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Australian Centre for
International Agricultural Research

An evaluation of the ACIAR Agriculture Sector Linkages Program



1

ACIAR OUTCOME
EVALUATION SERIES

An evaluation of the ACIAR Agriculture Sector Linkages Program

Penny Davis
Alinea International



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Foreword

This book is the first of a new series of reports that is based on outcome evaluations of research and programs supported by the Australian Centre for International Agricultural Research (ACIAR).

ACIAR establishes international research partnerships between scientists from Australia and partner countries in the Indo-Pacific region to improve the productivity and sustainability of agriculture, fisheries and forestry for smallholder farmers.

As a learning organisation, ACIAR is committed to understanding the diverse outcomes delivered by the research collaborations we develop, to demonstrate the value of investment of public funds, to continuously improve research design and to increase the likelihood that ACIAR-funded research improves the lives of farming communities in our partner countries. An important mechanism for achieving our aims is to work closely with the wider Australian development assistance program to develop promising research into improved agricultural practices and profitable enterprises at scale.

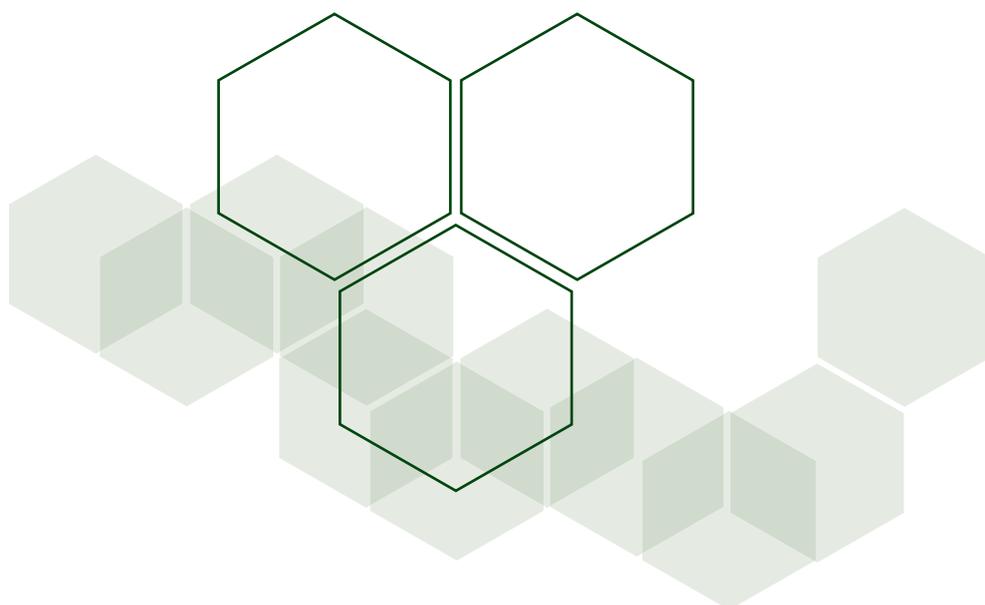
This report presents a suite of evaluations of the Agriculture Sector Linkages Program, conducted in Pakistan, and co-funded by the Department of Foreign Affairs and Trade (DFAT) and ACIAR from 2005 to 2015. The program was an opportunity for Australian agencies to partner with Pakistani researchers and ministries to advance the development of key agriculture sectors, seeking particularly to understand pathways to adoption for improved practices in Pakistan. The investment sought to strengthen learning and insights in these common areas by linking projects together into a programmatic structure.

The evaluations ultimately seek to understand the value that this programmatic structure delivered and identify lessons for future programmatic and/or place-based research-for-development investments. To inform these insights, a series of project-level outcome evaluations were conducted. These evaluations were designed to investigate the extent to which the funded projects contributed to short-term development outcomes.

Outcome evaluations adopt a largely qualitative, theory-based approach and seek to empirically test the project's articulated logic and investigate the assumptions underpinning this logic. In addition to documenting the contribution of ACIAR projects to intended outcomes, these outcome evaluations are intended to generate data for cross-case analysis that, over time, will support the elicitation of lessons regarding effective agriculture research-for-development practice.



Andrew Campbell
Chief Executive Officer, ACIAR



An evaluation of the ACIAR Agriculture Sector Linkages Program

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Part 2: Citrus projects

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Part 3: Dairy projects

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ACIAR Agriculture Sector Linkages Program

Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
ASLP	Agriculture Sector Linkages Program
AUD	Australian Dollar
AusAID	Australian Agency for International Development
DFAT	Department of Foreign Affairs and Trade
NGO	Non-government organisation
ODA	Official development assistance
RPM	Research Program Manager (ACIAR)
VBSE	Village-based Seeds Entrepreneurs

Acknowledgements

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The evaluation team would like to express its appreciation to all project stakeholders who gave their time to be interviewed and to review the evaluation findings.



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Summary

From 2005 to 2015, the Australian Centre for International Agricultural Research (ACIAR) oversaw the 2 phases of the Agriculture Sector Linkages Program (ASLP) in Pakistan, which was a research-for-development program in the Punjab and Sindh provinces of Pakistan, focused on enhancing selected agricultural value chains for the ultimate benefit of the rural poor. The program had 2 phases: Phase 1 ran from 2005 to 2010, and Phase 2 was implemented from 2011 to 2015. The program was funded by the Department of Foreign Affairs and Trade (DFAT)¹⁷ and was managed by ACIAR. Both phases included commodity-based projects focused on citrus, dairy and mango. Phase 2 also included a social science research project. The ASLP goals are at Appendix 3.4.

Research projects within the ASLP that focused on strengthening the dairy value chains in Pakistan were:

- Phase 1: Improving dairy production in Pakistan through improved extension services (LPS/2005/132).
- Phase 2: Strengthening dairy value chains in Pakistan through improved farm management and more effective extension services (LPS/2010/007).

The 2 dairy projects aimed to improve farm management and make extension services more effective, and focused on 4 main outcome areas:

1. Increasing the productivity and profitability of smallholder dairy farmers.
2. Improving the quality and availability of livestock feed to smallholder farmers throughout the year.
3. Developing model dairy farm systems and pro-poor extension approaches that could be scaled out throughout Pakistan.
4. Developing the capacity of future and current scientists, dairy extension and industry personnel who could research the production and marketing of milk from the farm to the consumer.

Led by Charles Sturt University (Australia) with University of Sydney, in partnership with the University of Veterinary and Animal Sciences, Lahore (Pakistan), the projects involved partnerships and collaboration with institutions in Australia and Pakistan. The projects were funded by the Australian Government with contributions from other sources, and were implemented from 2007 to 2015 with a total funding value of AUD3,770,000.

This evaluation is Part 3 of a suite of evaluations of the ASLP. It examines the achievements of the dairy projects, with a view to identifying lessons that will inform the design, implementation, and the quality of outcomes of future ACIAR investments.



¹⁷ ASLP was originally funded by the Australian Agency for International Development (AusAID). AusAID was merged with DFAT in 2013.



Key findings



What was the project's theory of change; and how did this evolve during implementation?

The dairy projects did not have an articulated theory of change. The evaluation team developed a suggested theory of change based on program documents covering the 2 projects, as outlined in Appendix 3.1. Key elements of the theory of change are:

- The projects were expected to **increase smallholder dairy farms' milk production rates and profits** by farmers adopting efficient practices and technology in livestock health, reproduction, and nutrition management. The projects would train farmers, provide extension services, improve farmers' access to high quality livestock feed, and develop dairy value chains.
- The projects were expected to **produce model dairy farms and extension approaches that could be scaled out** throughout Pakistan by piloting pro-poor dairy farming extension approaches and developing dairy value-adding and market innovation approaches. The projects would train extension workers and develop less intensive farming extension programs.
- The projects were expected to **increase scientific evidence-informed decision-making** as part of developing the dairy sector in Pakistan by scientists and primary investigators adopting enhanced research techniques and leading research on dairy. The projects would build the research capabilities of scientists and have twinning arrangements between Australian and Pakistani researchers and research institutions.

The dairy projects were relevant to addressing the issue of rapidly increasing local demand for milk in Pakistan and the need to improve the dairy productivity and profits of smallholder dairy farmers who make up 80% of Pakistan's milk producers.

Key findings (cont.)

2

What outcomes (intended and unintended) has the project achieved or contributed to?

Project activity and research reports, external review reports, key informant interviews and case studies provide sufficient evidence that the projects' outcomes have been achieved or will most likely be achieved.

Farmers' adoption of scientific and extension knowledge and practices has resulted in recorded increases in sales and profits from increased milk yields, healthier calves, and milk value-added products such as ghee, cream, ice-cream, and yoghurt. Farmers have adopted efficient farming practices in livestock health and nutrition management, and to a limited extent, agronomic practices, seed production and forage conservation.

Extension workers delivered inclusive extension services and continued to strengthen linkages between research knowledge, extension services and farmers' practices. This resulted in higher adoption rates among farmers. The projects have also **enabled innovation through improved extension approaches, the most significant being the 'whole family approach'**. The approach recognises the value of participation by women, young people and children in the smallholder farm system and has resulted in adoption rates of up to 80% of extension knowledge and practices. However, finalising a less intensive extension program and model farm system was not fully achieved, largely due to the lack of continuity of the process, caused by the high turnover of livestock department staff.

Pakistani researchers have led and contributed to dairy research and have generated numerous scientific knowledge products. Australian scientists and students who participated in *capacity-building* activities have improved exposure and expertise in dairy research. Scientific knowledge outputs have also been adopted by farmers and extension workers. The results suggest blending international and national expertise enriches the quality of capacity development activities and research outputs.

Women and youth have increased agency and participation in training, meetings, and extension services. Men, to an extent, have improved attitudes towards women and young people participating, and sharing project benefits.

However, the long-term sustainability of these outcomes depends on a few factors. Some were outside the projects' control, but all need to be considered during the design and monitoring of future projects. Well established dairy/beef markets and supply chains, and access to quality livestock feed and extension services, will support smallholder farmers' ability to maintain farming practices and sales. Commitment is needed from the Government of Pakistan to ensure equitable policies and well-resourced teams of dairy experts provide conducive operating conditions for farmers, extension staff, researchers, and other stakeholders. Community willingness to continue to transform cultural attitudes and barriers that limit women's participation will ensure sustainability of benefits and increase opportunities for women who contribute up to 80% of work inputs in dairy farms.



3

How did project activities and outputs contribute to the outcomes achieved?

Project review documents and interviews suggest that there has been successful adoption of knowledge and practices resulting in positive impact. However, some outcomes were delayed because they required additional activities or risks to be better managed. Both projects were extended by 3 months in 2010 and 2015, respectively, to allow for activity completion.

Farmers' ability to adopt new knowledge and practices was dependent on their access to resources and milk markets. Adoption required some level of input and investment by farmers such as land, water, equipment, animals, seeds, time and money. Adoption rates for extension messages that required inexpensive inputs were higher than for those that required more inputs. Access to markets influenced farmers' ability to negotiate and sell milk and milk products to achieve profits. Project reviews have recommended that future projects include more detailed dairy and beef value chain analysis and strategies.

Inclusive and effective stakeholder engagement significantly influenced adoption rates by farmers, extension workers and scientists, and strengthened the interface between scientific knowledge, extension programs and farmer experiences. The projects employed effective strategies for inclusive and effective stakeholder engagement, such as engaging farmer networks, working through farm advisors, and increasing the number of women extension workers. These strategies should be considered for similar projects in the future. However, the projects continuously addressed challenges of working with different groups of stakeholders, so finalising a less intensive extension program and model farm system suitable for scale out was not fully achieved. Future projects should consider such risks and ensure stakeholder engagement and communication strategies are in place to ensure consistent support in the scale out of programs.

Capacity building cut across the project outputs and significantly influenced adoption and impact among project stakeholders. The *capacity-building* activities ensured not only strong project results but will likely contribute to an improved dairy sector in the future. Future ACIAR projects will also need to consider a planned approach to balancing research focus; and address the growing issue of Pakistani students opting not to return to Pakistan after overseas studies.

Key findings (cont.)

4

What strategies were adopted to address gender equity and social inclusion and how effective were these?

The projects started during a period when addressing gender equity and social inclusion was not an explicit priority of Australia's overseas aid programs. Through ongoing learning processes, the need to move from men-only participation to include women and other marginalised groups led to the piloting of the **'whole family approach' to extension which has doubled adoption rates**, compared to just working with men. ASLP Phase 2 also implemented a social research project that included dairy farming communities.

Program data and interviews suggest **males and females have benefited in various ways**. Male and female extension workers have adopted gender equality and social inclusion principles to deliver more inclusive extension services. Women have increased agency and have actively contributed to decision-making on their farms; and have adopted options to increase profit margins by manufacturing products like cheese, ghee and cream. Men have more inclusive attitudes towards sharing decision-making and benefits with women and youth. Children's participation was instrumental in influencing families to adopt profitable calf-rearing strategies.

While there are clear benefits, it is **unclear how the projects addressed** or were effective in addressing:

- the **added burden of the projects on women** (for example, was their increasing role and participation in certain areas of dairy farming offset by a reduced workload in other areas?)
- **potential child safeguarding issues** arising from project activities (for example, child labour, exposure to diseases)
- **lessening the gap between more resourced registered farmers and less resourced unregistered and traditional farmers**.

Future projects should consider conducting gender equity and social inclusion analysis to inform project design, which should be monitored throughout delivery.

5

How did management arrangements impact delivery of the project?

The decision to collaborate with the University of Veterinary and Animal Sciences, Lahore, and use its financial systems over the partner government's systems, **avoided potential delays in financial flows and activity implementation**. The projects consistently worked with key government departments and collaborated with multiple Australian and Pakistani institutions, each bringing unique strengths to the projects.

