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Australian Centre for International Agricultural Research

Final report

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Contents

1 Acknowledgments

It's a long time between preparing a proposal for a project and submission of a final report. In this case the ride was from mid-2014 to mid-2022, eight years. The road is never straight in research, and we must gratefully acknowledge the excellent process and support of ACIAR who allow research to mould to the situation as it unfolds. It was an absolute pleasure having Dr Werner Stűr and then Dr Anna Okello as ACIAR program managers.

Central to the project was development of capacity within the Ministry of Agriculture and Fisheries in Timor-Leste. This would not have happened without on-going support of both the Minister and presiding Directors General. The vision of the international team took some time to gel with the whole team, and we are sincerely grateful that senior management continued to offer strong support, even through periods when the 'not so sure factor' was obviously clear to us. In the end, the project achieved it's aims, which the MAF and UNTL staff can rightfully claim as their success. It was a pleasure to do business with Sr Domingos Gusmão.

As in all ventures, it's the people who make it work. Our *Redi KAMODI* project team was very large and experienced change. Throughout, it seemed to us we had the cream of Timor-Leste's livestock industries involved. They are great people and great to work with. Drh Joanita Jong, Sr Carlos Amaral, Dr Carlito Mali Code, Prof Paulo Correia and Drh Antonino do Karmo are world champion leaders. Thank you.

Research being research meant not all went to original plan. Having international staff sited in Timor-Leste for the first three years was vital for the early research. But it became clear it did not matter how good these staff were (and they were all first class in their own right), they were still internationals who could not make the decisions that needed to be made within the prevailing cultural context. To proceed successfully we needed to transfer to Timor-Leste leadership. This was a masterstroke on two fronts: the project immediately shifted into high gear and enabled us to meet project objectives; we had unwittingly positioned ourselves perfectly to successfully continue during the COVID-19 pandemic. The team is eternally grateful for the great work done by Australian, New Zealand, Indonesian and Irish staff in the early stages of the project, when at no time was it ever easy.

In 2012 Calisto da Costa Varela, leader of our first large project recruited a driver, Justino Caldeira. This was a masterstroke. Justino is not just the best driver in Timor-Leste. At all times, he was visiting and talking to farmers and their families, helping the process through quiet sharing of key information. He recently actively contributed to a brief project review to initiate concept development for a potential new project. Without realising it, Justino developed capacity he never dreamed he would have. He will be a great acquisition for MAF.

During the project we had the misfortune to have two team members pass away. In 2019, then Director of Livestock in MAF, Sr Jose Orlando Magno, passed. Then in May 2022, our dear friend Adelino do Rego who has had a long association with our research, and who was a John Allwright Fellow studying for his PhD at UQ, passed. In 2007, Adelino, then MAF Director of Agribusiness, visited Indonesia with Calisto as part of the process to initiate the series of projects now completed. May they both rest in peace.

2 Executive summary

Why was the work done?

Cattle are a valued part of the Timor-Leste culture as both a store of wealth and cash and for major cultural events. The opportunity and need existed to implement more profitable, market-oriented, semi-commercial cattle systems and to improve the ability of support agencies to facilitate this. Achieving this will reduce poverty and help improve national economic growth.

What was achieved?

Capacity development of support-agency staff, including PhD training, underpinned substantial widespread changes to more profitable cattle farming. From two pilot sites established at the commencement of the project, 21 *Redi KAMODI* were established with 629 member families. *Redi KAMODI* are community groups who improve their livelihoods through assessment of their own situation, defining their needs, and then seeking, testing and implementing better beef cattle business practices. Training in *Redi KAMODI* operation is supported by a comprehensive program applicable in the Timor-Leste culture described in a five-volume manual in the indigenous language of Tetum. Training supports forage production for cattle, business skills and market-orientated selling. Two factors were key in improving the livelihoods of smallholder farmers and market chain operators in Timor-Leste: implementing a self-managed participatory process for local groups known locally as *Redi KAMODI*; and, following an early period with international support, transfer of leadership and fund management to in-country staff who are well positioned and committed at all levels, including the Minister, to continuing the changes introduced beyond the life of the project.

What impacts has the project had or is it likely to have in the future?

Cattle live weight production by participating smallholders is now much greater than achieved previously and is the basis of increased net family incomes. Withdrawal of day-to-day support from established *Redi KAMODI* has seen them continue, indicating the success of the process. A primary impact was that the new cattle farming systems, which enabled control of bulls, empowered women and their children to have a safe, time-efficient active role in profitable commercial beef production, which they greatly appreciate. Farmers are producing heavier bulls that are attracting approximately US$500 more (~US$700-900 v ~US$250-350) than received from local traders under traditional selling. This is a huge boost for family incomes and has been used for the purchase and operation of motorcycles and cars, renovation of homes and for children's education. This success has been broadcast to the general community, creating considerable demand from many rural communities to establish their own *Redi KAMODI*. Impacts are now being witnessed well beyond the project sphere.

What future actions might be required?

The project recommends the Agriculture Ministry institutionalise the *Redi KAMODI* model as the standard for extension/rural development. This implies that on-going investment is made in training facilitators and in supporting them to fulfil their duties, and assigning a communication for development specialist to lead rural development/extension.

Supply of feeder cattle is emerging as a limitation within households and nationally to increasing production of slaughter cattle. This issue appears common to all livestock species and reflects low reproductive rates, even in high-rainfall areas. Transitioning subsistence farmers to commercial practice is the next phase. Policy and strategy research to reduce livestock numbers nationally could substantially increase livestock production and efficiency, reduce costs, and improve environmental and community welfare.

3 Background

Census data indicates the proportion of Timor-Leste's population living below the poverty line on incomes of less than US$1.90 per day (UNDP 2020) was 50% in 2012 and remains high at >30%. Food insecurities and poor nutrition have contributed to a high rate of stunting and malnourishment. Food insecurity, especially in rural areas, manifests itself in fewer meals per day from the early to mid-dry season, progressing to the "hungry season" which extends from the late dry season into the early wet season until the first new crops can be harvested (Lopes and Nesbitt 2011). The average contribution of total dietary protein and protein from animal origin are near the minimum daily requirement of 55 g/day/person and 17%, respectively (Anon 2015), though recent data suggests food and energy deficits have been reducing since 2011. Developing cattle, pig and chicken production boosts protein supply.

Cattle are a vital contributor to cash flow in Timor-Leste rural households (Figure 1). Maize, rice or cassava farming are often not profitable due to the high cost of land tilling and fencing against the low cost of imported products. Therefore, cattle production is more profitable. Bull sales are usually associated with dry season cash-for-survival requirements, religious ceremonies, and availability of traders. The typical on-farm price received for bulls from traders is US$250-350, with prices being determined variously on age, condition, gender, and progeny. Live weight is rarely used. Farmers are rarely in a good price-negotiation position, except when bulls are in good condition and the sale is optional.

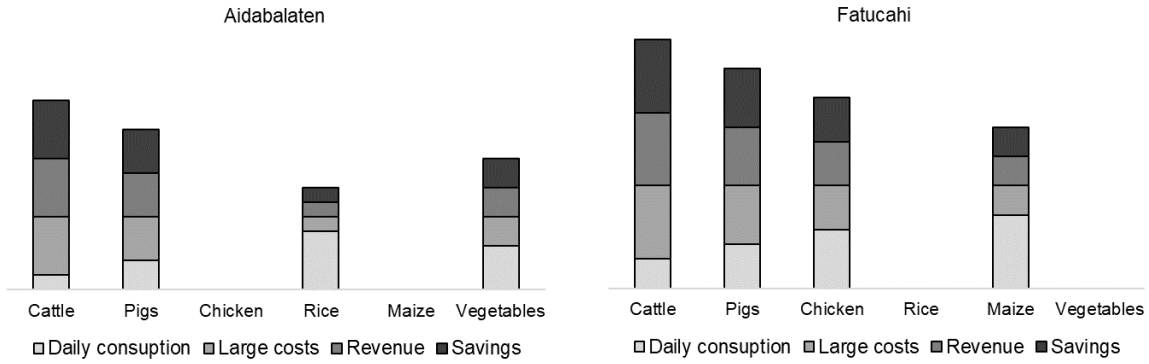

Figure 1. Relative importance of the major livestock species and of feed production in two Timor-Leste sucos

A preceding project (Fordyce et al 2016) indicated low reproduction rate, low growth rate, low meat quality, and prevalence of diseases such as brucellosis and haemorrhagic septicaemia in the Timor-Leste beef cattle population. More than 150,000 cattle, 100,000 buffalo, 200,000 small ruminants in addition to horses and pigs graze over approximately 200,000 ha of public lands. These lands are mostly highly degraded with dense woody and herbaceous weed infestation (e.g., *Chromolaena odorata*) and produce an average of not more than 0.5 t/ha of pasture when the grazing ruminants feed intake requirement is at least 2.5 t/ha annually. Very little control of cattle is used other than to seasonally exclude them from crops. Traditionally, there is virtually no management. Despite this, cattle are a valuable part of the Timor-Leste culture, eg, continuing practice being common of over seventy cattle or buffalo being required by a bride's family. Ownership of maximum numbers of livestock usually takes precedence over productivity.

As in most subsistence systems livestock play a major role as a store of wealth and source of cash for major cultural events or family needs such as housing, motorbikes, health care and education. The opportunity exists to capitalise on the social and economic importance of these livestock by transitioning to more commercial systems of ownership. Promoting agricultural growth through more market-oriented, commercial agriculture and livestock production will reduce poverty and contribute to improved economic growth of Timor-Leste.

The project aligned closely with MAF's strategic plan by directly contributing to three of the four development objectives (Improve rural income livelihoods and reduce poverty; Improve household food and nutrition security; Support the transition from subsistence farming to commercial farming) and the strategic objectives of; sustainable increase in the production and productivity of selected crops, livestock species, fisheries and forestry sub-sector; and, to enhance and improve market (domestic and export) access and value addition. Capacity development in the project aimed to underpin the vision of our project team "fading out" towards the end of the project leaving municipal MAF staff to sustain effective processes that will continually improve smallholder farming systems and associated product supply chains.

Australia's aid program aims to assist agricultural development by contributing to sustainable economic growth and poverty reduction through: increasing incomes of poor people; enhancing food, nutrition and water security; increasing contributions to national economic output. Relevant priorities of DFAT's assistance for agricultural research include private sector development, strengthening markets, gender equality and empowering women and girls. These priorities are encapsulated in the opportunity to develop profitable, market-oriented livestock production systems based on a combination of traditional grazing and forage production on agricultural land, improved livestock management and effective market linkages. Commercialisation of the beef industry required strengthened capacity of Ministry of Agriculture and Fisheries, University of Timor-Leste (UNTL) researchers and national and suco (village) MAF staff ensuring they are able to support smallholder farmers and private sector stakeholders in developing profitable production and marketing systems.

Bali bull tethered for fattening

Research by the previous project (LPS/2009/036) showed that market settings provide a favourable base for industry growth. Demand for slaughter cattle in Dili continually increases in response to increasing urbanisation and disposable income and is becoming more segmented with the development of a higher-value modern slaughter and retail segment to meet consumer and government demands for more hygienic beef. Better access to this market (based on per kilogram prices and over-the-scales weights) delivers more value back to farmers. These developments complement annual demand for beef including local and ceremonial consumption outside Dili of about 10,000 cattle per year.

4 Objectives

Aim: Increase the income of smallholder crop-livestock farmers and market chain operators in Timor Leste through more efficient, commercially-oriented cattle production and improved access to markets.

The research questions addressing this aim are:

- What structures and processes will accelerate the capacity of Timor Leste's regulatory and agricultural RD&E sectors to support adoption of more effective smallholder livestock management and cropping systems? - ***Obj 1 & 2***
- What business, marketing and credit systems and activities can improve incomes of cattle farmers and the beef supply chain operators?) – ***Obj 3***
- What livestock management and forage systems will create the best opportunity for smallholder farmers to increase beef cattle production and net farm income? – ***Obj 4***

Objective 1. Establish Beef Systems Development (BSD) groups to guide research at a regional level

- Design and pilot processes for establishing and operating Beef Systems Development groups
- Develop and pilot the methods for scale-out of Beef Systems Development groups in other regions

Objective 2. Strengthen capacity of Timor Leste beef cattle industry participants to support development of profitable production systems

- Develop and pilot training methods for Timor Leste beef cattle RD&E partners in technical and communication knowledge and skills
- Develop and pilot an effective system for transfer of new skills and knowledge to innovative smallholders and traders and from them to allied households
- Build research and leadership capacity through support of post-graduate training

Objective 3. Facilitate the development of farm business skills and cattle marketing systems

- Develop and pilot programs to train smallholders, both cow-calf and fattening operations, in farm management, business and marketing skills
- Evaluate the impact on profit for both traders and farmers households of marketing initiatives including more direct linkages, aggregation and selling methods
- Monitor and report on opportunities in, changes to, and requirements associated with beef cattle markets in Timor Leste

Objective 4. Develop profitable forage-based cattle management systems

- Evaluate and demonstrate forage production systems that will enable farmers to support new cow-calf and, fattening systems
- In collaboration with north Australian research, develop interventions to improve neonatal calf survival
- Develop and demonstrate robust and affordable cattle handling facilities that will enable improved cattle management by Timor Leste smallholders
- Evaluate demonstrate the impact of and achieve uptake of nutritional and husbandry interventions on increasing cattle productivity and profitability

5 Methodology

The project involved a large number of people from many agencies and several countries (Tables 1 and 2). The contracting agency was the University of Queensland. The sub-contracting agencies were the Ministry of Agriculture and Fisheries (MAF); Universidade Nacional Timor Lorosa'e (UNTL), Consortium for Large Ruminant Research, Indonesia (CLRR).

The project structure is outlined in Figure 2. To achieve the envisaged outcome of independent community groups defining business problems and then finding and implementing solutions with specialist help or assistance from peers if needed, required research of how the ultimate system would function plus research of solutions that were emerging in the areas of forage and livestock production and in business and marketing. Therefore, three research groups were established, highlighted in green in Figure 3. The research was supported by an administration or management team. The staff in each group are listed in Table 1. In addition to this, a large number of regional MAF staff and villagers were project team members, each associated with the sites established by the project (Table 2).

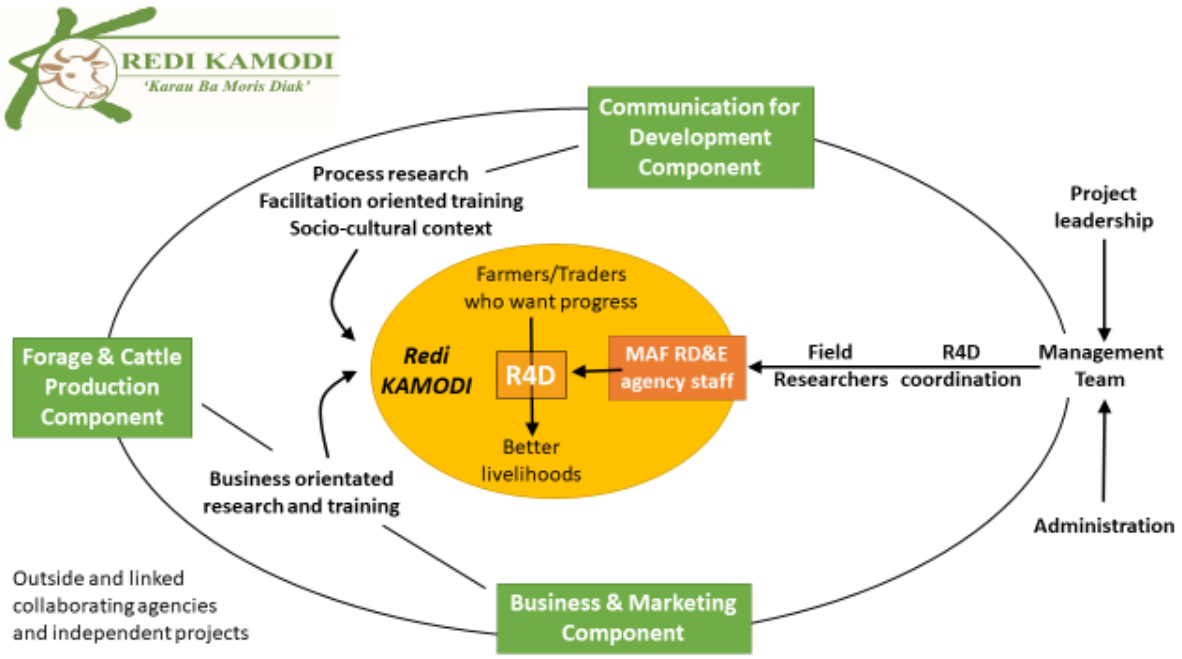

Figure 2. Diagram of the RK model in the context of the ACIAR-funded project. The yellow part was expected to remain beyond the project

The activities of each group to meet project objectives are outlined in detail in the following sections.

Table 1. Project team, excluding MAF facilitators and *Redi KAMODI* chiefs (see Table 2)
MAF: Ministry of Agriculture and Fisheries; UNTL: Universidade Nacional Timor Lorosa'e; CLRR: Consortium for Large Ruminant Research, Indonesia; UQ: University of Queensland, Australia

Role	*Agency*	*Name*
Funding		
LPS program manager	ACIAR	Dr Werner Stur (2016-2018)
	ACIAR	Dr Anna Okello (2019-)
Administration		
Project leader	UQ	Geoffry Fordyce (to Jun21)
	UQ	Assoc Prof Luis Prada e Silva (Jul21-Jun22)
Assistant project leader	CLRR	Prof Dahlanuddin (UNRAM)
MAF representative	MAF	Domingos Gusmão
UNTL representative	UNTL	Dr Carlito Mali Code
In-country project leader	MAF	Drh Antonino do Karmo (to Sep17)
	MAF	Drh Joanita Jong (Jan18-Jun22)
In-country coordinator	Project	Eric Thorne-George (to Jun16)
	Project	Martin Browne (Jul16-Sep17)
	Project	Dr Lea Coates (Jan18-Jun19)
	MAF	Carlos Amaral (Jul19-Jun22)
Project support officer	Project	I Made Adi Sudarma (Jan16-Jun17)
	MAF	Celestino Mali (Jan16-Mar18)
	Project	Florenciana de Jesus Rego (Sep17-Mar19)
Finance manager	Project	Carla da Silva (Aug19-Mar21)
Finance officer	Project	Alexandra Araujo (Sep17-Jul19)
	Project	Leticia Pereira (Amala; Aug19-Jun22)
Admin support	Project	Domingas Alves (to Mar21)
Driver	Project	Justino Caldeira
Driver	Project	Duarte (to Mar21)
Communication for development		
Group advisor	UQ	A Prof Elske van de Fliert
In-country component coordinator	MAF	Quintiliano Belo (Jan16–Aug18)
	MAF	Jacinto Araujo (Sep18–Mar19)
	Project	Florenciana de Jesus Rego (Apr19–Nov19)
	MAF	Adelia Gonzaga dos Santos (Feb20-Jun22)
Chief Investigator	CLRR	Dr Nurul Hilmiati (BPTP)
Forage and livestock production		
Group advisor	UQ	Dr Simon Quigley
In-country component coordinator	MAF	Pedro de Deus (to Mar18)
	MAF	Julio Vicente (Apr18-Mar21)
Chief Investigator (CI)	CLRR	Prof Yusuf Akhyar Sutaryono (UNRAM)
CI & PhD studies, Udayana Uni	UNTL	Dr Yuliaty
PhD studies, UNE	MAF	Latino Coimbra
Business and marketing		
Group advisor	UQ	Dr Scott Waldron
In-country component coordinator	UNTL	Sebastiana Dahu
Chief Investigator	UNTL	Prof Vicente de Paulo Correia
Researcher	UNTL	Dr Jose Nelson Salsinha
	UNTL	Marcolino Brito
	UNTL	Carlos da Conceição de Deus
PhD studies, UQ	UNTL	Adelino P. do Rego (deceased May22)
Field staff		
Field Researcher	Project	Jorge dos Santos (to Mar21)
	Project	Maria de Jesus (to Mar21)
	Project	Armando dos Santos (to Mar18)
	Project	Joanita de Araujo Magalhaes (to Mar21)
	Project	Regina Ikin Cardoso (to Dec18)
	Project	Marcelo (to Dec20)
	Project	Jaime Tomas (to Mar21)
	Project	Regina E R Soares (to Mar21)
	Project	Noelia Fatima Belo Talo (to Mar21)

Table 2. Chiefs and MAF facilitators of the 21 *Redi KAMODI*

Municipality	Sub-district	Facilitator (Technical)	Facilitator (Extension coordinator)	Facilitator (Extension)	Chief	*Redi KAMODI*
Bobonaro	Atabae	Aristides Tavares	Jose Baptista	Claudio Fontes	Joao Marques	Aidabaleten
				Betrisio Maubere	Pedro Leitao	Rairobo
				Jose Baptista	Paulinuo Maubere	Atabae
				Marcus Sarmento	Leonito Sousa	Hataz
	Cailaco	Noe Gonsalves	Placido dos Santos	Placido dos Santos	Ozorio Loilako	Meligo
Manufahi	Fatuberliu	Carlos Fernandes	Evaristo P Xinai	Jose da Silva	Andre Ornai	Fatukahi
				Armando de Jesus	Adolfo M Duarte	Clacuc
				Abilio M Madeira	Bento da Costa	Caicasa
Ermera	Hatulia	Valente Brites	Agusto dos Santos	Agusto Martins	Serafim da Costa	Asulau
Ainaro	Hatudo	Abilio de Jesus	Joel Antonio dos	Joel Antonio Santos	Isabel da Costa	Leolima
		Zeferino de Oliveira	Santos	Zeferino de Oliveira	Juvinal da Costa	Becala
	Ainaro Vila	Joanico de Araujo	Marcos de Araujo	Carlos C. do Rego	Marcelo Magno	Cassa
Covalima	Tilomar	Antonio Ferreira Hale	Carlos	Vicente Sarmentu	Octavio Maia	Casabauk
				Jose Ximenes Maia	Anacleto de Neri F Vicente	Maudemo
Viqueque	Viqueque	Jordao Reis Pinto	Bonifasio da Costa	Daniel Amaral	Saulostinu Pinto	Luca
			Amaral	Leanto Gomes	Jose Pinto	Bahalawain
Lautem	Tutuala	Egas dos Santos	Olivio Carvalho	Olivio Carvalho	Ze Meico Neto	Mehara
Manatuto	Natarbora/ Barilke	Antonio Marcos	Jose Madeira	Jose Madeira	Lukas de F Fernandes	Aubeon
				Miguel Braz	Bazilio Raimundo	Uma Boco
				Nazario Aleixo	Joao Berek	Sicone Diloli
				Silveiro Soares	Placido da Costa	Abat Oan/Fatuhake

Redi KAMODI are also strongly supported by senior staff within municipalities (equivalent to a state in other international jurisdictions) participating in the project. These include the heads of Livestock Departments and the Chief Administrator of these municipality. One example is Snr Agusto Fernandes, Head of the Livestock Department in Manufahi, who has gained considerable capacity as a result of participation, applied the interventions to his own family business, and now has a substantially higher family income.

