultural context

There are 54 ethnic minority groups in Vietnam with each minority group having different traditions, rules and practices around lifestyle, agricultural production and animal husbandry (housing, feeding and slaughtering). The research team from Vietnam National University of Agriculture investigated the two main groups of Thai (lowland) and H'Mong (highland) with respect to the scope of influence of each culture on their individual farm system. Analysis of various social/cultural factors was based on ethnicity differences, geography, and grazing practices. Primary data collection from the two provinces included:

- Households (HH) with cattle
- Living in different locations (Điện Biên, Sơn La)
- Living in different elevations (Lower Area, Higher Area)
- Different ethnic groups (mainly: Thai + H'Mong)
- Two communes in Sơn La (Tà Hộc (LA) + Long He (HA)): 82 HHs
- Two communes in Điện Biên (Quài Cang (LA) + Tỏa Tình (HA)): 108 HHs
- Total 186 people

5.4.3 Key Stakeholders

Workshops were conducted periodically throughout the life of the project to engage and network with key stakeholders of the beef cattle production system in Điện Biên and Sơn La. An initial workshop was conducted in Sơn La in September 2011 to confirm the objectives of the project and to establish priorities of research and to:

- review/clarify benchmarking results and cattle production constraints;
- identify possible solutions and discuss and analyse the potential social, economic and production impacts of these solutions;
- select the most viable strategies for on-farm testing;
- and design off-farm trials to address specific knowledge gaps.

Attendees included all the research partners, DARD, local community and government agencies, veterinary services, slaughterhouse representatives and farmers. Refer to Figure 4 and 5.



Figure 3 Stakeholder workshop



Figure 4 Setting research priorities

These and subsequent workshops were undertaken using a participatory approach involving initial presentation of topic, focus group discussions and whole group priority setting. The most important element that maintained 'grounding' of workshop outputs was the inclusion of small holder farmers in determining research priorities.

5.4.4 Inception meeting and annual reviews

The annual reviews were conducted in a different location each year and involved project site visits and consultation with the relevant stakeholders, culminating in a meeting/presentation day.

March 2011

The inception meeting was held in Thai Nguyen City and hosted by Thai Nguyen University of Agriculture and Forestry in recognition of its connection with the ethnic minorities that dominate the North West highlands.

March 2012

The first annual review was conducted over three days commencing with visits to project sites, provincial, district and communal offices, culminating in an official annual review workshop in Điện Biên on the last day. Day one involved travelling to Mai Sơn District, meeting provincial and district officials, followed by meetings and a tour of the project villages in Tà Hộc commune (Refer to Figure 6). Main outcomes were:-

- The programme enabled all partners to discuss the outputs of year 1 and proposed activities for year 2 with project participants at a local level.
- Overall project objectives were reinforced with local officials.
- Student placement from TUAF in the first year and planned placements for subsequent years was well received by commune officials and local farmers.



Figure 5 Farm visit to village chief in Tà Hộc commune, Mai Sơn District.

Day two commenced with a meeting at Thuận Châu District office, providing an overview of planned activities for year 2. The review team then travelled to Tuần Giáo District and further to Quài Cang Commune for meetings and discussions with DARD officials, extension officers and farmers. Local officials and selected farmers were then invited for an evening meal where Ms Tracey Lister presented the ‘chefs’ point of view of beef attributes required for the end user in Hà Nội (Refer to Figure 7). Main outcomes were:-

- Discussions at the local level about years 1 and 2 as for day one.
- Farmers were exposed to the ‘potential’ of their beef enterprises through the Hà Nội chef presentation.
- Overall project objectives were reinforced with local officials.



Figure 6 Presentation by Ms Tracey Lister, Director of Hà Nội Cooking Centre, in local restaurant in Tuần Giáo.

Day three of the annual project meeting included final planning and the official annual review workshop in Điện Biên.

March 2013

The second annual review was conducted in Tasmania and provided an opportunity to bring lead researchers in the project to the University of Tasmania for introducing new research concepts, capacity building and networking.

February 2014

The third annual review was conducted using the same approach as year 1, culminating with the annual review workshop in Tuần Giáo. This location was selected as it was central to all research areas and easily accessible for farmers, government officials and researchers.

March 2015

A fourth annual review was held in Tuần Giáo together with a planning workshop for any further activities required to fulfil project objectives. A beef research exposition was also held as part of the review and took place at the Điện Biên breeding centre.

July 2015

The final review meeting, which also included external reviewers, involved visits to project sites and discussions with local DARD and other beef value chain participants in Sơn La and Điện Biên. The format allowed ample opportunities for one on one discussion between researchers and the reviewers regarding activities, achievements and limitations. The final meeting/workshop was conducted at the National Institute of Animal Science in Hà Nội.

5.4.5 Student participation

This method was introduced initially by Thai Nguyen University of Agriculture and Forestry as practical application of research theory for undergraduate and post graduate students. The students at this university are from many of the 54 ethnic minorities recognised in Vietnam. The initiative of locating students in their home villages (project villages) to undertake field work associated with their studies (and relevant to the project), provided the unintended consequence of community 'buy-in' and acceptance of the project and its objectives. A list of undergraduate and post graduate theses completed and based on the data set output of this project is in Section 10.2.

5.5 Research intensive

The research activities were planned as a reiterative process with feedback mechanisms shown in Figure 8 informing forward planning for each of the project objectives.

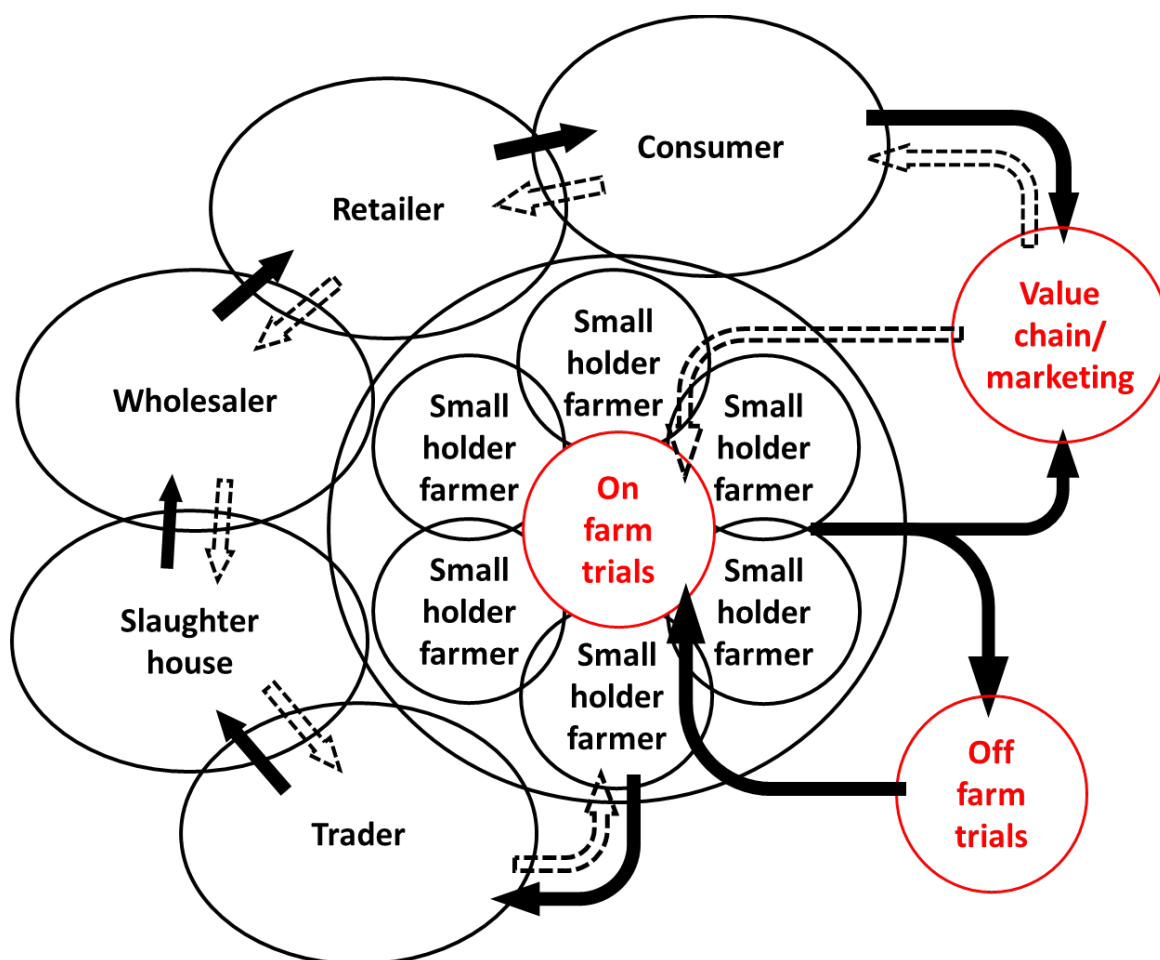


Figure 7 Research methodology – a reiterative process

The solid arrows show the feedback mechanism that was forecasted in the project planning and what eventuated throughout the project. The dotted arrow shows the intended feedback mechanism that occurred only as part of baseline surveys.

5.5.1 Value chain and marketing

A variety of methods were used for value chain and marketing commencing with a rapid value chain analysis (RVCA) involving the process of walking back up the chain from consumer to primary product source. This was followed by a degustation workshop at a large city supermarket in Hà Nội, where characterisation and quantifying beef quality attributes from laboratory analysis were compared with consumer preference.

A new method of chain communication appropriate to the regions was also developed to facilitate the flow of demand/supply information and customer/consumer feedback. This was in its simplest form as a farmer interest group.

The value chain component initially aimed to establish an exemplar chain as the focus for communication by the local community and Government agencies. Outputs from value chain intervention activities were then intended to inform the ongoing research activities addressing technical limitations and vice versa. However, it became clear within the first 2 years of the project that the baseline study was only the beginning of understanding the value chains in the two provinces. The remaining period of the project was then used to test various strategies, rather than test and then use the strategies to inform the technical research. There is now the opportunity to use the Value Chain and marketing research to inform and focus any follow up research activities.

5.5.2 Technical – off farm

Off farm technical experiments on the effect of cold stress on the performance of beef cattle were conducted to identify solutions for improving winter survival rates, and to assess the effect of supplements from locally available energy and protein sources and different finishing systems to mitigate identified constraints to productive performance. These were conducted at the National Institute of Animal Science in Hà Nội. Methods are summarised for each of the experiments listed below

Effect of low temperature and feeding levels on performance of beef cattle.

- Six local beef calves (9-10 months) were randomly allocated into a repeated Latin Square Experimental Design for 12 weeks and fed one of maintenance, below-maintenance and above-maintenance diets.
- The calves were placed in a climatic room with test temperatures of approximately 20°C, 10°C and 4°C.
- Metabolic activity measurements were recorded in a climate-controlled respiratory chamber. Total dry matter intake, feed residuals, faecal and urinary outputs were also recorded.

*Effect of feeding four graded levels of dried *Leucaena leucocephala* on weight gain and feed conversion ratio of fattening cattle.*

- Twenty (20) 15 to 18 months old bulls were allocated into 4 dietary treatment levels of *Leucaena leucocephala* (0, 20, 25 and 25%) with a basal diet of maize, rice bran, rice straw, elephant grass, molasses and minerals calculated to achieve a weight gain range of 0.5 to 0.7 kg/head/day.
- Cattle were fed twice per day for 84 days with all feed ingredients mixed well before pooling with rice straw.

Use of groundnut stem and leaf silage for beef cattle in household of Sơn La during winter - spring season

- This study used a combination of in vitro and in vivo methods.
- In-vivo - various silage formulations including groundnut stem and leaves, corn flour, cassava chips, molasses and salt were assessed for gas production (silage quality attribute) over 96 hours and then analysed for dry matter and crude protein.
- The in-vivo method used 24 head of cattle with a treatment combination of free-grazing and silage supplementation over 90 days, with cattle assessed for live weight gain over that period.

Estimation of feed value of crop by-products for beef cattle production in Northern Mountainous areas of Vietnam during the winter-spring season.

A study was undertaken to evaluate the feed value of available crop by-products for feeding to beef cattle in the NW Highlands of Vietnam (Quang *et al.*, 2015). Two formulations of crop by-products based on fresh cassava roots and corn cobs, were assessed using an *in vitro* cumulative gas production technique and an *in vivo* feeding experiment. The two crop by-product formulations consisted of 22% fresh cassava root and 20% corn cobs, and 26%

fresh cassava root and 16 % corn cobs respectively. Molasses, urea, vitamins, minerals and salt were added to each formulation. The ration formulations were analysed for dry matter, crude protein, crude fat, crude fibre, neutral detergent fibre, acid detergent fibre, ash, organic matter and nitrogen.

The *in vitro* gas production method showed a higher volume of gas production over a 96hr measurement period for the ration formulation with 22% fresh cassava and 20% corn cobs ($P < 0.05$), indicating that this formulation would be more readily fermented in the rumen of beef cattle.

The results of the *in vivo* experiment using these ration formulations with cattle in a feedlot situation over 90 days, supported the results of the *in vivo* study. Cattle fed the formulation consisting of 22% fresh cassava and 20% corn cobs achieved an absolute growth rate of 183.3 g/day, while cattle fed with 26% fresh cassava and 16% corn cobs had an absolute growth rate of 164.8 g/day ($P < 0.01$). From this research, it can be concluded that crop by-products such as cassava and corn cobs which are readily available in NW Vietnam can provide adequate nutrition for cattle growth during the winter period when feed shortage is a major problem.

5.5.3 Technical – on farm

The on farm technical trials included biophysical monitoring, assessment of natural pastures, feed efficiency of processed by-products, assessment of forage varieties, assessment of supplements on growing and finishing cattle and a feeding strategy x shelter trial of cattle production systems in Sơn La and Điện Biên provinces. All related to feed availability, feed quantity, quality and management, cattle breeding cycles and cattle growth rates. The on farm technical trials were followed with best-bet demonstration trials established on selected farms.