The projects recognised the value of blending Australian and Pakistani management expertise. An Australian team member was based in Pakistan during the first project which allowed close collaboration with Pakistani counterparts and cultivated relationships between teams in Australia and Pakistan. Having a **Pakistani team leader and dedicated project team who were engaged in both projects was also a critical success factor** – they understood the local context and could think and work politically with stakeholders. However, the external project review (Staal and Granzin 2015) and key informant interviews have questioned the sustainability of this arrangement in relation to adoption of approaches by central and local government officials. The projects worked closely with the government's livestock department to ensure transfer of skills to staff, but the department continuously faced high turnover of staff, limiting opportunities to develop and retain skilled researchers and extension workers, post-project.

Project review documents and key informant interviews also indicated the lack of:

- clear strategies to communicate project outputs to be taken up by key actors in dairy development
- a practical 'output to outcome to impact' strategy
- a robust monitoring, evaluation and learning system.

These limited opportunities for the projects' ongoing learning, risk management and adaptation to changing contexts.



6

How well did the project align with and contribute to the overall goals of its umbrella program?

The ASLP goals, while slightly different between Phases 1 and 2, focused on 3 key areas:

- enhancing the capacity of research and extension systems
- supporting poverty alleviation for smallholder farmers
- supporting value chains.

The **dairy projects gained ministerial approval from the Government of Pakistan and were well aligned with and contributed to the overall goals of ASLP.** The projects have enhanced the research skills of Pakistani and Australian researchers in dairy production, which has informed dairy extension approaches that have benefited dairy farmers. Smallholder farmers have increased the productivity and profitability of their dairy farms by adopting new farming techniques and extension service advice. The projects have certainly supported dairy value chains, which have contributed to the profitability of dairy farmers; however, benefits have been limited to a few groups of farmers.

The **dairy projects had the potential to achieve more by coordinating efforts across mango, citrus, dairy, and social research projects** to influence national dairy and agriculture sector policies and extension services and support competitive market conditions. Project review documents and interviews suggest better coordination and synergies at the ASLP program level could have achieved this and could have increased the projects' ability to influence policymakers.

Conclusion and lessons learned

The ASLP dairy projects have achieved strong results in most key areas. Smallholder farmers have increased sales and generated profits. Dairy extension workers, scientists and university students have led dairy research and strengthened the interface between scientific knowledge, extension services and farmers' practices. The projects' 'less intensive dairy extension approach' continues to be developed. There is evidence that elements like the 'whole family approach' to extension has effectively doubled adoption rates. More effort, however, was needed to get all stakeholders to finalise the approach to scale out.

The sustainability of the projects' results depends on:

- fair dairy supply chains and favourable market conditions that are supported by effective government policies and appropriate resources
- dairy research and extension services continuing to be relevant to farmers' needs and the needs of the dairy sector as a whole
- smallholder farming communities' willingness to ensure inclusiveness and that project benefits are shared.

The projects were aligned to the ASLP goals of enhancing the capacity of research and extension systems; supporting poverty alleviation for smallholder farmers; and supporting value chains. They also demonstrate the value of blending Australian and Pakistani expertise, and the benefits of identifying and using local partner systems that support efficient financial flows and activity implementation.

Lessons learned

This evaluation highlights some general lessons for ACIAR projects and programs:

- 1. Cross-cutting issues need to be considered in project designs and appropriate strategies developed and resourced to address them.** Important cross-cutting issues include gender equality and social inclusion, child protection, environment protection and 'do no harm'. Addressing these would remove barriers to participation, reduce potential harmful impacts on project beneficiaries and enhance results and sustainability.
- 2. Effective relationship management and stakeholder engagement is essential for timely project and program delivery and ownership of results.** Mapping internal and external stakeholders and managing relationships with power holders and power brokers is an ongoing process. A planned approach to managing relationships helps harness collective strengths and makes best use of resources. For large initiatives like the dairy projects, effective stakeholder engagement has significant influence on adoption rates and impact.
- 3. Market and value chain analysis and development, and business development plans, are essential for future project components that aim to generate profits.** These are foundational activities that should be managed very early during project implementation to guide downstream activities to maximise adoption and results of projects. For example, the scale out of the Village-based Seeds Entrepreneurs (VBSE) program could have benefited from a clear business plan. Milk market and value chain development could have benefited from clearer strategies at the beginning of the projects to ensure greater impact.



Introduction

Purpose, scope and audience

Since 1982, the Australian Centre for International Agricultural Research (ACIAR) has brokered and funded research partnerships between Australian scientists and their counterparts in developing countries. As Australia's specialist international agricultural research-for-development agency, ACIAR articulates its current mission as 'achieving more productive and sustainable agricultural systems, for the benefit of developing countries and Australia, through international agricultural research partnerships'. ACIAR receives a direct funding appropriation from the official development assistance (ODA) budget, as well as contributions for specific initiatives from external sources including the Department of Foreign Affairs and Trade (DFAT).

From 2005 to 2015, ACIAR managed the Agriculture Sector Linkages Program (ASLP)¹⁸, a research-for-development program funded by DFAT¹⁹, in the Punjab and Sindh provinces of Pakistan. The program focused on enhancing selected agricultural value chains for the ultimate benefit of the rural poor. There were 2 phases of the program: Phase 1 from 2005 to 2010, and Phase 2 from 2011 to 2015. Both phases included commodity-based projects focused on citrus, dairy and mango. Phase 2 also included a social science research project. The ASLP goals are at Appendix 3.4.

ACIAR commissioned a program-level evaluation to identify lessons that will inform the design and implementation of future ACIAR investments and improve the quality of outcomes.

Purpose

The program-level evaluation has 5 key purposes:

1. Compile performance information from each project under a program and investigate the contribution to specific project outcomes, with a particular focus on differential effects for women and men.
2. Generate project-level case studies for use in a qualitative cross-case analysis.
3. Summarise the contribution to outcomes of each program, with a particular focus on differential effects for women and men.
4. Establish how the different approaches to programmatic management adopted by each program influenced the achievement of outcomes.
5. Identify lessons related to programmatic management of agricultural research-for-development to inform future ACIAR investments.

Scope

The program-level evaluation focuses on the whole ASLP and its constituent projects.

This project-level evaluation assesses the 2 ASLP projects that focused on the dairy industry:

- Improving dairy production in Pakistan through improved extension services (LPS/2005/132)
- Strengthening dairy value chains in Pakistan through improved farm management and more effective extension services (LPS/2010/007).

18 The third phase of the Pakistan program that began in 2015 is known as the Agriculture Value Chain Collaborative Research Program (AVCCR). However the projects to be evaluated all started under the earlier phase, known as ASLP. For simplicity, this program is referred to as ASLP in the remainder of this document.

19 ASLP was originally funded by the Australian Agency for International Development (AusAID). AusAID was merged with DFAT in 2013.

The evaluation provides an assessment against the following key evaluation questions:

1. What was the project's theory of change; and how did this evolve during implementation?
 - Was the theory of change appropriate to the project context and desired results?
2. What outcomes (intended and unintended) has the project achieved or contributed to?
 - What was the unique knowledge contribution of the project/cluster that was/is expected to influence practice/policy?
 - To what extent is there evidence of adoption of new practices based on research process and findings?
3. How did project activities and outputs contribute to the outcomes achieved?
 - To what extent and how did they differ from what was planned?
4. What strategies were adopted to address gender equity and social inclusion and how effective were these?
 - How did the project impact men and women differently?
5. How did management arrangements impact delivery of the project?
 - What other factors influenced project performance?
6. How well did the project align with and contribute to the overall goals of its umbrella program?
 - To what extent has the programmatic approach added value at project level?

Audiences

The primary audience for this evaluation is ACIAR staff with direct responsibilities for programs and/or their constituent projects. This includes Canberra-based research program managers (RPMs), and field-based program managers and coordinators. The ACIAR Executive and senior managers, and DFAT fund managers, are also important audiences particularly for the program-level assessments and synthesis report.



Methodology

Data collection and analysis

Data was collated from key project documents, particularly project annual and final reports, and the mid-term and final project reviews. Seven semi-structured interviews were also undertaken with representatives of 6 stakeholder organisations²⁰ and 2 semi-structured interviews were completed with ACIAR staff. Stakeholders were intentionally selected in consultation with ACIAR. Interviews were conducted using Zoom and WhatsApp.

Systematic thematic analysis of data collected through these processes was undertaken using NVivo qualitative data analysis software to distil findings. ACIAR working definitions and assessment frameworks for project outputs, outcomes and 'next users' were used to analyse, categorise and summarise findings (see Table 5).

Preliminary findings were shared and tested in a project validation workshop involving the stakeholders previously consulted. These activities provided the opportunity to 'ground-truth' the assessments, identify any key issues not addressed, clarify any areas of uncertainty, and correct any misinterpretations. A draft evaluation report was then prepared for review by ACIAR and finalised in accordance with feedback received.

Table 5 ACIAR project outcome assessment terminology

Outputs	Next user	Outcomes
Scientific knowledge: New knowledge or current knowledge tested in other conditions, locations, etc.	<ul style="list-style-type: none"> Individual scientists/researchers/ agricultural professionals Individuals responsible for the management of research or a government institution Producers that the project engages directly or influences outside its immediate zone of operation (such as, at scale), including crop and livestock producers as well as fisherfolk Public and private extension service providers Public policy actors Public and private value chain operators Consumers 	Scientific achievement: Researchers use scientific knowledge outputs to make new discoveries or do their work differently
Technologies: New or adapted technologies and products that offer added value to intended end users		Capacity built: Project partners or stakeholders use enhanced capacity to do something differently
Practices: New practices and processes		Innovation enabled: Includes the adoption of improved technologies, systems or processes, access to new markets, or changes in the opinions or practices of policymakers and advocates
Policy: Evidence for policy formulation		
Capacity building: Short courses, academic training, coaching, and mentoring		

²⁰ The list of stakeholders consulted is at Appendix 3.2.

Limitations

There were limitations on stakeholder consultations. Direct consultations mostly focused on ACIAR staff and implementing partners. No program beneficiaries could be interviewed due to their remote locations and poor phone and internet connectivity. As primary data collection was restricted to online interviews, the evaluators had limited ability to build rapport with participants and interpret non-verbal communication.

The length of time since projects were completed in 2015 may have also made it challenging for interviewees to provide accurate data. In addition, there is a third phase of the dairy project²¹, which may have made it hard for some interviewees to recall and separate out what was achieved up until 2015 and what is being worked on in the third phase. In some cases, phone lines were poor and unclear, and English language skills of interviewees was limited.

Interviewees for the project were intentionally chosen by ACIAR. This means they were not a representative sample of project participants and, given their ongoing contact with ACIAR, it is possible that their experiences fall at the positive end of the spectrum. This means data from interviews is likely positively biased.

Ethical considerations

The evaluation was conducted in accordance with the *DFAT Monitoring and Evaluation Standards* (2017). This included considering:

- **Informed consent:** All participants in consultations were provided with a verbal overview of why they were being consulted, how the information would be used and that their participation was voluntary prior to the consultation. Consultations were only undertaken once verbal consent was obtained.
- **Privacy and confidentiality:** The identity of any program beneficiaries involved in the evaluation have been protected. Key informants in professional roles may be referred to by their position title in the report where explicit consent has been obtained; otherwise, they are referred to as a representative of the organisation they work with.

²¹ The dairy project went into a third phase under the Aik Saath program.



Overview of projects

Project number	Production projects	Value chain projects
	LPS/2005/132	LPS/2010/007
Project title	Improving dairy production in Pakistan through improved extension services	Strengthening dairy value chains in Pakistan through improved farm management and more effective extension services
Collaborating institutions	University of Veterinary and Animal Sciences, Lahore, Pakistan Livestock & Dairy Development Department, Punjab, Pakistan Livestock & Fisheries Department, Sindh, Pakistan Charles Sturt University, Australia University of Sydney, Australia	
Project leaders	Dr Peter Wynn, Charles Sturt University (August 2007 to February 2015) Dr David McGill, Charles Sturt University (February to December 2015)	
Duration	August 2007 to June 2011	January 2011 to December 2015
Funding	AUD1,455,834 ^a (Australian aid program contribution: AUD1,455,834)	AUD2,322,778 (Australian aid program contribution: AUD2,051,013) ^b
Countries	Australia and Pakistan	
Commodities	Dairy	
Related projects	(see next column)	(see previous column)

(a) Additional budget from other sources, if any, were not available in the project documents provided to the evaluation team.

(b) The project also received financial support from Charles Sturt University, University of Veterinary and Animal Sciences (Pakistan), other Pakistani collaborators, and the Bill and Melinda Gates Foundation.

Context

The population of Pakistan is forecast to increase from 169 million in 2010 to 234 million by 2025. Within the Pakistan economy, agriculture, including livestock, is the largest sector and is important for food security and poverty alleviation. An estimated 36 million of the rural population are engaged in livestock production. These farming households derive 30% to 40% of their income from their livestock (Government of Pakistan 2009).

Nearly 30% of household expenditure on food items is on milk and dairy products. Although national milk supplies have been increasing, supply does not match domestic demand, and with the projected population growth, the deficit between domestic supply and demand for milk is expected to grow. National milk production has been increasing at about 5% per annum, exceeding 42 million tonnes in 2008, from around 12 million tonnes in 1990.

This growth has been achieved by more than doubling the population of milking animals over that period to 33.7 million buffalo and 38.3 million cattle (in 2012–13), and by adopting better feeding practices and animal health management. The adoption of better feeding practices and animal health management require rapid development as know-how at the farm level is rudimentary (Wynn et al. 2006:5).