5.1 Communication for development (C4D)

5.1.1 Team roles

Assoc Prof Elske van de Fliert Team leader	Conceptual input, design of communication and outreach strategies, training of field researchers and facilitators, evaluation study design, implementation and reporting, and overall coordination
Dr Nurul Hilmiati Chief investigator	Conceptual input, facilitation of situation analysis and quarterly reflection and planning workshops, training of field researchers and facilitators, and evaluation study implementation and reporting
Adelia C. Gonzaga dos Santos In-country component coordinator since Feb 2020	Field coordination, field activity reporting, field-based mentoring of field researchers, and monitoring and evaluation data collection and reporting

Previous in-country coordinators have used capacity built in C4D to advance their careers:

- Quintiliano Afonso Belo (Mar 2016 - Aug 2018): supported with a Master's degree in Extension and Development Communication at Universitas Gadjah Mada, Yogyakarta, Indonesia, during 2013-15 (LPS/2009/036). Mr Belo left the project in 2018 as he obtained positions with the FAO Agricultural Census program and later the Ministry of Public Work, where he became National Director of Procurement.
- Jacinto Araujo (Sep 2018 - Mar 2019): ongoing informal training. Mr Araujo left the project in early 2019 to start an advisory position at the Ministry of Higher Education,
- Florenciana de Jesus Rego (Apr 2019 – Nov 2019, in addition to her duties as Project Support Officer): Ms Rego left the project to join a GIZ project (GIZ is a German development agency supporting international development and education.

5.1.2 Development of a 'Beef Systems Development' model (*Redi KAMODI*)

Based on the needs, opportunities and conditions identified with Timorese partners and communities in project LPS/2009/036, a 'Beef Systems Development' model – which was locally named *'Redi KAMODI'*, meaning *'Cattle for Better Lives Network'* – was designed and piloted during 2016-18. The *Redi KAMODI* (RK) was defined as *'a community group consisting of farmers and traders, who first define their goals, and then develop more profitable production and marketing systems through seeking, evaluation and selective implementation of new or improved practices'.* These groups are facilitated by local MAF staff (technical, extension) and, in the context of the project, they were supported by the three project components and by the project's Field Researchers who were based at the RK sites (Figure 3).

RK was piloted in two of the villages where the field research of project LPS/2009/036 had been conducted, ie, Aidabaleten in Bobonaro and Fatucahi in Manufahi.

Design workshops

Workshops were held in Australia (Feb 2016) and Timor-Leste (Mar 2016) to formulate the framework for a suitable model for a Timorese community-based innovation platform for beef system development, and fine-tune it to the conditions and capacities of the Timorese partners and communities.

Follow-up refresher training events were organised on site for the *Redi KAMODI* facilitators, managers and Field Researchers throughout the pilot years during Quarterly Reflection and Planning meetings, and centrally during the project's Annual Meetings in Dili.

Piloting of the RK model

Socialisation: The *Redi KAMODI* model is introduced to the community during an open community meeting. The objectives, structure, support activities and responsibilities of members are made clear, emphasising that benefits for members are in the form of individual capacity building and facilitation of individual and collective action, rather than the distribution of goods. Membership is through self-selection and registration.

RK establishment: The *Redi KAMODI* operates at Suco (village) level, with smaller cells at the Aldeia (hamlet) level. The self-registered members select a management committee consisting of a Head, Secretary and Treasurer. The *Redi KAMODI* Facilitators are, by default, the Suco Extension Officer and the sub-district Livestock Technical Officer, both MAF employees. As part of the pilot, the project's Field Researcher also functioned as Facilitators supporting the MAF Facilitators.

Participatory situation analysis: Through a range of data collection and discussion activities over two days, the *Redi KAMODI* members and facilitators analyse the issues, needs, opportunities and potential options for improvement in relation to cattle production in their village. The objective of this activity is two-fold: (1) conscientisation of the RK members about the status of their livelihood, opportunities for improvement, and the need for their own action; and (2) to inform agenda setting of the *Redi KAMODI* workplan. Activities during these three days include transect walks, participatory mapping of the village area, group discussions with farmers and traders (men and women) using a variety of participatory methods, and individual interviews with farm households (husband and wife together), and village/hamlet officials. The findings are presented and discussed during a planning meeting of the RK adaptive trials, as discussed below.

Adaptive trials of improved cattle management practices: Based on the outcomes of the situation analysis, and in consecutive seasons of the Quarterly Reflection meetings, *Redi KAMODI* members are facilitated to pose a question they want answered, and to design and plan adaptive trials to assess the selected option(s) to answer that question.

Quarterly Reflection and Planning meetings: While *Redi KAMODI* cells were encouraged to meet on a monthly basis for members to exchange experiences and learn from each other and the Facilitators, the C4D Component organised Quarterly Reflection and Planning meetings in each *Redi KAMODI*. Activities and achievements of the past three months are reported and analysed, based on which a workplan for the next three months is formulated.

Marketing of cattle: *Redi KAMODI* members are informed of marketing opportunities (prices, outlets), and facilitated to sell their cattle individually or collectively.

5.1.3 Development and piloting of a Redi KAMODI outreach strategy

In order to accommodate requests for expansion of *Redi KAMODI* units and to prepare for large-scale outreach beyond the project, the C4D team designed and piloted the following elements of an RK outreach strategy.

Training of facilitators (ToF)

- Building on the experiences of the first *Redi KAMODI* Facilitator Training in 2016 and follow-up field-based, on-the-job training for the Facilitator teams of the pilot sites during 2016-18, the original ToF model was adapted, and captured in the outline for the *Redi KAMODI* Facilitator manual. The model involves interactive technical modules (forages and cattle production, marketing and business), RK management and facilitation modules, a field visit to an existing *Redi KAMODI*, and workplan development.
- A four-day ToF pilot event was conducted in March 2019 in Dili, involving 12 *Redi KAMODI* facilitators (4 original and 8 new Facilitators from neighbouring sites in

Bobonaro and Fatucahi), four *Redi KAMODI* leaders, and eight project Field Researchers. The trainers of Trainers consisted of a mix of Timorese, Australian and Indonesian project partners.

- A 4.5-day ToF, led by MAF/UNTL project partners and supported by the C4D component, was conducted in February 2020 in Betano. This event involved 7 of the Facilitators that received previous training, and 14 new Facilitators from the municipalities to which the RK had expanded during the second half of 2019 and early 2020 (Ermera, Ainaro, Covalima and Viqueque).
- A last ToF was planned for June 2021 to support further expansion of *Redi KAMODI* establishment to additional sub-districts and municipalities, especially Manatutu and Lautem where several RKs have already been established in late 2020, but this could not proceed because of the pandemic.

Educational material for farmers

While most of the farmer learning takes place through the implementation and analysis of adaptive trials, some new bits of knowledge, required to be able to pose good questions and select the right options to experiment with, are conveyed to farmers through informal training sessions. These can be group training events or individual, field-based learning events, depending on what the *Redi KAMODI* Facilitator finds most suitable at a particular moment. To support these learning moments and better retain new knowledge, some educational materials are being produced, eventually for use by RK Facilitators, which will be available to the Facilitators by mid-2021. These materials include:

- A series of six posters on the following topics: the *Redi KAMODI* concept, Leucaena seedling preparation, Leucaena production, Cattle fattening, Cattle weight assessment, and Cattle pen construction. These posters can be put up in the *Redi KAMODI* meeting place and form a source of discussion among members.
- A series of 22 short (max. 90 seconds) instructional videos on technical topics (forage and cattle production/management) for distribution via smartphone using WhatsApp. These are complemented by several recorded short testimonials from *Redi KAMODI* members, *Redi KAMODI* Facilitators, and MAF and UNTL researchers/managers about the benefits experienced from RK structures and activities.

5.1.4 Participatory monitoring and evaluation

A participatory monitoring and evaluation system was put in place at the start of the project, and further developed over time, to serve both formative and summative functions.

Formative evaluation was embedded in the Quarterly Reflection and Planning meetings described above. Regular and systematic review of processes and achievements allowed both the *Redi KAMODI* Facilitators and the project team to identify needs for the adjustment of activities.

An evaluation study was conducted during the last year of the project in the eight municipalities of the project: Bobonaro, Manufahi, Ermera, Ainaro, Covalima, Manatutu, Viqueque, and Lautem. The aim was to explore and document (1) the efficacy of the *Redi KAMODI* model to enhance the business development capacity of rural communities, including farmers, local traders and technicians, (2) the perceptions of *Redi KAMODI* members and facilitators about the model as an innovation platform, and (3) the impact *Redi KAMODI* establishment has had on members' and facilitators' capacities As this was an evaluation study of a project component to document perceptions of project participants about the effectiveness of the project's approaches, we employed evaluative research methods (O'Leary 2017). The evaluation involved data collection from all key stakeholders of the project through multiple methods (Appendix 1), including: (a) review and analysis of quarterly reflection and planning reports; (b) focus group discussions; and (c) semi-structured interviews.

The study was conducted from January 2021 to June 2022. Unfortunately, the COVID-19 pandemic caused travel restrictions, precluding field visits, between March and June

2021, hence the extension of the data collection period until June 2022. The Australian and Indonesian team members were not able to travel at all to Timor-Leste to participate in the data collection. Consequently, the bulk of the data were collected by the local C4D team with assistance of the field researchers who received training in data collection in January 2021. A total of 54 farmers/members of *Redi KAMODI* groups, 47 non-*Redi KAMODI* farmers, 18 *Redi KAMODI* leaders, 18 village leaders, 29 *Redi KAMODI* facilitators, 9 sub-district leaders, and 7 municipality Heads of the MAF Livestock Division were interviewed. Meanwhile, focus group discussions with *Redi KAMODI* members were replaced by the last round of quarterly reflection and planning meetings with four *Redi KAMODI* groups. One focus group discussion was conducted with three Timorese, three Indonesian and four Australian research team members during a visit to Brisbane in June 2022.

All interview data were transcribed and coded for analysis to identify emerging themes. Themes were formulated by clustering recurring common responses.

5.2 Business and marketing

This component aimed to support the production component of the project by linking cattle production activities with the economic planning and budgeting of these activities. This enabled households to assess the costs, benefits and feasibility of different cattle production systems.

As well, the component aimed to stimulate improvement in cattle production systems through a “demand-pull” approach. It was based on the assumption that households are motivated especially by the revenues (cash income) from cattle, which can be substantial in improved systems. The calculations on profits from cattle sales were designed to capture the interest of farmers.

5.2.1 Business training

Thirteen detailed business training modules were developed on all aspects of cattle systems including investment (pens, water, tree forages, ground forages), cattle production (cow-calf and fattening) and cattle marketing (prices, transport, aggregation). The material was designed to integrate with cattle production training material and presented as powerpoint slides and Excel budget sheets in both English and Tetum.

5.2.2 Cross visits

The component organised a series of study tours. This included two trips to West Timor in 2017 and 2019 for a total of 38 people (farmers, village leaders, extension staff, MAF, UNTL). The aim was to provide direct experience and lessons from West Timor, which have similar agro-climatic conditions but considerably more developed cattle production and marketing systems.

The component also four organised the visits of RK members to Dili in 2017, 2018 and 2020. The aims were to help RKs understand first-hand the preferences of butchers, and to facilitate linkages between RKs and “modern” butchers.

5.2.3 Cattle marketing

The training and visits above were designed to provide opportunity and skills for farmers to enter into cattle fattening and to achieve premium prices for higher-value markets. Supported by MAF, ILO and MDF projects, a growing “modern” beef sector has emerged, with slaughter in a certified abattoir (Tibar) and 3-4 specialist butcher shops. The project facilitated communication with modern butchers in Dili, including aggregating cattle, truck hire and payment. Importantly, the cattle were purchased on the basis of live weight in Dili based on a set price schedule. This objective “over-the-scales” cattle sales system

contrasts with “traditional” cattle marketing systems where cattle are purchased basis on subjective, visual assessment of cattle, which are purchased on a per animal basis.

5.2.4 Developments in cattle marketing and policy

The preceding project (LPS.2009.036) produced a major report titled “Sub-sector analysis of the Timor-Leste Beef Industry” (2014) that documented and analysed all aspects of the industry. This project updated the information and (as discussed above) linked with RKs.

5.3 Forage and livestock production

The primary role of the forage and livestock team was to provide technical support to RK facilitators and groups through the preparation of Training-of-Facilitator materials, provide advice on the design of RK driven ‘trials’ including support through the collection and interpretation of data to assist RK groups with ‘post-trial’ decision making, technical training in the implementation of changes in production practices and the establishment of *in situ* demonstration activities.

After the initial development and refinement of a range of training modules component activities were largely driven by the priorities of RK groups (and their facilitators) rather than the specific activities outlined in the project document and described below. Therefore, activities that may have been deemed a high priority by the proponents of the project proposal (and therefore listed in the proposal as specific research activities at inception) may not have been of interest to RK groups, and thereby have not been implemented to the extent that was prescribed or expected in the project proposal.

Forage production was a key research activity as this underpinned all cattle production systems. High calf mortality rates identified in the previous project became the focus of PhD studies by Latino Coimbra in Queensland. Development of handling facilities to improve the efficiency of production and marketing was initiated. In addition, forage feeding and husbandry practice impacts on production were assessed. Research questions from RK were tested in experiments set up with undergraduate students at UNTL under the leadership of Dr Yuliaty.

6 Achievements against activities and outputs/milestones

Objective 1: Establish Beef Systems Development (BSD) groups to guide research at a regional level

no.	activity	outputs/ milestones	completion date	comments
1.1	Design and pilot processes for establishing and operating Beef Systems Development groups	Select 2 start-up municipalities and associated MAF staff (A,PC)	Mid-17	Consultation between project partners and with regional people agreed that Aidabaleten in coastal NW Timor-Leste and Fatucahi in south coastal Timor-Leste were the best locations to commence the project.
		Start-up workshop and employ project staff (A,PC)	Mid-17	A full complement of project staff were employed: • Project manager – Martin Browne • Field researchers who are based at each research site The project's start-up workshop was held on 15-16 Sep 2016 and attended by project staff and key stakeholders
		Two BSD groups selected and have had first meetings to describe their vision, and to plan description of their production and supply chains (A,PC)	Mid-17	A model for cattle sustainable self-development groups was developed, which have been named '*Redi Kamodi*' (RK). '*Kamodi*' is an abbreviation of '*Karau ba Moris Diak*' (cattle for prosperous livelihoods) and '*Redi*' means 'network'. Two *Redi Kamodi* (RK) groups were established in Aidabaleten and Fatucahi respectively. An RK operates at the suco (village) level and consists of cells at the aldeia (hamlet) level. The RK in Aidabaleten consists of around 30 farmers across 5 cells while the RK in Fatucahi consists of around 20 farmers across 4 cells. The two RK groups have had different focal activities, being forage production in Aidabaleten and cattle fattening in Fatucahi. They also established a monthly training plan for 2017 The process was slow to establish and required a lot of local facilitation. This was a key learning output for how to do this. The scaling out to a further 21 sucos was faster when these processes were understood.
		Advisory committee established and had first of their 6-monthly meetings	Mid-17	An advisory committee was not established. Initially, the project linked to the Livestock Working Group, which was chaired by the in-country project leader. This committee considered all significant RD&E associated with livestock in Timor-Leste on a regular basis.

no.	activity	outputs/ milestones	completion date	comments
		Five BSD groups have successfully implemented a business plan for production and marketing RD&E (A,PC)	Mid-18	Two networks had been established with five cells each. Several sites were close to establishment. The networks are operational in that a wide range of field activities take place, guided by regular reflection and planning meetings, and strong local leadership exists. While no formal business plan is in place yet for either network, capacity of the RK facilitators was approaching the point that they could start working on this. The project was slow to start because there was much to be learnt about how to set up a RK. Capacity was another limitation. Once the process was established scaling out has occurred at a rapid rate.
			Mid-21	21 RKs were established with 629 households.
		At least 5 women have been successfully engaged in each established BSD group in a leadership role and/or decision making authority(A,PC)	Mid-18	Membership of the RK is household-based and as such both male and female household members are, by definition, involved in the RK activities. Field researchers and facilitators received training on gender sensitive planning and implementation of activities, and follow-up discussions are facilitated during quarterly reflection and planning meetings. A gender analysis is conducted as part of the situation analysis during the RK establishment process, to provide guidance to gender sensitive planning of activities. Nevertheless, to have a high level of group participation by women and girls is quite aspirational in Timor-Leste. Notwithstanding that, one of the two *Redi Kamodi* Chairs is a woman, demonstrating this can be achieved. In each RK site, at least one female and one male Field Researcher has been deployed to effectively respond to varying gender specific facilitation needs. In July 2018, one of the new Field Researchers, who had prior experience in a Gender focused project, was appointed as the team's Gender Coordinator One demonstration of empowerment of women was a video by the C4D team depicting a woman outlining how the RK process had empowered her to make change and to profit by increasing cattle output to Dili markets.
1.2	Develop and pilot the methods for scale-out of Beef Systems Development groups in other regions	Principles for establishing and achieving full operation of a BSD group described (A, PC)	Mid-19	MAF staff have demonstrated their capacity to start and operate a BSD group. The process of establishing and maintaining a *Redi Kamodi* has been documented. This includes the basic principle of the MAP facilitator having a recognised level of training to facilitate an RK. The reference document in a (Tetun) manual reflects the research done to achieve this. This is complemented with training modules. *Redi Kamodi* will be formally included as an activity in MAF for the long term and as part of this process there will be official certification of those skilled in their facilitation.

no.	activity	outputs/ milestones	completion date	comments
		Mid-term project review	Mid-19	Completed and recommendations made which have all been considered in on-going planning and operations.
		Beef Systems Development groups successfully established by project-trained partners (A,PC)	Mid-17	Two groups called '*Redi Kamodi'* were established, one in each of the sites indicated above. Primary leadership in this process was provided by Quintiliano Belo from MAF who has received extensive training including a Masters degree from the project.
			Mid-18	The project was consolidating the process before scaling out.
			Mid-19	Scaling out started with local staff more confident of the process.
			Mid-20	
			Mid-21	21 RKs had been established across 8 municipalities, facilitated by local MAF RK Facilitator teams. More areas across the country are requesting to be facilitated in the establishment of a RK. Meeting demand has dependence on suitably trained staff within MAF and UNTL to facilitate the process.