- Assessment of the utilisation of unmanaged free-range pastures for cattle production
 - Includes introduced and native species
 - Species were identified and assessed for growth rates and potential feed sources.
- Use and processing of by-products for cattle production
 - This experiment was paired with the in-vitro off farm experiment.
 - Conducted using 3 groups of animals of 3 animals each for 90 days and measured for live weight gain.
- Initial assessment on growth and yield of some grass species grown in the north western mountainous region
 - Fully replicated randomised trials were established to assess growth rates of *Brachiaria X* (Mulato 2), *Panicum maximum* (Guinea grass TD58), *Pennisetum purpureum x P. glaucum* (VA06), *Tripsacum dactyloides* (Guatemala grass), along with the herbaceous legume *Stylosanthes guianensis* (CIAT 184).
 - Trials were established at both highland and lowland sites to determine sustainable (or not) production throughout the winter period.
- Effect of supplements from locally available energy and protein sources on performance and economic returns from growing cattle.
 - This feeding trial was undertaken for 90 days on a smallholder farm in Điện Biên using three groups of five growing bulls, each fed a different dietary treatment.
 - Fifteen growing bulls of yellow cattle with average live weight 175 kg and 15 month of age were divided randomly into three groups based on live weight and ages (i) group 1: free grazing; (ii) group 2: free grazing and supplement 4% urea treated rice straw and (iii) group 3: free grazing and supplement with 4% urea treated rice straw and concentrate.

- Feeds were offered and residuals recorded daily for each animal with live weights taken prior to feeding at 30 day intervals throughout the experiment.
- Implementation of best bet feeding regimes combined with shelter for cattle production in all study villages
 - Growth rates of cattle were assessed

5.6 Capacity building

5.6.1 Training workshops

Training workshops were conducted in each village for farmers and extension staff upon completion of each trial using a participatory approach to ensure understanding of identified solutions and strategies. The method involved the use of hands on demonstrations, posters and the distribution of forage management leaflets (in the case of the forage trials).

5.6.2 Train the trainer

Train the trainer workshops were conducted for extension staff and researchers from each province to ensure dissemination of identified solutions and strategies beyond the immediate study areas. These workshops included practical demonstrations and on-farm walks to assess results of trials.

5.6.3 Interest groups

Collective action groups or cattle raising interest groups were established in each study village in the project. The name 'interest group' was chosen to avoid any reference to cooperatives. The name cooperative was found to be unfavourable and unpopular with many of the farmers. The groups were formed with individual farmers of common interest to facilitate capacity building, increase technical knowledge and to reduce barriers to potential markets.

5.7 Extension and education

5.7.1 School programmes

A two hour education programme for ages 8 to 11 years was conducted in Quài Nưa primary school in 2013 and then Quài Nưa and Ninh Binh primary schools in 2014, with the aim of disseminating results of the research trials into the next generation of farmers. The programmes were run using a method of community engagement, introduction to the new learning, participatory activities to consolidate new learning - by doing, and concluding with a summary of new learning. It was based on the theory of:

- One listens – one may forget
- One sees – one may remember
- One does – one will remember

The method of delivery used games and singing as an introduction, followed by a play called 'Once upon a beef cow' (based on the learning theme). This was followed by the use of activity stations. The children were divided into five groups and stationed at each activity for 10 minutes, before rotating to the next activity. Each activity was based on beef cattle production and included:

- Drawing a map of house and yard
- Planting seeds and cuttings
- Fertiliser and manure
- The taste test – what do cattle like to eat

- Cutting and weighing grass, activity stations

Each activity was facilitated by researchers, extension staff and teachers.

5.7.2 Final dissemination workshop

The final dissemination workshop or beef cattle research exposition was held at the cattle breeding centre in Điện Biên in March 2015 and followed a similar method to the school programme. Each activity station focussed on key outputs of the project and included:

- Value chain stakeholder linkages
- Marketing and labelling
- Forage establishment, growth and management
- By-product utilisation
- Cattle growth assessments

The workshop was facilitated by researchers and the provincial DARD for the benefit of local DARD and extensionists from Điện Biên and Sơn La province and Lao PDR, slaughterhouses, traders, retailers and farmers.

5.8 Impact Assessment

5.8.1 Scientific, capacity, social and environmental impacts

Scientific and capacity impacts were assessed from the training activities undertaken, scholarships awarded, study commenced, and the informing of curricula. Social and environmental impacts of the project interventions were assessed by the research partners collecting stories (case studies) at regular intervals throughout the project period from project participants and then documenting using both written and photographic monographs. Participant responses to interventions have also been recorded on television for a local news broadcast.

5.8.2 Economic impacts

A specific activity to assess the impact of the projects interventions was conducted by VNUA in June 2015 using both quantitative and qualitative methods.

Sampling

A survey was conducted with farmers who actively joined in the project's research sites including Long He (Nong Coc), Tỏa Tình (Hua Sa A), Quài Cang (Kha), Quài Nưa (Tham and Quang Vinh). In order to compare with out-project farmers as well as looking for the expansion of project supported techniques to community, a further survey was conducted with adjacent and neighbourhood farmers not involved in the project (Table 1).

Table 1 Sample size in project sites

	Nong Coc	Hua Sa A	Tham	Quang Vinh	Kha	Total
In-project	7	2	3	2	1	15
Out-project	4	4	7	6	6	27
Total	11	6	10	8	7	42

Data collection

Participatory Appraisal: conducted focus group discussion, which included trial households and their neighbourhood, by using Participatory Rural Appraisal tools such as semi-

structured dialogue and mapping to identify obstacles in adopting and expanding project's feeding techniques.

Rural Rapid Appraisal: interviewed farmers in and out of project's trials by semi-structured questionnaire. Questions focussed on some basic characteristics of households, their income sources, cropping production for cattle as well as cattle production activities. Furthermore, the questionnaire also helped to identify costs associated with producing crops as well as ensilaging techniques.

Cost-benefit analysis approach: to calculate potential cost and benefit of adopted feeding techniques, in the absence of ACIAR project funding; to estimate opportunity cost of the feed management strategies which may be a significant inhibition to farmers' decision to adopt.

6 Achievements against activities and outputs/milestones

The project achieved its objectives with the research team using a pragmatic approach of setting expectations around activity deliverables. This included developing a Gantt chart within two months of the inception meeting that detailed all activities (and relativity to each other), personnel involved, chain of responsibility and timeline. There was a considerable time lapse between the inception meeting (February 2011) and the signing of the contract with in-country partners and subsequent release of funds (July 2011). However, this allowed detailed project planning and establishment of effective communication channels between partners. The presence of the Australian project co-ordinator living in-country for the first twelve months of the project also built relationships and provided a continual and consistent link with the Australian team.

Objective 1: To improve the efficiency and effectiveness of existing beef value chains and the profitability and sustainability of the value chain for smallholder cattle producers.



1.1 Value Chain Diagnosis Research

no.	Activity	outputs/ milestones	completion date	comments
1.1.1 PC	Literature review and secondary information collection	Methodologies and findings on previous VCA related research documented Background information on cattle development in VN and NW synthesized	December 2011	Literature review was completed by Pham Van Hung and included in the compendium of reports and publications. In December 2013 the VNUA team also submitted a socio-cultural literature review.
1.1.2 PC, A	Training on Value Chain Analysis/ workshop focussing on methodologies	Workshop report produced Training materials produced Detailed methodologies agreed and documented including site selection, sample selection, types of data collection methods and instruments, questionnaire, etc.) Detailed work plan agreed	June 2011	Training workshop conducted in 2011, including the production of training materials etc. Attached in appendices. Methodology workshops were also conducted and site selection criteria agreed and questionnaire formatted. Detailed work plans in the form of Gantt charts were developed for years 1 and 2.
1.1.3 PC, A	Design rapid value chain analysis process	Design questionnaires Pilot test questionnaires Diagnosis of questionnaires Checklist of inputs: supply companies; inputs supply agents/shops; Government extension service providers; cattle producers, assemblers, wholesalers, retailers, consumers prepared and tested	September 2011	Survey design was undertaken collectively by CASRAD, VNUA and TUAF

1.1.4 PC, A	Implementation of CVC survey and diagnosis or Rapid Value chain appraisal	Material flows, information flows, and relationships from input suppliers through to consumers described Profit sharing among stakeholders quantified Constraints faced by value chain stakeholders identified. Outputs for this activity included identifying socio-cultural effects on the value chain, beef quality assessment and other factors affecting cow raising. A poster was presented at the Uplands Conference in Germany in April 2012 that was a synthesis of findings to date.	December 2011	Due to budgetary allocations, CASRAD undertook surveys in Son La province, as it was perceived to be the larger of the two value chains, whilst VNUA undertook the surveys in Điện Biên province. TUAF accompanied both teams, thereby providing a necessary link
1.1.5 PC	Perform data analysis, combining data from all actors surveyed by province	All data synthesized	December 2011	
1.1.6 PC	Draft report	Report submitted	January 2012	The reports were submitted as individual partner reports relative to specific study areas. Unfortunately this affected the cohesion of the objective 1 team, which was later addressed to some extent. Preliminary results were submitted as a poster to Sustainable Land Use and Rural Development in Mountain Areas Conference, Hohenheim University in Stuttgart, Germany.
1.1.7 PC, A	Mid-term workshop	Synthesis of 6 actor reports Plan of next phase of research Publications Introducing market-based intervention to key stakeholders	March 2012	Undertaken at the annual review meeting in March 2012

PC = partner country, A = Australia

1.2 Value Chain Intervention Research

no.	Activity	outputs/ milestones	completion date	comments
1.2.1 PC	Product quality assessment and requirement	Beef quality attributes are characterized and quantified through internal and external quality signs, using laboratory analysis; Consumer assessment of product quality by degustation; Consumer value attributes determined by retailer or consumer research.	October 2012	This activity was undertaken and reports completed. The consumer assessment was conducted at Big C shopping centre and was televised on the national news network. Negotiations are continuing for distribution of this to a wider audience.
1.2.2	Develop, implement and review best practice value chain management models for participants in each stage of the focal chain			See below
1.2.2.a PC	Designing a system of recognition & tools of market development for Sơn La beef	Labels and packaging developed and used in experimental distribution channel	September 2013	
1.2.2.b PC	Widening scale of beef sensory evaluations	Consolidate 2012 data from Hà Nội	December 2013	80 consumers' comments on Sơn La beef quality were collected from 4 locations in Hà Nội (Cầu Giấy, Thành Công, Thái Thịnh, Hoàng Văn Thái)
1.2.2.c PC	Establish experimental distribution channels and Improve linkages between stakeholders	Sơn La slaughter houses – Rural food company - 5 retail shops	Feb 2014	An experimental chain was established from Sơn La to a small supermarket chain in Hà Nội. Preliminary evaluation found that meat supply was one of the limiting factors even for the experimental chain. 

1.2.3 PC, A	Final Dissemination workshop	Outputs presentation (product, linkage between farmer's group and other's stakeholders; Policy brief presented and disseminated; Policy maker and other stakeholder's understanding of how to improve the efficiency and effectiveness of existing beef value chains; Get farmers and other agents in the chain to understand market demand for beef: quality and willingness to pay, etc. (from consumer survey).	March 2015	A beef cattle research exposition was conducted in Điện Biên research centre and delivered key messages of research to major stakeholders in the value chain including farmers, traders, slaughterhouses, retailers and extensionists (from Điện Biên and Lao PDR). A short video is being produced to be uploaded on YouTube. Leaflets were also distributed to participants.
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Objective 2: To quantify the biophysical and socio-economic characteristics of the smallholder farming system involving cattle production

no.	Activity	outputs/ milestones	completion date	comments
2.1.1 PC	Literature review and secondary information collection (agency and historical climate records etc)	Critical analysis of previous projects and literature to confirm understanding of current beef cattle system. Collected background information to validate primary data from 2.2. Local agency information collected and collated to assist with survey design and methodologies.	December 2011	Literature review completed. Background data collected, although technical information from the areas of study was limited on specific aspects of cattle production such as numbers, grazing and feeding practices, impacts on the environment, disease and marketing.
2.1.2 PC, A	Conduct stakeholder group workshop including farmers, traders, retailers, and extension agency staff (joint activity with Objective 1)	Raised project awareness, relationships built and developed, constraints and opportunities (i.e. cultural, economic) discussed. Identify case study farmers based on defined selection criteria, to initiate biophysical and socioeconomic monitoring. Specific locations for primary data collection determined.	April 2011 + December 2011	After consultation with the in-country Coordinator, this stakeholder workshop was replaced with field meetings conducted by a project working group. The working group consisted of representatives from NIAS, CASRAD, TUA, TBU, VNUA and UTAS. The workshop was deemed an inappropriate terminology for the activity. However, a workshop was conducted in December 2011, once preliminary survey information, literature reviews and secondary information had been collected and summarised. This workshop was then used to discuss and confirm results obtained from literature, survey and desk top studies.

2.2.1 PC	Design and implement benchmarking surveys ensuring quality control (i.e. validation of data).	Key baseline socio-economic and farm management information collected and constraints faced by beef producers identified.	September 2011	Completed in conjunction with Objective 1 team.
2.2.2 PC	Implement biophysical and socioeconomic monitoring.	Baseline socioeconomic status of smallholder households quantified; Biophysical features of the farming system (forage availability, feed management practices, cattle breeding cycles, cattle performance, soil characteristics and climate) characterised.	December 2011	Information was also used as a basis for monitoring and evaluation of behavioural change with the actors in the beef cattle production system. Interaction and collaboration continued with ACIAR projects AGB/2008/002, FST/2010/034 and JICA forage project in Son La. There was an initial interaction in June 2012 with project AH/2006/159 "Best practice health and husbandry of cattle and buffalo in Lao PDR" which was addressing similar issues.
2.2.3 PC	Collate and validate survey data	Data on feed availability and animal performance monthly recorded (on targeted farms); data collected from primary survey validated and/or adjusted	February 2012	
2.2.4 PC	Data analysis and report preparation	Preliminary results were submitted as a poster to Sustainable Land Use and Rural Development in Mountain Areas Conference, Hohenheim University, in Stuttgart, Germany. Report/scientific papers have been written and documented in output schedule.	February 2012	
2.2.5 PC	Identify constraints and opportunities at bet best farm household	A full report of selected best bet farmer visit was prepared by Jeff Corfield	February 2012	Report completed and available on request.