Smallholder milking herds comprise both buffalo and cattle in different proportions depending on location and markets, with cattle used to maintain year-round production. Approximately 70% of smallholder farmers in Pakistan have buffalo and cattle herds of less than 5 animals, while 20% to 25% own 5 to 10 animals. Smallholder farms are often family-owned and much of the labour is sourced within the household. Women are mostly involved in daily management activities, such as feeding and watering, while the men are involved in marketing (Zia et al. 2011). Services to the dairy sector are provided by provincial and district government agencies and a range of non-government organisations (NGOs). Only 40% of farmers receive some form of support from the State Livestock Ministry due to the lack of extension workers with experience that crosses the nutrition-reproduction-disease management, farm economics or whole farm management interface.

The projects

The projects addressed the Government of Pakistan's priority to rapidly increase milk productivity to meet local demand for milk in Pakistan, and the need to improve the dairy productivity and profits of smallholder dairy farmers who make up 80% of Pakistan's milk producers. ASLP supported the following 2 dairy projects across its 2 phases:

- Phase 1: Improving dairy production in Pakistan through improved extension services (2007–2011) (LPS/2005/132).
- Phase 2: Strengthening dairy value chains in Pakistan through improved farm management and more effective extension services (2011–2015) (LPS/2010/007).

The projects were led by Charles Sturt University with University of Sydney, in partnership with the University of Veterinary and Animal Sciences, Lahore, with collaboration across institutions in Australia and Pakistan.

The specific objectives of the Phase 1 project were:

1. To demonstrate the economic and social benefits of improved extension services to smallholder dairy farmers.
2. To enhance the scope and quality of information used for training extension personnel.
3. To enhance the research capacity of Pakistani scientists in priority fields relevant to the ongoing development of the dairy sector.
4. To promote the benefits of agency linkages and enhanced extension services to national and provincial research and extension agencies and NGO groups.

During Phase 1, the dairy project focused on improving the profitability of smallholder dairy farmers through the introduction of new extension approaches and materials. The projects worked with 3 different farmer groups across 56 villages, including:

- registered farmers who directly benefited from the projects' extension services
- unregistered farmers who indirectly benefited through peer-to-peer learning with neighbours and friends who were registered farmers
- traditional farmers²² who did not have any direct interaction with the projects' extension services at all so were considered the control group.

During Phase 2, the extension program was expanded with an emphasis on the poor and marginalised producers. The project worked with men's and women's extension groups in each of the 56 villages, totalling more than 1,500 registered female and male farmers. The Phase 2 project objectives were:

1. To determine the most effective way the extension approach from LPS/2005/132 could be scaled out with a lower level of direct supervision to different areas of Pakistan.
2. To develop and promote strategies for optimising feed resources for smallholder dairy farmers.
3. To identify and promote profitable strategies for calf rearing.
4. To identify and promote strategies for improving smallholder profitability through marketing opportunities of a higher quality product.
5. To build the capacity of future and current extension and industry personnel driving the production and marketing of milk from the farm to the consumer.

Overall, both projects delivered activities that contributed to achievements in 4 main areas:

- increasing the productivity and profitability of smallholder dairy farmers
- improving the quality and availability of livestock feed to smallholder farmers throughout the year
- developing model dairy farm systems and pro-poor extension approaches that could be scaled out throughout Pakistan
- developing the capacity of future and current scientists, dairy extension and industry personnel who could drive research and the production and marketing of milk from the farm to the consumer.

22 Traditional farmers may have accessed extension services from provincial government and other NGOs.



Findings

1. What was the project's theory of change; and how did this evolve during implementation?

Project theory of change

The documentation of the dairy projects did not include an articulated theory of change. This is not surprising, given the use of theory of change was limited in the Australian aid program when the projects were designed. Drawing on documents and discussion with stakeholders, the review team developed a suggested theory of change which outlines how project activities were expected to lead to project outputs and outcomes.

A visual representation of the theory of change is at Appendix 3.1. This represents the theory of change at the end of the dairy projects, meaning any project evolutions have been incorporated.

The projects were expected to **increase smallholder dairy farms' milk production rates, sales, and profits**. To achieve this, the projects would support farmers to adopt efficient practices and technology in livestock health, reproduction, and nutrition management. The projects would train farmer groups in new animal husbandry practices, including profitable calf rearing; provide pro-poor extension services; improve farmers' access to high quality livestock feed; and develop dairy value chains and market options.

The projects would support the set-up of **village-based seeds entrepreneurs (VBSE) to operate profitable operations** as part of improving farmers' access to high quality livestock feed. VBSE were expected to adopt business practices and technologies for maintaining consistent supplies for quality forage crops and seeds. The projects would research viable seeds and forage crops options, train, and support VBSE to set up and market high yield seeds and quality fodder, and train farmer groups on livestock health and nutrition management and calf rearing.

Model dairy farms and inclusive extension approaches that could be scaled out throughout Pakistan were also a key focus. These were anticipated to be achieved through piloting pro-poor dairy farming extension approaches and developing dairy value-adding and market innovation approaches. The projects would increase the interface between scientific research, extension activities and farmers' experiences; develop practical extension messages and materials for farmers and extension workers; train extension workers on new extension approaches; conduct dairy value chain and supply chain activities; and develop less intensive farming extension models.

The projects were expected to **increase scientific evidence-informed decision-making as part of developing the dairy sector in Pakistan** by scientists and primary investigators adopting research techniques and leading research on dairy. The projects would build the research capabilities of Pakistani and Australian scientists through ongoing training, workshops, and professional development activities; research scholarships, conference presentations and research publications; veterinary student internships and exchange programs; and twinning arrangements between Australian and Pakistani researchers and research institutions.

Appropriateness of the theory of change

The overall focus of the projects to increase profitability of smallholder dairy farmers through improved dairy research, extension services and production and marketing methods remained consistent throughout the 2 projects.

Project documents highlight a few changes in activities and outputs over time. Phase 2 saw increased pro-poor and more inclusive extension approaches. The project learned in Phase 1 that the 'whole family approach' to extension services increased adoption rates and yielded better results. Extension services in Phase 2 also broadened from only targeting men to including women extension workers, women farmers, and their children. In Phase 1, farmers who were better resourced with land and animals were more likely to adopt new extension services. Phase 2 increased focus on improving the inclusion of poorer and marginalised farmer groups in extension activities.

In Phase 2, improving farmers' feed resources, calf rearing and milk value-adding capacity were more developed and focused. These built on research and learning on dairy nutrition, fodder production and calf management in Phase 1.

Building the capacity of farmers, extension workers, scientists and students as future researchers and scientists was a key feature of both projects. Phase 2 featured more applied research and capacity development events that focused on areas such as nutrition, calf rearing and milk marketing, and involved students from Pakistan and Australia.

Three key assumptions were made at the design and implementation of projects:

1. **Farmers' knowledge and access to resources and markets.** The projects assumed that farmers would consistently follow extension advice and would have the necessary financial and non-financial resources – such as reliable access to water and/or access to credit – to make changes in their farms and adopt new livestock health and nutrition practices. The projects also assumed that influencing the behaviour of farmers could be most effectively achieved through farmer advisor trainings and group meetings, extension support by well-informed extension workers, and the development of milk markets and milk value-adding activities.
2. **Animal health and nutrition.** The projects assumed farmers would, in the long-term, continue to have consistent access to vaccines, high quality fodder, water and equitable extension services from government and other extension service providers, including NGOs, to maintain healthy herds and high milk productivity.
3. **Extension workers, scientists, and future scientists.** The projects assumed trained extension workers, scientists and future scientists would, in the long-term, continue to provide quality services and research to smallholder farmers and the dairy sector in Pakistan.

The indicative theory of change is relatively simplistic about how behaviour change would happen for smallholder dairy farmers, extension workers and scientists. For farmers, it is assumed that increased knowledge and consistent access to extension services, and financial and non-financial resources, would lead to the adoption of new behaviours. For dairy extension workers, scientists, and future scientists, it is assumed that increased knowledge and expertise would continue to support dairy farmers and the dairy sector in Pakistan.

Developing theories of change for future projects will present an opportunity for ACIAR and project teams to more deeply consider how adoption of new practices happens and how behaviour change could be brought about, drawing on existing models of behaviour change. Such models should be explicitly incorporated into project designs and theories of change to ensure they guide project activities and monitoring.



2. What outcomes (intended and unintended) has the project achieved or contributed to?

Outputs

The projects delivered a range of outputs throughout the 2 ASLP phases. These outputs are summarised under 3 headings below, according to the expected project results. Outputs relating to increased sales and profits for smallholder farmers and VBSE are described under one heading as they share multiple activities.

Increasing milk production, sales, and profits of smallholder dairy farmers and VBSE

The projects delivered outputs related to capacity building and practices of farmers to increase milk production, sales and profits. Capacity building for farmers – delivered through trained project farm advisers and extension workers – focused on basic feeding and husbandry practices, animal breed selection and reproduction, calf rearing, and ration formulation. This was complemented by ongoing extension support and extension materials for farmer groups. The projects reached more than 1,500 farmers in 56 villages across 7 project districts in Sindh and Punjab.

Milk value-adding and market development activities with individual farmers and farmer groups were also a key focus of the extension programs. Farmers were introduced to milk value-adding strategies to produce milk-based products such as ice-cream, ghee and cream. Milk value-adding activities provided opportunities for the greater involvement of women farmers in the projects. The projects also introduced various milk marketing strategies, such as community-based milk selling systems, that farmers and farmer groups could continue to manage to sustain profit levels from their sales.

Profitable calf rearing strategies and fodder production initiatives were also delivered to increase milk production and sales for smallholder farmers. Calf rearing activities included trials on various breeds of cattle and buffalo and were delivered in innovative ways, such as competitions for children which also encouraged community engagement.

The projects worked with at least 20 communities in Punjab and Sindh to establish VBSE for berseem and other fodder species (maize/millet/oats) as part of ensuring consistent supply of high quality fodder throughout the year. These included set-up of demonstration plots and awareness sessions among farmer groups.

The above outputs were informed by existing local and international knowledge as well as new scientific knowledge that scientists and students generated during the projects. The projects carried out trials and research on economic and policy constraints for profitable smallholder dairy farming, milk value-adding and milk marketing, calf rearing, and fodder production. For example, student researchers and scientists from Sindh Agriculture University, University of Veterinary and Animal Sciences, and University of Agriculture Faisalabad conducted 3 calf rearing research projects on weaning age, milk feeding and growth performance as well as trials to identify effective and adoptable alternative colostrum feeding strategies involving buffalo calves from local animal markets.

Establishing model dairy farm systems and inclusive extension approaches

The projects delivered outputs to build the capacity and practices of dairy extension workers, and strengthen linkages between research knowledge, extension services and farmers' practices, to establish model dairy farm systems and inclusive extension approaches.

In Phase 1, the projects identified key extension messages and developed and tested a new approach to extension, the 'whole family approach' which they continued to develop in Phase 2. New extension materials, based on messages from Phase 1, were also developed for use by farmers and extension workers in Phase 2. The materials were developed collaboratively by the project team with all Pakistani veterinary universities, livestock department research staff, Australian partners, and smallholder farmers. They incorporated new scientific knowledge generated by the projects, existing knowledge and best practices, and feedback from farmers and extension workers. The materials were also translated into local languages and included 10 modules²³, 25 fact sheets as well as fodder and feed calendars, and a ration formulation booklet.²⁴

The projects explored innovative ways to scale-out extension messages. These included integrating messages into the 'whole family approach', individual farm visits, practical demonstrations at the farmer's doorstep, problem-based learning techniques, and fun community activities such as quizzes, live drama and video shows.

Training workshops and ongoing meetings and activities were delivered to selected extension workers from the government livestock departments of Punjab and Sindh. These events updated extension workers' scientific knowledge and were opportunities for extension workers to provide feedback and reflection on their field experiences with farmers. The process allowed for the continuous review, adaptation, and trial of the extension messages and program, as part of establishing model dairy farm systems and less intensive inclusive extension approaches. A condensed version of the trainings was delivered to 20 extension workers; 10 each in the provinces of Baluchistan and Khyber Pakhtunkhwa.²⁵

Pakistani researchers actively leading dairy research and contributing to dairy sector

The projects built the capacities of experts, academics, scientists and student scientists in Pakistan and Australia to lead dairy research and contribute to the development of the dairy sector. The projects provided strategic short-term training opportunities, which included student forums, an ongoing internship program, and participation in local and international conferences and workshops in Pakistan, Australia, Indonesia, China and Thailand. For example, at least 35 Pakistani veterinary and agronomy students were trained under the internship program and 5 young meat scientists participated in a meat judging competition and visit to Australia.

The projects also had twinning arrangements and promoted linkages between Pakistani and Australian students, scientists and institutions. Australian and Pakistani scientists and dairy experts have completed collaborative review publications and held joint workshops and seminars on breeding and genetics of Sahiwal cattle, statistics, feed formulation, and fodder growth/production. Students from Pakistan and Australia participated in annual inter-country visits and forums, although the events for 2014 and 2015 were cancelled due to security issues.

The projects have also trained and supported PhD and Master students to implement research, publish papers in international scientific journals and present research papers at international conferences on various topics including milk value-add and supply chains, dairy sector policies, livestock reproduction and calf rearing, and fodder production. For example, at least 8 PhD and 14 Master students from Pakistan and Australia were supported to research challenges relating to profitable smallholder farming enterprises which have been incorporated into the projects' extension materials. Research work has been presented at more than 25 national and international conferences and at least 11 scientific publications have been finalised.

23 **10 Extension Modules:** Cow Comfort/Animal Husbandry, Animal Nutrition, Animal Reproduction, Calf Rearing, Animal Health/Disease Management, Ration Formulation, Dairy Breeds and their Selection, Milk Value-addition, Improved Fodder Agronomic Practices, Community Mobilisation.

24 The Fodder and Feed calendar and Ration Formulation booklets were developed by the Nutrition Focus Group, which was set up to develop strategies for optimising feed resources for dairy farmers. They included representatives from national and international research institutions and the private sector.

25 Project activities primarily focused on the provinces of Sindh and Punjab. The projects only trained extension workers in the 2 provinces.