PC = partner country, A = Australia

Objective 2: Strengthen capacity of Timor Leste beef cattle industry participants to support development of profitable production systems

no.	activity	outputs/ milestones	completion date	comments
2.1	Develop and pilot training systems for Timor Leste beef cattle R&D partners in technical and communication knowledge and skills	All MAF staff who will be support for or partners in the initial BSD groups have received training in group facilitation support and operation (A,PC)	Mid-17	Training has been conducted monthly with quarterly reflection and annual workshops since January 2017 for district MAF staff in Aidabaleten and Fatucahi who are field extension and veterinary medical staff. Training has been on using a participatory approach, communication and facilitation of research and development initiatives.
		The first cycle of train the trainer in extension methods and in forage and cattle production, business management and marketing has been completed (A,PC)	Mid-21	A full suite of training modules was prepared and delivered to MAF facilitators. The training modules were continually adapted to the Timor-Leste situation and available in Tetun. This took much longer than expected and was an evolving process based on needs and adaptation of methods to suit the Timor-Leste farming situation.

		Beef R&D training of 4 field researchers in Indonesia conducted (A,PC)	Mid-18	In April 2018, 5 field researchers and 2 MAF staff were funded to have training in cattle systems in Lombok and Sumbawa. The training covered topics on C4D (the *Redi KAMODI* concept, participatory situation analysis, introduction to participatory research for development, recording and understanding data with farmers, farmer facilitation and building self-sufficient group), production (forage establishment, management and harvest, forages conservation, cow management, strategies to reduce calf mortality, weaner management and fattening management) and business (household plans, introduction to budgeting and calculating revenue). An evaluation after the training indicated it was very successful in knowledge uptake. The participants required more training on oestrous detection, pen construction, practical weaning technique, nursery establishment, effective engagement with farmers, data management and English. Training in Indonesia and exposure to what is possible was a valuable stage in bringing Field Researchers up to a level that enabled them to more effectively support *Redi KAMODI* and associated research and training. Capacity at all levels is a major constraint to further development of the cattle industry but in particular in application of the *Redi KAMODI* system. Interaction with Indonesian researchers with experience in similar systems has been successful and should be encouraged.
		An effective training program for R&D personnel is developed with some elements being delivered by Timor Leste partners (A,PC)		A large number of training modules have been developed for those who support *Redi KAMODI*. These modules are delivered as needed and span communication, business management, marketing, forage systems, and animal management. UNTL staff deliver all the business and marketing modules. Capacity for MAF staff to deliver modules is rebuilt as high-capacity staff take better-paid employment, a consequence of capacity developed by this and the preceding project. Field staff have many requests for alternate training, which were met if the outcome assisted with current or planned research.
		MAF facilitators of 8 BSD groups competent in marketing and margin analysis (A,PC)	Mid-20	MAF facilitators in all *Redi KAMODI* were trained in marketing and business skills and they in turn trained members (farmers and traders) of their groups, usually in a less formal manner.
		Technical and communication training is fully managed and delivered by Timor Leste nationals for 4 new BSD groups (A,PC)	Mid-20	A full suite of training courses was developed, translated to Tetum and delivered by in-country project personnel, formerly to local MAP staff.

2.2	Develop and pilot an effective system for transfer of new skills and knowledge to innovative smallholders and traders and from them to allied households	Workshop conducted to plan M&E and project team trained in the process M&E, i.e., of knowledge, skills, attitudes and practice changes in production and supply chain operations (A,PC)	Mid-17	A one-day workshop was conducted in Sep 2016. Simple M&E processes were implemented as it has to meet the expectations of the Timor-Leste people doing the M&E. In addition, quarterly participatory reflection and planning has by project team members in Dili (both from MAF and UNTL) and at project sites (MAF staff) has covered what has been going well, improvements needed and planning to achieve this.
		Participatory impact pathway analysis undertaken (A,PC)		A PM&E guide for Field Researchers and Facilitators in Tetun was developed. Most components have been successfully implemented, but due to several staff changes data collection processes were not as continuous and smooth as they should have been.
		Leadership training for facilitators from BSD private sector membership conducted (A,PC)		The option to achieve training of private sector facilitators did not emerge. This is mainly because the opportunity to have it viable at a local business level depends on government funding, which is not foreseeable.
		As result of active learning processes, farmers in two BSD groups have adopted improved practices that are providing financial and social benefits to their families.	Mid-19	Well-established *RK* have many members who are achieving large production, financial and social benefits from the process. For example, combined income from cattle sales for the Aidabalaten *Redi Kamodi* during the first 3 years of the project has increased by >US$90,000. In Fatucahi and Aidabalaten, production feeding of bulls to target the strong and ever-increasing Dili live-weight selling market is now an established practice. This success has ignited the surge of interest in Redi KAMODI across Timor-Leste. Prices/bull have almost doubled. In interviews butchers in Dili have praised the RK system for delivering suitable animals and demand is high.
		Strategies for effective uptake of new methods by peers of BSD group members defined and described in a report	Mid-19	The methods for establishment and conduct of new *Redi Kamodi* has been established and documented for on-going use in Timor-Leste. *Redi Kamodi* are always started by raising awareness of farmers existing situations, roles of cattle for household, problems and available opportunities to improve the cattle enterprise. Participatory work plan development and implementation then occurs. These steps have made farmers feel that all activities are theirs and has created ownership and responsibility for them to do what they have planned. Outcome data has been collected for reporting from each site, though only interim reports are available that do not cover all aspects. A conference paper described the process and a peer-reviewed publication will follow.

		A minimum of 20 women in BSD groups have achieved a significant role in leadership and/or decision making authority	Mid-19	Timor-Leste is a difficult situation for empowerment of women for leadership; even female project staff are hesitant on this issue. Many of the interventions being studied are suited to women and this is achieving high involvement in what has traditionally been men-only business. Some women have taken the opportunity to establish fattening and control the finances, thus enabling them to share the benefits. Two *Redi Kamodi* had a woman as the leader for about 2 years.
		An annual program of thematic training to complement research for BSD group households and peers completed by Timor Leste staff (A,PC)	Mid-19	A comprehensive training program has been established. Several modules are delivered each month by senior project team members to project staff, MAF facilitators and some *Redi Kamodi* members. These people in turn deliver the training in a relatively-informal manner to farmers and other *Redi Kamodi* members.
		Forage production, harvesting and utilisation training delivered to MAF facilitators of 10 BSD groups (A,PC)	Mid-19	A module on forage production, storage and feeding methods has been delivered to representatives from all *Redi Kamodi*. An outcome is increasing use of crop residues in diets of tethered and penned bulls and weaners.
		Forage systems training delivered to 75% of collaborating farmers who are using forages in cattle production (A,PC)	Mid-20	All *Redi Kamodi* members receive training in forage systems, with very high uptake of new methods. Training and mentoring activities for *Redi Kamodi* members (farmers and traders) transfers proven technologies based on lessons learnt from previous projects. Formal training of *Redi Kamodi* facilitators over 1 week has been conducted early each year, and then monthly through the year. This training provides capacity of the facilitators to transfer proven technologies to *Redi Kamodi* members and allied households. Established farmer to new farmer first-hand learning is also supported. Farmers are further motivated to implement better cattle feeding and management, therefore forage systems, as a result of market developments achieving significant price incentives from selling fat cattle to Dili processors.

		At least 500 households in BSD groups along with RD&E support staff have enhanced knowledge, skills and attitudes leading to practice changes in forage production and use, cattle management, business operation and marketing	2021	The 21 active RKs that had been formed by Feb 2021 enjoyed a total membership of 629 households. Household representatives have received group training and individual guidance from the 41 local MAF staff who had been trained as RK Facilitators, with support from the project's Field Researchers. This has resulted in 228.5 ha of land planted with forages (mainly Leucaena) in these 21 villages, in addition to many farmers having built pens for bull fattening, and sales of cattle with higher prices than usual as a result of both higher liveweight and better market price. An evaluation study was conducted in the last year of the project and to assess changes in RK members' knowledge, skills and attitudes. The quantitative and qualitative data showed the project was a resounding success on all fronts.
		At least 2,000 households have had indirect association with project activities and the opportunity to alter beef cattle ownership practices.	2021	The abovementioned evaluation study found direct and indirect influence of the project activities on the wider farming community. Farmers outside the *Redi KAMODI* adopted the practices, joining their local group. Communities across Timor-Leste are requesting *Redi KAMODI* for their communities.
2.3	Build research and leadership capacity through support of post-graduate training	Post-graduate student research achieves practical solutions for cow production inefficiencies		Three PhD students have been supported. Dr Yuliaty completed a PhD at Udayana University. Latino Coimbra and Adelino de Rego are enrolled at UNE and UQ respectively. Their studies have focused on nutritional management of cows, which are expected to have large impact in Timor-Leste through future tertiary teaching and on-farm research and extension. Adelino de Rego has had his PhD work suspended due to Covid but continuation is assured.

PC = partner country, A = Australia

Objective 3: Facilitate the development of farm business skills and cattle marketing systems

no.	activity	outputs/ milestones	completion date	comments
3.1	Develop and implement programs to train smallholders, both cow-calf and fattening operations, in farm management, business and marketing skills	At least 75% of households in BSD groups trained by MAF trainers in simple methods to assess returns and profitability (A,PC)	Mid-18	Thirteen detailed training modules on budgeting for cattle production and marketing were developed, translated and adapted, which are also coordinated with production training material. All "trainers" (field researchers and MAF members of *Redi Kamodi*) received training from UNTL staff in all modules, often repeated. The trainers and UNTL staff conducted business training with all *Redi Kamodi* members on multiple occasions.
			Mid-19	Delivery of the 13 training modules continued as above.

			Mid-20	All *Redi Kamodi* members have received training in business skills and marketing from MAF facilitators supported by UNTL staff. Additional funding to UNTL bolstered household budget training in the final half of 20-21.
			Mid-21	The component has conducted at least 25 training sessions, in 14 areas, by 6 trainers from UNTL, directly with at least 255 trainees (mainly farmers, but including FRs, extension and vet staff and local leaders). Practice change by farmers requires change in multiple facets. The business and marketing skills developed by *Redi KAMODI* participants has enabled a sound return on investments required for activities such as forage production and bull fattening. UNTL has led the activities on business and marketing.
		At least 50% of households in BSD groups are able to quantify the profitability of a range of household options (cattle production scale, feed options, enterprise choice, marketing) (A,PC)	Mid-18	Assessments on the business training from both trainers and from *Redi KAMODI* members were positive. There was however written and verbal feedback that the budgeting methods are hard to understand by some households especially with low numeracy levels. Alternative methods were planned.
			Mid-19	The majority of households are able to calculate main costs, revenues and profits for fattening in particular. The project – especially through a JAF PhD student Adelino do Rego – is investigating and trialling a range of innovative farm management communication methods adapted to for the Timor-Leste situation.
			Mid-20	UNTL and MAF facilitators have worked with all *Redi Kamodi* households that have taken up forage production and cattle fattening to cost and budget options. However, challenges with quantification and literacy levels means that not all would be able to replicate calculations or do budgets independently.
			Mid-21	Surveys of 30 trainees in 2020 found that all trainees said that they would apply the training. When asked about which aspects, trainees said they would use the general budgeting approach (31%), weighing and weight gain (33%) and marketing (33%). Developing farmers' business and marketing literacy is limited by their basic education. The on-going research by Adelino do Rego will help overcome some of these limitations. Capacity of staff and farmers is quite a constraint to developing a commercially oriented beef business.

		At least 25% of BSD group households have applied farm and business training in decision making to assess introduction of more commercial and profitable cattle systems (A,PC)	2021	It has not been possible to quantify this. However, it is probably in line with the uptake in improved cattle systems for the RK groups.
		Farmer training in understanding and assessing alternative marketing practices and channels conducted (A,PC)	Mid-18	All trainers and *Redi Kamodi* members have received training in the assessment of marketing options.
			Mid-20	All *Redi Kamodi* members are now aware of the opportunities associated with direct selling of bulls to Dili. A small percentage of farmers have had the opportunity to have individualised household budgets. This is influenced by the awareness and success of the supply chain linkages developed by the project to butchers in Dili. A butcher was interviewed by the review team and strongly supported the RK model and supply of suitable bulls.
		Two tours with BSD group members conducted to West Timor to visualise marketing alternatives (A,PC)	Mid-18	Eighteen members of a *Redi Kamodi* travelled to Kupang,District in West Timor in mid-2017 to study forage production, cattle production and marketing systems there.
			Mid-19	After a similar visit in 2017, a delegation of 22 people from MAF, UNTL and *Redi Kamodi* travelled to Kupang, District in West Timor in February (15-21) 2019 to study forage production, cattle production and marketing systems. The reported lessons and feedback were very positive. The impact of these study tours was large, especially through the impact on the MAF and UNTL staff who have been able to incorporate their learnings into the training they do, plus the operation of their family businesses. A video of a woman from a RK who had gone on the tour outlined how the tour made her aware of the opportunities which she had employed to increase her income.

		Visits by members of multiple BSD groups to processing and retailing sectors conducted (e.g., butchers in Dili) (PC)	2021	Visits to Dili have been organised for 35 RK stakeholders, focused on the mechanised abattoir and two modern butchers. These visits have been a catalyst for changes by the farmers who participated.
3.2		Identified alternate marketing methods in 6 BSD groups (A,PC)	Mid-18	With support and coordination of the project, *Redi Kamodi* sold 3 consignments of cattle using alternative marketing methods, including farm-gate weighing, sales on per kg live weight basis, and hiring own trucks.
			Mid-21	Butchers and farmers were now linked directly through the supply chain. The system of live weight marketing of cattle is now much more mature in Timor-Leste with all RK participating. The strategy complements the needs of butchers. Both farmers and butchers have elevated business profitability as an outcome. This provided the financial incentive for farmers to adopt the RK system.
		Testing of improved cattle marketing initiatives achieved and monitored in 4 BSD groups (A,PC)	Mid-19	In addition to 3 consignments last year, the project supported *Redi Kamodi* to organise another 4 consignments in 2019 (1 Aidabalaten, 4 Fatucahi) using alternative marketing methods, including aggregation, hiring own trucks, farm-gate weighing and sales on an objective (per kg of live weight) basis.
			Mid-21	The project and the RKs coordinated to sell 267 cattle through formal over-the hooks (weighed) methods to modern butchers in Dili. The cattle came from 134 different households, in 30 different aldeia/areas. 88% were over the 250 kg threshold to achieve the highest price premium in the pricing schedules of modern butchers (US$2.70/kg liveweight). Price/bull achieved by farmers has almost doubled. This has raised the interest of many farmers and probably accounts for the interest in other farmers wanting a RK established in their region. Butchers have praised the system for supplying bulls suitable for commercial slaughter.
3.3		Updated data and analysis on current and potential beef cattle markets locally and in Dili reported (A,PC)	Mid-18	Based on a detailed and comprehensive industry report (2016), researchers in the business component – and other components – have remained informed about developments in the broader cattle industry, including policy, trade, and the processing / retail sector. Project members have provided detailed advice to stakeholders including on the national livestock policy, abattoir/feedlot developments, and the formalisation of the Indonesian export trade in live cattle (MAFF, ADB, DFAT, NT government).

			Mid-21	Updated in project final report (Business and Marketing component) and communicated constantly by component with RKs, butchers and agencies including MAF, MDF and ADB. There is much more awareness of the market and what is happening locally and regionally and with cross border trade. Butchers in Dili have provided positive feedback. Farmers have seen a modern butcher and now understand better what the requirements are and how to capitalise by providing the right sort of bull for slaughter.
		Updated information on agribusiness activity and policy in the live cattle trade to Indonesia reported (A,PC)	Mid-21	Information available. Contribution to discussion on cross-border trade. The export market trade has been formally stopped, with few informal leaks. Regulations are being devised for biosecurity and health at a higher level to open up this trade. There is expected to be demand but there is competition within Indonesia of cheaper imports from Brazil and India.

PC = partner country, A = Australia

Objective 4: Develop profitable forage-based cattle management systems

no.	activity	outputs/ milestones	completion date	comments
4.1	Evaluate and demonstrate forage production systems that will enable farmers to support new cow-calf and fattening systems	Identified possible forages that can be used for Cattle in Timor Leste farming systems and selected at least 5 promising species (A,PC)	Mid-17	Based on previous project results Forage Tree Legumes (FTL) and herbaceous legumes were identified as forages that would potentially provide the biggest improvements in cattle productivity. These were established with varying levels of success with Redi Kamodi members in the two established groups. Farmers are planning to establish and assess leucaena-grass grazing systems as opposed to cut-and-carry in some areas where land is readily available. Leucaena most widely used FTL and there is a lot of support expertise. This provides an entry point to consider other forage options.
		At least 3 separate systems developed for integrating forage production with cropping and for accessing forage from these systems for cattle diets (A,PC)	Mid-19	*Redi Kamodi* has almost solely focussed on the integration of leucaena into existing cropping systems (eg, corn) or with other crops (eg,.Sandalwood). Whilst a range of other options have been presented to farmers, including the use of herbaceous legumes to fill feed gaps within the leucaena system, interest and uptake in alternative systems by *Redi Kamodi* remains low. A strategy of linking *Redi Kamodi* with agencies such as the Betano agriculture training college aims to introduce alternate systems using complementary research. This aims to overcome having groups specifically request research support into alternative systems with which they have limited or no experience.

		Practical and efficacious forage storage and feeding systems developed at 6 sites (A,PC)	Mid-19	Training modules for feeding different classes of cattle and forage conservation have been developed and extended to established *Redi Kamodi* groups. Farmers in established *Redi Kamodi* are adopting more intensive feeding systems with mixed results. There have been no requests from *Redi Kamodi* for research and demonstration of forage storage systems. The strategy used above is being implemented to overcome this.
4.2	In collaboration with north Australian research, develop interventions to improve neonatal calf survival	North Australian research collaboration identified and demonstrated practical interventions to reduce calf loss associated with nutrition and environmental risk factors by up to 10% (A)	Mid-20	Several experiments involving Latino Coimbra, a Timor-Leste PhD student, have now been completed that show for the first time the direct impact of modulating pre-calving nutrition on the ability of cows to initiate lactation on the day of calving. .
			Mid-22	The opportunity to develop and apply interventions that can reduce neonatal calf mortality were thwarted by the global pandemic as no international staff, nor Latino Coimbra, could travel to Timor-Leste and conduct the required training until near the end of the project when this was undertaken.
4.3	Develop and demonstrate robust and affordable cattle handling facilities that will enable improved cattle management by Timor Leste smallholders	Affordable facilities with new design operating at 3 sites making cattle handling and monitoring significantly easier and safer (A,PC)	Mid-18	An adaptable plan for cattle handling facilities suitable for Timor-Leste famers and traders has been developed. Sites have been assessed and selected. The leader of the implementation group left the project in early 2018 to take higher-paid employment, which has left this task incomplete. There has been some development and testing of some infrastructure.
		Modifications of cattle farmer handling facilities completed and operating at 20 sites (A,PC)	Mid-22	This milestone could not be achieved without the above milestone being completed, and it was over two years late. Impetus for this planned outcome has come from both our project and the need for facilities in Timor-Leste to conduct effective disease surveillance in cattle as part of establishing credentials for live export of cattle to Indonesia.
4.4	Evaluate, demonstrate the impact of, and achieve uptake of nutritional and husbandry interventions on increasing cattle productivity and profitability	Impact of cattle management interventions on live weight production measured at farm level (A,PC)	Mid-19	Live weight gain of growing bulls is measured directly or estimated by girth tape in all households adopting more intensive feeding systems. Pilot testing of different weaning methods were tested in some sites in an attempt to facilitate greater implementation of weaning to increase reproduction rates.