PC = partner country, A = Australia

Objective 3: To develop and test viable farm management strategies for capitalizing on market opportunities and minimizing the impact of the cold, dry season and other important cattle production constraints

no.	Activity	outputs/ milestones	completion date	comments
3.1.1 <i>PC, A</i>	Conduct workshop to review/clarify VCA and benchmarking results particularly cattle production constraints, to identify and analyse potential on farm and off farm experiments	Workshop conducted, and experiments determined, including protocols, methodologies etc. Potential solutions identified and discussed with potential social, economic and production impacts modelled. Trial intent, number, nature, scale and design of on and off farm trials confirmed.	March 2012	
3.1.2 <i>PC</i>	Conduct on-farm experiments to evaluate best-bet strategies for addressing cattle production and market constraints arising from workshop.	'Best bet' strategies identified and used to inform and refine value chain analysis and off farm experiments.	July 2015	A series of individual experiments related to forage production, native grass assessment, by-product processing were completed and then combined in a whole of system experiment with shelters and feeding troughs. 'Best bet' strategies are continuing with farmers from each village. Train the trainer and farm field schools were also conducted to reinforce the methods used in the 'Best Bet' process. This activity ran concomitant with Objectives 1 and 2, and was also used for application of outputs from 3.2.1 and 3.2.2.
3.2.1 <i>PC</i>	Conduct off-farm experiments on the effect of cold stress on the performance of beef cattle.	Solutions identified to improve winter performance and survival rate of beef cattle. One peer reviewed conference paper presented to AAAP 2014. Vu et al (2014)	May 2014	The first of these experiments was conducted to investigate the interaction of cold stress and nutrition at 3 different but constant temperatures. However, more work is required to determine effects of changing temperature (i.e. sudden reduction) which more closely simulate the adverse weather events that occur in the NW Highlands.

3.2.2 PC	Conduct off farm experiments to assess effect of supplements from locally available energy and protein sources and different finishing systems to mitigate identified constraints.	Supplement feeds and strategies identified to improve performance and profitability of growing and finishing beef cattle. Three peer reviewed conference papers presented to AAAP 2014. Nguyen et al 2014a, Nguyen et al 2014b & Pham et al 2014.	May 2014	Two trials were conducted. The first in the Điện Biên district in conjunction with the Điện Biên DARD using Urea treated rice straw. The second at NIAS, Hà Nội using locally available feed and different levels of legume (<i>Leucaena spp</i>) for a protein source in feed regimes.
3.3.1 PC, A	Dissemination /training workshop for farmers, extension staff and other key stakeholders	Training courses organised; appropriate technical solutions disseminated.	Refer to Schedule	14 training and dissemination workshops conducted with a total of 998 participants. Refer to Workshop Schedule 3.3.1

PC = partner country, A = Australia

7 Key results and discussion

7.1 Preliminary data collection and review

7.1.1 Literature review

Value Chain

The main outcomes of the literature review of beef value chains were as follows:

- Limited studies on beef value chains in Vietnam.
- More research on cattle production and techniques.
- There are many participants along the chain. Many have a role which is localized and transitory; few specialize in cattle and beef marketing to the exclusion of other economic activities.
- Beef value chains are difficult to separate from the buffalo value chain.
- Slaughterhouses play a key role in the chain, but most have no certification.
- The value of a live animal is based primarily on its estimated meat yield and the current prices for meat and not usually based on animal characteristics (age, sex).
- Most beef cattle supplied to urban markets is transported by truck.
- Beef production in Vietnam is mainly
 - extensive beef production (90%),
 - semi-intensive and intensive farming (10%).
- In Vietnam, the consumption of beef is gradually increasing but seasonal.
- Farmers currently raise cattle for multiple purposes.
- In recent years, trend of cattle production has decreased due to bad weather and diseases.
- Information transfer up and down the chain is limited and diffused.

Overview of beef cattle production, management and performance

The technical review provided details of cattle distribution, breeds, and management and feeding, pasture fodder and by-products, performance and potential intervention strategies.

The North West of Vietnam consist of 4 provinces; Sơn La, Điện Biên, Lai Châu and Hòa Bình, with Sơn La and Điện Biên considered the more disadvantaged in terms of accessibility and economic development. The region is dominated by smallholder cattle farmers with an average of 3.5 head per household. The cattle are kept mainly for personal use and are one of two main animal husbandry systems; the closed breeding system (breeding cattle => calf => beef cattle) and the open breeding system (calf => beef cattle), where calves are bought in. The cattle breeds include 74 % Vietnam Yellow cattle, 13 % H'Mông cattle, with the remainder consisting of Lai Sind and Brahman. Only 10 % farmers' use cut & carry all year with between 60 % and 90 % using a combination of tethered grazing and supplements at different times of the year. The highland farms in particular practice free-grazing. Potential strategies have been identified for further investigation. These include:

- Subsidies from provincial and local government for subsistence farmers to buy roughage for cattle during cold periods.
- Provision of nutritious feeds such as cereal silage.
- Construction of draft free stables for cattle through winter with enough space and good well drained floor.
- Forage plantation of at least 300 m² of grass per animal.
- Make use of agricultural residues such as rice straw, corn stems.

- Ensilage summer/autumn over supply of fresh forage (at least 1 tonne/head).
- Plant cattle feed specific (high density) maize (need 500 m²/head) and ensilage.
- Prepare young calves for the cold weather.

7.1.2 Background information and Baseline Data

Sơn La

According to the Provincial Statistics Agency (2010), Sơn La has 190,000 cows and 170,000 buffaloes. Developing cattle production is one of the key plans of the government, to be concentrated in the 3 districts with the largest number of cattle: Thuận Châu (22,800 cattle, 5700 buffaloes), Sông Mã (29,000 cattle, 17,700 buffaloes, - 100 km from the city) and Mai Sơn (20,700 cattle, 14,700 buffaloes). Based on the project selection criteria, DARD and the project group chose Thuận Châu and Mai Sơn districts to establish the research sites. In Thuận Châu, the communes Cò Mạ (with a cattle market) and Mường Khiêng (Thai commune) were initially selected but due to some concerns about access, the research was moved to Long He commune.

Mai Sơn district contains 21 communes, 1 town, has an 8 km border with Lao PDR, and produces a range of crops including sugarcane, cassava, tea, maize, and rubber. From the 2011 project survey there were 148,000 head of livestock including 1,400 buffaloes, 2,000 cattle, 92,000 pigs and 1,000 horses. However, it was noted that the low number of cattle was purported by farmers to be the result of recent cattle deaths from cold weather. As a result, the government had given priority to developing cattle production and forage on approximately 60 ha in the region. Tà Hộc commune, Mai Sơn is located in a steep valley area, with potential for free grazing in the forest. Cassava and maize have been poorly developed, with some upland villages having potential for cattle grazing. The government staff suggested that there was a potential market for local cattle both outside and inside the district, but currently limited by numbers.

Thuận Châu has been actively encouraging cattle production as a consequence of the recent decision by the Sơn La Government to develop cattle and double cattle numbers to 22,000 head. There has also been support provided for low interest loans for developing cattle, forage planting and calves. Approximately 400 ha of elephant grass was planted with 200 ha set aside as a gathering area. The government continues to support breeding improvement as well as developing and increasing the forage planting area.

Điện Biên

Up until 2010, there were 4 districts with a large number of cattle including Điện Biên (10,200 cattle, distinct from Điện Biên city), Điện Biên Đông (8,300 cattle, upland), Tuần Giáo (6,300 cows, on the border with Thuận Châu – Sơn La), and Mường Nhé, Mường Ảng. Thái ethnic groups are located in the low lands, while H'Mông ethnic groups are located in the upland. Almost all local beef is currently consumed locally, because low quality and small size cattle limit export outside the province.

Communes near Pha Đin mountain pass in Tuần Giáo, on the border with Thuận Châu, Sơn La, have large cattle numbers, but also a high prevalence of mortality because of cold and Foot and Mouth Disease (FMD) with farmers not knowing how to administer appropriate treatment. There are some local slaughter houses and a town market with 30 cattle per day consumption. The local government recommended Tỏa Tình, an upland commune with 100% H'Mông, and Quài Cang, a lowland commune, 2 km from the town. The baseline survey found that upland farmers practice mostly free grazing, returning the cattle to the village at the end of the day.

Tỏa Tình has 7 villages, 409 households, with a total of 1889 people. At the time of survey, there were 438 cattle and more than 700 buffaloes. Although it was a key commune in the district's programme of cattle development, the reduction of natural grazing area because of

forest protection policy, and farmer's lack of technical knowledge, has led to a decrease in cattle numbers. Furthermore, recent severe winter cold was reported to have resulted in 100 cattle deaths. However, there are still many households raising cattle and planting elephant grass.

Quài Cang has 22 villages, with 1,440 households, 7,437 people (67% poor), and a native grazing area of 4,000 ha. In this commune cattle have been raised under shelter, but have faced challenges of reduced free grazing area, technical knowledge and limited forage availability. At the time of the survey there were 305 cattle and 1195 buffaloes. An extreme cold event recorded in February/March 2011 was reported to have resulted in more than 500 cattle deaths. This commune was selected because of its proximity to, and the existence of, a local cattle market, with small collectors able to collect cattle from farmers.

7.1.3 Socio-Cultural study

Conclusions of the socio-cultural study prepared by VNUA (Duong et al, 2014) were:

- Farmers believed that they appear to be rich if they have more cattle, but they may not want to sell them
- Understanding more about the socio-economic factors of this belief may help target interventions
- Market development/Production for market is likely to take more time
- Although similarities within the Northwest region, farming practices may still differ due to
 - Geographical reasons (higher/lower land)
 - Ethnic cultural differences
- Age/Sex of household head cannot be checked because different roles of family members
- Regulations may help better access to natural resources (i.e. pasture) in short term but for further development, better techniques/practices may be required
- People in the NW (most of them are also farmers/producers) consume a little beef (and also other meat)
- Low income in Minority people is the main reason for low demand for beef in the region
- Consumption of beef is concentrated more in social events such as wedding, funeral, New Year celebrations (TET), and 'village ceremonies'.
- Other measures should be combined to motivate ALL chain actors to adopt new behaviours

In summary, the differences between farmers with respect to cattle raising and cattle selling were related to ethnicity, geographic location and grazing practices. H'Mông farmers were more likely to sell for building houses, whilst Thái farmers thought more about improving income. Điện Biên farmers kept cattle for breeding only, whilst Sơn La farmer's kept cattle for breeding and draught. Cattle sales were higher from those farmers that practiced free grazing with the proceeds of sales used more for general consumer purchases than tuition fees (education) and savings. It was noted that most farmers interviewed would have liked more cattle, but not necessarily for income improvement. For cattle sold, Figure 9 shows cattle and subsequent meat flows in the beef value chain.

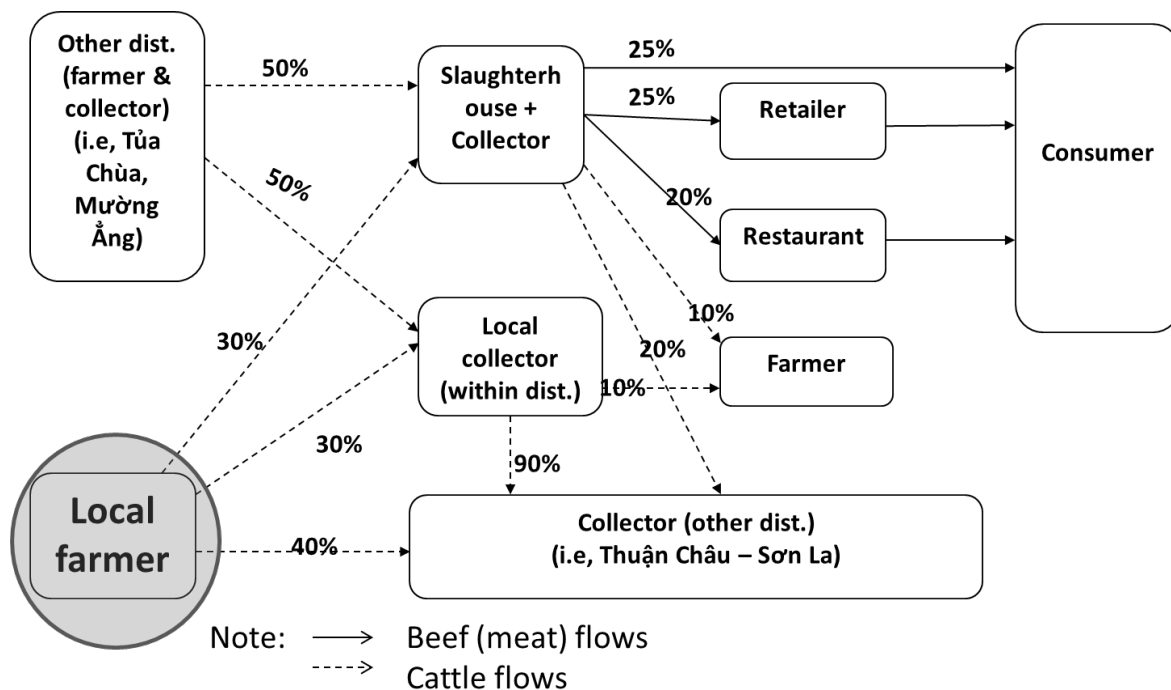


Figure 8 Cattle and meat flows in the Beef value chain - Tuần Giáo

7.2 Research output

7.2.1 Value chain and marketing

Điện Biên Beef Value Chain

- Điện Biên has small scale chains suited to traditional local markets – collaboration & aggregation required to supply larger markets.
- Chain is loosely linked vertically but horizontal linkages are strong at slaughtering & retail – chain collaboration & communication necessary.
- >80% farmers want to increase cattle numbers in the future & participate in husbandry clubs – use farmer clubs in extension.
- Farmers identified their priorities as finance, fodder, seed/cuttings & technical training.
- Consumers concerned about quality and safety but have little awareness of beef quality control & quarantine.
- Farmers are passively involved in the VC because of many social & economic factors.
- As passive participants individual farmers cannot influence the VC unless they combine into marketing clusters (associations/clubs).
- Understanding socio-economic factors in chain behaviour has potential to improve efficiencies.

Sơn La beef value chain

- Sơn La has beef value chains to local and larger markets (Hà Nội). However, there has been an increase in contract farming supplying the Thang Tung enterprise.
- Consumers have shown appreciation for the quality of Sơn La beef through tasting (refer to meat quality and sensory analysis).
- Consumers appear to be willing to pay higher prices to buy quality beef with clear origin and safety.

- Beef is generally consumed from September to December and because of the lunar demand, prices may be higher at these time, but also dependent on the Chinese market.
- The proposed capacity of meat supplied by experimental chains was too small for the slaughterhouses in Thuận Châu, Mai Sơn and Sơn La to participate in the project. Furthermore, the condition of food safety of the slaughterhouse appeared unqualified and good practices were untested.
- Food safety conditions of slaughterhouses appear to be below standard – but difficult to assess.
- Lack of uniformity in quality, as it is dependent on the ordered volume, weight and age of the cattle.
- The chain from Sơn La to Hà Nội may affect the beef quality due to unreliable transport times in excess of 9 hours.