Adoption

During Phase 1, the projects collected case studies and conducted a longitudinal study of farmers. In Phase 2, separate impact assessments were undertaken with farmers and extension workers to understand the results of the extension programs. The studies included an assessment of adoption levels of knowledge, understanding and practices that the projects promoted through the extension program. Data from these studies, end of project reports and interviews indicate that adoption rates were generally high for scientists but variable for extension workers and farmers.

Increasing milk production, sales and profits of smallholder dairy farmers and VBSE

Data indicate **adoption rates varied among different farmer groups for different extension messages** about increasing milk production, sales and profits.²⁶ The projects promoted 7 key extension messages from their extension modules, and farmers' adoption of these messages was assessed by the impact study.²⁷ Overall, the average adoption rate of these messages by all farmer groups ranged from 40%–70%, with messages that required farmers to make capital expenditure resulting in lower adoption rates. On the other hand, messages that were easier and less costly to implement, such as improved calf rearing, had higher adoption rates (70%).

Registered farmers recorded the highest adoption rates of key extension messages. For example, 96% of registered farmers adopted messages on vaccination and deworming, compared to 84% of the traditional farmer group. Registered farmers were direct beneficiaries of the extension services. These female and male farmer groups had opportunities to participate in all extension activities, including accessing monthly extension support from the projects. Traditional farmers did not have any direct interaction with the projects' extension services at all so were considered the control group.²⁸

Unregistered farmers recorded lower adoption rates of key extension messages, but the rates were still relatively high. For example, 93% of unregistered farmers adopted messages on improved vaccination and deworming. Unregistered female and male farmers benefited indirectly through their peer-to-peer learning with neighbours and friends who were registered farmers (direct project beneficiaries).²⁹ The high adoption rates recorded among indirect beneficiaries indicates high quality extension service delivery by the projects, and that the promoted knowledge, practices and technology was relevant to the needs of farmers.

Trial berseem VBSE farmers adopted agronomy practices that helped grow quality fodder at low cost. Project documents report VBSE farmers recorded a one-third increase in forage yields and more than a three-quarter increase in seed yields. Based on the success of the VBSE trials, the initiative has been extended to at least 20 other villages in Punjab and Sindh.

The adoption of milk value-adding marketing and value chain practices was limited. The projects developed milk marketing and value-adding modules that were rolled out as part of the extension program. As a result, some farmers and farmer groups, particularly female farmer groups, were able to increase profits by up to threefold per litre of milk. This indicates adoption of knowledge and practices at community level; however, these results were limited to small pockets of farmer groups.

26 Key messages included untying of animals and providing free access to water; vaccination and deworming; calf rearing and colostrum feeding; and high-quality fodder production.

27 The projects measured adoption levels between 3 different farmer groups: registered farmers, unregistered farmers, and traditional farmers.

28 Traditional farmers may have accessed extension services from provincial government and other NGOs.

29 Included direct observation of registered farmers in their farms and information exchanges with communities.

Establishing model dairy farm systems and inclusive extension approaches

Female and male extension workers in Sindh and Punjab recorded high levels of adoption of knowledge and practices. Workers were selected from government livestock departments in Sindh and Punjab, and participated in at least 10 training workshops and relevant project meetings over 5 years. Impact assessments of capacity building indicate extension workers gained higher levels of technical knowledge, communication skills and levels of self-confidence when compared to their counterparts who were not part of the program.³⁰

Project-trained extension workers in Baluchistan and Khyber Pakhtunkhwa recorded a 20% adoption rate, despite having received a few days' training and very limited follow-on support from the projects. When compared to their counterparts in Sindh and Punjab, who received many more opportunities for training and follow-on support, this result suggests the less intensive approach to capacity development for extension workers needs further development.

The **project-trained extension staff were instrumental in influencing adoption rates among registered farmers** who were reached through the projects' extension program. The projects measured the impact of extension approaches through the adoption of knowledge and practices by different farmer groups (as discussed in the previous section). This supports a key project assumption: that behaviour change of farmers could be most effectively achieved through farmer adviser training and group meetings, and extension support by well-informed extension workers.

Project documents and interviews also report **private sector companies, such as Nestlé, and research institutions, such as Sindh Agriculture University, have adopted the projects' extension materials.** These have been adapted and printed for their own extension programs and farmer communities. This has been an unintended positive result of the project.

Pakistani researchers leading dairy research and contributing to dairy sector

Pakistani and Australian student scientists, scientists and dairy experts who participated in the projects' *capacity-building* programs **recorded a high adoption of dairy research knowledge and practices.** Capacity-building programs, such as short trainings, student forums and research into applied issues affecting smallholder farmers, enabled researchers and experts to incorporate research outcomes into extension materials, and publish papers in international journals and present at conferences.

Project documents report more than 30 Pakistani postgraduate students completed their research work under the projects' guidance. The outcomes of their research were incorporated into the projects' extension materials, informed project management, and were published in 'high impact factor' journals. For example, 2 PhD theses included reviews of dairy policies at the national and provincial levels, and developed recommendations to address economic and policy constraints for profitable smallholder dairy farming. The results were published in scientific journals, presented at an international conference and shared with the broader ASLP team.

30 Technical knowledge (p<0.001), communication skills (p=0.002) and levels of self-confidence (p=0.013).



Outcomes

Project activity and research reports, external review reports, key informant interviews and case studies provide sufficient evidence that the projects' outcomes have been achieved or will most likely be achieved.

Increasing milk production, sales and profits of smallholder dairy farmers and VBSE

The projects built the capacity of smallholder dairy farmers to increase their milk production, sales and profits. **Farmer adoption of scientific and extension knowledge and practices resulted in recorded increases in sales and profits** from increased milk yields, healthier calves and milk value-added products such as ghee, cream, ice-cream, and yoghurt. For example, by the end of Phase 2:

- 40% of farmers were providing their animals free access to feed and water, resulting in an average 25% increase in milk production per animal per day.
- 70% of farmers were using new health and feeding practices to ensure healthy calf growth. As a result, calf mortality rates reduced to as low as 5% in some cases, and calf growth rates increased by 250–400g per day through to weaning, resulting in farm profits increasing by an average of 30%.
- A limited number of individuals and farmer groups were using recommended milk marketing and milk value chain strategies, which resulted in 25%–40% increased profits.
- Female farmers' involvement in different milk value-adding activities grew over time. This resulted in increased production and sale of value-added milk products such as ghee, cream, ice-cream and yoghurt, which added to farmer profits.
- Berseem VBSE farmers in trial areas increased forage yields by 37% and seed yields by 82%. Farmers producing improved berseem seeds also received a 60% increase in income per kilogram compared to traditional varieties. However, this result was limited to farmers in areas where the berseem VBSE program was trialed. While it suggests that the VBSE program worked, VBSE trials were conducted towards the end of Phase 2 (2014–2015), so there was limited time to scale out the initiative. After trials it was then rolled out to 20 villages in Sindh and Punjab. Stakeholders consulted during the evaluation agreed the VBSE program had limited results in Phase 2. The external review (Staal and Granzin 2015) at the end of Phase 2 suggested the program needed a clear business plan to ensure a successful scale out to all villages.

The projects also enabled innovation among smallholder farming communities. For example, female farmers who previously used traditional methods to produce butter and ghee obtained cream separator machines, which reduced processing time. New VBSE operators had started using refined agronomic practices and improved varieties of berseem clover forage seeds to produce and use/sell high quality fodder.

Establishing model dairy farm systems and inclusive extension approaches

The projects built the capacity of **extension workers to deliver inclusive extension services and strengthen linkages between research knowledge, extension services and farmers' practices**. Project reports and interviews indicate a correlation between the increased capacity of extension workers and farmers' increased adoption of new knowledge and practices. The impact study data on extension workers also indicate that project-trained workers increased their technical knowledge, communication skills and confidence to deliver extension services. Project-trained extension workers changed their community engagement approach from mostly didactic to more contextual and inclusive approaches, where they invest in building relationships and trust with farmer groups to impart key extension messages that farmers could adopt. This approach and its results were increasingly being recognised by the livestock departments in Sindh and Punjab.

The projects also **enabled innovation through improved extension approaches, the most significant being the 'whole family approach'**. The approach recognises the value of participation by women, young people and children in the smallholder farm system, and resulted in adoption rates of up to 80% of extension knowledge and practices. By the end of Phase 2, women and youth had increased agency and participation in trainings, meetings, and extension services. Men, to an extent, had improved attitudes towards inclusion of women and young people in participation, and in sharing project benefits.

Finalising a less intensive extension program and model farm system was not fully achieved, largely due to the lack of continuity of the process, caused by the high turnover of livestock department staff.

Pakistani researchers leading dairy research and contributing to dairy sector

The projects built the capacity of **Pakistani researchers and students (as future scientists) to actively lead dairy research and generate numerous scientific knowledge outputs and publications.**

In addition, Australian scientists and students who participated in *capacity-building* activities gained improved exposure to, and expertise in, dairy research. The results suggest blending international and national expertise enriches the quality of capacity development activities and research outputs.

Scientific knowledge outputs were also adopted by farmers and extension workers. Most significant were scientific knowledge in profitable calf rearing, improving forage seeds and milk marketing. As previously described, adoption of these outputs resulted in farmers increasing milk yields, sales and profits, improving calf health and reducing calf mortality rates, and increasing forage and seed yields. The projects also strengthened the interface between research knowledge, extension services and farmers' practices. These were the result of the projects' improved extension services which also utilised scientific knowledge outputs.

The dairy projects also made **scientific achievements in calf rearing research.** Calf rearing research trials were initially conducted by 3 Pakistan universities and successfully demonstrated that calf mortality could be reduced, and growth rates increased.³¹ The success of these trials enabled Dr Bhatti from University of Agriculture, Faisalabad, to secure additional grants from external donors to conduct further research in profitable calf rearing and to supervise at least 20 postgraduate students.

31 University of Agriculture, Faisalabad, Sindh Agriculture University, and University of Veterinary and Animal Sciences.



Discussion

Overall, the data suggest positive results for the projects. Evidence gathered from project documents, interviews and verification workshops was sufficient to assess the level of adoption and outcomes of the projects.

However, the long-term sustainability of these outcomes depends on a few factors. Some were outside the projects' control, but all need to be considered during the design and monitoring of future projects. For example, well established dairy/ beef markets and supply chains, and access to quality livestock feed and extension services, will support smallholder farmers' ability to maintain farming practices and sales. Commitment is needed from the Government of Pakistan to ensure equitable policies and well-resourced teams of dairy experts provide conducive operating conditions for farmers, extension staff, researchers and other stakeholders.

Community willingness to continue to transform cultural attitudes and barriers that limit women's participation is also needed, as this will ensure benefits and increase opportunities for women who contribute up to 80% work inputs in dairy farms.

Table 6 summarises adoption of project outputs, while Table 7 summarises capacity built through the projects.

Table 6 Levels of adoption of key project outputs

Project	New technologies or practical approaches	New scientific knowledge	Knowledge or models for policy and policymakers
ASLP dairy projects	Nf – Milk value-adding and milk marketing Nf – Fodder production NF – Calf rearing NF – Extension approaches NF – Extension staff, smallholder farmers and scientists	Nf – Improved berseem varieties and agronomic practices NF – Calf rearing	N – dairy policies research

Notes:

O No uptake by either initial or final users

N Some use of results by the initial users but no uptake by the final users

Nf Demonstrated and considerable use of results by the initial users but only minimal uptake by the final users

NF Demonstrated and considerable use of results by the initial and final users

Table 7 Capacity built relevant to project outcomes

Who	Skills and knowledge
Male and female smallholder farmers	<ul style="list-style-type: none"> • Best practice dairy management in areas such as feed, water, animal health, and milk value-adding • For women and youth: increased agency in trainings and meetings • For men: improved attitudes to women and youth involvement in the projects
Berseem farmers	<ul style="list-style-type: none"> • Best practice in increasing forage and seed yields, and producing improved berseem seeds
Extension workers	<ul style="list-style-type: none"> • Technical knowledge of best practice dairy management • Improved communication skills • Increased confidence to deliver extension services • Strengthened links between research, extension services and farmers
Research / academic community in Pakistan	<ul style="list-style-type: none"> • Individual capacity built through obtaining higher degrees • Ability to actively lead dairy research and generate scientific knowledge

3. How did project activities and outputs contribute to the outcomes achieved?

Factors influencing adoption and impact

Project review documents and interviews suggest that there has been successful adoption of knowledge and practices resulting in positive impact. However, some outcomes were delayed because they required additional activities, or risks to be better managed. Key factors that influenced adoption and impact are described in this section.

Farmers' access to resources and markets

The projects trained smallholder farmers on husbandry practices, provided enhanced extension services, and established community-based fodder producers and seed entrepreneurs that enabled farmers to access high quality livestock feed throughout the year.

Farmers' ability to adopt the new knowledge and practices was dependent on their access to resources and milk markets. Adoption required some level of input and investment by farmers, such as land, water, equipment, animals, seeds, time and money. Adoption rates for extension messages that required inexpensive inputs were higher than those that required expensive inputs. For example, there was a 95% adoption rate among registered farmers for vaccination and deworming compared to a 40% adoption rate for untying of animals and providing them free access to water. The high adoption rate for vaccination was the result of farmers being aware of the benefits of vaccination and deworming, and that vaccines and deworming medication could be easily accessed at low cost. On the other hand, untying of animals and providing them free access to water required farmers to invest in animal fences and ensure farms had consistent water supply. One interviewee also noted that in some areas, farmers did not own land or had no money to grow fodder.