		Systems for achieving a live weight production ratio of 0.3 described for Bali cattle in Timor Leste systems (A,PC)	Mid-20	The implementation of cattle forage production, preservation and feeding to penned bulls has seen farmers achieve bull growth of 0.2-0.4 kg/day. For a bull weighing an average of 250 kg during fattening, this is a live weight production ratio of at least 0.3.
		Impacts of successful interventions on labour (total and disaggregated by men, women, and youth) and profitability of cattle production of 100 smallholders described (A,PC)	Mid-22	A comprehensive evaluation study was conducted from late February to June 2022. The overall response to the project was very favourable.

PC = partner country, A = Australia

7 Key results and discussion

7.1 Communication for development (C4D)

7.1.1 Development of a 'Beef Systems Development' model (*Redi KAMODI*)

Piloting of the RK model

Adaptive trials of improved cattle management practices: At the two pilot sites, the main issues were the lack of sufficient (and sufficiently nutritious) feed for cattle and the lack of control over the animals that are generally free-ranging. The improved practices tested by the *Redi KAMODI* initially included (1) the cultivation of leucaena as feed, and (2) the tethering or penning of bulls to be fattened for the market. In the process, additional improved practices of forage and cattle management and marketing were introduced to the RK members according to emerging needs.

Quarterly Reflection and Planning meetings: Over the two years of the pilot, the process for these meetings was fine-tuned and documented, and the *Redi KAMODI* Facilitators and project's Field Researchers were increasingly put in charge of facilitating the meetings. The outcomes of the June/July meetings would feed into the project's Annual Meetings and form the basis for planning activities during the next season.

A Redi KAMODI meeting in Atabae, March 2017

Marketing of cattle: In particular, access to Dili markets and the coordination of transport, hence cutting short the supply chain, became a beneficial practice for *Redi KAMODI* members.

It took the full two years of the pilot before the benefits of the *Redi KAMODI* became tangible. For farmers, this was in the form of nutritious forages becoming available, resulting in higher liveweight gain of cattle and, consequently, a higher income from cattle sales. Moreover, increased capacity of MAF staff to facilitate the *Redi KAMODI* system (as opposed to just deliver messages and goods, as they used to do in conventional projects), and a higher level of self-efficacy among *Redi KAMODI* members became evident, confirming that the overall approach of the *Redi KAMODI* as a community-based innovation platform was promising for the Timorese livestock sector. By that time, neighbouring communities began to request the establishment of *Redi KAMODI*, allowing the C4D team to take stock and beginning to design an outreach strategy.

7.1.2 Development and piloting of a *Redi KAMODI* outreach strategy

Piloting of *Redi KAMODI* outreach

The Training of Facilitators events allowed the establishment and facilitation of a total of 21 RKs across eight municipalities, involving 59 cells, 629 *Redi KAMODI* members (farm families) and 202.5 ha of land planted with forages (Figure 3). Expansion resulted both from requests by communities or local MAF units who had observed the functioning of successful *Redi KAMODI* in other places, and from invitations to participate to local MAF units in areas with high potential for cattle production. In both scenarios, the socialisation processes that are part of the *Redi KAMODI* model appeared to be crucial for successful establishment of new *Redi KAMODI*. The team of MAF staff involved in the facilitation of the 21 *Redi KAMODI* in the eight municipalities consisted of 10 sub-district level Extension Coordinators, 11 sub-district level Technical Livestock staff, and 21 village-level Extension Officers.

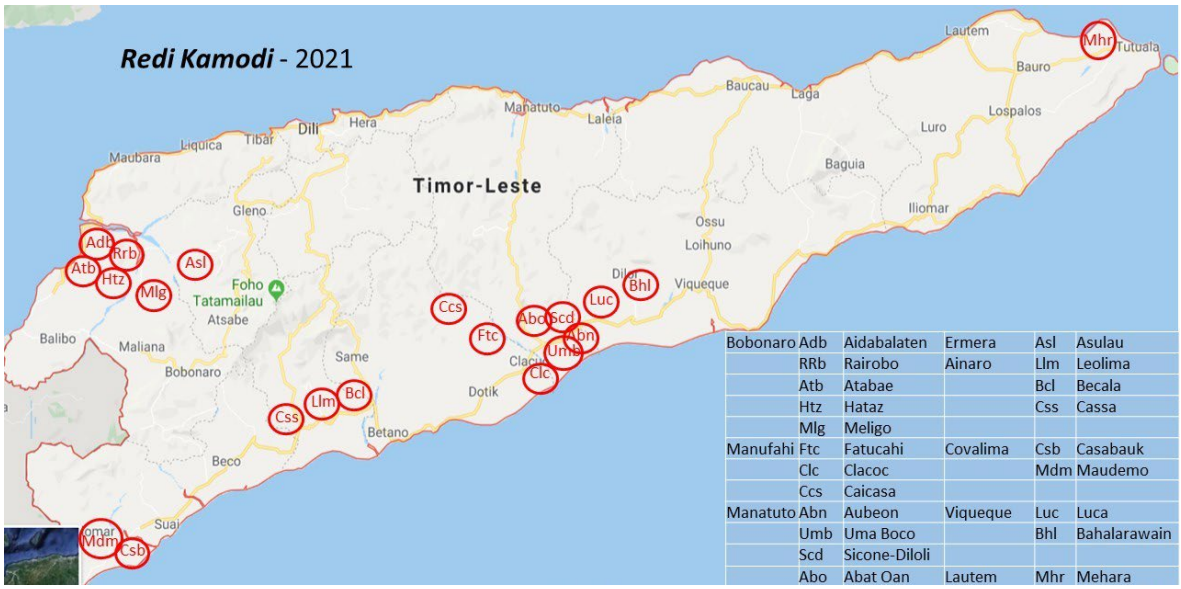

Figure 3. Project field sites

The *Redi KAMODI* manual

A manual for *Redi KAMODI* Facilitators was under development since the first ToF (Table 3) and undergoing constant updates based on experiences in the pilot sites and at pilot training events. The manual consists of three parts in six volumes: (1) How to establish and facilitate a *Redi KAMODI*, (2) Field guides for *Redi KAMODI* learning activities, and (3) Technical guidelines on forage and livestock production, business and marketing. The manual is written in Tetum, with various parts being translated (and adapted) from materials originally produced in English or Indonesian. The final manual was printed in mid-2022 and will be the basis of training for all *Redi KAMODI* Facilitators when attending ToF.

Table 3. *Redi KAMODI* training modules within the Facilitator manual

C4D	***Forage and Cattle***		***Marketing and Business***	
The *Redi KAMODI* concept	Land area measurement	Lamtoro grazing systems	Cattle selling options	Forage tree legumes
Redi KAMODI establishment and facilitation	Seed & seedlings production	Monitoring cattle	Cattle transport systems	Fattening
Socialisation	Growing tree legumes	Fence construction	Decision making for cattle systems	Herbaceous legumes and grasses
Situation analysis	Growing herbaceous legumes	Yard construction	Revenue	Cow-calf production
Activity planning	Growing grasses	Intensive feeding for fattening	Variable costs	Bull fattening
Engaging women	Fodder conservation	Cow management	Budgeting	
Reflection	Water	Weaning and feeding of calves	Infrastructure	
	Legume feeding systems	Reducing calf mortality	Water	

Promotional activities to inform policy

Several promotional activities demonstrating the *Redi KAMODI* achievements were conducted in 2021 and 2022 to encourage policy makers to institutionalise the *Redi KAMODI* model in future programs as a more effective rural development and extension approach. These activities include:

- The production of a promotional video of approximately 10 minutes that shows the processes and achievements of the *Redi KAMODI* and provides several testimonials of farmers, facilitators, local administrators and researchers.
- The production of stories about field achievements in an attractive, journalistic style. The in-country C4D coordinator underwent training with a journalist in January 2021 to write and publish such stories.

A national seminar was envisaged involving policy makers, administrators, researchers and farmer representatives, at which the *Redi KAMODI* model and achievements to date would be presented, and institutionalisation within the MAF structures and programs explored. However, this could not proceed because of the pandemic. Instead, more emphasis was placed on direct communication with the Minister of Agriculture and Fisheries.

7.1.3 Participatory monitoring and evaluation

The *Redi KAMODI* evaluation was analysed through a functional division of respondents, based on their type and duration of engagement with the activities (Tables 4-7).

Table 4: *Redi KAMODI* evaluation responses by farmers (pilot; n=7) with long-term engagement in the project, including the *Redi KAMODI* farmer respondents from Fatucahi village (Manufahi municipality) and Aidabaleten villages (Bobonaro municipality), who have been involved in the *Redi KAMODI* program since the pilot seasons in 2016-2017 and into the expansion phase

Theme	*n*	*Details*
Increased capacity in cattle production and marketing	7	All of the long-term *Redi KAMODI* farmers and leaders cite that they have completed all training offered through the *Redi KAMODI*.
High appreciation of training provided through the *Redi KAMODI*	7	Almost all respondents in this category praised the training they received with a perfect score (10 out of 10).
Increased willingness to share information with neighbours	5	Long-term *Redi KAMODI* farmers and leaders expressed a greater willingness to share the *Redi KAMODI* method with surrounding villages.
Ongoing practice to experiment to improve livestock business	2	Some long-term RK farmers expressed that they have started experimenting with different soil and planting techniques outside of what was trained to see what works best for them.
Increased confidence in sustaining improved cattle business management practices	1	Some long-term *Redi KAMODI* farmers and leaders express that they would be able to continue utilising the practices learned and developed through the *Redi KAMODI* after assistance is no longer provided.

Table 5: *Redi KAMODI* evaluation responses by leaders (n=18)

Theme	*n*	*Details*
Dependence on external parties	16	Many *Redi KAMODI* leaders expressed that for the *Redi KAMODI* program to continue, that they would need external assistance from parties such as the government to regulate and ensure the program's continued success into the future.
Being a role model for the community	5	Some *Redi KAMODI* leaders felt that as an elected village head, they had responsibility to be a role model and show the rest of the village how to utilise the improved cattle production method (as learned through the *Redi KAMODI*).

Table 6: *Redi KAMODI* evaluation responses by members (expansion; n=54) with engagement in the project since the expansion seasons, ie, 2018 onwards

Theme	*n*	*Details*
Transforming livelihoods	50	Almost all *Redi KAMODI* farmers expressed that the *Redi KAMODI* has radically changed their life in a positive manner, relating to (1) improved (income from) cattle production, and (2) enhance knowledge and skills to take control over their farming practices.
	11	Some farmers expressed benefits beyond the immediate, citing the ability to send children to school and improve family living conditions
	10	Some *Redi KAMODI* farmers expressed that the *Redi KAMODI* program has increased monetary profit for them.
Continuation of the *Redi KAMODI* program	49	Mostly all *Redi KAMODI* farmers strongly expressed a desire for the *Redi KAMODI* program to continue.
	10	Some *Redi KAMODI* farmers showed continued dependency on external assistance after the project would end in an official capacity.
Collective action and teamwork	45	Many *Redi KAMODI* farmers expressed that diligent application of the *Redi KAMODI* program through teamwork and regular meetings at the village level proves the basis for the greatest success and largest profits. Some *Redi KAMODI* farmers expressed that the Leucaena planting method takes a lot of effort and working in groups is optimal.
	15	However, some farmers stated that many other farmers can be individualistic in nature, which was seen as an obstacle for collective action needed to be successful with the *Redi KAMODI* system.
Sharing of information	15	Some *Redi KAMODI* farmers feel the need to share the knowledge of a beneficial program such as the *Redi KAMODI* program to neighbouring villages. This may ensure sustainability and the ability to pass on learned knowledge to others without the possible need for external assistance or intervention.
Cattle getting sick/dying of illness	5	Some *Redi KAMODI* farmers expressed that one of the biggest obstacles to the cattle fattening is if their cattle get sick.

Interim findings from research team focus group discussion

The project started with two *Redi KAMODI* in the first two years (2016-2017) and then gradually expanded to 21 *Redi KAMODI* between 2018-2021. Despite the challenging first two years, the project managed to achieve the target. The research team identified several favourable and constraining factors for *Redi KAMODI* establishment and expansion, as summarised below.

What worked well and should be maintained or further enhanced?

- Local leadership by MAF directors was crucial to gain acceptance of and support for the *Redi KAMODI* approach, which in turn is the basis for institutionalisation of the model within MAF's policies and programs.
- The Leucaena-based fattening system works well under the Timorese conditions and was quite readily adopted by farmers.
- The holistic/systems approach, with each of the three components having its own role but together working in a complementary way, was instrumental to achieve impact within the whole farming system.
- The project provided proof of concept: (1) of the *Redi KAMODI* model, and (2) of the cattle fattening/business system.
- Twenty-one *Redi KAMODI* were established and are continuing to run (some more successful than others). Farmers' main motivation to be involved seems to come from the market engagement opportunities that the *Redi KAMODI* offers.
- The *Redi KAMODI* system helped farmers understand the cattle business very well.
- The *Redi KAMODI* approach presented farmers with OPTIONS to test, adapt and integrate in their existing farming system, rather than with a one-size-fits-all solution that would not have suited all farming families.
- The internal monitoring and evaluation system, in particular (1) the Quarterly Reflection and Planning Workshops at the *Redi KAMODI* level (village), and (2) the monthly meetings at the *Redi KAMODI* cell level (hamlet), were vital in establishing and sustaining the *Redi KAMODI*.
- *Redi KAMODI* members were facilitated to access bank loans and successfully received – and paid back – credit. The *Redi KAMODI* platform seems to offer some sort of guarantee for the banks.
- Farmers received training in all areas of cattle business development, supported by all three project components (forage/cattle production, marketing/business development, collective action/adaptive research). This also helped them to navigate bank loan opportunities.
- The Field Researchers played an important role in supporting the *Redi KAMODI* members in their cattle business operations.
- Comprehensive Training of Facilitators has been conducted at multiple occasions.
- MAF Technical staff and Extension Officers are continuing to facilitate the *Redi KAMODI* as part of their day-to-day jobs. MAF supports them to do so.

Table 7: *Redi KAMODI* evaluation responses by non-member farmers (n=47)

Theme	*n*	*Details*
Desire to join a *Redi KAMODI*	44	Almost all respondents not only knew about the *Redi KAMODI* program, but also had a desire to join a *Redi KAMODI*.
Knowledge of what the *Redi KAMODI* program entails	40	Most farmers knew what the *Redi KAMODI* farmer program entailed. An interesting observation was that many farmers knew the name '*Redi KAMODI*, suggesting that the name itself is catching the attention of non-participating farmers.
Interest in *Redi KAMODI* because of potential profit/benefit	40	Most non-*Redi KAMODI* farmers expressed a desire to join as they have heard it can bring profit to them in one way or another, improving livelihoods.
	5	Some respondents mentioned arbitrary values that *Redi KAMODI* farmers received for cattle ($1,000, $800, $500) without understanding the liveweight concept introduced to *Redi KAMODI* farmers.
Belief in *Redi KAMODI* system	20	Many non-*Redi KAMODI* farmers felt that they must try and prove the validity of cattle production system promoted through the *Redi KAMODI* before hoping to offer it to other members in their village as a viable source of profit. A 'seeing is believing' mindset was evident among many farmers.
Neighbours participating in the *Redi KAMODI* program	10	Some non-*Redi KAMODI* farmers are noticing and gaining interest in the *Redi KAMODI* program through neighbours.
No knowledge of the existence of *Redi KAMODI* program	7	Only some farmers had little to no prior knowledge about the *Redi KAMODI*.
Lack of communication about the *Redi KAMODI* program	2	A few non-*Redi KAMODI* farmers only heard about the *Redi KAMODI* program several years after its introduction into neighbouring villages.
Traditional beliefs	2	A few non-*Redi KAMODI* farmers believed that traditional methods such as freeing the cattle on land with lots of grass is the best way to fatten the cattle.

What did not work so well and requires consideration in future initiatives?

- Low calving rate/high calf mortality was not tackled well. It needs more attention, starting with an approach that works on changing farmers' mindset to consider a medium-long term vision for their cattle business.
- The project had a bumpy start in the first two years considering (1) insufficient integration of the three components, and (2) limited opportunities for local/Timorese leaders to have an important voice in project decisions. This should not be repeated. To avoid these situations, future initiatives should be based on a more inclusive and collective planning process with Timorese leaders.
- The underlying mechanism of an innovation platform rests on the ability of farmers to ask the right questions and work towards answering them, which was not readily achieved within the *Redi KAMODI* and only became evident among those farmers who had been involved for several years. Critical skills development, needed to enhance farmers' ability to experiment, will not happen in the short term, considering levels of education, limited experience with research processes and cultural factors. This is an ongoing process, requiring *Redi KAMODI* facilitators to be thoroughly trained to facilitate farmers in the process of their adaptive research.
- Limited feeder cattle availability is a constraint for further expansion.

7.1.4 Discussion

Redi KAMODI has been a resounding success. Since the first meeting in March 2016 at the Arbiru Hotel on Dili's foreshore where a group of about 30 stakeholders, mainly field facilitators and coordinators facilitated by MAF's Quintiliano Belo, conceptualised the name in a lengthy debate, the locals have owned this innovation platform. Success is highlighted by the changes in how villagers manage and market their cattle with mutual support, the substantial increases in household income that continue to be achieved, the increasing requests from sucos across the country requesting support to establish *Redi KAMODI* and the competent enthusiasm of in-country leadership. When project support has been withdrawn from *Redi KAMODI*, either deliberately as part of the research or because of the global pandemic, they have not faltered.

The development of a model for a locally-suited innovation platform requires careful analysis and mutual attuning of the farming system where innovation processes are to take place, the institutional structures and mechanism that will manage it, and the socio-cultural context within which the platform will operate. There are no blueprints; therefore, this process takes considerable time based on a shared vision of all stakeholders. The previous project (LPS/2009/036), during which a participatory situation analysis and a series of forage production and cattle fattening trials had been implemented, provided project partners with a solid basis to design an initial framework for the model. However, further step-wise adaptation was needed and materialised through a range of training events and workshops, and two pilots. Though there were local feelings of ownership of the '*Redi KAMODI*' name, it took considerable time to achieve the shared vision at the higher levels within MAF; achievements from the two pilot sites provided the evidence after two years to turn things around.

A feature of the project has been the huge development of capacity within MAF. Of particular importance is in facilitation of innovation platforms, supported by the development of a comprehensive training manual, plus competent local leadership by senior MAF staff. This has happened over many years and the international project team members have witnessed incredible change. For all the reasons above, the current national Minister for MAF has vowed to continue with and scale up *Redi KAMODI* through Timor-Leste.

Initial resistance was encountered at all levels as the *Redi KAMODI* model was unconventional in that no incentives that facilitate quick (but unsustainable) results were provided. The emphasis was on critical skills development of farmers and facilitators and the provision of a mechanism for them to collectively work out, step by step, how to make

improvements in their farming businesses. But once farmers began to experience achievements, they became confident advocates for the approach, which triggered interest from neighbouring communities and districts, and strong support from the local leadership, leading to accelerated expansion of the number of *Redi KAMODI* across the country.

It is a challenge for families to abandon traditional practices, especially when change may threaten prevailing cultural needs. However, *Redi KAMODI* have a powerful osmotic effect that slowly draws in all seeking to improve their livelihoods within the impoverished rural communities of Timor-Leste. Despite the huge advantages of implementing Leucaena production, cattle fattening and direct live weight selling to butchers, facilitators continually support *Redi KAMODI* through regular review in which other options are considered and necessary for some. It is fair to say that not all MAF staff truly understand the fundamental process, in contrast to the Leucaena-based system, but this will slowly evolve as new opportunities emerge.