Designing a Logo and label for Sơn La and Điện Biên beef

Before implementing trial beef channel from Sơn La to Hà Nội, the value chain team investigated the market and discussed options with stakeholders involved in the supply chain.



Figure 9 Logo and label proposals for Sơn La beef



Figure 10 Promotional products suggested for Sơn La beef

Meat Quality and Sensory Analysis

This activity was undertaken on beef samples from four different animals: three-year-old animals from Sơn La, Điện Biên and Thailand and a five-year-old animal from Sơn La. Information about the beef cattle was collected from the breeders and is shown in Table 2. The grazing method was unknown for the 3-year-old Thai beef because it was collected in the slaughterhouse in Hai Boi – Dong Anh. The beef samples were analysed by Vietnam National University of Agriculture. In addition, sensory evaluation was held at Big C Hà Nội supermarket to assess sensory properties of beef samples before and after processing.

Table 2 Characteristics of the beef cattle used in evaluating beef quality traits

Beef origin	Sơn La		Điện Biên	Thailand
Age (years old)	3	5	3	3
Breed	Local	Local	Local	Unidentified
Male/female	Male	Male	Female	Male
Weight	65kg	130 kg	170 kg	600kg
Origin	Mai Sơn	Mai Sơn	Tuần Giáo	Thailand
Grazing method	Free range	Semi-free range	Free range (dry season), daily herding (wet season)	Unidentified
Feed	Grass	Grass	Grass and other by product	Unidentified
Vaccination	2 times/year	2 times/year	2 times/year	Unidentified
Slaughterhouse	Mai Sơn	Mai Sơn	Tuần Giáo	Hai Boi

The meat was collected immediately after slaughter from slaughterhouses in Mai Sơn – Sơn La, Tuần Giáo - Điện Biên and Hai Boi - Dong Anh – Hà Nội. After slaughter, meat was trimmed from ribs 6 to 9, cooled for 30 minutes, covered with airtight nylon film and stored at 4 to 6°C, then analysed for pH, colour and water loss (WL) during storage, WL during processing, chewiness protein, lipid, dry matter, total mineral content, and Arsenic (As) and Lead (Pb).

Customer evaluation was organised at BigC market as a sensory activity involving 102 customers. They observed the fresh raw meat and tasted the cooked meat and were then asked to complete an assessment sheet (100-point scoring scale) of sensory properties. The fresh raw beef samples were assessed for colour, colour attraction, smoothness, odour and overall acceptance, whilst the beef steak samples were assessed for water content, chewiness, sweetness and overall acceptance. Table 3 shows that 5-year-old Sơn La beef was the most favoured for purchase by consumers.

Table 3 Raw meat purchasing decisions

Sample	Most favoured (%)	Purchase decision (%)
3-year-old Sơn La	21	22
5-year-old Sơn La	60	49
Điện Biên	6	14
Thai beef	14	16

Table 4 shows that 5-year-old Sơn La beef steak was also most favoured by consumers after a sensory evaluation.

Table 4 Customers' choice for cooked beef samples

Sample	Most favoured (%)
3-year-old Sơn La	17.02
5-year-old Sơn La	32.98
3-year-old Điện Biên	27.66
3-year-old Thai beef	22.34

7.2.2 Technical – off farm

Effect of low temperature and feeding levels on growth rate of beef cattle.

In this experiment, calves were fed diets of below maintenance (A), maintenance (B) and above maintenance (C) and placed in a climatic room where the test temperatures were set up at approximately 4°C, 10°C and 20°C throughout three periods of a digestibility trial.

The results showed significantly different feed intake between the group fed diet (B) and (C) compared to diet (A) (2.1 and 2.0 vs 1.8 kg DM respectively). Furthermore, effect of temperature levels on digestibility of the DM, CP, Fat, NDF and OM digestibility were the lowest in 4°C (41.18; 42.66; 39.27; 50.34; 45.74% vs. 45.01; 44.27; 44.56; 53.97; 49.48% in 10°C and 47.47; 45.98; 52.30; 55.09 and 50.58% in 20°C).

Effect of feeding levels on digestibility of DM, CP, Fat and OM digestion were also significantly different between diet (A) compared to diet (B) and (C). There were significantly different urea concentrations of plasma in calves subjected to 4 °C and 10 °C compared to calves subjected to 20 °C (4.34 and 4.07 vs. 3.05 nmol/L).

Low temperature and feeding levels significantly reduced digestibility and affected metabolic rate of cattle, with below maintenance feeding exacerbating cold stress and temperature effects on blood urea concentration.

Effect of supplements on fattening cattle

The supplemental feeding experiment to assess the effect of feeding four graded levels of dried *Leucaena leucocephala* on weight gain and feed conversion ratio of fattening cattle, found that cattle fed with 20 % dried legume leaf achieved a weight gain of 760 g/head/day after 3 months. In contrast cattle fed 31.5 % dried legume leaf only achieved a weight gain of 573 g/head/day, which was not significantly different to cattle that were not fed the legume

supplement. This suggests that higher protein diets in these cattle may not be conducive to achieving optimum weight gain.

Further work is required to investigate the optimum ratio of supplements to fresh feed.

The use of processed by-products in beef production

Two experiments were conducted to analyse both gas production (in-vitro) and weight gain (in-vivo) from processed by-products. The first study involved using groundnut stem and leaf silage for beef cattle in households of Sơn La during winter - spring season (November 2012 to March 2013). The silage consisted of ground nut leaves with various ratios of two additional formulations of some materials such as groundnut leaves, fresh sliced cassava, cornmeal and molasses.

In vitro analysis showed that gas production increased with incubation time, with the highest volume of gas production produced after 48 hours. Formulation that used 65 % groundnut leaves had a higher gas volume than the formulation using 72 % groundnut leaves.

In vivo testing of feed supplements for cattle fattening during 90 days in the winter – spring season showed that the groundnut leaves silage had an absolute growth rate of 162 – 175 g/day.

The second experiment used in vitro gas production of processed crop by-products to assess the possibility of using processed by-products in beef cattle production in small households in Northern Mountainous areas of Vietnam during the spring-winter season. The studies used 2 formulations of crop by-products; corn cobs, corn flour, fresh cassava and molasses. In vitro gas production showed an increase in correlation with incubation time, with the highest gas production volume achieved between 12 to 48 hours after incubation.

The formulation of 21.6 % fresh cassava and 20.0 % corn cobs had a higher gas volume than the formulation using 25.6 % fresh cassava and 16.0 % corn cobs. Furthermore, the formulation of 21.6 % fresh cassava and 20.0 % corn cobs achieved the highest absolute growth rate of 183.3 g/day with DM and CP of 13.9 % and 1.5 % respectively, compared to absolute growth rate of 164.8 g/day for cattle fed with 25.6 % fresh cassava and 16.0 % corn.

Crop by-products provided adequate nutrient supplement for cattle growth during the winter period, but formulation is critical in achieving maximum growth rate.

7.2.3 Technical – on farm

Utilisation of free-range pasture for cattle production

This assessment of natural pastures identified and characterised 30 introduced and native species with 30% of farmers using pastures for cut and carry, with remaining farmers using pastures for grazing. Species most consumed whilst grazing included *Cynodon dactylo*, *Apluda spp.*, *Mutica Hos*, *Digitaria abludens*, *Centosteca lappacea*, and *Cymbopogon caesius*, whilst species used for cut and carry included *Trema orientalis*, *Broussonetia papyrifera* and *Pseudoxyste-nanthera albo-ciliata*.

The assessment found that the major growth of natural pastures occurred in summer and autumn, which is not sufficient to fill the winter feed gap.

Use of crop by-products for cattle production

The research showed that rice straw, corn by-products and banana trunk are available in sufficient quantities to satisfy the winter feed gap. Although the biomass production of these by-products was shown to be very high, the study found that the utilization of them was limited due to farmer knowledge and awareness, as only 50 % of farmers utilised non-

processed by-products. The crop by-products, supplements and locally available energy and protein sources were tested on the performance and economics of growing cattle.

After three months, there were significant differences between the average daily gain (ADG) of the three groups; 125 g/head/day for group 1 (free grazing), 271 g/head/day for group 2 (free grazing and supplement with 4% urea treated rice straw), and 504 g/head/day for group 3 (free grazing and supplement with 4% urea treated rice straw and concentrate).

Calculated economic returns for different groups showed that supplement 4% urea treated rice straw and supplement 4% urea treated rice straw plus concentrate can earn 1,217,000 VND and 2,775,000 VND respectively more than free grazing cattle in group 1.

In conclusion, the study found that the feed regime for grazing cattle should be supplemented to improve growth performance and economic returns. For best and optimal economic returns, growing calves should be fed a combination of concentrates and rice straw.

Evaluation of introduced forages

Initial assessment of *Pennisetum purpureum* x *P. glaucum* (VA06), *Brachiaria X* (Mulato II), *Panicum maximum* (Guinea grass TD58), *Tripsacum dactyloides* (Guatemala grass), along with the herbaceous legume *Stylosanthes guianensis* (CIAT 184), found very little difference in overall dry matter (DM) yield between species grown in both highland and lowland communities.

The results of the trial over a twelve month period are shown in the Table below.

Variety	Highland yield/year (DM t/ha)	Lowland yield/year (DM t/ha)	Harvests/year
VA06	66.7	63.7	5
Mulato II	36.1	33.9	8
Guinea TD58	54.6	51.9	8
Guatemala	11.7	11.2	5
Stylo	10.1	10.5	5

7.3 Community engagement and capacity building

7.3.1 Training workshops

Training Seminar, Tà Hộc Commune – May 2013

The seminar was facilitated by Ms Hai from CASRAD and conducted primarily for establishment of cow raising interest groups and production of a beef selling plan. Outputs included completion of a monitoring notebook. It was attended by 32 trainees from the villages of Nong Coc, Ban Hoc 1 and Ban Hoc 2 (Refer to Figure 14).



Figure 11 Ms Hai leading training activity, Tà Hộc Commune – May 2013

Training Seminar, Tay Bac University – June 2013

The seminar was facilitated by Dr Nguyen Xuan Ba (Hue University, Vietnam) and Dr David Parsons (UTAS), and attended by 20 students and 20 researchers and lecturers (Figure 15).

Nguyen Xuan Ba presented information on the use and management of different forages suitable for cattle production, and David Parsons gave a presentation on:

1. Farming System Research
2. Best Bet Approach
3. Descriptions of Options
4. An example from South Central Coastal Vietnam



Figure 12 Dr Ba from Hue University presenting participation certificates to students at Tay Bac University after a Farming Systems Seminar in June 2013.

Paper Writing Workshop – October 2013

A workshop funded by the Crawford Fund was conducted at Hue University and delivered by Associate Professor Caroline Mohammed, Dr Chris Beadle and Dr David Parsons. This was attended by Dr Mai Anh Khoa (TUAF), Dr Nguyen Hung Quang (TUAF), Le Van Hung

(NIAS), Nguyen Duy Linh (NIAS) and Ms Dang Thi Hai (CASRAD) who all had significant roles in the project. Papers were written by each participant and used as the basis for abstracts submitted to the AAAP congress in November 2014. The intention was for these papers to be further developed for submission to international journals after mentoring from workshop facilitators and research partners.

Farm Field Schools - June 2013

Tà Hộc Commune - 10 researchers and 18 farmers (Thai descendants) discussed forage options and observed planting areas of “elephant grass”.

Quài Cang Commune - 21 farmers and 10 researchers and lecturers discussed forage options and investigated reasons for crop failures.

Tỏa Tình Commune - 10 researchers and lecturers were joined by extension officers, members of the Peoples Party and 21 farmers (15 men and 6 women). Instruction was given by Dr Nguyen Hung Quang on techniques for producing forages.

7.3.2 Train the trainer

Best Bet Training Seminar, Tay Bac University – May 2014

The seminar was delivered by Mr Jeff Corfield and was attended by 16 students, 8 lecturers, 4 extension staff from the DARD and 8 project partner researchers. This involved a morning of lectures and group discussions and an assignment to assess the uptake of knowledge, followed by field visits in the afternoon (Figure 16 and Figure 17).



Figure 13 Mr Jeff Corfield (left) defining ‘Best Bet’, translated by Dr Mai Anh Khoa (right)



Figure 14 Forage field visit by students of Tay Bac University – May 2014

Best Bet Training Seminar, Điện Biên – May 2014

The seminar was delivered by Mr Jeff Corfield and was attended by 5 JICA (Japan International Cooperation Agency) project staff, 5 staff from the provincial DARD, 20 district extension staff, 7 farmers from Tỏa Tình, Quài Cang and Quài Nưa and 8 project partner researchers (Figure 18). Although the information provided and discussed was the same as at the Tay Bac seminar, the format was modified to accommodate the field based participants (i.e. extension and project staff).



Figure 15 ‘Best Bet’ training, Điện Biên DARD, translation by Dr Vu Chi Cuong

7.3.3 Interest groups

Three interest groups were established in Mai Sơn and Thuận Châu districts; Nong Coc, Ban Hoc 1 and Ban Hoc 2 with a total of 53 farmers in the two districts. The basis of involvement in the interest group was that each farmer owned at least two head of beef cattle (Table 5).

Table 5 Scale of interest group in Mai Sơn and Thuận Châu districts

No.	Nong Coc	Hoc village No 1	Hoc village No 2
Members	17	24	12

Total cows	108	46	37
Average cows/household	6	2	3

The leaders of the peoples committee in Tà Hộc and Long He communes had been granted approval for interest groups to operate in the villages.

After the group was established, the representatives of each group were trained about building interest group profile, making product plans, developing marketing skills and business accounting.

A supporting fund was established with seed funding, which was built on by members. The group selected two members who were able to borrow from the fund in the first year to buy two head of cattle between them, with the objective that the loan would be repaid once calves were born, reared, finished and sold in the following years.

Further interest groups have been established in Tỏa Tình and Quài Cang in Tuần Giáo district.

7.4 Extension and education

7.4.1 School programmes

The first school based programme was conducted in Quài Nưa Commune Primary School, Tuần Giáo District, Điện Biên Province, Viet Nam in October 2013 and repeated in the same school and Ninh Binh Primary School in November 2014 in recognition of the importance of children as ‘future users’ of innovation strategies to improve livestock management (Refer to Figure 19 and Figure 20). The two hour bi-lingual programme involved interactive learning through play, ‘learning by doing’ activities and reflection. 63 children aged eight to eleven, six farmers, fourteen teachers, six researchers, three agricultural extension officers (DARD), two observers, a translator and the district Director of Education were in attendance in 2013. Qualitative feedback revealed that within eight weeks of delivering the programme DARD conducted forage management training with over thirty farmers who had heard about the school programme, and teachers requested a follow up programme to ‘train the trainer’ for undertaking future agricultural knowledge transfer activities. The method used in this project offers a useful template for age-specific, culturally appropriate training in animal production (systems), and strongly supports the recognition of children as legitimate recipients of agricultural extension activity. *(Extract of paper submitted to AAAP Congress 2014).*

In 2014, a further 350 students from Ninh Binh Primary School and 100 students from Quài Nưa Primary School were in attendance at the programme.