Access to markets influenced farmers' ability to negotiate and sell milk and milk products to gain profits. The projects also worked with farmers to develop some successful examples of supply chain interventions; however, the results remained limited to the individual and farmer group level. Farmers made sales and profits depending on their location, and the existence of milk processing companies and wholesalers in these locations. In some instances, farmer groups were able to collectively influence prices in their locations. The projects' achievements in milk value chains and milk marketing were also limited due to the complex nature of milk marketing systems and milk value chains in Pakistan. Project stakeholders noted milk markets do not function well and corruption was significant, making it challenging for this project to undertake significant work on improving markets. Project reviews have recommended that future projects include more detailed dairy and beef value chain analysis and strategies.

Inclusive and effective stakeholder engagement approaches

Inclusive and effective stakeholder engagement significantly influenced adoption rates by farmers, extension workers and scientists, and strengthened the interface between scientific knowledge, extension programs and farmer experiences. The projects employed effective strategies for inclusive and effective stakeholder engagement, such as engaging farmer networks, working through farm advisers, and actively increasing the number of women extension workers. These strategies should be considered for similar projects in the future.

However, interviews and project documents also highlight the projects continuously faced and addressed challenges of working with different groups of stakeholders, particularly, smallholder farmers, and Punjab and Sindh livestock departments. For example, finalising a less intensive extension program and model farm system that could be scaled out was not fully achieved, largely due to the lack of continuity in the process, caused by the high turnover of livestock department staff. Future projects should consider such risks and ensure stakeholder engagement and communication strategies are in place for consistent support in scale out of programs.



Strong focus on capacity building

Capacity building cut across the project outputs and significantly influenced adoption and impact among project stakeholders.

The *capacity-building* activities ensured not only strong project results, but will likely contribute to an improved dairy sector in the future.

Scientific research was a key component of capacity building. The external review in 2015 identified some research topics were less relevant and some new knowledge had not been disseminated and/or adopted. During consultations, project stakeholders also noted that not all scientific knowledge was relevant to all farmers, so some knowledge generated was likely to have lower dissemination and adoption.

For future projects, ACIAR will need to consider a planned approach to balancing research that is relevant to many farmers versus more specialised knowledge that is useful to smaller groups.

Numerous stakeholders also highlighted the issue of growing numbers of Pakistani students on scholarships opting not to return to Pakistan after their studies due to better work opportunities outside of Pakistan. ACIAR will need to discuss with the Government of Pakistan how they could support future students to return to Pakistan after completing their studies overseas to minimise further skills drain. See Table 8 for a summary of factors influencing adoption and impact.

Table 8 Factors influencing adoption and impact

	Factor	Key findings
Knowledge	Do potential users know about the outputs?	Not identified as a constraint for these projects.
	Is there continuity of staff in organisations associated with adoption?	Staff turnover within the livestock departments in Sindh and Punjab provinces was a major factor in delaying the finalisation of a less intensive extension approach that could be scaled out through Pakistan. The projects acknowledged this very early and continued to explore multiple avenues to maintain connections with the livestock departments.
	Are outputs complex in comparison with the capability of users?	The external review in 2015 identified some research topics were less relevant and some new knowledge generated by the projects had not been disseminated and/or adopted. However, project stakeholders confirmed during consultation that not all scientific knowledge was relevant to all farmers, so some of the knowledge generated was likely to have lower dissemination and adoption.
Incentives	Are there sufficient incentives to adopt the outputs?	Not identified as a constraint for these projects.
	Does adoption increase risk or uncertainty?	At the farmers' level, adoption required some level of input and investment, such as land, water, equipment, animals, seeds, time and money. Adoption rates for extension messages that required inexpensive inputs were higher than those that required more expensive inputs. The projects worked with farmers to understand levels of input and investment required through farmer group meetings and trainings, extension materials and demonstration farms.
	Is adoption compulsory or effectively prohibited?	Not identified as a constraint for these projects.
Barriers	Do potential users face capital or infrastructure constraints?	Farmers' access to resources influenced levels of adoption and impact. Adoption of new extension knowledge and practices required various levels of input from farmers. Adoption rates of extension messages requiring more financial inputs were lower among farmers with capital constraints.
	Are there cultural or social barriers to adoption?	The cultural and social status of Pakistani women in general was a barrier to adoption. ASLP addressed this through the inclusion of women extension workers and extension worker training; implemented the 'whole family approach' to extension services; and delivered outputs specifically targeting women's farmer groups.

4. What strategies were adopted to address gender equity and social inclusion and how effective were these?

The projects started during a period when addressing gender equity and social inclusion was not an explicit priority of Australia's overseas aid programs. The dairy projects did not have a planned strategy to address gender equity and social inclusion, but as the projects evolved, elements of gender equity and social inclusion were integrated into project activities with some positive results observed.

A key development for ASLP was the addition of the social science project in Phase 2. This project did significant work on gender and social inclusion issues.

Gender equity

Women farmers were initially not included in extension programs even though they provided significant labour inputs into their family farms. Project extension services in Phase 1 predominately targeted male farmers as they were traditionally considered heads of households and key decision-makers on their farms. A review of the extension program in Phase 1 highlighted the significant lack of involvement of women in project activities, which led to the piloting of the 'whole family approach' to extension. The approach ensured the whole smallholder farm household (women, children and men) were targeted through extension services. This involved increasing the diversity of the trained extension worker cohort from men only to include female extension workers. Extension workers worked simultaneously with male and female farmer groups throughout Phase 2 to ensure female and male farmer groups received the same extension messages and services. Women farmers also had opportunities to increase their economic activities and diversify their income sources through milk value-adding training and activities. One interviewee noted that women generally had control over their income from milk product sales; however, men continue to play a dominant role in major decision-making within families.

The 'whole family approach' to extension doubled adoption rates of extension messages, when compared to working with male farmers only. Project data and interviews suggest males and females have benefited in various ways. Male and female extension workers have adopted principles of inclusion to deliver more inclusive extension services. Female farmers have increased agency, contributed to decision-making in their farms, and adopted options to increase profit margins by manufacturing and selling products like cheese, ghee and cream. Male farmers have also shown more inclusive attitudes towards sharing decision-making and benefits with women and young people in their communities.

Overall, the project was able to contribute to strong results for women farmers due to its ability to adapt and learn during implementation. Future ACIAR projects with extension programs targeting smallholder farmers should consider the achievements of the dairy projects in addressing gender equity and the 'whole family approach' to extension, as a potential model to adapt or replicate.



Social inclusion

The projects primarily worked with registered smallholder farmers in target communities. The registered farmers were direct beneficiaries of the projects' monthly extension services and activities. Project documents and interviews suggest registered farmers and their families were educated and market-oriented, had social connections and better access to resources compared to unregistered farmers. A second group of farmers, the unregistered farmers, indirectly benefited from the projects. Unregistered farmers lived in the same communities as the registered farmers and indirectly benefited by adopting new knowledge and practices through observations and interactions with registered farmers. While adoption rates for both registered and unregistered farmers were high overall, the rates and results for registered farmers were always higher than for unregistered farmers, with margins of between 5% to 25% for different extension messages.

Apart from working with registered and unregistered farmer groups, project documents did not highlight working with any marginalised groups or people with disability. One interviewee highlighted some farmers chose not to be involved or could not participate because of internal community conflicts – often caused by religious differences.

As part of the 'whole family approach' to extension, children (including teenagers) were encouraged to participate in the extension program, particularly the calf rearing program. Interviews with project teams indicated this was a strategy to influence future generations to remain interested in dairy farming as a career choice as there was anecdotal evidence that young people were becoming less interested in dairy farming. Children were engaged through school-based and community-based activities and were instrumental in influencing families to adopt profitable calf rearing strategies.

While the projects have, to an extent, addressed gender equity and social inclusion, it is unclear how the projects addressed or were effective in addressing:

- The added burden of the projects on women, for example, was their increasing role and participation in certain areas of dairy farming offset by a reduced workload in other areas?³²
- Lessening the gap between more resourced registered farmers and less resourced unregistered and traditional farmers. Did this gap widen because of the projects?
- Potential child safeguarding issues arising from project activities – these include child labour issues and children's exposure to diseases and toxins from poor handling of milk and milk products.³³

Future projects should consider conducting gender equity and social inclusion analysis to inform project design; these issues should then be monitored throughout delivery (ACIAR 2017).

32 For example, see <http://www.fao.org/3/a-i6786e.pdf>

33 For example, see <http://www.fao.org/3/i3098e/i3098e.pdf>

5. How did management arrangements impact delivery of the project?

Initially, ACIAR and the Government of Pakistan arranged for the Phase 1 project to be based in Lahore within the Punjab Government's Dairy Development Department. While the optics of this arrangement were good, interviews identified 2 key issues outside of the project team's control that affected management and implementation. The first issue was that accessing project funds took a long time. Funds were tied up federally and long bureaucratic government processes delayed disbursements, resulting in delayed activity implementation.

The second issue was staff turnover and bureaucratic processes within the department. The projects needed to work with extension workers to access farmers, but approvals for relevant officers to be engaged took time and effort, resulting in initial implementation delays. Following discussions with ACIAR, approval was granted for the University of Veterinary and Animal Sciences to host the projects instead.

The decision to collaborate with the University of Veterinary and Animal Sciences, Lahore, and use its financial systems rather than the partner government's systems, avoided further delays in financial flows and activity implementation. The project team, however, consistently worked with key government departments and collaborated with multiple Australian and Pakistani institutions to deliver the projects. Each brought their unique strengths:

- collaboration with Pakistani universities gave the projects access to veterinary students to work as interns on the projects
- collaboration with dairy departments facilitated access to dairy farmers
- collaboration with Nestlé provided employment pathways for students and adoption of project extension materials.

The projects also explored working with NGOs and other funding bodies active in the same sector, but there were challenges in advancing these relationships due to different organisational priorities.

The projects also recognised the value of blending Australian and Pakistani management expertise. An Australian team member was based in Pakistan during Phase 1, which allowed close collaboration with Pakistani counterparts and cultivated relationships between teams in Australia and Pakistan. Having a Pakistani team leader and dedicated project team engaged in both projects enabled high quality project delivery – national team members understood the local context and could think and work politically with stakeholders.

However, the external project review and key informant interviews questioned the sustainability of adoption of approaches by central and local government officials. The projects worked closely with the government's livestock department to ensure transfer of skills to staff, but the department continuously faced high turnover of staff, limiting opportunities to develop and retain skilled researchers and extension workers, post-project. This issue also contributed to the delay in finalising a less intensive extension approach – an expected outcome of the projects.

Project review documents and key informant interviews also highlighted the lack of:

- clear strategies to communicate project outputs for take-up by key actors in dairy development
- a practical 'output to outcome to impact' strategy
- a robust monitoring, evaluation and learning system.

These limited opportunities for the projects' ongoing learning, risk management and adaptation to changing contexts. Future projects should consider the development of these strategies and an appropriate monitoring, evaluation and learning system to track progress and learning.



6. How well did the project align with and contribute to the overall goals of its umbrella program?

The ASLP goals, while slightly different between Phases 1 and 2, focused on 3 key areas:

- enhancing the capacity of research and extension systems
- supporting poverty alleviation for smallholder farmers
- supporting value chains.

The dairy projects gained ministerial approval from the Government of Pakistan and were well-aligned with, and contributed to, the overall goals of ASLP.

Capacity of research and extension systems

There was good alignment between the dairy projects and the ASLP goal of enhancing the capacity of research and extension systems. The projects have built the capacity of Pakistani researchers and students (as future scientists) to actively lead dairy research and generate numerous scientific knowledge outputs and publications. Research has informed dairy extension approaches that have benefited dairy farmers.

Poverty alleviation for smallholder farmers

There was good alignment between the dairy projects and the ASLP goal of supporting poverty alleviation for smallholder farmers. The projects have built the capacity of smallholder dairy farmers to increase their milk production, sales and profits. Farmers' adoption of extension program knowledge and practices has resulted in recorded increases in sales and profits from increased milk yields, healthier calves, and milk value-added products such as ghee, cream, ice-cream, and yoghurt.

Supporting value chains

There was good alignment between the dairy projects and the ASLP goal of supporting value chains. However, achievements have been limited to a few groups of farmers due to the complex nature of milk marketing systems and milk value chains in Pakistan. Project stakeholders noted milk markets in Pakistan do not function well and corruption was significant, making it challenging for this project to undertake significant work on improving markets. Milk value chain analysis was conducted as part of a PhD research. The projects further engaged a consultant to assess marketing options for dairy farmers; however, this could not be completed due to conflicting schedules. The projects also worked with farmers to develop some successful examples of supply chain interventions, but this remains limited to the farmer level. Project reviews have recommended that future projects include more detailed dairy and beef value chain analysis and strategies.

Programmatic level value-add

This review also examined the extent to which ASLP's 'programmatic' approach added value for the dairy projects. In ASLP's second phase, a social science research project was added to the program and was run by a team from the University of Canberra. It aimed to:

- increase the engagement of rural poor who might benefit from the commodity-based projects (citrus, dairy and mango)
- increase collaboration between project teams
- foster effective collaborative development in rural Pakistan.

The social science research project worked with 2 dairy project communities and took a participatory action research approach to its delivery. The project ended in 2015, at around the same time the Phase 2 dairy project was ending. This meant that project impact was limited to the 2 participating dairy project communities. However, the research work provides valuable learning that future dairy projects could draw on. These include:

- Adequate resources must be allocated to address gender equity and social inclusion, particularly the meaningful involvement of women and young people.
- Influencing behavioural change takes time and should always consider social dimensions to be sustainable – this affects adoption of knowledge, practices and technology, and sustainability of project benefits.
- Utilising technology such as mobile phones could assist farmers to better manage their farms and improve project reach of up-to-date information and extension messages.

The dairy projects had the potential to achieve more by coordinating efforts across mango, citrus and social science research projects to influence national dairy and agriculture sector policies and extension services, and support competitive market conditions. Project review documents and interviews suggest better coordination and synergies at the ASLP program level could have increased the projects' ability to influence policymakers. Interviews and ASLP reports also highlighted challenges with activity coordination and unclear ways of working between the dairy, mango, citrus and social research project teams. Added to this, each team faced vast geographical dispersion of target beneficiaries. It appears each project team was committed to delivering their own project outputs and had different priorities at different times, so coordinating inter-project activities and learning was challenging. This is an important learning that could be considered for future ACIAR programs.