While MAF is determined to continue supporting the 21 *Redi KAMODI* that were established over the course of the project, continued Training of Facilitators will be required, both refresher training for existing facilitators and original training for new facilitators to serve new *Redi KAMODI* or replace facilitators who will be retiring or promoted to other positions. To determine what support is needed, it is advisable for MAF staff to maintain and participate in the participatory monitoring and evaluation system that was put in place as part of the *Redi KAMODI* operations.

There is potential for the *Redi KAMODI* model to become an all-encompassing 'Rural Service System' that includes improvement of other commodities or business endeavours by rural families. This can either work alongside the current agricultural extension system or replace most of the functions of the system. Further research is needed to work out what changes in policies and program operations would be required and what mechanisms and capacity is needed to institutionalise such a system.

This research has facilitated transition of subsistence farmers to semi-commercial practices. However, the farmers remain fundamentally in subsistence mode. A new phase of systems research may find an appropriate way to support community transition to being farmers, not subsistence farmers, which entails they are fully commercial. Major hurdles exist, such as having to transition from some traditional culture, and developing a feed base that takes a number of years to produce a financial return. However, it is envisaged that this is entirely possible.

7.2 Business and marketing

It was shown that increasing sales income was best achieved through intensive fattening, that allowed faster weight gains and turnoff. In turn, households require feeder cattle for their fattening systems, which can be bought in or self-produced. Given capital and other constraints, households are generally interested in feeding cattle from their own cow-calf systems. This then stimulated interest in cow-calf production and the requirements to make it productive (calf mortality, weaning, nutrition).

7.2.1 Business training material/modules

Thirteen business training modules were developed, translated and adapted (Table 8, Figure 4). Features of the training material include:

- These cover all aspects of the cattle production system disaggregated into budgets for investment in cattle fattening (pens, water, tree forages, ground forages), cattle production (cow-calf and fattening) and cattle marketing (prices, transport, aggregation).
- The modules are designed to complement the cattle production training modules. For example, if a household was planning physical part of building a leucaena nursery, there would be an accompanying tool to plan land size, tree numbers and costs.
- The training material is presented in PowerPoint slides, Excel budget sheets and presented in various ways in the field (white board and butcher's paper).
- All materials were prepared in English and Tetum.

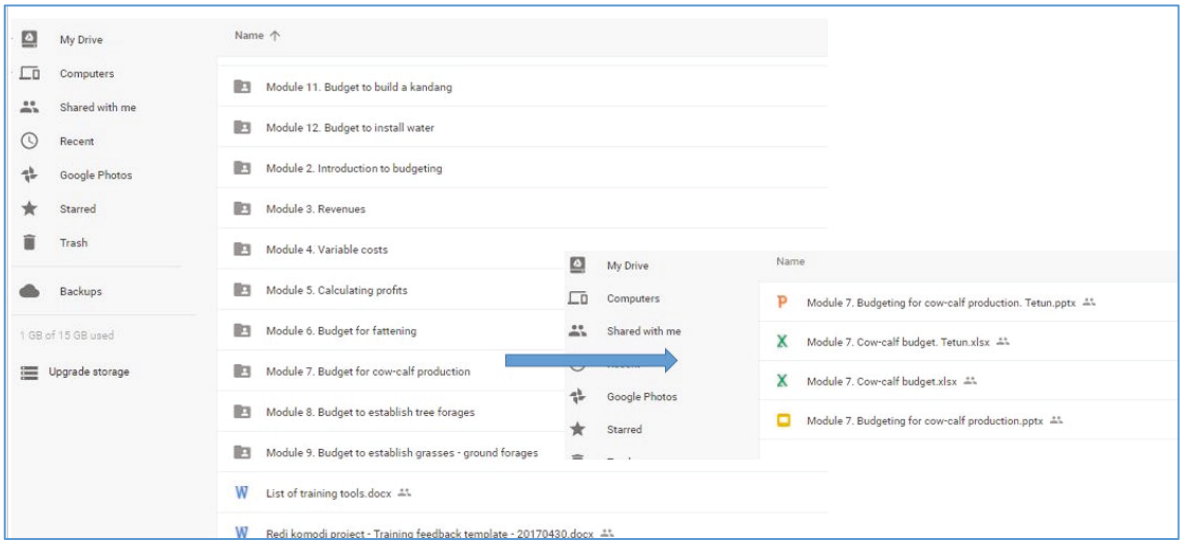

Figure 4. An example of on-line module access

7.2.2 Business training

The training modules were used to conduct training predominantly by UNTL staff (Paulo Correia, Sebastiana Dahu, Marcolino Brito, Jose Nelson Salsinha, Adelino do Rego, Carlos da Conceição de Deus) for FRs, *Redi KAMODI* groups, including MAF staff, vets, local leaders and farmers.

More than 25 formal training sessions were conducted for the *direct* training of 255 people (Table 4). Many trainers (FRs, MAF staff, extension agents) were then able to conduct widespread *indirect* training of many more groups and farmers.

Table 8. Business training conducted, excluding 2021 training

	Date	Place	Who did the training	Who was trained?	Number of trai	Moduless taught
1	27 -28 July 2017	Dili	Adelino/Sebastiana	FRs	4	Modules 1-3
2	30-31 Augut 2017	Dili	Adelino/Sebastiana	FRs	4	Modules 4-6
3	27-28 Sept 2017	Dili	Sebastiana	FRs	4	Modules 7-8
4	30-31 Octo,2017	Dili	Sebastiana	FRs	4	Modules 9-10
5	29-30 Nop,2017	Dili	Sebastiana	FRs	4	Modules 11-12
6	15-17, Maret 2018	Fatucahi	Paulo/Sebastiana	Farmer , MAP Staff,FRs	15	Modules 13
8	17th Feb 2018	Aidabaleten	Paulo/Sebastiana	Farmer , MAP Staff+ FRs	15	Modules 1-5 + Log Book
9	13th Sept 2018	Aidabaleten	Paulo Sebastiana	MAP STAFF,FRs	8	Modules 6-8
10	8-11 May 2018	Fatucahi	Paulo/Sebastiana	Farmer,MAP Staff+ FRs	17	Modules 1-5 + Log Book
11	6-19 September 2018	Sare/Asulau	Paulo/Sebastiana	Farmer,MAP Staff+FRs	14	Modules 1-5
	2019 training poorly recorded - 8-10 sessions					
12	5th Feb 2020	Betano	Paulo/Sebastiana	MAP STAFF,FRs Marcelo,and Stud	35	Modules 1-13 + XL Modules 6
13	18th Sept 2020	Hataz (Bobana	Marco/Adelino	1 ext, 1 MAF, 8 farmers	10	Marketing
14	25th Sept 2020	Cailaco (Boba	Marco/Adelino	1 vet, 1 ext officer, 10 farmers	12	
15	29th Sept 2020	Sare (Emera)	Marco/Adelino	1 ext, 9 farmers	10	Modules 7-13
16	8th Oct 2020	Hataz (Bobana	Marco/Adelino	1 ext, 1 MAF, 8 farmers	10	Modules 7-13
17	15th Oct 2020	Cailaco (Boba	Marco/Adelino	7 farmers (MAF staff at other trair	7	Modules 7-13
18	1st Dec 2020	Cassabauk & I	Nelson/Adelino	2 ext workers, 1 MAF, 1 vet, head	8	Modules 1-6
19	8-9 Dec 2020	Hatudo	Nelson/Adelino	2 ext, 2 MAF, 1 vet, 1 FR, 3 farmers	9	Modules 1-6
20	14-15 Dec 2020	Natarbora	Nelson/Adelino	2 ext, 2 MAF. 1 FR, 4 farmers	9	Modules 1-6
21	17-18 Dec 2020	Clacuk	Nelson/Adelino	8 ext, I MAF, 3 tech, I village head	12	Modules 1-6
22	6-7 Feb 2021	Natarbora	Marco/Adelino	2 ext, 6 farmers	8	Modules 7-13
23	6-7 Feb 2021	Clacuc (Manut	Marco/Adelino	2 ext, 8 farmers	10	Modules 7-13
24	11th Feb 2021	Bobe (Hatudu	Carlos	extension staff and farmers	10	costs, revenues, prices
25	12th Feb 2021	Maudemo (Co	Carlos	extension staff and farmers	8	costs, revenues, prices
25	Total				255	

7.2.3 Assessment of business training

Some lessons on the training material and delivery emerged over the project:

- The training material provides detailed and useful information and tools especially for trainers to use as reference material and to “discipline” the training
- However, many trainers (eg, extension staff, *Redi KAMODI*) were not able to source or find the material on google drive.
- Every effort was made to simplify the material, but some (eg, cow-calf production budgeting) was necessarily quite complex.
- The material was interpreted, adapted and delivered in different ways by different trainers in the field – mainly to simplify and present through examples and in cultural context. The trade-off between formal (especially quantitative) methods and more intuitive training methods took some time / trial and error to work out, but seems to have proceeded well, given responses from trainees (see below).
- The project made efforts to coordinate the business modules with the cattle production modules. While the alignment has been helpful and successful, it was not often possible to align the sequencing, ie, for technical and budgeting aspect of leucaena nurseries to be done at the same time.

To evaluate and improve the business training, trainees completed conducted brief (3 question) surveys of the training. The short and qualitative nature of the survey limited findings, but patterns are as follows.

In the initial rounds of "train the trainer" sessions with 10 trainees in 2017 the results were:

- *What did you like most about this training module?* Trainees thought the budgeting approach was interesting/useful, especially for planning for particular activities (establishing a nursery and specialised fattening)
- *What did you like least about this training module?* Criticisms of the training is that it was too complicated with too much information, with too few concrete examples
- *What changes would you recommend to improve this training module?* Suggestions included (besides fixing criticisms above) to spend more time training and providing more examples

In the training in 2020 with 30 trainees the responses were

- *What parts of the training did you like the best?* Virtually all trainees liked the training. 12% liked the general budgeting approach, 32% were most interested in calculating the costs of cattle investments and 56% were most interested in marketing
- *Would you use the training on your farm?* All trainees said that they would apply the training. When asked about which aspects, trainees said they would use the general budgeting approach (31%), weighing and weight gain (33%) and marketing (33%)
- *When asked about how to improve the training*, trainees said that no improvements were required (29%), more or fewer participants would be better (21%), more time was required (25%), more clarity in explanation was required (25%)

7.2.4 Cross visits

West Timor

The small-holder cattle fattening and marketing systems in parts of West Timor (around Kupang) are famous for being well developed, in a similar bio-physical system as found in much of Timor-Leste. The trips were designed to provide stakeholders in Timor-Leste a first-hand account of these systems and knowledge that can be used at home. The international trips required a lot of organisation (e.g. passports, documents and hosting) and travel time (by bus). Two visits were conducted.

2017 (July 31 to August 4)

- 18 people – 12 from *Redi KAMODI* (farmers, leaders, extensionists from Aidabaleten and Fatucahi), three from MAF, three from UNTL.
- Organised through Univeratas Cendana (Marthen Mulik)
- Hosting, presentation and discussions with the Kupang livestock office (Dinas)

- Visits to cattle fattening groups and farms in Kupang District (South Amarasi, Fauleu sub-districts, Champlong II village).
- Kupang cattle market


2019 (Feb 18-22)
Visit by ~20 people, *Redi KAMODI* (farmers, leaders, extensionists), 1 MAF, 2 UNTL, UNRAM (Dr Nurul) to to Kupang BPTP and nearby fattening areas to see:

- Sabu Bani farmer group
- Lili cattle market
- Meat drying / processing company


Dili

Visits of *Redi KAMODI* members to Dili were organised to help *Redi KAMODI* understand first-hand the preferences of butchers (weight, age, handling, consignments) in the major market of Dili. The visits also facilitated linkages between cattle fattening groups/households (that are interested in better cattle prices) and “modern” butchers (interested in capturing cattle supply, especially heavier cattle). The visits led directly and indirectly to a large number of cattle sales (see below).

2-3 June 2017
9 members of Aidabalaten *Redi KAMODI*, 2 MAF field staff, 2 Field Researchers (FRs) visited two modern butchers (Komoro and Bemori) and two traditional abattoirs (Comoro, Maloa).

- Modern butchers displayed systems, preferences and price schedules. After visits, farmers were most interested in dealing with modern butchers as they buy over-the-scales on a set schedule.
- These modern butchers agreed to purchase any numbers of cattle that farmers are ready to sell at any time but involved coordination on logistics
- A consignment of 8 cattle organised from Aidabalaten to Comoro

8-9 June 2017
Similar to above, but for Fatucahi

13-14 June 2018
For different members of Aidabaleten and Fatucahi *Redi KAMODI* visited:

- Comoro market, CCT, modern butchers Zefra and Talho Moris




2020 (September 15)
Visit by 35 new *Redi KAMODI* farmers, FRs and MAF staff visited:

- modern butchers (Zefra, Talho Moris) and Tibar abattoir

Cattle exhibition, Atabae

At a celebration of TL Independence Day at Aidabaleten (28 November 2018), the project presented an “exhibition” of Bali cattle. It was attended by many dignitaries from Bobonaro (Minister of Education, President of Municipality, Administrador Atabae etc.). Cross-visits from the Fatacahi *Redi KAMODI* were organised. Activities included a weigh-guessing competition, and for a *Redi KAMODI* member and FR to explain the improved systems.

Banks

Credit is a potentially important aspect of improved cattle systems, especially in accessing capital to buy feeder cattle. A number of *Redi KAMODI* and farmers requested "organisation" of loans from banks. The B&M team were reluctant to become directly involved in formally brokering loans, but did facilitate links with banks, including in 2018:

- Farmers and leaders from Aidabalaten *Redi KAMODI* were taken to meet the director of BNCTL who provided information about loan application processes, requirements, interest and repayments. *Redi KAMODI* members could use budget information to assess feasibility.
- Members of B&M met with the Director of BNCTL Same. Information on loan processes were delivered to *Redi KAMODI* in Fatucahi and Clacuc on January 14.

7.2.5 Cattle marketing

Live weight sales were quickly adopted (Table 9). Consignments of cattle (1-13 cattle) were aggregated by the *Redi KAMODI* (usually in one truckload, but sometimes two) per sales month. This typically required cattle from several households (e.g. 1-12) across several areas (1-5). The *Redi KAMODI* in the project sold a total of 267 cattle through formal over-the hooks sales to modern butchers in Dili. The cattle came from 134 different households, in 30 different aldeia/areas. There was a significant weight range (120-443 kg, average 306 kg) but 88% overall were over the 250 kg threshold to achieve the highest price premium in the pricing schedules of modern butchers (US$2.70/kg liveweight). The average liveweight was over 300kgs (and could achieve a US$2.75 price in another butcher). Where recorded (Fatucahi), 93% were sold from fattening systems (tethered or penned with intensive feeding).

Bull fattening in most *Redi KAMODI* almost wound up during the pandemic. This happened when people movement was prevented between districts, therefore cutting off access to the Dili markets. Coupled with the virtual disappearance of the ACIAR project team, most *Redi KAMODI t*hought the project had been terminated about two years ago. In spite of this, the *Redi KAMODI* were operating as strongly as ever. This was because they had found the process very empowering in finding both problems and solutions, with big benefits to their commercial enterprise. For example, they use *Redi KAMODI* to organise trading and trucking to get optimum return on their bulls. They also work out the best way to do forage planting in each other's farms.

Table 9. Cattle sales

	Date of sale	Households	Area / Group	Cattle	Min weight (kg)	Max weight (kg)	Average weight (kg)	Average price (US$/kg LW)	Total value (US$)
Fatacahi									
	Oct-17	6	5	7	220	410	310	2.64	5,773
	Dec-17	5	3	8	210	298	266	2.56	5,506
	Nov-18	7	4	10	259	418	353	2.66	9,377
	Nov-18	6	5	10	243	371	302	2.66	8,049
	Dec-18	9	3	13	244	375	305	2.67	10,620
	Mar-19	6	3	7	300	386	331	2.70	6,253
	Mar-19	1	1	6	236	287	211	2.41	3,429
	Jun-19	3	1	4	245	415	295	2.70	3,189
	Jul-19	5	2	7	270	381	327	2.70	6,174
	Aug-19	4	2	7	311	414	339	2.70	6,408
	Aug-19	4	3	7	265	399	306	2.70	5,778
	Aug-19	1	1	2	250	294	272	2.70	1,469
	Dec-19	8	3	12	263	410	336	2.68	10,820
	Dec-19	12	5	13	263	439	340	2.68	11,898
	Dec-19	5	3	6	265	354	316	2.70	5,125
	Mar-20	4	1	6	289	331	309	2.70	4,102
	Apr-20	8	1	6	218	383	293	2.56	6,079
	Aug-20	8	3	13	231	443	310	2.65	10,714
	Nov-20	10	7	12	266	408	324	2.70	10,496
	Dec-20	13	3	17	276	411	318	2.70	14,612
		81 (distinc	**18 (distinc**	**173**	**210**	**443**	**308**	**3**	**145,870**
Atabae									
	Dec-18	2	1	3	280	314	294	2.70	2,384
	May-19	9	2	10	261	310	287	2.68	7,695
	Aug-20	6	1	7	278	356	310	2.70	5,196
	Apr-20	7	2	8	235	424	301	2.63	6,357
	May-20	3	1	5	289	358	312	2.70	4,212
	May-20	4	3	6	282	346	317	2.70	5,131
	Jun-20	5	2	6	243	335	292	2.63	4,632
	Jun-20	3	3	8	269	368	300	2.70	6,472
	Jul-20	5	1	6	236	317	281	2.67	4,512
	Dec-20	6	3	7	266	354	298	2.70	5,634
	Jul-18	3	2	7	226	319	278	2.61	5,106
		43 (distinc	**9 (distinct**	**73**	**226**	**424**	**297**	**2.67**	**57,331**
Ainaro									
	Nov-20	1	1	6	263	443	325	2.63	5,164
Asalau, Ermera									
	Dec-20	5	1	5	271	413	327	2.70	4,419
Cailaco, Maliana									
	Dec-20	4	1	10	271	413	327	2.63	4,419
Total all sites		**134 (distir**	**30 (distinc**	**267**	**210**	**443**	**306**	**2.66**	**217,202**

It is problematic to compare these prices in “modern” sales channels to prices in alternative “traditional” sales channels because the cattle are bought subjectively - no records of weights are available. However, cattle under 200kgs received a price of just US$2/kg.

Through detailed training in assessing the pros and cons of these cattle sales’ methods and repeat demonstrations and established links, over-the-hooks sales to modern butchers have become self-sustaining by households and *Redi KAMODI* in project areas.

7.2.6 Developments in cattle marketing and policy

This project updated the 2014 report. Data was used extensively by policy makers in MAF, by the Asian Development Bank and several Australian state government agencies.

There have been a number of changes in the slaughter and beef retail sector since the detailed 2014 report. In 2015 there were 3 modern butchers in Dili (Tailho Moris, Zebra & ADF). There are now four (Tailho Moris, Metinaro Furak, Zebra and Quantum). The modern butchers now supply into supermarkets and mini markets in Dili.

Government regulations in 2014 were designed to channel all cattle slaughter in Dili through the mechanised abattoir at Tibar and to ban unregistered butchers for food safety reasons. This has proved unfeasible to enforce, but the number of traditional unregistered butchers in Dili has declined from 16 to around eight, partly because of the high cattle prices.

In 2015, there was a large informal trade of cattle into Indonesia. The trade has essentially stopped since 2017, partly due to increased policing and other factors – prices in Indonesia and exchange rates. This has increased the supply of cattle into Dili from around the country.

The business and marketing component has provided extensive ongoing advice to industry stakeholders, including MAF, MDF, ADB and TradeInvest Timor-Leste (TITL).

7.2.7 Discussion

During the project, an increase in sale revenues of at least US$0.2M by participating farmers underlines its huge success. Increasing numbers of farmers are fattening and supplying bulls meeting market specifications direct to butchers on a live weight basis, resulting in substantial increases in net household income.

Business and marketing research has underpinned changes in cattle farming practices by *Redi KAMODI* farmers. Training to suit Timor-Leste conditions and development of capacity to deliver this has been documented and implemented. The research reinforced that a key element of skills development is direct peer-to-peer learning from both domestic and international systems.