Figure 16 Introductions for dissemination activity, Quài Nưa Primary School – October 2013



Figure 17 Forage growing activity, Quài Nưa Primary School – October 2013

The full programme including the play (and Vietnamese translation) and materials required is included as Appendix 11.2.

7.4.2 Extension materials

Information about the forages tested in this project, together with forage cuttings, have been distributed by the Điện Biên DARD to other districts within the province. Management leaflets developed by Thai Nguyen University were provided with all distributed plant material supporting on-site demonstrations to ensure the transfer of correct information (Refer to Figure 21).

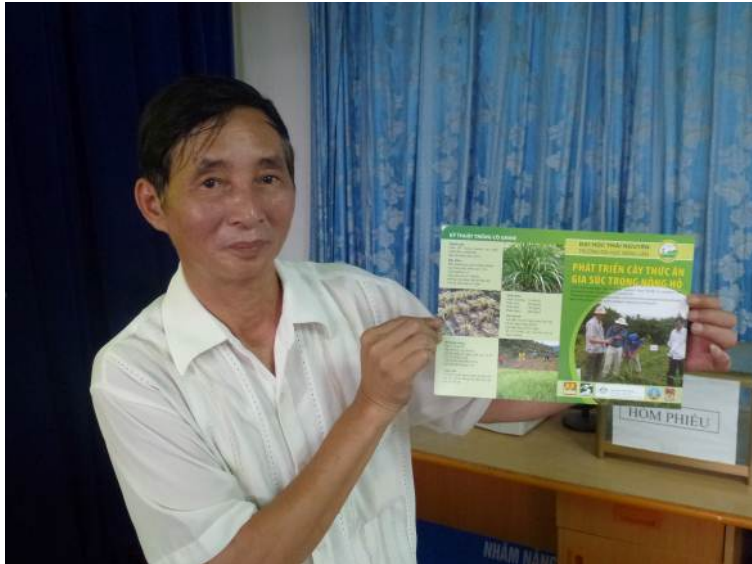


Figure 18 Dr Phan Dinh Tham displaying one of four forage management leaflets distributed with cuttings from the project

7.4.3 Early adopters

As a result of project research activities, the research team found that 31 farmers in total from Bản Học, Pà Nó A, Xã Tà Học, Huyện Mai Sơn and Bản Nông Cốc A, Chá Mạ B, Xã Long Hẹ, Thuận Châu distric,Điện Biên; 12 from Bản Hua Xạ A, Che A, Xã Tỏa Tình; and 7 from Bản Khá – Xã Quài Cang, Tuần Giáo were primary adopters of technologies. The number of best-bet activities adopted by each farmer varied depending on their circumstance. Farmers used new forages around houses, ponds and larger dedicated planting areas, improved forage management (i.e. cutting height, fertiliser), Leucaena living fences, Urea treated rice straw, Cassava chip silage, Feeding troughs and shelters.

8 Impacts

8.1 Scientific impacts – now and in 5 years

This project has developed beef cattle feeding strategies using local available feed resources to compose rations that meet nutritional requirements for energy and protein at levels above maintenance as an antidote to cold stress and calf mortality. Staff from NIAS, TNU, DARD and other collaborative partners developed substantial scientific knowledge on the evaluation of local available feed resources and nutritive components of gross energy, crude protein, acid and neutral detergent fibres to formulate concentrate mix for growing and finishing cattle. This work resulted in presentation of seven papers at the 16th AAAP Animal Science Congress, Gadjah Mada University, Yogyakarta, Indonesia by representatives from our partner agencies. Papers are shown in publication list.

Four Higher Degree Research (PhD) students have commenced study at the University of Tasmania as a consequence of their involvement as researchers with the project. Three directly relate to nutritional supplementation and meat quality traits of ruminants, and one is on beef value chains. Two have been funded through the John Allwright Fellowships (one from NIAS, the lead Vietnamese institution, and one from VNUA) and two have been funded through Australian Development Scholarships (one from NIAS and one from TUAU). One PhD based specifically on this project was completed and defended in December 2015 at NIAS and supervised by Professor Vu Chi Cuong.

The market and value chain surveys increased understanding of farmer knowledge, cultural behaviour, husbandry skills and the effect of nutrition and socio-economic factors on beef cattle management and beef marketing practices. Over the next five years, it is anticipated that methods used in the research will be used in the teaching programme of the universities involved, particularly with forage species, adaptation to different growing regions and management.

The outcomes of the project activities have also informed curricula at the tertiary level. Dr Mai Anh Khoa and Dr Nguyen Hung Quang (Thai Nguyen University of Agriculture and Forestry) and Mr Tran The Cuong (Vietnam National University of Agriculture) have already incorporated project outputs into their current undergraduate teaching programmes. This includes research outputs as well as new methodologies for undertaking field research.

8.2 Capacity impacts – now and in 5 years

Capacity of farmers, extension workers/ DARD, undergraduate students and researchers/institutions was built.

Farmers

The trial farmers have become empowered with new knowledge and reported to have become local suppliers of the introduced forages, with stems/cuttings exchanged between farmers and then sold out of the local area. However, they have also found that expansion of forage area is constrained by:

- land resources – forage is in direct competition with land that is currently used land for cropping maize and cassava
- distance - if forage is grown on cropping areas, it is often far from the houses, is not as convenient and harder to manage/protect from other free grazing animals
- limited size of convenient areas around houses/ponds
- high price of chopping machines for making silage from excess summer feed (a small machine at 17 Million dong is the same price as one head of cattle)

These limitations provide an opportunity for farmers to explore an intensified livestock production system, which would be the focus of any follow on project.

Extension workers/ DARD

The value chain and technical workshops conducted in 2014, followed by the beef research exposition in March 2015, provided an opportunity for skill development and networking between farmers, extension workers, DARD and private industry. The request by the local DARD to invite extension workers from Lao PDR to attend the beef research expo demonstrated the confidence that local staff had developed in wanting to share their research understanding and project outputs. This initial meeting will form the basis for cross border collaboration over the next 5 years, which is critical in monitoring cattle movements, biosecurity and animal health and productivity for the whole region.

A direct result of DARD training has been the establishment of a farmer group in Dien Bien district that has 26 members, of which 21 are women. The DARD have already undertaken training for the members in the areas of silage production, and rice straw utilisation.

Undergraduate students

A student from Thai Nguyen University named Ms Huyen, under the supervision of Dr Phan Dinh Tham, completed her final thesis after working in the project. A strategy initiated by the research team from Thai Nguyen University was to engage final year students in the project who then use the data collected in the project to complete their final thesis. The most effective part of the strategy was to place the students in the communes of their origin. This ensured support from the commune and ongoing exposure. Ms Huyen's father is a part time farmer in Quài Cang Commune and part time teacher at Quài Nưa Primary School. Once Ms Huyen graduated she obtained employment with the Điện Biên DARD and was assigned to the Tuần Giáo District. Through attending the school programme in October 2013 (elsewhere detailed in this report) in support of her father, children at the school encouraged their parents to seek training on forage production from Ms Huyen. The first training was undertaken with 30 farmers from Quài Nưa Commune in attendance. These same farmers have also been given forage cuttings by Ms Huyen's father (who has established a forage nursery on 2 ha behind his house) and plan to follow and support future activities of the project.

Researchers/Institutions

The project saw the establishment of the only climate controlled installation for animal experiments in northern Vietnam, located at the National Institute of Animal Science, Thuy Phuong, Tu Liem, Hà Nội.

Two researchers from the project were also awarded John Dillon Fellowships in 2012 and 2013.

8.3 Community impacts – now and in 5 years

The project has made small localised impacts in the communities where the research activities were undertaken. It is anticipated that over the next 5 years that contact through extension workers, the DARD and farmer networks will increase the uptake of new technologies. The use of undergraduate students in the research activities will also provide longer term benefits in their home communities when they return to take up positions in the local DARD or extension service. However, there is more work that needs to be done to change current attitudes of farmers from cattle keeping to cattle production. Nonetheless, there have been reportable impacts from a post intervention economic study (https://ivessblog.files.wordpress.com/2017/03/vnua_intervention_response_may_2015.pdf), and case studies of social and environmental changes described herein.

8.3.1 Economic impacts

A cost benefit analysis using introduced interventions was completed by VNUA in June 2015 and is shown in Table 6. Of the farmers interviewed 67 % plan to increase their number of cattle, 18 % intend to increase forage production but retain cattle numbers, and the remaining 15 % do not plan to change their current situation.

Table 6 Cost Benefit Analysis – Feed Comparisons

		S1 = Traditional practice	S2 = S1 + forage	S3 = S2 + silage
Year 5	Revenue	25000	0	0
	Forage ('000vnd)	-115	0	0
	Cassava ('000vnd)	300 [‡]	300 [‡]	300 [‡]
	Net Value Year 5	23221	277	277
Year 4	Revenue	0	25000	0
	Forage ('000vnd)	0	-115	0
	Cassava ('000vnd)	300 [‡]	254.4 [‡]	300 [‡]
	Straw ('000vnd)	0	-42.1	0
	Net Value Year 4	21686	23395	532
Year 3	Forage ('000vnd)	0	-115	0
	Cassava ('000vnd)	300 [‡]	300 [‡]	300 [‡]
	Net Value Year 3	20271	21741	767
Year 2	Revenue	0	0	25000
	Forage ('000vnd)	0	-115	-115
	Cassava ('000vnd)	300 [‡]	300 [‡]	-182.3*
	Straw ('000vnd)	0	0	-168.5
	Net Value Year 2	18967	20215	23327
Year 1	Calf ('000vnd)	-8000	-8000	-8000
	Forage ('000vnd)	0	-115	-115
	Cassava ('000vnd)	300 [‡]	300 [‡]	-182.3*
	Straw ('000vnd)	0	0	-168.5
	Net Present Value ('000vnd)	11267	12400	14862

Source: Pham, 2015.

Note: S1 - Traditional practice (controlled grazing), S2 - controlled grazing with supplementary forage, S3 - controlled grazing with supplementary forage and silage (cassava and straw mixed). Net Value and Net Present value was calculated at a rate of -7.8% (Tanaka et al, 2010) [‡] Cassava sold for starch production. * Cassava silage for cattle feed.

Using a combination of controlled grazing with forage and silage supplementation (S3) showed a potential income increase of 32% above traditional grazing. The estimated time differences between selling the cattle also favoured S3 (2 years) over S1 (5 years).

Considering that a smallholder farmer could sell at least 1 cow per year at the net price of 14.8 Million vnd (US\$ 672), for a 6 person household, there would be a US\$ 9/person/month increase in income. This would shift farmers considered poor at US\$ 13/person/month above the poverty line of US\$ 20/person/month (Tran et al, 2014).

A cattle fattening for sale study conducted by NIAS over a three month period found that farmers achieved the best monetary return on investment after only two months (Table 7).

Table 7 Economic analysis of cattle fattening trial in Điện Biên over 90 days

		Body weight (kg)	Price	Total ('000 VND)
30 days	1. Purchase cost of animal	143	100	14,300
	2. Feed cost	336	7.5	2,520
	3. Selling cost of animal	173	110	19,030
	4. Return = 3 - (1 + 2)			2,210
60 days	1. Purchase cost of animal	145	100	14,500
	2. Feed cost	422	7.5	3,165
	3. Selling cost of animal	189	110	20,790
	4. Return = 3 - (1 + 2)			3,125
90 days	1. Purchase cost of animal	143	100	14,300
	2. Feed cost	715	7.5	5,363
	3. Selling cost of animal	204	110	22,440
	4. Return = 3 - (1 + 2)			2,777

8.3.2 Social impacts

The project has taken very small steps with regard to making any major social impacts in the communities in which it worked. However, individual stories have demonstrated the potential for longer term impacts over the next 5 years and beyond.

Mrs Lo Thi Mai

Mrs Lo Thi Mai a widow with 2 young children in Quài Cang Commune, Tuần Giáo District, Điện Biên was considered one of the poorer members of the village. As such she was able to access 'left behind' resources after harvest by other farmers as a form of community initiated welfare. Although Mrs Mai owns 100 m2 of land, it is not big enough to grow enough rice to sustain her family through the year. Mrs Mai did not have any cattle, but saw the potential of being involved in the beef cattle project. She had enough land to grow a small amount of forage, firstly as trials and then over the last 2-3 years as a 'Best Bet' farmer. Due to her involvement in the project, she was able to borrow money to buy a cow in calf. The cow has now calved twice (as of November 2014), with the sale of the first calf paying off her original loan. Ms Mai has been able to provide sufficient feed to both mother and calf from native pastures, her forage growing area and by-products that she obtains from other farmers in exchange for helping them harvest their crops. Furthermore, Mrs Mai is happy

that she now has the potential to increase her income and escape from poverty whilst maintaining personal care of her children.

Time management

Farmers in Tà Hộc Commune, Sơn La Province, have indicated that they spend less time sourcing forage for their cattle. Prior to the project, they (either wife or husband) supervised the grazing from 7am until 5pm. After introduction of new management techniques cattle are now supervised from 7am until 12 noon. In the afternoon, forage supplement is used for the animals. They are also happy that cattle can be housed and fed during unfavourable weather conditions not conducive for grazing.

8.3.3 Environmental impacts

The environmental impacts of the project have been an indirect consequence of the introduced interventions. Planted forages around houses (below animal shelters) and ponds have reduced soil erosion and nutrient loss, whilst cut and carry has reduced animal movements across the landscape. Air quality in the North West region after rice harvests has generally been poor due to burning of harvest residues. Project farmers have reduced the burning of crop residues over the life of the project and it is anticipated that over the next 5 years, increased utilisation of these resources as feed, will reduce burning further and ultimately improve air quality.

Although the improved feed rations for the cattle have the potential to decrease methane emissions, neither gaseous losses nor air quality changes from interventions have been quantified as part of this project.