The challenges highlight an important lesson for ACIAR that was also identified under the citrus projects' evaluation: specific strategies should be considered to ensure projects benefit from being part of a broader program. Such strategies could include:

- Ensuring sufficient time and resources are allocated to cross-project collaboration, both in Australia and in the project country.
- Developing program structures that incentivise or even enforce cross-project collaboration. This could include, for example, having a 'lead' contractor who could be responsible for and has authority to bring about cross-project collaboration.
- Ensuring project team selection processes consider staff traits such as openness to collaboration, good communication, and willingness to work in interdisciplinary teams.



Conclusions and lessons learned

The ASLP dairy projects have achieved strong results in most key areas. Smallholder dairy farmers have increased sales and have generated profits from adopting knowledge, practices and technology to increase milk yields and fodder production, raise healthier calves, and produce milk value-added products. Women farmers have also increased agency because of their involvement in project activities. Dairy extension workers, scientists and university students have led dairy research and strengthened the interface between scientific knowledge, extension services and farmers' practices. The projects' 'less intensive dairy extension approach' continues to be developed. There is evidence that the 'whole family approach' to extension had effectively doubled adoption rates; however, more effort was needed to get all stakeholders to finalise the approach to scale out.

The sustainability of projects' results depends on:

- equitable dairy supply chains and favourable market conditions that are supported by effective government policies and appropriate resources
- dairy research and extension services continuing to be relevant to farmers' needs and the needs of the dairy sector as a whole
- smallholder farming community willingness to ensure inclusiveness and that project benefits are shared.

The projects were aligned to the ASLP goals of enhancing the capacity of research and extension systems, supporting poverty alleviation for smallholder farmers, and supporting value chains. They also demonstrate the value of blending Australian and Pakistani expertise, and the benefits of identifying and using local partner systems that support efficient financial flows and activity implementation.

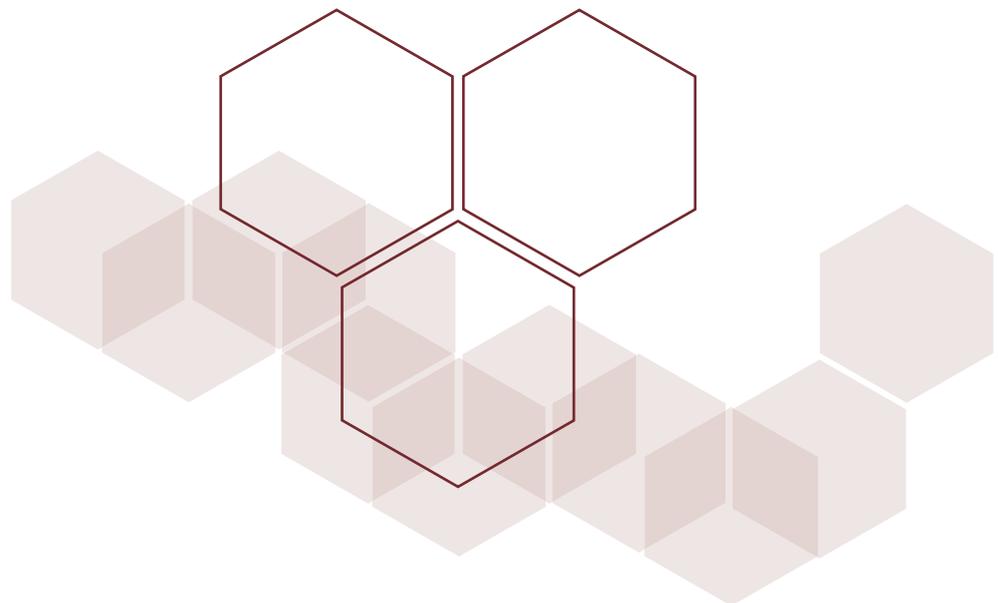
Lessons learned

This evaluation highlights some general lessons for ACIAR projects and programs:

- 1. Cross-cutting issues need to be considered in project designs and appropriate strategies developed and resourced to address them.** Important cross-cutting issues include gender equality and social inclusion, child protection, environment protection and 'do no harm' principles. Addressing these would remove barriers to participation, reduce potential harmful impacts on project beneficiaries, and enhance results and sustainability.
- 2. Effective relationship management and stakeholder engagement is essential for timely project and program delivery and ownership of results.** Mapping internal and external stakeholders and managing relationships with power-holders and powerbrokers is an ongoing process. A planned approach to managing relationships helps harness collective strengths and makes best use of resources. For large initiatives like the dairy projects, effective stakeholder engagement has significant influence on adoption rates and impact.
- 3. Market and value chain analysis and development, and business development plans, are essential for future project components that aim to generate profits.** These are foundational activities that should be managed very early during project implementation to guide downstream activities to maximise adoption and results of projects. For example, the scale out of the VBSE program could have benefited from a clear business plan. Milk market and value chain development could have benefited from clearer strategies at the beginning of the projects to ensure greater impact.

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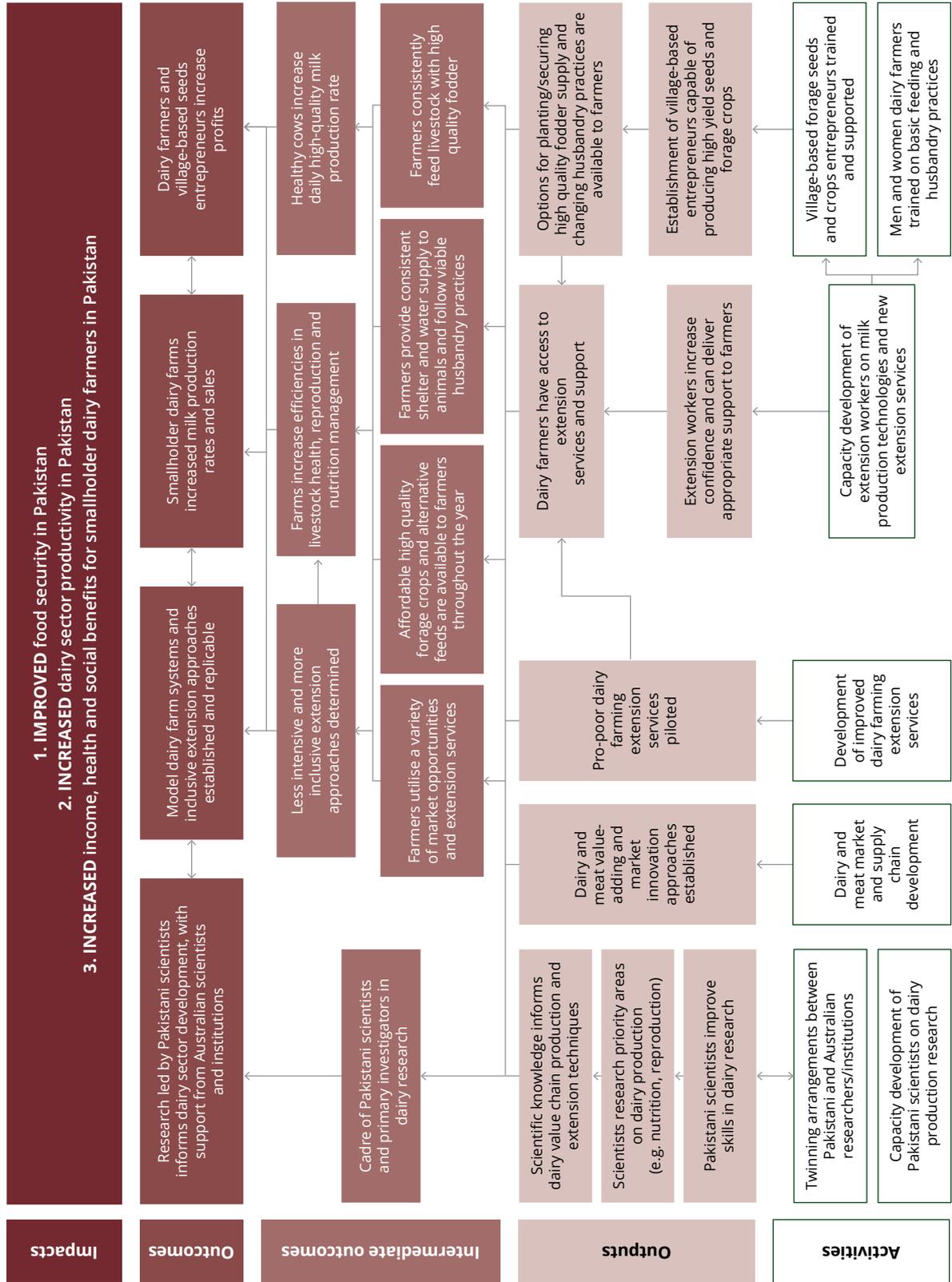
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- Zia U, Mahmood T and Ali MR (2011) *Dairy development in Pakistan*, Food and Agriculture Organisation of the United Nations, Rome.





Appendixes

Appendix 3.1: Theory of change



Appendix 3.2: Stakeholders consulted

Name	Title	Organisation or location
Dr Peter Wynn	Project Leader, ASLP Project	Charles Sturt University, Australia
Dr David McGill	Project Leader, Dairy-Beef Project	University of Melbourne, Australia
Dr Hassan Warriach	Project Manager	ASLP Dairy Project, Pakistan
Dr Muhammad Afzal	Project Leader, ASLP Project	Livestock and Dairy Development Board, Pakistan
Dr Aleem Bhatti	Expert	University of Veterinary and Animal Sciences, Lahore, Pakistan
Ms Sobia Majeed	Area Advisor, Sindh	ASLP Dairy Project, Pakistan
Dr Rukhsana Vighio	Veterinary Officer	Sindh Livestock Department, Pakistan
Dr Kazmi Munawar	Country Manager, Pakistan	ACIAR
Mr Gerard McEvilly	Aik Saath Program Coordinator	ACIAR



Appendix 3.3: Project evaluation framework

The data and process used for addressing each of the key evaluation questions (KEQs) is summarised in the table. Bold questions are high priority and were explored in more depth.

Key Evaluation Question	Evidence/information required	Data sources	Data collection and analysis approach
1. What was the project's theory of change; and how did this evolve during implementation? <ul style="list-style-type: none"> – Was the theory of change appropriate to the project context and desired results? 	<ul style="list-style-type: none"> • Documented theory of change at project commencement • Information on subsequent changes • Information on project context • Perspectives of key stakeholders regarding appropriateness of the theory of change 	<ul style="list-style-type: none"> • Project concept / design documents and variations • Project progress reports, annual plans, etc. • Key stakeholders (project managers and collaborating partners, program manager/ coordinator, government authorities, producers, businesses) 	<ul style="list-style-type: none"> • Desk review of available documents • Interviews with key stakeholders • Triangulation of findings from different sources • Project verification workshops
2. What outcomes (intended and unintended) has the project achieved or contributed to? <ul style="list-style-type: none"> – What was the unique knowledge contribution of the project/cluster that was/is expected to influence practice/policy? – To what extent is there evidence of adoption of new practices based on research process and findings? 	<ul style="list-style-type: none"> • Robust, documented evidence of progress towards planned outputs and outcomes (including progress along adoption pathways), and any unintended consequences • Theory of change assessment from KEQ1 • Perspectives of key stakeholders, to test/validate written reporting, including 'next users' of research outputs 	<ul style="list-style-type: none"> • Annual and/or final reports • Mid-term and/or final reviews • Key stakeholders (as above) 	<ul style="list-style-type: none"> • Desk review of available documents • Interviews with key stakeholders • Triangulation of findings from different sources • Project verification workshops • ACIAR progress assessment and analysis tools (e.g. Table 5 and Table 6)
3. How did project activities and outputs contribute to the outcomes achieved? <ul style="list-style-type: none"> – To what extent and how did they differ from what was planned? 	<ul style="list-style-type: none"> • Theory of change assessment from KEQ1 • Documented evidence of impact pathways, as per KEQ2 • Perspectives of key stakeholders including 'next users' of research outputs 	<ul style="list-style-type: none"> • Annual and/or final reports • Mid-term and/or final reviews • Key stakeholders (as above) 	<ul style="list-style-type: none"> • Documentation review, stakeholder interviews, triangulation, verification workshops • Analysis of adoption and impact pathways, including 'next users' (e.g. Table 5 and Table 6)

Appendix 3.3: Project evaluation framework (cont.)

Key Evaluation Question	Evidence/information required	Data sources	Data collection and analysis approach
<p>4. What strategies were adopted to address gender equity and social inclusion and how effective were these?</p> <ul style="list-style-type: none"> – How did the project impact men and women differently? 	<ul style="list-style-type: none"> • Evidence of analysis/awareness of the potential gender equity issues that may impact on the project • Evidence of steps taken to address the issues identified • Evidence of level of participation of women and men in research activities • Evidence of changes in women's and men's control of assets, resources and decision-making, and gender equity (e.g. through impacts on female researchers; gendered knowledge generation; influence on inclusivity within partner organisations) • Perspectives of key stakeholders 	<ul style="list-style-type: none"> • Documented gender strategy or analysis (if available) • Existing reports providing gender-disaggregated data and/or discussion of gender issues, e.g. annual and/or final reports, mid-term and/or final reviews • Any existing gender audits or inclusion-focused reviews • Key stakeholders (as above) 	<ul style="list-style-type: none"> • Documentation review, stakeholder interviews, triangulation, verification workshops • Gender analysis to explore the level and type of participation of men and women, and influence on positive or harmful gender norms
<p>5. How did management arrangements impact delivery of the project?</p> <ul style="list-style-type: none"> – What other factors influenced project performance? 	<ul style="list-style-type: none"> • Any existing reporting and commentary on management arrangements • Perspectives of key stakeholders • Evidence of contextual factors external to the project that may have impacted performance 	<ul style="list-style-type: none"> • Annual and/or final reports • Mid-term and/or final reviews • Key stakeholders (as above) 	<ul style="list-style-type: none"> • Documentation review, stakeholder interviews, triangulation, verification workshops • ACIAR progress assessment tools
<p>6. How well did the project align with and contribute to the overall goals of its umbrella program?</p> <ul style="list-style-type: none"> – To what extent has the programmatic approach added value at project level? 	<ul style="list-style-type: none"> • Assessment of KEQs 1–5 • Information on program goal and approach • Relevant existing reporting and commentary • Perspectives of key stakeholders 	<ul style="list-style-type: none"> • Annual and/or final reports • Mid-term and/or final reviews • Key stakeholders (as above) 	<ul style="list-style-type: none"> • Assessment of consistency and value-add, based on analysis for KEQs 1–5 and supplementary program-level documentation, stakeholder interviews and verification workshops



Appendix 3.4: ASLP goals

ASLP ran for 2 phases between 2005 and 2015.