Key elements of on-going development of livestock industries including beef are the availability of credit and savings, and development of government policies to support appropriate practices. Policy such as those limiting slaughter of female cattle need review to ensure they do not create inappropriate business practice.

7.3 Forage and livestock production

7.3.1 Development of training modules

Twelve Training-of-Facilitator modules were initially prepared in English and pilot tested with project employed field researchers. The modules were refined based on feedback, which was largely positive (except for the fact that the modules were prepared in English). The preparation of the first draft of the modules in English was unavoidable as most were prepared and subsequently refined by Australian component members prior to translation to Tetun. The initial 12 modules prepared were:

- Cattle feeds available in Timor-Leste
- Forages – what are they?
- Tree legume establishment and management Herbaceous legume establishment and management
- Grass establishment and management
- Conserving feeds and forages for cattle (Figure 5)
- Cattle infrastructure
- Live cattle assessment
- Calf management
- Weaner management
- Cattle fattening
- Cow management

Figure 5. *Redi KAMODI* group members receive training on conservation of crop residues

These modules were further refined based on experiences from 'trials' undertaken by *Redi KAMODI* throughout the project.

7.3.2 Evaluate and demonstrate forage production systems that will enable farmers to support new cow-calf and fattening systems

The project recommendations for forages appropriate to different regions across Timor-Leste were largely based on findings from LPS/2009/036 and there was no need to repeat intensive, controlled replicated forage evaluation studies. The recommended forage species included

- *Leucaena leucocephala* and *Sesbania grandiflora* (tree legumes),
- *Lablab purpureus* (annual) and *Clitoria ternatea* and *Stylosanthes* spp. (perennials)
- *Bracharia brizantha* (most *Brachiaria* species would be suited to local conditions), *Panicum maximum* and *Setaria spachelata* (grasses)

Similarly, the project did not prescribe a specific forage production system but provided *Redi KAMODI* with a range of forage production options that included forage tree legumes (i.e. leucaena, sesbania and gliricidia), herbaceous legumes (annuals and perennials) and grasses. The relative training modules presented the advantages and disadvantages of various forages and forage production systems, with example production systems. Species-specific technical information was included where appropriate (e.g. land preparation, sowing rate, sowing depth, harvest method, time and frequency) which was largely transferable across the different systems adopted by farmers. Farmers adopted, adapted and integrated these into their existing farming systems, which often included cropping activities that generated crop residues (rice straw, corn stover) which were also used in the development of feeding systems. The systems developed were based on the availability of land and

labour, other agricultural activities undertaken by households within their existing land resources and the timeframe within which households wanted to commence their fattening activities. Regardless of the forage production system adopted by households in almost all cases these forages were to supply feed for bulls within cut-and-carry, kandang (stall)-based fattening systems. Little attention was applied to the forage production systems to meet the nutritional requirements of cows and calves within these systems, presumably as these were not considered to have an immediate and significant economic impact compared to the higher turnover and higher cash-flow generated from the fattening systems in the short-term.

Despite the diverse range of options included in training materials presented to facilitators of *Redi KAMODI*, almost all households established leucaena as their long-term forage production strategy. Given the previous success in both establishment of leucaena in Timor-Leste and the productivity gains and increased income from feeding bulls leucaena compared with prevailing practices (in both Timor-Leste and eastern Indonesia), this was the most appropriate long-term strategy in the majority of *Redi KAMODI*. The approach will result in a single forage and feeding system supporting a large and increasing proportion of the cattle fattening sub-sector in Timor-Leste; it is important that *Redi KAMODI* continue to be provided with information that a range of forage production system options are available in Timor-Leste, as leucaena is not suited to all biophysical conditions (for example, the acidic soils in eastern Timor-Leste where leucaena production would not be a viable option) or cattle production systems (e.g. cow-calf producers). Follow-up on the application of training materials may be warranted, so that training materials may be further refined where required to ensure *Redi KAMODI* members understand the potential risks of planting leucaena in some area's and the feeding management required for different classes of cattle.

Whilst leucaena formed the basis of the majority of the forage production systems, the integration into existing farming practices was varied. Whilst training materials provided example leucaena production systems farmers adapted systems in alignment with their own priorities and resources. The approach of filling the 18 month feed gap, for leucaena to establish, with faster establishing tree (*Sesbania grandiflora*) or herbaceous (*Lablab purpureus*, *Clitoria ternatea*) legumes or grasses was adopted by some farmers and demonstrated a more systematic approach to system development. A range of 'leucaena production systems' were developed by farmers including.

- leucaena or sesbania established as single stands solely for cut-and-carry purposes adjacent to cattle (or with both species integrated) (Figure 6)
- leucaena integrated with corn, cassava or vegetables (Figure 7)
- leucaena integrated with grasses and/or herbaceous legumes (Figure 8)
- herbaceous legumes integrated with corn (Figure 9)

Whilst the above systems were solely cut-and-carry systems, and largely integrated with existing cropping systems (horticulture, grains) it was evident to the component team that in some regions (mainly on the south-coast of Timor-Leste) sufficient land was available to establish small grazing systems based on improved forages (leucaena, grasses). The rationale for fattening under grazing was related to the significant step-change in input (labour) requirements for farmers in Timor-Leste as they transitioned from essentially a no-input (low labour) cattle raising system (free-grazing, unimproved pastures with no husbandry practices) to an extremely high-input system where cattle survival (let alone production) is reliant on increased labour inputs for the provision of feed and water several times per day. Whilst the economic gains of this transition are evident, the practicalities of making this transition are a challenge for many households that are already time poor. The end result was that cattle in kandangs may be under-fed or under-watered on occasions due to an under-appreciated of the increased labour (and feed and water) requirements of the new system (one group of farmers explained they were '*now married to my cattle'*). A revisiting of training materials on feed and water requirements of bulls in kandangs was

recommended to address this issue, which may also been an explanation for the lower than expected growth rates measured on some farms on some occasions early in the project

a. b.

Figure 6. Leucaena (a.) and sesbania (b.) stands established for cut-and-carry to bulls tethered in adjacent kandangs.

a. b.

Figure 7. Leucaena integrated with corn (a.) and vegetables (b., egg-plants) for cut-and-carry to bulls tethered in adjacent kandangs.

a. b.

Figure 8. Leucaena integrated with grasses (a. *Panicum maximum* and *Brachiaria* spp) and herbaceous legumes (b. *Stylosanthesis guianensis* and *Clitoria ternatea*) for cut-and-carry to bulls tethered in adjacent kandangs.

Figure 9. Herbaceous legumes integrated with corn for cut-and-carry to bulls tethered in adjacent kandangs.

An alternative option to cut-and-carry, to reduce some of the rate limiting factors (labour availability), by establishing a grazing system. Whilst a grazing system would require significant financial, infrastructure and labour inputs (fencing, water supply) to establish, coupled with a potential opportunity cost of converting land from its existing purpose to forage production only, the ongoing labour requirements once established would be relatively low. It is also likely that animals would receive adequate nutrients and water at all times if stocking rates were managed appropriately. For most farmers in Timor-Leste, their only experiences of cattle fattening were cut-and-carry or free grazing low productivity (often communal) natural grasslands, the concept of a managed grazing system is a foreign concept. As such a demonstration site was established on unutilised land at the Instituto Politecnico Betano (IPB) at Betano on the south coast of Timor-Leste. A 1 ha site was fenced with leucaena planted from viable seed imported from Australia in rows, with inter-row cropping with corn undertaken in the first wet season to assist with weed control. There were low germination rates (30%) from the first sowing, probably due to inappropriate sowing depth, and additional trees were established from seedlings in the second wet season, along with the establishment of *Brachiaria* spp and *Panicum maximum* grasses between the rows of leucaena. Unfortunately progression to a small cattle handling facility and water system for cattle was not constructed within the site, and first grazing may not commence till the 2022/2023 wet season. Staff and students from the IPB have been responsible for the establishment of the site, which will subsequently be used for training of *Redi KAMODI* members. A number of research questions are likely to arise once the site is established around stocking rates, rotational management, additional inputs and an economic analysis will be conducted once the site is fully established and production data is available.

a.

b.

Figure 10. Leucaena established in a 1 ha site for grazing by cattle at the Instituto Politecnico Betano, Betano. Students collect seed (a.) and land prepared for grass transplant between rows (b.).

7.3.3 In collaboration with north Australian research, develop interventions to improve neonatal calf survival

Previous research in Timor-Leste has identified high rates of calf mortality (25 to 40%). Under similar conditions in neighbouring West Timor (Indonesia) calf mortality was reduced from approximately 35 to 5% through improved feeding management of the young calf (from approximately 6 weeks of age) (Jelantik et al., various publications). In LPS/2009/036, it was established that similar post-natal management models could be established in Timor-Leste - although no data on calf mortality was obtained due to the short nature of the pilot-test and small number of animals involved, all of whom survived. Research in progress in northern Australia (Coimbra PhD, described below) has focussed on pre-parturition nutritional management of the cow.

Latino Coimbra PhD research program: Milk delivery to neonatal beef calf

Justification: High calf mortality is a major problem in beef cattle production across the dry tropical areas including Australia and Timor-Leste. This problem has a significant negative impact not only on the profitability of the farms but also on cattle welfare. The main risk factors appear to be poor nutrition and environmental stress (high temperature) during the prepartum period and early lactation. These factors may reduce milk yield and delivery during the first few days after calving, causing dehydration and death of newborn calves. It can also impair passive immunity transfer, increasing the risk of calf mortality. Therefore, Latino's PhD research project is studying the effects of improving nutrition and minimizing the environmental stress during the prepartum period on milk delivery to newborn calves. This research includes: (a) investigating the effect of protein supplementation around

prepartum and early lactation on milk yield and delivery, passive immunity transfer, and calf growth; (b) validating a practical and cheap method to measure milk yield in *Bos indicus* cows that can be applied in the field; and (c) investigating the effect of heat stress and water availability for late-pregnant cows on milk delivery to neonatal calves.

Research progress

Experiment 1. "Nutritional modulation of the transfer of passive immunity in tropically adapted cattle". We hypothesised that lack of dietary protein during late pregnancy, with its effects on hormonal and metabolic profiles, are important modulators of colostrum quality and delivery. Thirty-six late pregnancy Brahman cows were fed with 3 treatment diets: Control, *ad libitum* low-quality hay; Protein, control plus 1 kg/day of a protein supplement; and Yeast, the addition of 14 g/d of a Saccharomyces cerevisiae fermentation product to the protein treatment. Data were analysed using the linear mixed-effects model in RStudio. The results showed that protein supplementation improved prepartum cows' live weight gain, increased plasma urea, decreased fat mobilization metabolites, increased colostrum IgG1, and improved calves' growth. Yeast further decreased cows' plasma progesterone and increased calves' plasma IgG1. In conclusion, protein supplementation and yeast fermentation products in the supplement improved colostrum quality and the transfer of passive immunity, increased milk yield, and increased calves' growth.

The benefit of Experiment 1 to the beef cattle industry in dry tropical areas: Maternal demand for nutrition during the late gestation period is remarkably increased, due to rapid foetus growth and mammary gland remodelling. In the dry tropics, prepartum cows are usually consuming poor-quality forages and, as a result, experience protein starvation during the critical transition period. This study has demonstrated that short-term protein supplementation around the prepartum period and early lactation can be applied as a solution to improve milk yield and delivery to the newborn calf, thus increasing calves' survival and growth.

Experiment 2. "Measuring milk yield using calf growth during the first week of life". Milk is the only feed consumed by the newborn calves in the first week of life. Therefore, newborn calves in extensively managed herds in dry tropic pastures will die when they are not suckling milk within the first 3 days after birth. Consequently, when testing interventions with the potential to increase calf survival, it is imperative to be able to monitor changes in milk delivery. Nonetheless, monitoring changes in milk delivery in beef breeds is not trivial, especially in extensive production systems. Therefore, in this trial, we sought to validate a practical and cheap method to measure milk yield in *Bos indicus* cows that can be applied in the field. Twenty-four newborn Brahman-cross calves were fed four treatments: 2.3 kg/d, 3.5 kg/d, 5.5 kg/d, or 7.5 kg/d of fresh Holstein milk. Total intake was adjusted based on analysed Holstein milk composition and estimated Brahman's milk composition. The relationship between Brahman's adjusted milk intake and ADG was tested using linear regression analysis in RStudio. Data analysis indicates that there was a strong linear relationship between milk intake and calf ADG kg/d = 0.208 x Milk intake (kg/d) – 0.403; RMSE = 0.11; R^2 = 0.89. In conclusion, on-farm, growth rates of *Bos indicus* calves in the first week of life can be used as an accurate method to monitor changes in milk delivery of dams.

The benefit of the study to the beef cattle industry in dry tropical areas. The regression equation from this study, Milk (kg/d) = (ADG + 0.403)/0.208, can be used by researchers and producers to monitor the milk yield and delivery to the cows in extensive beef systems. The simple way to use this equation is to weigh the newborn calves when they are at the water points. Another important implication of this study is to demonstrate the higher than reported milk yield in *Bos indicus* cows. Previous research has demonstrated that newborn calves are gaining between 700 to 1000 g/day during the first few weeks after birth. This corresponds to 5.3 to 6.7 kg of milk being produced per day, much higher than estimated by the current lactation curves.

Experiment 3. “Water restriction impacts on milk delivery to neonatal calves”. Late pregnant cows require water for physiological processes related to feed intake, maintenance, pregnancy, and milk production. In the tropical pasture areas, some of the cattle, including pregnant cows and newborn calves, are forced to walk 5 to 6 km from the water point to the preferred grazing areas. Previous research has been conducted to assess the effect of water restriction on eating and drinking behaviour, health, live weight gain and body condition, calving percentage, and calves body measurements. However, very few studies assessed the impact of water restriction on milk delivery and the transfer of passive immunity in tropically adapted beef cattle breeds. The outcomes from this trial will not only enhance the understanding of the impact of water restriction on milk delivery but, in more practical terms, assist in monetizing the benefits of having more frequent water points in large paddocks. The animal trial has been conducted and Latino is now finishing the laboratory work on the experimental samples.

Training courses: During the PhD program, Latino attended a basic statistics course for 3 months, learning sampling principles and strategies, summarizing data, probability, distribution of random variables, the foundation of inference, inference for categorical and numerical data, introduction to linear regression, and multiple and logistic regression. Moreover, Latino was able to learn how to use the R language (RStudio) to analyse data. With the additional training received from the group, Latino has become more confident and independently used the RStudio to analyse all the data from his PhD research project.

Latino has also actively participated in university seminars, conferences, workshops, symposia, and a beef cattle journal club involving lecturers, researchers, and students from DAF, UQ, UNE, and other universities in Australia and New Zealand. From this discussion group, Latino has improved his understanding of how to plan and conduct research and the way scientific results are presented in manuscripts. Moreover, reading the papers has assisted in developing his writing skills, a very useful trait to have when you plan to publish three scientific papers and a PhD dissertation.

Application of outcome in Timor-Leste

Latino travelled to Timor-Leste in May 2022 and met with multiple Redi KAMODI. He discussed his research and potential strategies to reduce losses of calves with farmers. Testing of strategies in Timor-Leste with Bali cattle will commence when Latino completes his PhD studies.

7.3.4 Develop and demonstrate robust and affordable cattle handling facilities that will enable improved cattle management by Timor-Leste smallholders

There were no specific researchable issues associated this activity, as such this was considered purely as a training and demonstration exercise by the component team. A range of cattle handling models were presented and available in the various training modules which included traditional kandang design for cattle fattening, loading ramps for cattle disposal to markets, and race-ways for cattle monitoring and animal health treatments and inspections.

The majority of the *Redi KAMODI* farmers developed intensive fattening systems which involved the daily cut-and-carry of feeds for bulls tethered in traditional kandangs (Figure 11). The preferred cattle handling infrastructure (kandang) was largely adapted by all farmers to suit their own conditions (availability of funds, labour resources, access to materials, proximity to feeds, number of bulls to fatten). No farmers expressed interest in alternative designs, which might be suitable in more extensive grazing-based production systems. Once introduced and adapted to the traditional kandang, and familiar with the household members who tend them, these kandangs become quite safe for animals and owners throughout the fattening period. The main issues in terms of worker safety, animal welfare and risk to incomes therefore become the safe securing of animals prior to entry to the kandang (i.e. sourcing animals from free-ranging cow-calf herds) and the safe loading

and transporting of animals to market upon completion of the fattening period. Further, with a potential future emphasis on health protocols for access the Indonesian (export) market, facilities for safe animal inspections and treatments may be required. Therefore the project has constructed three separate cattle handling facilities at this stage. These are solely for demonstration purposes and there has been little evidence that this type of infrastructure would be adopted by a *Redi KAMODI* household with a small number of bulls to fatten. All of these facilities incorporate a bugle race for cattle handling and include a loading ramp, with two of these facilities including a water point as a means to train cattle to access the infrastructure.

The first set of cattle handling infrastructure was constructed by a volunteer (Farmers-without-borders) at the Tibar abattoir in Dili (**Figure** 12). The facility is manufactured from steel and is fully portable. After an opening ceremony it was unclear what level of exposure or demonstration MAF officers or farmers have had to the facility. In 2021, the facility was transferred to Dotik research station in the south.

Two sets of cattle handling infrastructure were constructed at the IPB (Betano) by MAF and IPB staff and students (Figure 13) in 2020. One is built of and the other mainly of bamboo to generate data on cost of different materials and their lifespan under local conditions. Given its proximity to a number of *Redi KAMODI* and the increasing number of students attending IPB it is likely to be in a better location for demonstration of safe handling and loading of cattle to farmers and their children. The facility also has the potential to be used as a research facility in future; this was the original rationale for the selection of this site.

Figure 11. Typical infrastructure (kandang) used for stall based fattening of bulls across Timor-Leste.

Figure 12. Cattle handling infrastructure established at Tibar, Dili.

It is hoped a small cattle handling facility of similar design to that described above (IPB model, Figure 13) but smaller in scale and incorporating a stand-alone water catchment and conservation tank to provide water to cattle within the infrastructure will be constructed. It is expected cattle will become accustomed to entering and exiting the yard daily to access water, providing a means for farmers to secure animals as required for husbandry, to enter fattening systems or for marketing practices. Such a model would be relevant to the majority of RK households who manage free-ranging cow-calf systems as part of their overall cattle production system, providing them with a stress-free method of securing cattle in robust infrastructure when they arrive for water.

Figure 13. Cattle handling infrastructure established at Instituto Politecnico Betano, Betano.

7.3.5 Evaluate, demonstrate the impact of, and achieve uptake of nutritional and husbandry interventions on increasing cattle productivity and profitability

The major 'research' focus of *Redi KAMODI* has been the establishment of forage tree legumes (mainly leucaena) for bull fattening under cut-and-carry systems. Over 600 households across 21 *Redi KAMODI* have been exposed to this system, with many implementing (or planning to implement) the approach to some extent. Depending on a household's location and access to resource, such a transition may result in increased average daily liveweight gain of bulls for sale from 0.1 to 0.3 kg under prevailing practices to 0.5 kg, if improved forages, appropriate feeding management and improved animal husbandry practices are implemented. The impacts of these increased growth rates on household cash-flow (returns to labour) and domestic beef supply to the local markets and livelihoods of communities has been demonstrated elsewhere in the project.

A number of 'husbandry' interventions were trialled by some *Redi KAMODI* groups during 2020. These smaller 'trials' were conducted with support of UNTL students who used the research data for their degree thesis. This model works well and is proposed to continue during the extension of the project. Thirty-four UNTL undergraduate students had the opportunity to prepare a final year thesis (skripsi) through participation in three experiments led by Dr Yuliaty (Appendix 2). A summary of the results is as follows:

1. Effect of Vitamin B complex injection on growth of Bali bulls
    a. Vit B had no significant effect on LWG or feed intake when gaining 0.60-0.71 kg/d.
    b. Vit B caused stress in some of the bulls
    c. Results were demonstrated to farmers who declared no further use
2. Weaning using nose flaps to supply cattle for fattening.
    a. Weaning increased vocalisation by calves ($P< 0.05$) but had no effect on LWG.
    b. Pregnancy rate after weaning was 62%.
    c. Despite no previous knowledge of weaning, 80% of farmers were willing to wean using nose flaps in the future, especially as cattle adjust feed intake soon after the weaning, growth is unaffected and more pregnancies are achieved.
3. Effect of once daily v *ad lib* drinking water supply on cattle growth
    a. Restricted water supply reduced water intake (12.4 vs 13.7 L/d). This compares to 16-17 L/d previously reported by Yuliaty (2014).
    b. LWG at 0.40–0.58 kg/d was unaffected by frequency of drinking.