8.4 Communication and dissemination activities

Date	Title	Location	Target Participants	No people
March 2011	Inception Meeting	Thai Nguyen City	NIAS, UTAS, ACIAR, TUAF, 20+ VNUA, CASRAD, CIRAD, Hohenheim University, DARD	
29 May 2011	CASRAD Staff Value Chain Theoretical & Field Training	CASRAD	Senior and junior CASRAD Staff	11
31 May-1 June 2011	Project Partner Staff Value Chain Theoretical & Field Training	NIAS	Senior and junior NIAS, VNUA & CASRAD Staff	14
12-13 September 2011	Value chain innovation workshop (2 days) (Joint with AGB/2008/002)	CASRAD	Senior & junior staff: NOMAFSI, PPRI, CASRAD, TBU, VNUA, CIRAD, World Bank, SNV, VECO, GRET, Oxfam, M4P, Helvetas.	46
16 Sep 2011	Beef Value Chain Stakeholder workshop	Sơn La	Farmers, traders, researchers, extension staff, veterinary services, commercial operators	60
29 Nov 2011	Farming systems research and analysis training workshop	Thai Nguyen University of Agriculture and Forestry	TUAF lecture and students	45

Date	Title	Location	Target Participants	No people
March 2012	Annual review and planning workshop	Điện Biên	NIAS, UTAS, TUAUF, VNUA, CASRAD, CIRAD, DARD	35
01 Aug 2012 30 Jun 2013	Farmer Field School - Management of new forage	Long He Commune, Thuận Châu, Sơn La	Farmers, DARD	18
10 Aug 2012	Farmer Field School - Management of new forage	Quài Cang Commune, Tuần Giáo, Điện Biên	Farmers, DARD	17
05 Sep 2012 14 Jun 2013	Farmer Field School - Management of new forage	Tỏa Tình Commune, Tuần Giáo, Điện Biên	Farmers, DARD	35
Oct 2012	Degustation workshop	Big C, Hà Nội	CASRAD, VNUA, Consumers, researchers	136
15 Oct 2012 19 Nov 2013	Farmer Field School - Using and storage of agriculture by-products	Tà Hộc Commune, Mai Sơn, Sơn La	Farmers, DARD	39
Feb 2013	Annual review and planning meeting	UTAS, Australia	NIAS, VNUA, UTAS, CASRAD, TUAUF	14
13/14 Mar 2013	Training workshop on Livestock Experimental Designs, Statistical Analysis and Writing and Publishing Livestock Research Data	NIAS, Hà Nội	NIAS, VNUA, CASRAD and DARD	60
May 2013	Interest group training	Sơn La and Điện Biên	Farmers	80+
11 Jun 2013	Forage Management Workshop	Trường Đại học Tây Bắc (Tay Bac University, Sơn La)	Lecturers from TBU & TUAUF, Sơn La DARD and students	60
Jun 2013	Value Chain Workshop	Điện Biên	Lecturers from TBU & TUAUF, Điện Biên DARD and students	30+
09 Oct 2013	Farmer Field School - Using and storage of agriculture by-products	Quài Cang Commune, Tuần Giáo, Điện Biên	Farmers	12
25 Oct 2013	Farmer Field School - Using and storage of agriculture by-products	Long He Commune, Thuận Châu, Sơn La	Farmers	17
14 November 2013	Điện Biên DARD Workshop "Application of Value Chain Principles in Điện Biên Province"	Điện Biên Phu	Dien Ben & Sơn La DARDs, CASRAD, VNUA, TNU, farmers	100+
February 2014	Annual review and planning workshop	Tuần Giáo	NIAS, UTAS, TUAUF, VNUA, CASRAD, CIRAD, DARD, ACIAR, TBU	25
4 August 2014	Value Chain Management	Điện Biên	Điện Biên DARD	36
Aug 2014	Stakeholder workshop	Điện Biên	Điện Biên DARD, traders	40+

Date	Title	Location	Target Participants	No people
Aug 2014	Farmer Field School - Farmer Account Management	Điện Biên	Farmers	30+
Sep 2014	Immersion Tour – experimental value chain	Cao Bang	Điện Biên DARD, traders, researchers	30+
09 Oct 2013 20 Nov 2014	Cattle production – school education programme	Trường tiểu học Quài Nưa (Quài Nưa Primary School)	Lecturers from TBU, TUAF, NIAS, Điện Biên DARD, teacher and 60 students (8 – 11 years old), UTAS	200
21 Nov 2014	Cattle production – school education programme	Quài Nưa and Binh Minh Primary Schools	Lecturers from TBU, TUAF, NIAS, Điện Biên DARD, teacher and 60 students (8 – 11 years old), UTAS	400
14 Mar 2015	Beef cattle research expo - dissemination workshop	Điện Biên DARD Breeding Centre	TUAF, NIAS, VNUA, CASRAD, Điện Biên DARD, farmers and Lao PDR extension staff, UTAS	60
July 2015	Final review meeting	NIAS, Hà Nội	NIAS, TUAF, CASRAD, CIRAD, DARD, TBU, CIAT, HUAF	
September 2015	Final meeting	Ha Long Bay	NIAS, TUAF, CASRAD, DARD, TBU, MARD	

9 Conclusions and recommendations

9.1 Conclusions

This research project has brought together a range of different research and extension institutions over the last four and a half years and formed a cohesive team delivering on all objectives outlined in the project proposal. This is despite some changes in key personnel through the life of the project. The team has used some innovative approaches to undertake research including using ethnic minority undergraduate students to assist with activities in their home villages, raising community awareness through school programmes, and developing farmer interest groups to enable networking and skills training.

Research staff from NIUAS, VNUA, CASRAD, TUAJ and TBU have benefitted from involvement in the project and training workshops, which has increased their research capacity and developed knowledge and skills. Their co-authorship of international conference and journal papers and presentation experience in English at international conferences has increased their exposure in the international science arena, and will enable them to take on new roles and undertake new research for development projects.

Research activities and subsequent outputs to overcome the constraints related to long cold winters and remoteness have led to reduced mortality and increased production of beef cattle in the small holder farm system in the North West of Vietnam. The small holder farmer in the study regions now has a suite of forage and associated management options suited to their respective environments. Forage species evaluated as being suitable included *Pennisetum purpureum* (VA06), *Brachiaria spp.* (Mulato II), *Panicum maximum* (Guinea – TD58), *Tripsacum andersonii* (Guatemala) and *Stylosanthes spp.* (Stylo).

The research activities have led to farmers being more informed about crop by-product conservation, processing and re-use for cattle feed, including urea treated rice straw, cassava stem and root silage and nutrient cake. Furthermore, small holder farmers are now better equipped to move from extensive grazing systems to intensified cattle production systems (with the introduction of shelters and feeding troughs).

However, a major constraint identified by the farmers in scaling out the interventions introduced in this project, is the continuing competition for land resources between increasing forage production to satisfy livestock and increased cropping of maize and cassava on the steep slopes of the region. Furthermore, the uptake and adoption of new technologies by farmers and other beef value chain stakeholders' remains limited while poverty rates among the ethnic minorities that dominate the region remain among the highest in the country.

9.2 Recommendations

A key issue identified out of this project is the need for transforming the extensive cattle production systems of Điện Biên into market-oriented, more intensive beef production which is integrated with the upland cropping system on sloping lands.

The external end-of-project review of the project in July 2015 highlighted the strong partnerships among the research and implementation partners, capacity building and knowledge bank that was developed by the project and recommended a follow-on project, with an emphasis on integrating cattle production with other farm activities (i.e. cropping), peer to peer learning, segmenting the cattle production system (i.e. cow-calf, growing or finishing cattle) to match farm resources and facilitating collective information flows. A further recommendation was to focus the project in Điện Biên, with some additional activities in Sơn La in support of established cattle interest groups.

A strong request and a pledge for support for a follow-on project has also been expressed by the Provincial Department of Agriculture and Rural Development in Dien Bien and the National Institute of Animal Science. Driven by recognition of the unsustainability of the current extensive livestock system, the vision of the DARD is to transform livestock production from extensive to intensive systems, boost farmers' awareness of market oriented production, motivate stakeholders that accept change, and build capacity of local authorities, extension workers and farmers to continually grow production in the region. Forecasted impacts of a further project would include:

- Improved cattle feeding systems, integrated with cropping and improved environmental sustainability as farmers transition to a more intensive, market-oriented beef production system
- Improved gender equity and reallocation of farming tasks, with time available for non-farming activities for women and education for children
- Increased market access and understanding for farmers and traders resulting in improved incomes
- Improved information exchange between stakeholders leading to a resilient beef value chain that innovates to meet changing market demands and conditions and
- Increased capacity of local DARD and government that maintains a regulatory and political environment conducive to continual market improvement and poverty alleviation

Decisions by the Vietnam government to concentrate beef cattle production in the highland areas of Vietnam to facilitate programmes to alleviate poverty for smallholder farmers, and address environmental issues of intensified cropping such as erosion, provides the impetus for developing a follow on project. It is anticipated that a further project would investigate and implement whole farm solutions for the highlands of North West Vietnam to establish and maintain sustainable crop-livestock systems for improved profitability of small holder farmers.

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10.2 List of publications produced by project

Journal Publications

Mai Anh Khoa, Nguyen Hung Quang, Phan Dinh Tham, Nguyen Duy Hoan, Stephen Ives (2014). Initial assessment on growth and yield of some grass varieties grown in the northwestern mountainous region, *Journal of Science and Technology*, Thai Nguyen University, ISSN 1859-2171, Vol 115 01, p27-32

Nguyen Hung Quang, Phan Dinh Tham, Mai Anh Khoa and Stephen Ives (2014). Assessment of the utilization of natural grass and agricultural crop by-products in cattle production *Journal of Animal Science and Technology*, NIAS, ISSN 1859-0802, Vol 46, p30-38.

Phan Đình Thắm, Phạm Thị Hiền Lương, Nguyễn Hưng Quang, Khuất Thanh Tuyên, Mai Anh Khoa (2014). Sử dụng thân lá lạc ủ chua làm thức ăn bổ sung cho bò nuôi trong các nông hộ ở vụ Đông - Xuân tại Sơn La, *Tạp chí KHKT Chăn nuôi - Hội chăn nuôi Việt Nam*, ISSN 1859-476X, Tập 22, số 04 (181), tr71-79.

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Conference Proceedings

Nguyen, Q.H., Phan, T. D., Mai, K.A. and Ives, S.W (2014). Crop by-products satisfy the winter feed gap for beef cattle ensuring sustainable grazing of native pastures *in Proceedings of the 16th AAAP Animal Science Congress Vol. II, 10-14 November 2014*, Gadjah Mada University, Yogyakarta, Indonesia, p277-280.

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Duong Nam Ha, Pham Van Hung, Nguyen Thi Thu Huyen, Laurie Bonney and Stephen Ives (2014) Impacts of Socio-Cultural Factors on Beef Cattle Value Chain: a Case Study of Producers in the Northwest Region of Vietnam *in Proceedings of the 16th AAAP Animal Science Congress Vol. II, 10-14 November 2014*, Gadjah Mada University, Yogyakarta, Indonesia, p1000-1004

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Presented Posters

Pham, Thi Hanh Tho, Dao, The Anh, Trinh, Van Tuan, Bonney, Laurie and Ives, Stephen, (2012). Value chain appraisal for an action research approach to sustainable beef enterprises in the northwest highlands of Vietnam. Poster presentation in Sustainable Land Use and Rural Development in Mountain Areas Conference, Hohenheim University, Stuttgart, Germany.

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Student thesis related to project activities

Post graduate students list

Lăng Văn Khôi (2013), The utilization of supplemental diet for cattle during winter season in some provinces of the Northwestern region of Vietnam, MSc thesis, TUAF

Khuất Thanh Tuyên (2013), Utilization of silage groundnut stem for beef cattle in Sơn La province, MSc thesis, TUAF

Nông Văn Trung (2015), Evaluation of growth and the utilization of some plantation forages for cattle production in the northwest region, MSc thesis, TUAF (on going till Nov/2015)

Undergraduate student list

Lê Xuân TUnderùng (2012), The assessment on the infection of hepatic fluke in cattle at Thuận Châu, Sơn La and the treatment and prevention of Han - Detril – B. TUAF

Liêu Lương Sơn (2012), The assessment of external parasite in Hmong cattle at Thuận Châu, Sơn La and the treatment and prevention effectiveness of Hanmectin – 25. TUAF

Lê Thị Xoan (2012), Assessment and investigation on the causative factors contributed to cold stress fatal in cattle during winter season at Mai Sơn , Sơn La . TUAF

Nguyễn Thị Quyên (2012), The prevalence of hepatic fluke infection in cattle at Mai Sơn , Sơn La . TUAF

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Phong Ngọc Hùng (2012), Evaluation on the growth, regrowth and the productivity of some forage varieties, the utilization in winter season at ACIAR research sites at Tả Hộc, Mai Chau, Sơn La . TUAF

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Vi Thị Tròn (2015), Assessment of the winter feed resources for cattle in Quài Cang, Tuần Giáo, Điện Biên and the solutions for the development. TUAF

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Quàng Văn Quân (2015), Utilization of cassava silage for cattle production in Long He, Thuận Châu, Sơn La . TBU.