The goals of ASLP's first phase (2005–2010) were:

1. To transfer Australian knowledge and expertise to key sectors of Pakistan agribusiness to increase profitability and enhance export potential.
2. To contribute to poverty alleviation of smallholder farmers through collaborative research and development.
3. To enhance the capacity of the Pakistan research, development and extension system to deliver targeted and practical research outputs to agribusiness and farmers.

The goals for the second phase were adapted, but retained a core focus on building value chains to support smallholder farms and building technical capacity in Pakistan. The Phase 2 goals were:

1. Pro-poor value chains: To support 'keystone' interventions to sustainably enhance selected value chains and increase understanding and delivery of benefits to the rural poor through productivity improvements and market and employment opportunities.
2. Agricultural capability: To enhance agriculture capability and sustainably improve agricultural value chains by providing short-term 'smart linkages', scoping studies and other initiatives, as well as longer-term formal training, that are demand-driven and catalytic, and complement the initiatives supported under other components of the program.
3. Enabling policy: To support policy analysis and interventions which improve or enable better economic and natural resource management, particularly where they underpin or strengthen pro-poor value chains and more sustainable farming systems.

Appendix 3.5: Project team members

#	Team member	Gender	International/National researcher
1	Prof Peter Wynn	M	International
2	Dr Russell Bush	M	International
3	Dr David McGill	M	International
4	Dr Muhammad Afzal	M	National
5	Mr Babar Yaqoob	M	National
6	Dr Rifaqat Hussain Raja	M	National
7	Dr Zia Ahmad	M	National
8	Dr Sosheel Solomon	M	International
9	Dr Karl Behrendt	M	International
10	Dr Hassan Warriach	M	National
11	Dr Muhammad Ishaq	M	National
12	Ms Zahra Batool	F	National
13	Prof Talat Pasha	M	National
14	Dr Muhammad Aleem	M	National
15	Dr Imtiaz Nagra	M	National
16	Dr Ghulam Sarwar Shaijh	M	National
17	Mr Hafeez Ullah	M	National



Appendix 3.6: Research outputs

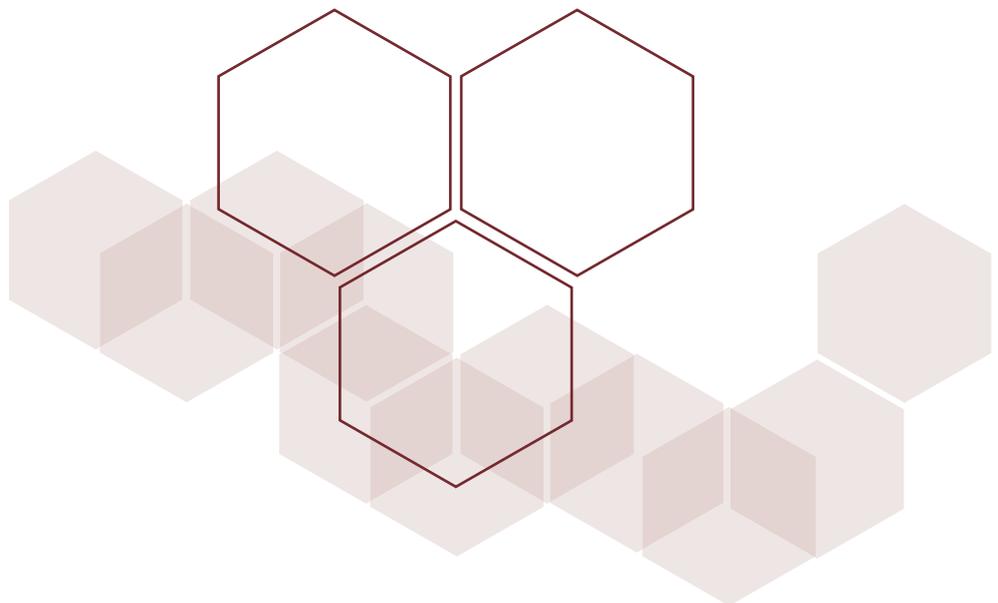
Peer-reviewed journal articles	
Publication	Author (gender, nation)
Aslam N, Iqbal ZM, Warriach HM and Wynn PC (2014) 'Pattern of partitioning of aflatoxins from feed to urine and its effect on serum chemistry in Nili-Ravi buffalo heifers', <i>Animal Production Science</i> , 54(10):1671–1675.	Aslam (Male, Pakistan) Iqbal (Male, Pakistan) Warriach (Male, Pakistan) Wynn (Male, Australia)
Aslam N, Rodrigues I, McGill DM, Warriach HM, Cowling A, Haque A and Wynn PC (2016) 'Transfer of aflatoxins from naturally contaminated feed to milk of Nili-Ravi buffaloes fed a mycotoxin binder', <i>Animal Production Science</i> , 56(10):1637–1642.	Aslam (Male, Pakistan) Rodrigues (Female, Portugal) McGill (Male, Australia) Warriach (Male, Pakistan) Cowling (Female, Australia) Haque (Male, Pakistan) Wynn (Male, Australia)
Aslam N, Tipu MY, Ishaq M, Cowling A, McGill D, Warriach HM and Wynn P (2016) 'Higher levels of aflatoxin M1 contamination and poorer composition of milk supplied by informal milk marketing chains in Pakistan', <i>Toxins</i> , 8(12):347.	Aslam (Male, Pakistan) Tipu (Male, Pakistan) Ishaq (Male, Pakistan) Cowling (Female, Australia) McGill (Male, Australia) Warriach (Male, Pakistan) Wynn (Male, Australia)
Aslam N and Wynn PC (2015) 'Aflatoxin contamination of the milk supply: A Pakistan perspective', <i>Agriculture</i> , 5(4):1172–1182.	Aslam (Male, Pakistan) Wynn (Male, Australia)
Batool Z, Warriach HM, Ishaq M, Latif S, Rashid MA, Bhatti A, Murtaza N, Arif S and Wynn PC (2014) 'Participation of women in dairy farm practices under smallholder production system in Punjab, Pakistan', <i>The Journal of Animal and Plant Sciences</i> , 24(4):1263–1265.	Batool (Female, Pakistan) Warriach (Male, Pakistan) Ishaq (Male, Pakistan) Latif (Male, Pakistan) Rashid (Male, Pakistan) Bhatti (Male, Pakistan) Murtaza (Female, Pakistan) Arif (Female, Pakistan) Wynn (Male, Australia)
Bhatti SA, Ali A, Nawaz H, McGill D, Sarwar M, Afzal M, Khan MS, Amer MA, Bush R, Wynn PC and Warriach HM (2012) 'Effect of pre-weaning feeding regimens on post-weaning growth performance of Sahiwal calves', <i>animal</i> , 6(8):1231–1236.	Bhatti (Male, Pakistan) Ali (Male, Pakistan) Nawaz (Female, Pakistan) McGill (Male, Australia) Sarwar (Male, Pakistan) Afzal (Male, Pakistan) Khan (Male, Pakistan) Amer (Male, Pakistan) Bush (Male, Australia) Wynn (Male, Australia) Warriach (Male, Pakistan)

Appendix 3.6: Research outputs (cont.)

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Bhatti SA, Ahmed MF, Wynn PC, McGill D, Sarwar M, Afzal M, Ullah E, Khan MA, Khan MS, Bush R and Warriach HM and Kahn A (2012) 'Effect of diet on preweaning performance of Sahiwal calves' <i>Tropical Animal Health and Production</i> , 44(4):819–826.	Bhatti (Male, Pakistan) Ahmed (Male, Pakistan) Wynn (Male, Australia) McGill (Male, Australia) Sarwar (Male, Pakistan) Afzal (Male, Pakistan) Ullah (Male, Pakistan) Khan (Male, Pakistan) Bush (Male, Australia) Warriach (Male, Pakistan) Khan (Male, Pakistan)
McGill DM, Mulder HA, Thomson PC and Lievaart JJ (2014) 'Selecting an appropriate genetic evaluation model for selection in a developing dairy sector', <i>animal</i> , 8(10):1577–1585.	McGill (Male, Australia) Mulder (Male, the Netherlands) Thomson (Male, Australia) Lievaart (Male, the Netherlands)
McGill DM, Thomson PC, Mulder HA and Lievaart J (2014) 'Optimal and efficient test-day recording regimes for estimating lactation yield in Sahiwal cattle', <i>Genetics Selection Evolution</i> .	McGill (Male, Australia) Mulder (Male, the Netherlands) Thomson (Male, Australia) Lievaart (Male, the Netherlands)
Warriach HM, McGill DM, Bush RD and Wynn PC (2012) 'Production and reproduction performance of Nili-Ravi buffaloes under field conditions of Pakistan', <i>The Journal of Animal and Plant Sciences</i> , 22(3 Suppl):121–124.	Warriach (Male, Pakistan) McGill (Male, Australia) Bush (Male, Australia) Wynn (Male, Australia)
Warriach HM, McGill DM, Bush RD, Wynn PC and Chohan KR (2015) 'A review of recent developments in buffalo reproduction—a review', <i>Asian-Australasian journal of animal sciences</i> , 28(3):451.	Warriach (Male, Pakistan) McGill (Male, Australia) Bush (Male, Australia) Wynn (Male, Australia) Chohan (Male, Pakistan)
Wynn PC, Warriach HM, Morgan A, McGill DM, Hanif S, Sarwar M, Iqbal A, Sheehy PA and Bush RD (2009) 'Perinatal nutrition of the calf and its consequences for lifelong productivity', <i>Asian-Australasian Journal of Animal Sciences</i> , 22(5):756–764.	Wynn (Male, Australia) Warriach (Male, Pakistan) Morgan (Female, Australia) McGill (Male, Australia) Hanif (Female, Pakistan) Sarwar (Male, Pakistan) Iqbal (Male, Pakistan) Sheehy (Male, Australia) Bush (Male, Australia)



Publications in progress	
Publication	Author (gender, nation)
Batool Z, Warriach HM, McGill D, Thomson PC and Wynn PC (2017) 'Impact of improved extension services on technical knowledge of female farmers and factors affecting their participation in the program'. <i>Resubmitted</i>	Batool (Female, Pakistan) Warriach (Male, Pakistan) McGill (Male, Australia) Thomson (Male, Australia) Wynn (Male, Australia)
McGill DM, Ishaq M, Iqbal J, Thomson PC, Mulder HA and Lievaart, J (n.d.) 'Defining the breeding objective for Sahiwal cattle in Pakistan'. <i>Resubmitted</i>	McGill (Male, Australia) Ishaq (Male, Pakistan) Iqbal (Male, Pakistan) Thomson (Male, Australia) Mulder (Male, the Netherlands) Lievaart (Male, the Netherlands)
Tufail S, Krebs G, Southwell A and Wynn P (2017) 'Village based forage seed enterprises: A sustainable intervention for rural development in the mixed farming systems of Pakistan'.	Tufail (Male, Pakistan) Krebs (Female, Australia) Southwell (Female, Australia) Wynn (Male, Australia)



Appendix 3.6: Research outputs (cont.)