In addition to the above, students also gained skills in live weight gain prediction using methods prepared by ACIAR (Quigley) and UNRAM (Dahlanudin).

7.3.6 Discussion

Redi KAMODI farmers generally identified leucaena-based fattening of bulls in kandangs as the preferred method to increase cattle production and household cash flow. Approximately 300 farmers established approximately 200 ha of leucaena within a range of systems compatible with cropping activities and household resources. Such a system potentially at least doubles liveweight gain of bulls, resulting in the sale of an increased number of heavier and younger animals each year by households compared to previous managements strategies. The Leucaena-based fattening systems are familiar to many households in Timor-Leste, relatively easy to establish with a quick result from a biological perspective (relative to cow-calf interventions). However, the adoption of a leucaena-based fattening system requires a major step-change in intensification for most households. The wide-spread adoption of the approach, both within and beyond *Redi KAMODI*, demonstrates that farmers understand and accept the higher inputs required to implement the system to produce the additional liveweight for sale.

A key outcome of this activity was increased capacity within Timor-Leste on forage production and cattle nutrition. Training modules increased the knowledge and skills of group facilitators, which was extended to the members of the *Redi KAMODI*. The modules

are a tangible output from the project that is physically available to the relevant stakeholders in Timor-Leste now and into the future, and as such they will be a valuable resource for any future government or non-government programs, or for use of any existing or emerging private sector stakeholders. These modules have been used in various forms in other projects in Indonesia and in the Pacific demonstrating impact beyond the immediate project. Research capacity was built at four levels:

1. Farmers were provided advice and support to develop research questions and to then design experiments to answer these research questions within their own farming systems,
2. MAF livestock and extension staff were provided with training and access to training modules to assist with facilitation of *Redi KAMODI* which can now be extended to other aspects of their MAF roles,
3. Undergraduate students from UNTL, supported research in village sites and generated experimental data for inclusion in their scripsi (research reports) to be completed before conferral of their degree, and
4. Senior team members received postgraduate training and will graduate with PhDs in animal nutrition, metabolism and husbandry on topics of direct relevance to Timor-Leste.

The foundations for continued development of the beef cattle industry in Timor-Leste have been established across the Phase 1 (LPS/2009/036) and Phase 2 (LPS/2014/038) projects, and from other programs in Timor-Leste and Indonesia. Animal monitoring systems are established, and baseline data has been collected, technical and research capacity and farmer facilitation skills are developing, forage production systems have been developed and adapted, fattening systems have been adopted, and improved cattle handling facilities, calf feeding and weaning strategies have been demonstrated. Future technical production research is likely to utilise the large amount of existing research and development information and adapt this to evolving farming, market, policy environments, to any new cattle production systems in Timor-Leste and to address any major constraints or threats to the industry. The main opportunity to increase growth of the cattle industry in Timor-Leste is to increase weaning rates from more efficient cow-calf systems, which may include improved grazing and weed management of communal grazing lands and pre- and post-weaning management of calves.

8 Impacts

8.1 Scientific impacts – now and in 5 years

The support of PhD training (see below) will substantially improve science capacity within the Timor-Leste livestock sector where such qualifications are rare. A reflection of this are the multiple scientific papers emerging from the group and will emerge in the near future.

The impact on teaching curricula at UNTL and IBP, premier tertiary institutes in Timor-Leste are large. Lecturers such as Sebastiana Dahu, a member of the Business and Marketing R&D team, is a UNTL lecturer who has achieved considerable enhancement in her knowledge and skills in applying her academic perspective to farming practice. This was highlighted by a study tour to Indonesia where she learned of new opportunities. She now takes all students to Atabae to learn about profitable production systems in comparison to harvesting from free-range systems.

Dr Yuliaty's knowledge and skills development in forage systems during the project, complemented by her PhD studies that the project supported is reflected in much better curricula in her unit. Thirty-four UNTL undergraduate students had the opportunity to prepare a final year thesis (skripsi) through participation in three experiments led by Dr Yuliaty (Appendix 2).

In May 2022, the team leadership met with the Minister for MAP, His Excellency Senor Pedro dos Reis. In addition, the team was invited to have dinner with the Minister and his wife. The Minister was very impressed with the project achievements and was committed to up-scaling *Redi KAMODI* in Timor-Leste. He was particularly impressed with the model for conduct of the project, with a highlight for him being the support of study tours and of Masters and PhD studies for Timor-Leste students in Indonesia and Australia over the past ten years.

8.2 Capacity impacts – now and in 5 years

The project has achieved huge capacity development in all sectors of the industry, including farming, government and education.

Through participation in *Redi KAMODI*-based adaptive trials and training activities, 623 farm families strengthened their capacity for better informed decision making to sustainably support their transition towards more productive cattle management and business practices. The confidence with which they are willing to express themselves and share information and problems is obviously much higher than we have ever seen previously. Farmers and local MAF staff are so enamoured with the *Redi KAMODI* system that they firmly believe MAF will continue to support it. They particularly value their ownership of their *Redi KAMODI*, ie, it is not a government solution and is not used to deliver government solutions.

The greatest impact of this component at this stage has been on the increased capacity of a large number of MAF and UNTL team members to assist farmers implement changes to their cattle production systems. The training of *Redi KAMODI* group facilitators, and thence *Redi KAMODI* members, has resulted in the production of increased quantities of high-quality forage across Timor-Leste. This, coupled with improved feeding systems, has resulted in higher growth rates and an increased number of heavier cattle achieving a price premium in the Dili markets. This has improved household incomes and the supply of local cattle into the domestic market.

Three MAF employees acquired expertise in Communication for Development, a previously unrecognised field within MAF, through formal (postgraduate) and informal training. Two of them moved on to other Ministries but are expected to still apply the C4D principles and methods learned in other areas of application, and as such contribute to more equitable and sustainable development models.

8.2.1 Post-graduate training

The project has been privileged to provide partial support for three PhD scholars. This was integral to the primary focus of the project, capacity development. These PhDs will be important for future capability in the conduct of agricultural research in Timor-Leste where only a very small number of people have this level of training at present.

9.1 Dr Yuliaty

Dissertation	Feed evaluation and determination of energy and protein requirements on post-weaning Bali cattle in Timor-Leste
University	Udayana University, Denpasar, Bali Indonesia
Funding	Government of Timor-Leste
Supervisor	Prof Dr Ir I Gede Mahardika MS
Co-Supervisors	Dr Ir Ni Nyoman Suryani MSi Dr Ir I Gusti Lanang Oka Cakra MSi
Timeline	Aug 17 - Sep 19
Graduation	12 Dec 19

Research

The nutritional requirements of Bali cattle, the predominant cattle breed in Indonesia and Timor-Leste, are not fully established. Neither is the nutritional value of many commonly-available feeds in Timor-Leste. This has been partially overcome by Yuliaty's research, now published in a scientific journal, in which the primary nutrient requirements of growing Bali cattle are defined. Further research produced a database on the quality of common cattle feeds in Timor-Leste.

Young bull eating local feeds

9.2 Latino Coimbra

Dissertation	Milk delivery to neonatal beef calves
University	University of New England
Funding	John Allwright Fellowship
Supervisor	Dr. Frances C. Cowley
Co-Supervisors	Professor Roger Hegarty, UNE Assoc Prof Luis Prada e Silva, UQ Geoffry Fordyce, UQ
Timeline	Jul 19 – Jun 23

Research

Calf mortality is a major problem in tropical beef systems, including in Timor-Leste and Australia. The main cause appears to be poor nutrition. Latino is aiming to develop recommendations on nutritional management for pregnant cows to minimize newborn calf deaths. Latino is investigating both water and feed quality as critical nutrients for cows to achieve good milk delivery to calves on the day of birth, thereby reducing the chances of calf mortality. His research also includes methods to study this very complicated issue. Latino's studies are being conducted at the University of Queensland's Gatton campus using Brahman cows and on a large north Queensland cattle station using Droughtmaster cows

Bali cow with newborn calf

9.3 Adelino Pimentel do Rego

Dissertation	Increasing income of smallholder cattle farmers in Timor-Leste: An analysis of farm decision-making, management options, and decision tools
University	University of Queensland
Funding	John Allwright Fellowship
Supervisor	Dr Scott Waldron
Co-Supervisors	Assoc Prof Elske van de Fliert Geoffry Fordyce
Timeline	Jul 19 – Jun 23

In a twist of fate, while Adelino was in Timor-Leste conducting field studies, COVID-19 struck and isolated him away from UQ. His studies were suspended until he could return to Australia. But at the same time Adelino developed health problems which ultimately resulted in him passing away in May 2022.

Research

Practice change by farmers in Timor-Leste is partially limited by them not understanding the concepts of commercial business and marketing. Adelino was developing and testing the efficacy of methods that will enable farmers to more readily recognise business problems and opportunities and adjust their practices to improve their livelihoods. The research was being conducted with the mostly-subsistence farming community in Timor-Leste.

Adelino (at back) with group at Dili butcher's

8.3 Community impacts – now and in 5 years

8.3.1 Economic impacts

As mentioned, the project has conducted budgeting with a large number of cattle households, which yielded a large number of variable results. As a central part of his PhD studies Adelino do Rego collected data and budgeted household cattle production systems in three sites. This is illustrated in the case of a representative household in Aidabalaten.

The household has four bulls in a pen fed intensively on a leucaena-based diet (60% in wet season) for 465 days. The feeder cattle enter the pen at 134kgs, with an ADG of 0.35kg to reach 300kgs, and receive a price premium of US$2.70/kg live weight at a butcher in Dili. The household incurs high costs for the value of the initial feeder, but low variable costs and depreciation, leaving gross profits of US$450 per bull. There are, however, significant labour inputs required (especially in forage collection and work in the pen) of 93 person days. This leaves a “return to labour” value of approximately US$5 per (8 hour) labour day. This is about the same as the daily wage off-farm (construction, transport) but is more consistent and reliable.

It also compares favourably to returns to bull production in extensive grazing systems. Whilst liveweight gain is much lower (ADG of 0.1 kg) under extensive management systems, costs and labour inputs are also much lower (23 person days over the 456 days) but even then, returns to labour are less than half that of the intensive system (US$2.20 compared to US$5 daily).

Do Rego also modelled the differences between unimproved and improved cow-calf production systems supported by *Redi KAMODI*. In an unimproved grazing system in Aidabalaten, a representative household had 6 cows, with conservative values for calving rate of 50%, calf mortalities of 50% and bulls/heifers with an ADG (average daily gain) of just 0.1 kg. Even with low labour input (32 person days per year), the household will earn just $8.68 per day from cow-calf production. This was compared to an improved household system with 6 cows, a calving rate of 67%, calf mortality of 33% and bulls/heifers having an ADG of 0.2 kg. Though there was supplementary feeding and labour use increased to 78 days per year, returns to labour were more than double that of the unimproved system at $22 per day.

While there is major variation in the uptake of systems and the benefits to different types of households, it is likely that improved systems can sustainably double the cattle incomes of participating households well into the future.

It is important to note that these returns are mainly in the form of cash, and in large “lumpy” assets. These revenues then tend to be used for larger household expenditures rather than smaller consumption items. Examples recorded during the project include land purchase (2), water pump purchase (1), motorbike purchase (14), car purchase (3), shop construction (4), house renovation (10), school fees (2).

8.3.2 Social impacts

Community organisation through the *Redi KAMODI* has led to collective action at the hamlet and village levels to (1) productively utilise common land for forage production, (2) establish shared cattle facilities, and (3) organise more efficient means of marketing cattle. This, in turn, led to increased income of individual farm families.

Participation in the *Redi KAMODI* has supported empowerment and enhanced self-efficiency of farm families, as evidenced by farmers’ attitudes towards (self-)development, expressions of ownership over the change process, and sustained activity in collective action.

The *Redi KAMODI* platform facilitated horizontal communication between farmers, traders and MAF officers, resulting in more dynamic and mutually beneficial exchanges and relationships.

One of the best features of bull fattening is that bulls are restrained either by tethering or penning. This has quietened them considerably and enabled participation of the whole family in cattle production. The women are reportedly very happy about the new system for several reasons: the money is good; accessing feed is much easier as produced on site rather than foraging for it in distant parts; it is safe to feed the quiet bulls; and, their overall time spent on cattle is much less. The new system has enabled women to fully manage bull fattening, as was exemplified in a video prepared for a project review in early 2021.

8.3.3 Environmental impacts

No significant environmental advantages have been noted by the project. Certainly, no negative effects of the new cattle systems are apparent or conceived. If forage production systems are developed as recommended, these can have significant positive environmental effects through soil conditioning.

8.4 Communication and dissemination activities

A range of communication, facilitation and dissemination activities was conducted to support *Redi KAMODI* and to improve farmers' and MAF staff knowledge and skill. These included facilitation of *Redi KAMODI* by field researchers, 3-monthly reflection and planning workshops facilitated by the C4D team and field researchers, and training of MAF staff in both technical and facilitation skills and knowledge. To ensure the integrity of *Redi KAMODI* and to facilitate expansion, a comprehensive detailed manual was produced in Tetun, Indonesian and English.

To support delivery of technical materials on cattle fattening throughout Timor-Leste, a series of nine short videos were made by the *Redi KAMODI* team.

Title	Duration	YouTube link
1. Leucaena as cattle forage	1'45''	https://youtu.be/M6F2BjtXkjM
2. Leucaena seedling preparation	3'03''	https://youtu.be/hZvrAU4EqVg
3. Transplanting Leucaena	1'21''	https://youtu.be/rB-_AXwNBfE
4. Leucaena cultivation and harvesting	1'49''	https://youtu.be/sRBP8ICIdAw
5. Feeding cattle	1'18''	https://youtu.be/xkdhNOlLnew
6. Cattle management	3'36''	https://youtu.be/r4dcmwk58dY
7. Care of cows and calves	1'57''	https://youtu.be/RVcKOl--Sko
8. Cattle marketing	1'10''	https://youtu.be/LU8V_XA_iBc
9. The benefits of Redi KAMODI (testimonials)	12'50''	https://youtu.be/j3cgd5uaFNo

Examples of press releases are shown in Appendix 3.

9 Conclusions and recommendations

9.1 Conclusions

Redi KAMODI is a variation on innovation platforms and is highly effectively in the improvement of householder livelihoods in Timor-Leste

Adoption of forage production, bull fattening to meet Dili butcher specifications and live weight selling as an initial stage of transition to a semi-commercial beef sector can double the income from beef cattle for Timor-Leste households

Fattening of controlled bulls empowers women and their children to have a safe, time-efficient active role in profitable commercial beef production

The Timor-Leste government is committed to upscaling *Redi KAMODI* across the country to underpin development of their beef sector, with the ultimate aim of achieving export income from either live animals or processed beef carcasses

Sustaining *Redi KAMODI* requires the government to commit funds for dedicated leadership and field staff operation

An up-to-date training manual and peer-to-peer learning from practicing groups in both Timor-Leste and Indonesia are a vital resource during upscaling

Support for a viable and growing, hygienically-produced, high-quality beef market in Dili is fundamental to on-going development of beef systems in Timor-Leste

Support for more wide-spread live-weight selling will create more accurate and strong market signals, equitable for farmers, traders and butchers

Forage production is the basis for any viable commercial beef system and in Timor-Leste the best entry point appears to be through Leucaena production.

A looming shortage of feeder beef cattle reflects poor reproductive rates and will limit expansion of bull fattening systems

Cattle handling infrastructure suitable for the Timor-Leste smallholder situation is desperately needed by farmers throughout the country to facilitate handling, marketing, and veterinary interventions.

International study tours and international post-graduate study are key elements of a future successful agricultural sector

9.2 Recommendations

Redi KAMODI

MAF consider the institutionalisation of the *Redi KAMODI* model as the standard for extension/rural development. This implies that an investment is made in (1) training *Redi KAMODI* facilitators, (2) resources for *Redi KAMODI* facilitators on a continuous basis allowing them to fulfil their duties, and (3) assigning a communication for development specialist to lead rural development/extension. Involvement of government departments responsible for agriculture (MAF) and education (eg, UNTL and technical colleges such as Instituto Politécnico de Betano [IPB]) is recommended. *Redi KAMODI* is a process for development in multiple rural enterprises, not just cattle.

Business and marketing

Adopt the “demand-pull” approach for beef cattle business and marketing, which is a successful model. When households appreciate that cattle can generate substantial cash income with relatively low risk, it is a significant incentive to adopt improved production and commodity supply systems.

Implement ongoing, repeat training and follow up in planning all aspects of beef production and supply to help households with more entrepreneurial people invest resources and especially labour to suit their circumstances and objectives.

Adapt policy to support the ever-growing demand for all beef business products, and especially high quality and safe beef, in Dili.

Forage and cattle production

Introduce better pregnant cow management to reduce calf mortality.

Further demonstrate and ‘trial’ weaning practices to improve adoption and reproductive rates.

Remove the reliance on cattle scales by training in the use of girth tapes to measure live weight.

Focus on construction of simple earth-ramps for cattle loading as an initial stage of cattle handling infrastructure development.

Future research

An in-country team assisted by potential international partners should advance the process initiated in May 2022 (Appendix 4) towards a new project.

Supply of feeder cattle is emerging as a limitation to expansion of cattle fattening, both in numbers of households and the number of cattle being fattened per household. The problem reflects low reproductive rates, even in high-rainfall areas. High calf loss rate is a significant contributor. Overcoming poor reproductive rates in multiple livestock species used for human consumption, eg, cattle, buffalo, sheep, goats, pigs, chickens and horses, should be a key feature of future livestock research.

The lack of robust and efficient cattle handling facilities in Timor-Leste continues to pose high risk to cattle and handlers during marketing. Yards would be valuable in the advent of a disease outbreak that requires control by vaccination. Developing infrastructure that can also be used for multiple species will greatly improve production and supply chain efficacy and also dramatically improve the ability to apply biosecurity measures and veterinary care.

Research achievements to date have essentially helped make better subsistence farmers, ie, adoption of some semi-commercial practices. Transition from subsistence farmers to farmers, ie, commercial production focussed on a small number of commodities, is the next phase. This requires integrated systems research for several species, eg, of supportive policies, credit and savings capacity, feed supply, increased reproduction, growing for slaughter, integrated handling, transport and processing facilities and marketing, in addition to business skills and strategies to enable farmers to change practices.

All industry development requires integrated knowledge and skills provided by international academic and trades training and business operations experience.

A massively-excessive livestock population exists in Timor-Leste, a consequence of government policy, limited formal land tenure and cultural practices underpinned by a lack of understanding of the inefficiencies and damage this causes. Policy and strategy research to reduce livestock numbers could substantially increase livestock production and efficiency, reduce costs, and improve environmental and community welfare.