Vàng Tô Châu (2015), Effect of by-products supplement in cattle diets on performance/ TBU

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11 Appendixes

11.1 Site selection report



Trung tâm Nghiên cứu & Phát triển Hệ thống Nông nghiệp
Centre for Agrarian Systems Research & Development

**Overcoming technical and market constraints
profitable beef enterprises
Vietnam LPS/2008/049**

**to the emergence of
in the North-Western highlands of**

Report on:

PROJECT SITE SELECTION MISSION

IN SON LA PROVINCE

(From 24th April to 29th April 2011)



Prepared by:

MSc. Pham Thi Hanh Tho

PhD. Dao The Anh

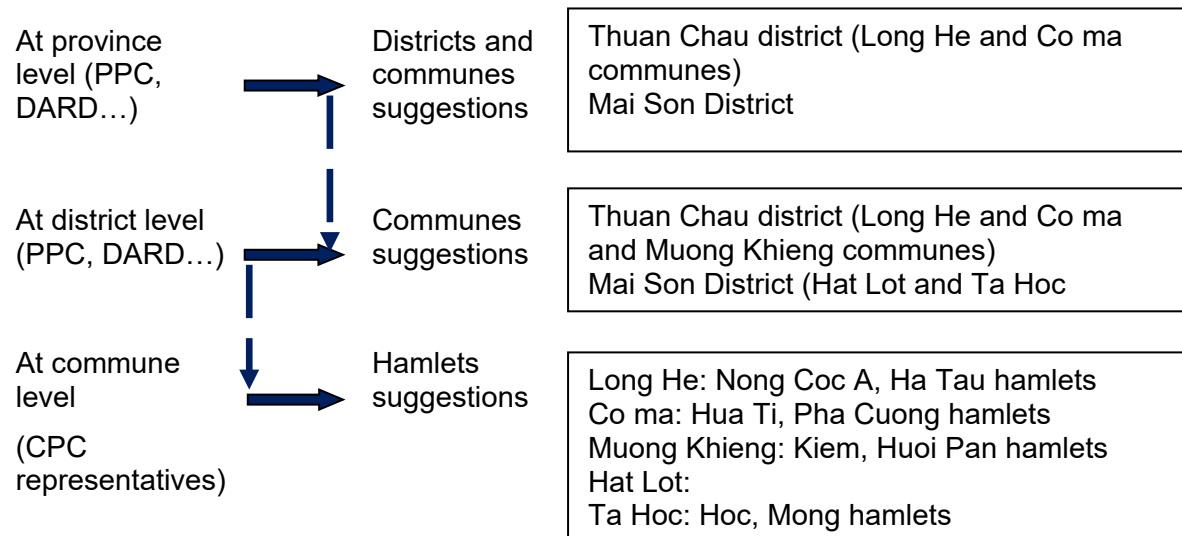
MSc. Trinh Van Tuan

Hanoi, May/2011

1. Introduction

This mission is a participatory process in order to select the best places to implement the project LPS/2008/049, participated by all institution partners of the project (NIAS, UTAS, TNU, HUA, CASRAD, TBU) and local partners and authorities (PPC¹, DARD², DPC³, line agencies of the districts⁴, and CPC⁵).

Site selection process



More than the purpose of site selection but including:

- Clarify objectives and activities of the project to competent agencies and line agencies.
- Enrich practical data of the expected target locations
- Providing input to field study coming as the next step during project implementation.

Method of gathering information

- + Open discussion
- + Interviews based on checklist (based on agreed criteria), more time consuming with farmers of proposed communes.
- + Field Observation (road access, farming, forage area, grass growing, breeding facilities...)

There have been 6 communes visited, as follows:

- 2 communes considered the high-land area in Thuan Chau district: Long He and Co ma
- 4 communes considered the lower-land area in Thuan Chau (TC) and Mai Son (MS) districts
 - + Muong Khieng and Chieng Ly communes (TC)

¹ Province people committee,

² Department of agriculture and rural development at province and district levels)

³ District people committee

⁴ Extension Station of the district, District Department of Agriculture and rural development, Veterinary station...

⁵ Commune People committee

+ Hat Lot and Ta Hoc communes (MS)

Method of data analyzing

Calculating total score for each proposed commune based on:

- + Priority levels of criteria
- + 3 levels of scoring for each level of priority

2. Insights from CASRAD team

Almost information from dialogues, interviews and observations is qualitative being transferred into qualitative data by scoring. Among 5 communes suggested by local partners, 3 ones are potential for further studies and interventions in the framework of the project, being:

- Long He and Co Ma (highland) in Thuan Chau district, and
- Ta Hoc (lowland) in Mai Son district

(See table below and appendices for further information)

Marketing's situation

It takes the some road to reach firstly Co Ma then Long He. Long He commune centre is 9 km far from Co Ma. By car, it takes about 45 minutes from Thuan Chau to Co ma. Co ma is considered the commercial centre of some proximity communes, having newly established wholesale market for cattle (funded by Thanh Tung Ltd. Company). However, this market há not yet operated as the cattle-wholesale-market. It has been used twice for introducing mountainous products and good-cattle selection.

In both Long He and Co ma communes, it is convenient to carry cattle from farm to main road. Normally, collectors will come to hamlets asking for cattle (Direct contact with farmers). If farmer's place is far from the main road, a hired-accompany-person will be called and paid by buyer from VND 100.000 to 200.000. Farmers can meet them daily. Information of farmers who want to sell will be transferred to collectors through neighbours. That implies availability of buyers. However, symmetric information may occur when farmer's awareness about prices and demand from their neighbours (experienced from previous sale or local market price) compared to collectors who know both local and distant market price. Farmers don't need to accompany their cattle to collecting point which also means they may have fewer references in terms of quality and price than farmers who sell cattle at the wholesale market (such as in Ha Quang district, Cao bang province).

Quality of cattle differentiates its prices; local yellow cattle is paid lower than Shine-hybrid one giving an opportunity to improve calf from artificial fertilization and improving nutrition. When live-cattle is sold, quality is judged buy external aspect to estimate carcass proportion.

The similar situation of marketing is also observed in Ta hoc commune. However, in limited time of the mission, more distant hamlets have not been investigated. In that area, marketing situation may be various.

We have found that marketing situation of a commune links to combined aspects:

- Location of the hamlets: the ones nearby the main roads are easier to develop cattle.
- Numbers of cattle of the hamlets (determined by availability of forage and by-products from crops; alternative income sources)

- Tradition

Among them, availability of forage or cultivated grass is considered the most important requirement. Therefore, improving marketing situation could be at different levels with differences changes:

- +Household level: recording and supervising marketing practices of household to see changes (negotiation skill...) → That would be linked to technical intervention
- +Commune level: marketing capacity improved from production organization improvement. Changes may be evaluated from visiting frequency of traders.
- + Specific products of typical beef could access potential market.

FURTHER SUGGESTIONS:

1. Conducting surveys in Long He, Co ma, Ta Hoc communes to figure out:
 - Current situation of beef production: characteristics, constraints
 - Area available can be used for grass cultivation: communes may have bare area but not convenience due to the distance from farmer's resident.
 - Farmers feed cattle by keeping instead of free raising: During the mission, many cases showing that cattle is free raising, which is impossible to carry out trials (feeding) or supervising.
2. Conduct surveys with key stakeholders of the up-stream pole
 - Thuan Chau district town, Chieng Ly (slaughters and collectors)
 - Mai Son district town
 - Thanh Tung Ltd. company: Private stakeholder producing and collecting cattle
3. Combine technical intervention and marketing

We found that, there is still a big shortage of supply compared to demand in the cattle value chain in Son la in general and visited communes in specific. In some communes such as Ta hoc, Co ma and Long he, farmers could meet collectors coming for live cattle purchase daily. Even in the location where collectors come once a week, farmers mean that it is not difficult to sell cattle. Hence, encouraging marketing here is to improve farmer's possibility in:

- Negotiation with others from their better quality cattle
- Better quality cattle could attract potential collectors, slaughters
- More benefit from price differences of better quality

To achieve that, it would be linked with trial of improving feeding method by technical team. We could have the trials (feeding...) and marketing supervising to see whether technical interventions affect marketing capacity of farmers

For regional marketing interventions, the wholesale market for cattle in Co ma commune is one of the options. It has been built but not yet been a centre of collecting where people can accompany cattle for sale. Activate this type of market in a cooperation with local stakeholder is recommended.

Table 1: PROPOSED COMMUNES SCORING (Based on agreed criteria and its priority levels)

#	Criteria	COMMUNES					Scoring scales
		Muong Khieng	Long He	Co Ma	Hat lot	Ta Hoc	
1	Accessible	3	6	6	9	6	3 ; 6 ; 9
2	Number of cattle/HH 5- 10	2	6	4	1	6	2; 4; 6
3	Farmer willingness to participate	6	6	6	3	6	3 ; 6 ; 9
4	Farmer willingness to invest	2	4	4	2	4	2; 4; 6
5	Potential for semi-intensive household practice	1	2	2	0	3	1; 2, 3
6	Local labour available	2	2	2	2	2	1; 2, 3
7	Authorized by Local Government	6	9	9	3	9	3 ; 6 ; 9
8	Soil fertility suitable for growing some cold tolerant grass varieties	4	6	6	2	4	2; 4; 6
9	Farmer willingness to fertilize if required/able	4	4	4	4	4	2; 4; 6
10	Good wholesale market access	6	9	9	9	6	3 ; 6 ; 9
11	Ethnic groups: Minority group a priority	6	9	9	3	6	3 ; 6 ; 9
12	Breed (dominant breed of area)	2	4	4	4	6	2; 4; 6
13	Good local veterinary of animal and health services	3	6	6	9	9	3 ; 6 ; 9
TOTAL (Minimum 30 and Maximum 90)		47	<u>73</u>	<u>71</u>	51	<u>71</u>	

Scoring scale:

- 3, 6, 9 3 scoring levels representing the high level of priority
- 2, 4, 6 3 scoring levels representing the medium level of priority
- 1, 2, 3 3 scoring levels representing the low level of priority

The higher score the better matching with criteria; score lower than the minimum indicates that the site does not meet criteria

11.2 School Programme

Introduction to Cattle production

School programme November 2014 – Tuan Giao District

Programme

- 9:00 am **Introduction/ Welcome**
- This will be done by Ms Nga. She will introduce the team.
- 9:10 am **Games and Singing**
- Animal names – children are given a card with the name of an animal on it. Once signalled all children then make the sound of the animal (cow, dog, cat, pig, duck, chicken, elephant, tiger, horse, mouse)
 - Numbers up – children form into groups of the number that is called (end in groups of 12)
 - Sing “Head (Cái Đầu), shoulders (Những vai) knees (Những đầu gối) and (và) toes (những ngón chân)”
- 9:30 am **Learning**
- Once upon a beef cow
- Read the play in Vietnamese – this will involve the children listening to a story and watching a play about growing food for cattle. It is meant to be funny but educational.
- 9:50 am **Doing** activity – this will involve organising the children into smaller groups and rotating them through 5 learning station. The children would be at each station for 10 minutes and when the bell rings, move to another. Each learning station will have an activity that is focussed on beef cattle production. The stations will be as follows:
- Drawing a map of house and yard
 - Planting seeds and cuttings
 - Fertiliser and manure
 - The taste test – what do cattle like to eat
 - Cutting and weighing grass
- 10:50 am Concluding discussion and Sing “Old (cổ kính) MacDonald had a farm (có một nông trại), E I E I O”
- 11:00 am Finish

Proposed Outcomes

- Children will understand cattle production and be able to help their families in the future
- Scale out of programme to more children

Once upon a beef cow – a story of food and happiness

Cổ tích chú bò thịt- một câu chuyện về thức ăn và hạnh phúc

- Narrator: Once upon a time there was a farmer (use English word for farmer).
- Người kể chuyện: Ngày xưa ngày xưa có một Farmer
- Audience: What's a farmer? (They are shown a placard with the question)
- Khán giả: Farmer là gì?
- Narrator: You know, a Farmer (this time in Vietnamese) someone who grows food to eat, like fish, rice, maize, cassava, cows, pigs and chickens.
- Người kể chuyện: Các bạn biết không? Một nông dân là người nuôi trồng thực phẩm để ăn như cá, cơm, ngô, sắn, bò, lợn, và gà
- Audience: Oh. Okay
- Khán giả: Được rồi!
- Narrator: She had a husband and 5 children.
- Người kể chuyện: Chị có một chồng và 5 con
- Audience: What were their names?
- Khán giả: Tên họ là gì?
- Narrator: You ask a lot of questions. Their names were Chi Hoa, Anh Hung, Con Hai, Trang, Tung, Hung and Hoa. The family had 2 cows, 4 pigs and 8 chickens.
- Người kể chuyện: Các bạn hỏi nhiều thế! Tên họ là chị Hoa, anh Hùng, con tên là Hải, Trang, Tùng, Hưng và Hoa. Gia đình họ có 2 con bò và 8 con gà
- Audience: What were their names?
- Khán giả: Tên chúng là gì?
- Narrator: They didn't have names because if you name your animals you can't really eat them. Anyway, they all lived in a village.
- Người kể chuyện: Chúng không có tên vì nếu mình đặt tên cho chúng thì mình không ăn thịt chúng được! tất cả họ sống trong một bản làng
- Audience: Where?
- Khán giả: Ở đâu?
- Narrator: Up in the mountains?-
- Người kể chuyện: Ở trên vùng núi
- Audience: What mountains?-
- Khán giả: Vùng núi nào?
- Narrator: You sure do ask a lot of questions - the mountains up behind us. Anyway, back to the story. One day Anh Hung came running to Chi Hoa and said "We have no more grass to feed Moo one and Moo two and they are very hungry. (We get two children from audience, cover them with a brown sheet, and get them to walk across the floor rubbing their stomachs and saying "I'm Hungry" with lots of groans). We need them to grow big and heavy so we can eat one at the wedding of our daughter Hai to Em Cuong " (Introduce Hai and

Cuong – and say something like, aren't they a beautiful couple – so handsome, so pretty).

Người kể chuyện: Các bạn lại hỏi nhiều thế- ngọn núi sau chúng mình. Quay lại câu chuyện nhé. Một ngày anh Hùng hớt hải chạy đến bên chị Hoa và nói “chúng ta không còn cỏ để cho Moo 1 và Moo 2 ăn nữa, chúng đói lắm rồi. (Im hungry – Tôi đói). Nhà mình cần chúng lớn nhanh và nặng cân để mổ thịt một con cho đám cưới của con gái Hải với Cường. (Introduce Hai and Cuong – and say something like, “aren't they a beautiful couple – so handsome, so pretty”- “họ có đẹp đôi không các bạn?”

Narrator: Chi Hoa did not have an answer because she thought Anh Hung had the answers so she asked “Anh Hung, what do you think we should do?”

Người kể chuyện: Chị Hoa không biết trả lời sao vì chị tưởng anh Hùng biết giải quyết chuyện này. Vì vậy chị hỏi “Anh Hùng, anh nghĩ mình nên làm thế nào?”

Audience: Ooh?

Khán giả: Ooh?

Narrator: Anh Hung had an idea that he had heard from someone in Tuan Giao the last time he went to the Bia Hoi with some of old school friends. So he said “I heard there was a new project up here about beef cattle. Maybe we should talk to Ms Thanh the Extension Officer - she will know”

Người kể chuyện: Anh Hùng có một sáng kiến mà anh nghe được ai đó ở Tuần Giáo nói khi đang đi uống bia với bạn cũ. Thế nên anh nói “anh nghe nói có một dự án mới ở đây về bò thịt. Hay mình đi hỏi chị Thanh – cán bộ khuyến nông, chị ấy sẽ giúp mình.

Audience: Ms Thanh, Ms Thanh?-

Khán giả: Chị Thanh? Chị Thanh nào?

Ms Thanh: “Did someone call?”

Ms Thanh: “Ai gọi đấy nhỉ?”

Anh Hung: “Can you help me to grow grass to feed Cow one and Cow two?”

Anh Hung: Chị ơi, chị có thể giúp tôi trồng cỏ để cho bò 1 và bò 2 ăn được không?”

Ms Thanh: “I can help a little bit but I think we need Dr Quang who is a teacher of farmers”

Ms Thanh: Tôi chỉ có thể giúp một chút thôi nhưng tôi nghĩ tiến sỹ Quang – giáo viên của nông dân có thể giúp.

Audience: Dr Quang, Dr Quang, where are you?-

Khán giả: Tiến sỹ Quang, Tiến sỹ Quang ở đâu?

Dr Quang: “Did someone call?”- Ai gọi đấy nhỉ?

Dr Quang: “Ai gọi đấy nhỉ?”

Anh Hung: “Can you help me to grow grass to feed Cow one and Cow two?”

Anh Hung:	Anh ơi, anh có thể giúp tôi trồng cỏ để cho bò 1 và bò 2 ăn được không?
Dr Quang:	"I think I can.....- Tôi có thể giúp anh
Dr Quang:	"Tôi có thể giúp anh"
Narrator:	So Dr Quang and Ms Thanh gathered all the farmers from the village to a meeting and showed them how to plant some different grasses that cows like to eat. The farmers even had to try the grass themselves to see if it tasted good.
Người kể chuyện:	Và anh Quang và chị Thanh đến với bà con nông dân trong bản và chỉ họ các trồng một vài loại cỏ khác nhau mà bò thích ăn. Nông dân còn ăn thử xem cỏ có ngon không?"
Narrator:	Anh Hung ate some grass and said "This is good grass?" (Then grass is given to other children in the audience to try).
Người kể chuyện:	Anh Hùng đã ăn thử cỏ và nói "đây có phải là cỏ tốt không? (Then grass is given to other children in the audience to try).
Narrator:	A neighbour was just walking by called Anh Po. He was very curious about what Hung was doing. So he asked "Why are you eating grass, don't you like rice anymore. Are you turning into a cow, or a pig, because you look a bit big to be a chicken?"
Người kể chuyện:	Có một nông dân tên là Pô đi ngang qua. Anh ta rất tò mò không biết anh Hưng đang làm gì. Anh hỏi "Sao anh lại đi ăn cỏ, thế anh chán cơm rồi à? Hay anh biến thành bò rồi, hay thành lợn vì nếu là gà thì anh béo quá?"
Narrator:	Anh Hung laughs very loudly and replied to Po, "Oh, don't be silly, I have plenty of rice. But Dr Quang said that if the grass tastes sweet, the cows will like it. I want to see if it tastes sweet to me"
Người kể chuyện:	Anh Hưng cười to và trả lời anh Pô "Ồi trời, anh đừng ngốc thế, tôi có nhiều cơm lắm, Nhưng anh Quang nói nếu cỏ có vị ngọt thì bò sẽ thích ăn lắm. Tôi chỉ là đang ăn thử xem cỏ có ngọt không"
Narrator	Anh Po still wasn't convinced and said "Be careful because some people might think you are crazy when they see you with a green mouth"
Người kể chuyện:	Anh Pô vẫn chưa tin và nói "anh cứ cẩn thận đấy vì vài người sẽ nghĩ anh điên điên khùng khùng khi anh ăn cỏ đầy mồm xanh lè"
Narrator:	Mr Po walked away. In the meantime the farmers at the meeting also learned how to cut the grass. Too low – no go, Too high – see the sky, Medium height – just right.
Người kể chuyện:	Anh Pô bỏ đi. Trong khi đó các nông dân khác trong buổi họp được học cách cắt cỏ. Cỏ thấp quá- không cắt được. Cỏ cao quá- cao chọc trời, cũng không được. Cỏ cao vừa tầm- cắt được.
Audience:	Too low – no go, Too high – see the sky, Medium height – just right
Khán giả:	Cỏ thấp quá- không cắt được. Cỏ cao quá- cao chọc trời, cũng không được. Cỏ cao vừa tầm- cắt được.
Narrator:	They learned how to fertilise the grass with lots of manure or fertiliser if they could afford it.

- Người kể chuyện:** Họ học cách bón nhiều phân chuồng cho cỏ hay phân bón mà vừa túi tiền của họ.
- Audience:** Lots of manure, lots of manure
- Khán giả:** rất nhiều phân, rất nhiều phân
- Narrator:** The farmers also realised that they had plenty of space around their house to grow grass, which meant that the children did not have to take the cows to the forest for feeding. It also meant that the children could go to school more.
- Người kể chuyện:** Bà con nông dân cũng nhận ra xung quanh nhà họ có nhiều đất để trồng cỏ. Như thế thì con cái họ không phải đi chăn trâu ăn cỏ ở trong rừng nữa.
- Narrator:** At the end of a long day with Dr Quang and Ms Thanh, Anh Hung said “you are good teachers and you have taught us very much about how to grow grass for our cows”
- Người kể chuyện:** Cuối ngày làm việc vất vả, anh Hùng nói với anh Quang và chị Thang “các anh chị là giáo viên rất tốt vì đã dạy chúng tôi rất nhiều về trồng cỏ cho bò ăn”
- Narrator:** But Dr Quang shook his head and said “Even though I have been to University, I do not know everything. Even if you do not realise it, you are also a good teacher and I have learned a lot from you as well”
- Người kể chuyện:** Nhưng anh Quang lắc đầu và nói “mặc dù tôi đi học đại học nhưng không phải tôi biết mọi thứ. Tuy anh không nhận ra đấy thôi, nhưng anh cũng là giáo viên rất tốt và tôi đã học từ anh rất nhiều.”
- Narrator:** Ms Thanh also said to the farmers “We don’t like to think that we are teachers and know everything. We like to say that we share knowledge”
- Người kể chuyện:** Chị Thanh cũng nói với bà con nông dân “Chúng tôi không coi mình là giáo viên và biết mọi thứ. Chúng ta đang chia sẻ kiến thức với nhau”
- Narrator:** We all learn when we share knowledge.
- Người kể chuyện:** Chúng ta cùng học khi chúng ta chia sẻ kiến thức với nhau.
- Audience:** We all learn when we share knowledge.
- Khán giả:** Chúng ta cùng học khi chúng ta chia sẻ kiến thức với nhau.
- Narrator:** So in the end, all of the farmers were able to grow good healthy cows
- Người kể chuyện:** Và sau đó tất cả bà con nông dân đều có thể trồng nhiều thức ăn để nuôi bò béo khỏe.

Materials:

Old sheets for clothes and to pretend to make cows, chickens and pigs.

12 A1 sheets and a big black marker pen to write the audience responses

Pretend grass (or real grass)

Additional Notes:

Ensure to include as many children in the play as possible, pausing often to allow them to 'act' and say words on the script. Use only one language (i.e. either Vietnamese or English depending on the audience).

Doing Activities

Drawing a map of house and yard

Rationale

The layout of a farm is important to ensuring long term sustainability of the production system. Inappropriate positioning of houses, crops and waste distribution can have negative economic, environmental and social impacts. The farm layout needs to consider the topography, climate, existing shelter and access so that people and animal movements are minimised and nutrients remain on the farm or are recycled appropriately. For example, planting crops and forages downhill from where animals are kept is good practice in nutrient cycling.



Figure taken from Stür, W.W. and Horne, P.M. (2001) Developing Forage Technologies with smallholder farmers - how to grow, manage and use forages. ACIAR Monograph No. 88.96 pp.

Materials

- Base maps provided A3 size (70 sheets)
- Cut outs required for house, animal shelter, home garden, trees (70 sheets, scissors – 12 pairs, glue - 12 sticks, box of colouring in pencils)

Delivery Notes - Method

- Explain that the children need to think about their own farm and try to imagine how the layout of the farm could be improved. (2 minutes).
- Then assist them in cutting out and sticking the different items onto the farm maps

- If they have time they can colour in the objects – make sure their names are on the back of the drawings and set aside for later collection.

Forage - planting seeds and cuttings

Rationale

Forages can be planted from seed or cuttings. Often tropical grass varieties are better propagated by cuttings, whilst legumes can be grown from seed. If grass seed is to be used, the germination requires checking because quality is variable in the tropics and viability is affected long term storage. Grass seed is small (sometimes hard to distinguish from buds, empty seed structures and flowers), is easily washed away by rain or heavy watering and can also be stolen by ants. On the other hand what looks like legume seed is actually seed. Despite this, if a nursery is established using grass seed, it provides an opportunity to propagate from cuttings once plants are well established. Providing grass seed is good quality, expect a germination of 20 – 40%. In other words, plant 4 seeds to get 1 plant. Dormancy is not usually a problem with grass seed because of the 3 – 6 month storage time between harvesting seed and planting. There can be as little as 100 or as many as 2000 grass seeds in every gram, so when planted it will require 2 – 5 g per 10 metre row.

Materials

- Seeds (at least 300 seeds)
- Egg cartons – 30 (4 cups per person) – alternative in Vietnam?
- Planting mix
- Permanent markers to put name on cups
- Water – about 10 L

Delivery Notes – Method

- Explain the process of planting (2 – 3 minutes)
 - Soil particles around seed are smaller than the seed
 - Planting depth is about 4 – 5 times the diameter of the seed
 - Need to keep the soil moist but not too wet
- Explain how seeds germinate (2 – 3 minutes)
 - The root starts growing first
- Distribute materials to the children and assist them in planting (5 minutes)
 - Fill each capsule with soil
 - Plant 4 seeds per filled capsule
 - Water until damp to the surface
- Make sure their names are on the containers
- Put the containers to one side for later collection

Fertiliser and manure

Rationale

Growing any crop, whether it is vegetable or forages, draws nutrients out of the soil. This means that regardless of original fertility of soils, nutrients need to be replaced. Napier Grass (elephant grass) cut regularly for 12 months can yield 18 tonnes/ha. However over a 1000 m² area in one year this can remove 32 kg of Nitrogen, 2 kg of Phosphorus and 21 kg of Potassium (equating to 70 kg Urea, 10 kg TSP and 42 kg MOP respectively). Using manure alone, although cheap and easily accessed, may not provide sufficient quantities to maintain or improve soil fertility. Therefore there may be a requirement to add mineral fertilisers.

Regular soil testing is the best way to determine the nutrient status of the soil, both in terms of long term storage and immediate or medium term availability. However, farmers in isolated and rural communities may not be access these facilities, either because of practical issues or financial issues. There are alternatives in the short to medium term for checking current fertility. These include colour of the forage, size of the plant with respect to age and overall yield. Although specific nutrient deficiencies can often be confused with similar symptoms shown by such things as insect damage, disease prevalence and climate, there are some rule of thumb guides for nutrient status (<http://5e.plantphys.net/article.php?id=289>).

- Nitrogen – this is often displayed as chlorotic symptoms. In other words, leaves will start to lose their green colour, turning yellow and then white (dead). This is most obvious in older leaves, but leads to the new young leaves being smaller and less branching or tillering. Recovery can be almost immediate (within days) if addressed before the new leaves start turning yellow.
- Potassium – this is a very mobile nutrient and as such symptoms occur first in the new young leaves. It is evident as necrosis (or dying) of the leaf edges moving towards the vein of the leaves. Unlike nitrogen, potassium deficiencies are irreversible on affected leaves.
- Phosphorus – the colour symptoms of phosphorous deficiency are not as clear as other nutrients. The most notable symptom is that the plants are stunted. In some dicot plants, older leaves develop a dark green purple or blue grey tinge.
- Sulfur – leaves show a general chlorosis over the whole plant, whilst maintaining some green colour. The veins show a distinctive red colour. In advanced stages, the leaves become necrotic, become twisted and brittle.

Materials

- Pot of tea (need to keep refilling)
- 5 glasses
- Quick symptom cards

Delivery Notes - Method

- Broad explanation of nutrient use of plants and loss in soil
- Pour 1st glass full, then pour half into 2nd glass, top up with water and mix. Pour half from 2nd glass to 3rd glass, top with water etc etc until 5 glasses are full of reduced colour liquid.
- Walk to school garden and ask students to look for nutrient symptoms (use cards provided)

The taste test – what do cattle like to eat

Rationale

Cattle are not unlike people in that they have food preferences if given the opportunity. Young children, if offered alternatives, will choose food that is sweet and/or salty. However, with children, this may not be the most suitable for their overall diet and long term nutrient requirement. So, food needs to be offered that will be nutritious, easily digested and provide long term health benefits. Feeding cattle is no different. We need to watch how cattle eat, what they choose and how long they stay in one place 'chewing their cud' before moving on. Some food provided to cattle fills them up, but does not provide long term satisfaction. This is the case with dry grass and/or hard stems. As with children, cattle like sweet feed, which may include a silage (processed with molasses) and young growing leaves. The idea of this activity is to get the children to taste different parts of a plant.

Materials

- Need a variety of grass parts (flower, root, leaf etc)
- Some snack food would be good and also some sticky rice

Delivery Notes – Method

- Explain the differences in choice of feed for humans and cattle
- Ask them to choose between a sweet snack or sticky rice and ask them why they made their selection.
- Divide up the parts of the plant and ask them to test the taste of each part and explain which ones the cattle may like to eat.

Cutting and weighing grass

Rationale

This activity leads on from the taste test, but doesn't matter if done before. The main objective of this activity is to demonstrate that cutting grass at the right time means that the cattle obtain the most benefit from the feed. Weighing the grass, or having an idea of how much you are feeding the animal also determines whether or not the animal is getting sufficient feed and subsequent nutrient to maintain and/or increase body weight and body condition. This will also depend on the growth and/or development stage of the animal (i.e. calf, growing, pregnant cow).

Materials

- Need some forage plants – whole plants if possible
- Sketch paper – to show round the differences in the cow stomach and hip bones depending on body condition status.

Delivery Notes – Method

- Start by explain why we cut plants before they flower – maybe if they are a group that has already done the 'taste test' activity – you could ask them where and when would be the best place to cut the plants.
- Then get them to divide in two smaller groups and each one be given a cow shape to mimic. Take a photo of their group, so that can be given back to the school.

Doing Activities - Materials

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- Base maps provided A3 size (70 sheets)
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Forage - planting seeds and cuttings

- Seeds (at least 300 seeds)
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- Planting mix
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- Water – about 10 L

Fertiliser and manure

- Pot of tea (need to keep refilling)
- 5 glasses
- Quick symptom cards

The taste test – what do cattle like to eat

- Need a variety of grass parts (flower, root, leaf etc)
- Some snack food would be good and also some sticky rice

Cutting and weighing grass

- Need some forage plants – whole plants if possible
- Sketch paper – to show the differences in the roundness of the cow stomach and hip bones depending on body condition status.