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11 Appendixes

11.1 Appendix 1: M&E data collection guidelines

11.1.1 Focus group discussions

Participants	Objective – Discussion topics	Techniques
A. MAF key staff at municipality and sub-district level (6 groups as per municipality – Adelia): • Dept of Livestock manager • Dept of Extension manager • Municipality and sub-district Government key administrators • Sub-district agricultural extension coordinator • Sub-district livestock technical staff and extension officers (RK facilitators)	To explore the roles and capacities of managers, technicians and extension officers to effectively coordinate and facilitate the RK model, in particular, their capacity in terms of policies, and practices of program planning, management and implementation: • Their understanding of the Redi KAMODI (RK) model: definition of objective, main characteristics, and distinctiveness from regular agricultural extension/development approaches implemented by MAF. • Perceptions on strengths and weaknesses of the RK model to support the TL livestock sector. • Perceptions on the opportunities and barriers of the RK model to be implemented as a national MAF program support the TL livestock sector. • Requirements for municipality and sub-district offices to implement the RK model as a national MAF program, in terms of (i) facilitation capacity at village and municipality level to support RK groups, (ii) leadership capacity at municipality level to coordinate a nationwide RK program, and (iii) availability of financial and physical resources at municipality level to conduct a RK program	• Dialogical conversation • Card-based brainstorming • SWOT analysis
B. RK members as part of the final Quarterly Reflection and Planning Workshops (18 groups – Adelia)	To review activities and achievements since establishment of the RK and formulate workplan for future: • Recording of RK members, area of forages planted, number of heads of cattle fattened, number of cattle sales, and price received. • Review of events since RK establishments • Listing of planned activities and targets for 2021 • Perceptions on the benefits and barriers of RK to improve cattle production Discussion outcomes is backed by observations of forage/cattle management	• Dialogical conversation • Achievements table • Timeline exercise • Card-based brainstorming

Participants	Objective – Discussion topics	Techniques
	resources/practices in the field, as recorded by the Field Researchers.	
C. Project Field Researchers (1 group – Nurul/Elske)	To explore their perceived improvements in professional capacity: • Review of training and work activities during employment as Field Researcher. • Perceptions of changes in their capacity (research, facilitation, communication). • Perceptions of factors that have favoured or hampered their professional development.	• Dialogical conversation • Card-based brainstorming

11.1.2 Semi-structured individual interviews

Participants	Objective – Discussion topics	Techniques
D. Selected RK leaders (18 – Adelia)	To assess their capacity and skills in terms of RK management, farm management decision-making, experimentation, farm planning, economic analysis and improved practices in cattle management and attitudinal changes as a result of RK participation: • Review of training, research and group activities since RK establishment. • Perceptions of changes in their capacity (research, leadership, collaboration, livestock management). • Perceptions of factors that have favoured or hampered their capacity development. • Perceptions on the future of RK continuation and expansion. • Recommendations for a future national RK program.	• Dialogical conversation • Timeline exercise
E. RK members in RK villages (54 – FRs)	To assess their capacity and skills in terms of farm management decision-making, experimentation, farm planning, economic analysis and improved practices in cattle management and attitudinal changes as a result of RK participation: • Review of the process and factors that influenced their decision to participate in the RK. • Review of training, research and group activities since RK establishment. • Perceptions of changes in their capacity (research, collaboration, livestock management). • Perceptions of factors that have favoured or hampered their capacity development. • Perceptions on the future of RK continuation and expansion.	• Dialogical conversation • Timeline exercise

Participants	Objective – Discussion topics	Techniques
	• Recommendations for a future national RK program.	
F. Non-RK-member farmers in RK villages and non-RK villages (18 – FRs)	To assess the level of awareness about the RK model and interest in participation in future RK activities: • Current cattle management practices. • Information sources about cattle management • Awareness/knowledge about the RK system. • Review of the factors that influenced their decision not to participate in the RK. • Interest in participation in future RK activities.	• Dialogical conversation
G. Village traders in RK villages (18 – Adelia)	To assess the level of interest and participation in RK; • Current cattle trading practices and any possible changes that occurred since RK establishment. • Awareness/knowledge about the RK system. • Participation in RK activities since establishment of the RK in village. • Perceptions about the benefits and barriers of the RK system for traders and farmers. • Recommendations for a future national RK program.	• Dialogical conversation
H. National policymakers (2 – Elske/Nurul): • MAF DG Livestock & Fisheries • MAF DG Agricultural Extension	To explore their commitment for and support to the institutionalisation of the RK approach nationwide: • Their understanding of the Redi KAMODI (RK) model: definition of objective, main characteristics, and distinctiveness from regular agricultural extension/development approaches implemented by MAF. • Perceptions on strengths and weaknesses of the RK model to support the TL livestock sector. • Perceptions on the opportunities and barriers of the RK model to be implemented as a national MAF program support the TL livestock sector. • Requirements for MAF to implement the RK model as a national MAF program.	• Dialogical conversation
I. MAF and UNTL researchers (national level, 6 – Elske/Nurul): • In-country Project Leader	To explore the effectiveness of the leadership and management structure, capacity to facilitate and coordinate the RK model (as a form of TR4D): • Their understanding of the Redi KAMODI (RK) model: definition of objective, main	• Dialogical conversation

Participants	Objective – Discussion topics	Techniques
• MAF project coordinator • UNTL project coordinator • In-country Component coordinators: C4D, Marketing and Business, Forages and Livestock, Forages	characteristics, and distinctiveness from regular agricultural extension/development approaches implemented by MAF. • Perceptions on strengths and weaknesses of the RK model to support the TL livestock sector. • Perceptions on the opportunities and barriers of the RK model to be implemented as a national MAF program support the TL livestock sector. • Requirements for MAF to implement the RK model as a national MAF program, in terms of (i) facilitation capacity at village, municipality and national level to support RK groups, (ii) leadership capacity at national level to design and guide a nationwide RK program, and (iii) availability of financial resources at national level to conduct a nationwide RK program • Perceptions on indicators for a successful national RK program.	
J. International partners (Australian, Indonesian – Elske/Nurul): • Project Leaders (2) • C4D Component leader and member (2) • Marketing and Business Component leader and member (2) • Forages and Livestock Component leader and member (2)	To explore perceptions about the TR4D model applied in the ACIAR project, the effectiveness of the RK model, and the readiness of the Timor-Leste institutions to adopt the model as an ongoing government program: • Experiences of involvement in the RK project (positives, negatives). • Perceptions about the Transdisciplinary Research for Development model applied in the ACIAR project. • Perceptions about the effectiveness of the RK model for cattle business development in Tior Leste. • Perceptions about the readiness of the Timor-Leste institutions to adopt the RK model as an ongoing government program (favouring, hampering and unknown factors). • Recommendations for a future national RK program in Timor Leste.	• Dialogical conversation

11.2 Appendix 2: UNTL undergraduate skripsi

Final year Agricultural Science project theses emanating from the project and supervised by Dr Yuliaty

Effect of injection with Vitamin B complex on growth of Bali bulls

	Student	*Research title*	*To finish*	*Complete*
1	Augustinho T Sequeira	Consumption and body weight gain of Bali cattle injected Vitamin B complex		X
2	Jacinta Satriana da Costa Amaral	Body weight estimation and BCS of Bali bulls injected with Vitamin B complex	X	
3	Marcelina Soares	Eating behaviour of Bali bulls injected with Vitamin B complex		X
4	Delia de Araujo Bormeu	Correlation of feed intake with body weight gain in Bali bulls injected with Vitamin B complex		X
5	Marciana de Jesus Maia	Volume and trend of urination and defecation in Bali bulls injected with Vitamin B complex		X
6	Lucio M Verdial	Economics of rearing Bali bulls injected with Vitamin B complex	X	
7	Martinho da Costa	Water consumption of Bali cattle injected Vitamin B complex	X	
8	Rudolfo Soares	Marketing margins in Bali cattle injected Vitamin B complex	X	
9	Julito E Binsesi	Feed conversion ratio of Bali cattle injected Vitamin B complex	X	
10	Febisnus de Souza	Body weight gain of Bali cattle injected Vitamin B complex	X	

Weaning own cattle to produce progeny for fattening

	Student	*Research title*	*To finish*	*Complete*
11	Anaraciti de Canossa	Farmer perceptions of weaning	X	
12	Antonieta A C de Galucho	Herd behaviour when using nose flaps for weaning	X	
13	Jenulia do Carmo Amaral	Defecation frequency, urination and rumination in the herd during weaning	X	
14	Jorge de Oliviera	Eating and drinking frequency of the herd during weaning	X	
15	Mariazinha dos Santos S Mesquita	Herd bod weight gain trend during weaning	X	
16	Pedro Clever	Herd behaviour when without nose flaps during weaning	X	

	Student	*Research title*	*To finish*	*Complete*
17	Denciana de C Barreto	Defecation, urination and rumination in the herd during weaning	X	
18	Guilhermina Nunes Tavares	Body weight gain of the herd during weaning using nose flaps	X	
19	Delson Nunes	Body size measurements of a Bali cattle herd at weaning	X	
20	Jacob Soares	Live weight gain of cows during weaning		X
21	Sebastiao Alberto	Cow BCS and body measurements during weaning	X	
22	Videl Gaspar Coelho Silva Pereira	Probability of pregnancy after weaning of the cow	X	

Effect of drinking water supply on cattle growth

	Student	*Research title*	*To finish*	*Complete*
23	Melania S Pereira de Lima	Dry matter consumption and body weight gain of Bali bulls offered water *ad libitum*	X	
24	Auxiliadora N F B de Sousa	Body size and BCS of Bali bulls offered water *ad libitum*	X	
25	Celia R Maglhaes	Water consumption of Bali bulls offered water *ad libitum*	X	
26	Eliseu Lopes	Feed conversion ratio of Bali bulls offered water *ad libitum*	X	
27	Filomena da Costa	Behaviour of Bali bulls offered water *ad libitum*	X	
28	Mariano Amaral	Trends in rumination of Bali bulls offered water *ad libitum*	X	
29	Aquilina da Cruz Pires	Volume and trends in urination and defecation of Bali bulls offered water *ad libitum*		X
30	Elizeu Mendonca S da Costa	Correlation of water consumption and body weight gain in Bali bulls offered water *ad libitum*	X	
31	Genesiao Alves Nana	Cost analysis of rearing Bali bulls offered water *ad libitum*	X	
32	Rainato Tania Marques	Body weight estimation of Bali bulls offered water *ad libitum* using the ACIAR and UNRAM formulae	X	
33	Roberto Afonso	Farmer perception of fattening in the herd using the *Redi KAMODI* system	X	
34	Octaviana Mario Pinto	Water consumption of Bali bulls in the dry and wet season	X	

11.3 Appendix 3: Redi KAMODI project press releases, February 2022

Adelia Gonzaga, MAF, Dili, Timor-Leste

The Redi KAMODI program in Atabae becomes a model for other districts

The Redi KAMODI or (Karau ba Moris Diak) program in Atabae Sub-district, Bobonaro District, has become a model for other districts involved in the program. Redi KAMODI is a program of the international agency ACIAR. It was founded in Timor-Leste in 2016 with the aim of helping the community increase their income through fattening cattle using lamtoro Taramba.

Redi KAMODI group, Manufahi

Lamtoro trees in Aidabalaten

From 2016 to 2020 the Redi KAMODI program has been implemented in 21 groups in seven districts: Bobonaro, Manufahi, Ermera, Ainaro, Viqueque, Covalima, and Lautem. Through the Redi KAMODI program, a team from the technical MAF staff socializes, motivates, and facilitates the community from the process of planting, fattening cattle, to selling them to the market. The Redi KAMODI farmers in Atabae have high interest and creativity to expand and develop Redi KAMODI 's activities.

A member from Aidabaleten suco in Atabae, Lucas Angelino, said that at first he was a fish trader, he bought fish from fishermen and resold them as papalele. In 2018 he joined Redi KAMODI 's activities and planted lamtoro trees.

Lucas Angelino, Aidabaleten, inspecting his lamtoro

Lucas's bulls eating lamtoro

Initially, Lucas planted 750 lamtoro trees in his one-hectare garden. Once the trees were established, Lucas tethered and started feeding three bulls. He saw a big change in the bull that was previously thin, and after 4 months his weight had increased to 360 kilograms.

"When I saw how lamtoro feeding to bulls achieved significant growth, I was motivated to plant more than 6,000 lamtoro trees," Lucas said.

Another group member, Flaviano, said that he started planting lamtoro in 2014, but he didn't know why because there was no explanation about the benefits. In 2018, after the Redi KAMODI team shared information about lamtoro and its benefits, Flaviano started to seriously plant lamtoro trees.

Flaviano said, "Cattle growth was significantly higher and bulls could be sold faster." Though initially he experienced difficulties in establishing lamtoro, that did not prevent him from planting.

"I have experienced the benefits and in the future I will plant many lamtoro trees so that I can fatten more bulls," he said.

Meanwhile, Joanita Magalhães, a project field researcher assigned to Atabae explained that initially the community did not want to participate in the Redi KAMODI program, but through continual approaches they finally wanted to join the program to plant lamtoro trees.

"In the end they can get the benefits of planting lamtoro trees because it accelerates the growth of bulls which can be sold the high-value markets, especially the Talho Moris butcher in Dili," she said.

Joanita explained that the lamtoro tree has high protein for faster cattle growth and good quality meat. The buyers very satisfied with the very tenderness of the meat.

High value of lamtoro tree

Lamtoro taramba tree is high nutrition cattle food that can rapidly increase their body weight.

The high value of this lamtoro taramba encouraged Joao Marcus, who was previously a Aidabaleten fisherman, to switch professions from fishing to breeding and fattening cattle.

"When I visited some families in Loes, I saw people fattening bulls with lamtoro taramba," Joao said at his home in Tasi Mean hamlet.

From his own observations and from conversations with several farmers, Joao realised that lamtoro taramba had high nutritional value for bulls. He saw that stall feeding of tethered bulls achieved high growth, and these bulls were easily sold to earn a lot of money.

In 2014, when the Redi KAMODI commenced, João was motivated to plant 250 lamtoro trees in his 60 x 40 metre garden. Once the trees were large enough to feed cattle, he started stall-feeding three bulls.

"Within three months the bulls had reached their target of 340 kilograms," João said. With the help of Redi KAMODI and facilitated by UNTL, João sold his bulls at the abattoir.

“From the sale of cattle from 2018 to 2020, I have used it to buy motorbikes, renovate houses, pay for children's school fees, and for daily needs" João said. With such great benefits, João wants to expand his lamtoro garden so that he can fatten more bulls.

Lamtoro taramba trees

Bali bulls being fattening with lamtoro

João is very grateful to the Redi KAMODI program, because the program has taught him how to fatten bulls and earn good money.

"Before the Redi KAMODI program, our bulls were allowed to roam freely, and when people came to buy them, we searched and caught them to sell, but at a much lower price than now," João said.

Lamtoro benefits for Celsio

Celsio Pires, a 53-year-old Maliana man currently living in Atabae, has greatly improved his livelihood from lamtoro after joining the Redi KAMODI (Karau ba Moris Diak) program.

Before planting lamtoro, Celsio was a farmer, fisherman, and livestock owner, but none of these ventures was sufficiently profitable to support household and other needs.

In 2015, before the Redi KAMODI program was implemented in Atabae, Celsio already knew about lamtoro from the ACIAR research team in Loes who promoted and explained it. This encouraged Selcio to plant lamtoro in his garden.

"One benefit of lamtoro is it very easy for women and children to harvest and feed to animals, especially because of the short distance from the lamtoro to the fattening stalls,” Celsio said.

Celsio said another benefit of lamtoro was that because it is no longer difficult to find cattle food, it is very easy to stall feed bulls. Before planting the lamtoro, Celsio learned the establishment process, including cultivating the soil and then planting trees.

Initially, Celsio planted 350 lamtoro trees in an area of 35 x 50 metres, spaced at 1 x 5 metres. Between the trees he planted other crops such as corn, pumpkin, and peanuts.

Atabae Redi Kamodi group

Celsio Pires cutting lamtoro for his bulls

After the trees were ready to harvest, Celsio tethered three bulls in stalls and hand-fed them. When the weight of the bulls reached the target, Celsio sold at a high price. Because of good results, Celsio decided to increase the quantity of lamtoro trees.

In the second phase, Celsio added 300 to 400 lamtoro trees, and also increased the planting area to 40 x 60 metres, with a spacing of 1 x 7 metres. Celsio said the main difficulty faced so far is constructing fences that can keep out roaming animals.

“Also,” he said, “in the dry season, insects lay eggs on the lamtoro leaves, making it unpalatable for the bulls. We are looking for other feeds such as cogon grass/alang-alang to feed.”

"But this is only in the dry season. In the rainy season I feel happy because the lamtoro is growing well,” Celsio said.

Since starting in 2015, Celsio has sold 5 bulls to Talho Moris at Tibar. The money was used to buy more bulls because Celsio did not own cows. He also bought a motorbike, payed children's school fees and met other household needs.

11.4 Appendix 4: Basis for a new ACIAR project

Meeting at Liquica, 15May22

Chairs: Assoc Prof Luis Silva (Project leader, UQ), Prof Dahlanuddin (Assistant leader, UNRAM)

Others present: MAF: Drh Joanita Jong, Sr Carlos Amaral, Sra Adelia Gonzaga; UNTL: Sra Sebastiana Dahu; Redi KAMODI project: Justino Caldeira; UNRAM: Prof Yusuf Sutaryono; UQ: Dr Geoffry Fordyce

The method used was based on Fordyce et al (2022).

Objective

To initiate the process of scoping for a new project

Situation analysis from previous and current research

Luis	*Redi KAMODI* very successful & operating strongly despite problems Farmers ready to talk because used to the discussion process Reason for success is structured fattening business and low costs No doubt farmers will improve, eg, by adding more forages, accessing credit
Joanita	Good communication through the project MAF (Carlos) ensure district staff continue to be available to support *Redi KAMODI* Need focus on reproduction, especially high calf mortality, to improve production Current MAF staff committed to sustaining and scaling out *Redi KAMODI* Adelia likely to be a key person for *Redi KAMODI* support Demand for *Redi KAMODI* exists, eg, soon to visit Oecussi to introduce *Redi KAMODI* Already people looking for bulls and difficult because market places don't exist
Adelia	*Redi KAMODI* actively defining and solving problems, not just growing and feeding Leucaena *Redi KAMODI* very good in building support networks for farmers
Carlos	Need more cattle feed, more cattle produced Need more financial support to support and scale up *Redi KAMODI* Need farmers to want to fatten bulls to underpin the objective of increased supply
Justino	*Redi KAMODI* already know the Leucaena and bull fattening system Farmers without animals can grow forages and need a way to get animals to fatten Some farmers still need to grow more feed to move into viable fattening The new market created has been excellent Even if the project finishes, *Redi KAMODI* will continue
Sebastiana	Fattening is profitable and the good market is a key ingredient Need livestock market places across the country to trade animals
Conclusion	*Redi KAMODI* is successful, but future feeder supply is an emerging problem

Potential problems as the basis for a future project

Question: What problems are envisaged to exist for Timor-Leste beef cattle farmers in the next 5-10 years?

Lack of feeder cattle	Low pregnancy rate High calf mortality Lower prices Low margins for current system Lack of labour Low feeder bull availability Insufficient breeding bulls
Low feed availability	Low feed availability Land competition for crops Weed invasion Land degradation
Exotic disease risk	Exotic disease risk
Lack of knowledge and skill	Cattle low MAF priority Lack of knowledge and skills Young farmers not interested Insufficient young scientists
Poor infrastructure	Inaccurate statistical data Cow-calf business not seen as business Inefficient infrastructure for production, marketing and transport

Priority problems needing solutions

Question: What is the impact overcoming the expected problems on beef cattle business in Timor-Leste and how researchable are these elements?

Priority can be assessed by its impact on EBIT (earnings before interest and tax)

EBIT = Production (kg) * Value ($/kg) – Costs ($)

Score potential impact on each element and add

Researchability denotes whether the option for research exists, eg, if it is a regulatory issue or if extensive research has already been done and the issue is adoption, then researchability is low

Overall score = Total impact score * Researchability

	Impact if overcome (-3 to +3)				Researchability	Overall
	Production	Costs	Value	Total	(0-3)	Score
Lack of feeder cattle	+3	-2	0	+1	3	3
Low feed availability	+3	-2	+1	+2	1	2
Exotic disease risk	+1	-2	+1	0	0	0
Lack of knowledge and skill	+3	-1	+1	+3	1	3
Poor infrastructure	0	-1	+1	0	1	1

Concept for a new project

Developing knowledge and skills to implement profitable cow-calf systems that meet feeder market needs in Timor-Leste

Environment for success of the research: Bull fattening; Savings and credit facilities; *Redi KAMODI*

Next steps

Potential solutions	To be discussed
Review	Other stakeholders need to have their input into what has been conducted, eg, are there other problems that need to be dealt with ? do the priorities need editing ?
Team	Select a group leader, domestic team and potential international support to progress the proposal
Concept note	Prepare a concept note for ACIAR with assistance of the in-country coordinator