Conference proceedings	
Publication	Author (gender, nation)
Aslam N, Rodrigues I, McGill D, Warriach H, Cowling A, Haque A and Wynn P (8–12 September 2014) 'Transfer of aflatoxins from highly contaminated feed to milk and effect of mycotoxins binder on transfer rate in Nili-Ravi buffaloes', <i>Joint ISNH/ISRP International conference 2014: Harnessing the ecology and physiology of herbivores</i> , Canberra, Australia.	Aslam (Male, Pakistan) Rodrigues (Female, Portugal) McGill (Male, Australia) Warriach (Male, Pakistan) Cowling (Female, Australia) Haque (Male, Pakistan) Wynn (Male, Australia)
Aslam N, Warriach H, McGill D and Wynn P (2–3 December 2013) 'Aflatoxin M1 in milk and milk products in Pakistan: A short review', <i>2nd International Food Safety Conference, Food safety: Critical dimension of feed security in emerging economics</i> , Kuala Lumpur, Malaysia.	Aslam (Male, Pakistan) Warriach (Pakistan) McGill (Male, Australia) Wynn (Male, Australia)
Batool Z, Warriach H, Ishaq M, Latif S, Afzal M, Bhatti A, Murtaza N, Arif S and Wynn P (26–30 November 2012) 'Participation of women in dairy farm practices under small holder production system in Pakistan', <i>15th AAAP Animal Science Congress on Improving Smallholder and Industrial Livestock Production for Enhancing Food Security, Environment and Human Welfare</i> , Thammasat University (Rangsit Campus), Bangkok/Pathum Thani, Thailand.	Batool (Female, Pakistan) Warriach (Male, Pakistan) Ishaq (Male, Pakistan) Latif (Male, Pakistan) Afzal (Male, Pakistan) Bhatti (Male, Pakistan) Murtaza (Male, Pakistan) Arif (Female, Pakistan) Wynn (Male, Australia)
Bush R, Sothoeun S, Khounsy S, Young J, Nampanya S, Warriach H, McGill D, Wynn P and Windsor P (28–31 July 2014) 'Engaging smallholder large ruminant producers to improve food security: lessons from Cambodia, Lao PDR and Pakistan', <i>28th World Buiatrics Congress</i> , Cairns, Australia.	Bush (Male, Australia) Sothoeun (Male, Laos) Khounsy (Male, Cambodia) Young (Male, Australia) Nampanya (Male, Laos) Warriach (Male, Pakistan) McGill (Male, Australia) Wynn (Male, Australia) Windsor (Male, Australia)
Bush R, Warriach H, McGill D and Wynn P (26–30 November 2012) 'Developing a feed calendar for Pakistan's small-holder dairy farmers', <i>The 15th Asian-Australian Association of Animal Production Animal Science Congress</i> , Bangkok.	Bush (Male, Australia) Warriach (Male, Pakistan) McGill (Male, Australia) Wynn (Male, Australia)
Coombes C, Warriach H, McGill D, Latif S, Naqvi Z and Wynn P (26–30 November 2012) 'The Influence of Improved Colostrum Management and Milk Feeding Regimens on Serum Protein and Weight Gain in Sahiwal Calves in Pakistan', <i>15th AAAP Animal Science Congress</i> , Bangkok, Thailand.	Coombes (Female, Australia) Warriach (Male, Pakistan) McGill (Male, Australia) Latif (Male, Pakistan) Naqvi (Female, Pakistan) Wynn (Male, Australia)



Conference proceedings	
Publication	Author (gender, nation)
Godfrey S, Aslam N, Nordblom T, Warriach H, Ishaq M, Wynn P, Ramsay G and Behrendt K (26–30 November 2012) 'Marketing milk from small-holder dairy farmers in Pakistan', <i>15th AAAP Animal Science Congress on Improving Smallholder and Industrial Livestock Production for Enhancing Food Security, Environment and Human Welfare</i> , Thammasat University (Rangsit Campus), Bangkok, Thailand.	Godfrey (Male, Pakistan) Aslam (Male, Pakistan) Nordblom (Male, Australia) Warriach (Male, Pakistan) Ishaq (Male, Pakistan) Wynn (Male, Australia) Ramsay (Male, Australia) Behrendt (Male, Australia)
Godfrey S, Behrendt K, Nordblom T and Wynn P (7–10 February 2012) 'Dairy enterprise and whole farm performance in mixed farming systems in Punjab, Pakistan', <i>56th Annual Conference of the Australian Agricultural & Resource Economics Society</i> , Fremantle, Australia.	Godfrey (Male, Pakistan) Behrendt (Male, Australia) Nordblom (Male, Australia) Wynn (Male, Australia)
Godfrey S, Behrendt K, Ramsay G, Wynn P and Nordblom T (6–8 February 2013) 'Identifying producer, middlemen, retailer and consumer issues from a pro-poor value chain perspective: A dairy case study from Punjab of Pakistan', <i>57th Annual Conference of the Australian Agricultural & Resource Economics Society</i> , Sydney, Australia.	Godfrey (Male, Pakistan) Behrendt (Male, Australia) Ramsay (Male, Australia) Wynn (Male, Australia) Nordblom (Male, Australia)
Ishaq M, Warriach H, McGill D, Bush R, Arif S, Murtaza N and Wynn P (26–29 July 2011) 'Effect of body condition score on milk production and reproductive disorders in buffalo', <i>3rd International Conference on Sustainable Animal Agriculture for Developing Countries</i> , Nakhon Ratchasima, Thailand.	Ishaq (Male, Pakistan) Warriach (Male, Pakistan) McGill (Male, Australia) Bush (Male, Australia) Arif (Female, Pakistan) Murtaza (Male, Pakistan) Wynn (Male, Australia)
Khan M, Lievaart J, Wynn P, McGill D and Warriach H (26–30 November 2012) 'Comparison of Traditional Prostaglandin and CIDR Based Synchronization Protocols on Oestrous and Fertility in Buffaloes in Low Breeding Season in Pakistan', <i>15th AAAP Animal Science Congress</i> , Bangkok, Thailand.	Khan (Male, Pakistan) Lievaart (Male, the Netherlands) Wynn (Male, Australia) McGill (Male, Australia) Warriach (Male, Pakistan)
Khan S, Warriach M, McGill D, Bush R and Wynn P (11–15 July 2010) 'Effectiveness of the Provision of Extension Services for Small-holder Dairy Farmers in Two Regions of the Punjab in Pakistan', <i>28th Biennial Conference of ASAP</i> , University of New England, Armidale, Australia.	Khan (Male, Pakistan) Warriach (Male, Pakistan) McGill (Male, Australia) Bush (Male, Australia) Wynn (Male, Australia)
Latif S, Hand E, Warriach H, McGill D, Ishaq M, Batool Z, Arif S, Bhatti A and Wynn P (26–30 November 2012) 'Relationship of body condition score on ovarian cyclicity and pregnancy rate in Nili-Ravi buffaloes', <i>15th AAAP Animal Science Congress on Improving Smallholder and Industrial Livestock Production for Enhancing Food Security, Environment and Human Welfare</i> , Thammasat University (Rangsit Campus), Bangkok, Thailand.	Latif (Male, Pakistan) Hand (Female, Australia) Warriach (Male, Pakistan) McGill (Male, Australia) Ishaq (Male, Pakistan) Batool (Female, Pakistan) Arif (Female, Pakistan) Bhatti (Male, Pakistan) Wynn (Male, Australia)

Appendix 3.6: Research outputs (cont.)

Conference proceedings	
Publication	Author (gender, nation)
Majeed S, Latif S, Kumbher A, Warriach H and McGill D (16–19 October 2017) 'Cost effectiveness and effect of buffalo and cow milk feeding on growth performance of pre-weaned buffalo calves', <i>Sustainable Animal Agriculture in Developing Countries</i> , Batu, Indonesia.	Majeed (Female, Pakistan) Latif (Male, Pakistan) Kumbher (Male, Pakistan) Warriach (Male, Pakistan) McGill (Male, Australia)
Marsetyo, Tufail M, Mbuku S, Mutimura M, Guo X and Piltz J (15–19 September 2013) 'Utilisation of conserved forage to improve livestock production on smallholder farms in Asia and Africa', <i>22nd International Grassland Congress: Revitalising grasslands to sustain our communities</i> , Sydney, Australia.	Marsetyo (unknown) Tufail (Male, Pakistan) Mbuku (unknown) Mutimura (unknown) Gou (unknown) Piltz (Male, Australia)
McGill D, Thomson P, Mulder H and Lievaart J (20–23 October 2013) 'Modification of lactation yield estimates for improved selection outcomes in developing dairy sectors', <i>Association for the Advancement of Animal Breeding and Genetics</i> , Napier, New Zealand.	McGill (Male, Australia) Thomson (Male, Australia) Mulder (Male, the Netherlands) Lievaart (Male, the Netherlands)
McGill D, Warriach H, Bush R and Wynn P (26–29 July 2011) 'Improving the productivity of dairy cattle and buffalo on small-holder dairy farms in Pakistan', <i>3rd International Conference on Sustainable Animal Agriculture for Developing Countries</i> , Nakhon Ratchasima, Thailand.	McGill (Male, Australia) Warriach (Male, Pakistan) Bush (Male, Australia) Wynn (Male, Australia)
Shafiullah S and Wynn P (21–23 November 2011) 'The development of a simulation model to analyse the productivity and financial viability of dairy farms', <i>International Workshop on Dairy Science Park</i> , Agricultural University Peshawar, Pakistan.	Shafiullah (Male, Pakistan) Wynn (Male, Australian)
Warriach H, McGill D, Ishaq M, Latif S, Bhatti S, Batool Z, Arif S, Murtaza N, Bush R and Wynn P (26–30 November 2012) 'Effect of improved extension services on adoption rates and production of small holder dairy farmers in Pakistan', <i>15th Asian-Australian Association of Animal Production Animal Science Congress</i> , Bangkok.	Warriach (Male, Pakistan) McGill (Male, Australia) Ishaq (Male, Pakistan) Latif (Male, Pakistan) Bhatti (Male, Pakistan) Batool (Female, Pakistan) Arif (Female, Pakistan) Murtaza (Male, Pakistan) Bush (Male, Australia) Wynn (Male, Australia)
Wynn P, Warriach H, Arif S, Bush R and McGill D (25–30 July 2013) 'The evolution of a model for extension services for small-holder dairy farmers in Pakistan', <i>3rd SAADC conference</i> , Lanzhou, China.	Wynn (Male, Australia) Warriach (Male, Pakistan) Arif (Female, Pakistan) Bush (Male, Australia) McGill (Male, Australia)
Wynn P, Warriach H, McGill D, Ishaq M, Godfrey S and Bush R (1–4 October 2012) 'Development of extension programs for the small holder dairy farmers of Pakistan', <i>International Conference on Livestock Production and Veterinary Technology</i> , Bogor, Indonesia.	Wynn (Male, Australia) Warriach (Male, Pakistan) McGill (Male, Australia) Ishaq (Male, Pakistan) Godfrey (Male, Pakistan) Bush (Male, Australia)



University thesis	
Publication	Author (gender, nation)
Abbas W (2015) 'Effect of weaning period and milk feeding regimens on post weaning growth performance of Nili-Ravi Buffalo calves', [MSc thesis], University of Agriculture, Faisalabad.	Abbas (Male, Pakistan)
Ahsan A (2010) 'Effect of early pre-weaning treatment on post-weaning growth performance, in Sahiwal calves', [MSc thesis], Institute of Animal Nutrition and feed Technology, University of Agriculture, Faisalabad.	Ahsan (Male, Pakistan)
Arif S (2018) 'Epidemiology of brucellosis in smallholder farming system in Pakistan', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Arif (Male, Pakistan)
Aslam N (2015) 'Mycotoxins and their effect on milk quality and health related issues in the Pakistan dairy sector', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Aslam (Male, Pakistan)
Batool Z (2020) 'Meat quality characteristics in aged and young beef animals', [PhD thesis], University of Melbourne, Australia.	Batool (Female, Pakistan)
Cheema A (2014) 'Effect of pre-weaning feeding regimens on post-weaning growth performance of Sahiwal calves', [MSc thesis], University of Agriculture, Faisalabad.	Cheema (Male, Pakistan)
Farhan (2017) 'Growth and yield performance of berseem (<i>Trifolium alexandrium</i> L.) under the impact of levels of NPK and irrigation frequencies', [MSc thesis], Sindh Agriculture University, Tandojam.	Farhan (Male, Pakistan)
Godfrey S (2015) 'Milk value chain analysis: industry competitiveness and the dairy policy environment in Pakistan', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Godfrey (Male, Pakistan)
Irfan M (2015) 'Passive transfer of immunity and pre-weaning growth performance, structural development, health, and economic viability in buffalo calves fed fresh and heat treated buffalo colostrum or colostrum replacer', [Master thesis], University of Veterinary and Animal Sciences, Lahore.	Irfan (Male, Pakistan)
Kaka N (2011) 'Effect of buffalo milk vs cow milk on growth performance of Kundi buffalo calves', [MSc thesis], Sindh Agriculture University, Tandojam.	Kaka (Male, Pakistan)
Kashif M (2017) 'Effect of sowing time on fodder quality of rye grass', [MSc thesis], University of Agriculture Faisalabad.	Kashif (Male, Pakistan)
Kashmiri A (2012) 'Comparative study of barseem hay and green barseem on growth performance of post weaned Kundi buffalo calves', [MSc thesis], Sindh Agriculture University, Tandojam.	Kashmiri (Male, Pakistan)
Khan M (2013) 'Comparison between traditional progesterone and CIDR based synchronization protocols on oestrous and fertility in buffaloes in the low breeding season in Pakistan', [Master of Philosophy], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Khan (Male, Pakistan)
Latif S (2019) 'Mechanism of Photosensitization in <i>Biserrula Pelecenus</i> ', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Latif (Male, Pakistan)

Appendix 3.6: Research outputs (cont.)

University thesis	
Publication	Author (gender, nation)
McGill D (2014) 'Modifying genetic analysis to maximise the effective output from dairy progeny testing programs in Pakistan', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	McGill (Male, Australia)
Menghwar D (2012) 'Comparative study of barseem Hay and green barseem on the various blood pictures in post weaned Kundi buffalo calves', [MSc thesis], Sindh Agriculture University, Tandojam.	Menghwar (Male, Pakistan)
Muhammad F (2010) 'Growth performance, health status and hematology of Sahiwal calves fed milk or milk replacer with or without calf starter', [MSc thesis], Institute of Animal Nutrition and feed Technology, University of Agriculture, Faisalabad.	Muhammad (Male, Pakistan)
Shafiullah S (2012) 'The development of an assessment tool to analyse the productivity and financial viability of dairy farms in Pakistan', [Master thesis], Charles Sturt University Wagga Wagga.	Shafiullah (Male, Pakistan)
Shan M (2017) 'Yield performance of Alfalfa under different plant population densities', [MSc thesis], University of Agriculture, Faisalabad.	Shan (Male, Pakistan)
Tufail M (2015) 'Development of Berseem clover (<i>Trifolium alexandrinum</i> L.), village-based forage seed enterprises for the profitability and sustainability of smallholder farmers of Pakistan in mixed farming systems', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Tufail (Male, Pakistan)
Williams T (2018) 'Endoparasites in buffalo in Pakistan; prevalence and management in Punjab and Sindh', [PhD thesis], School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga.	Williams (Male, Australia)
Zahid M (2017) 'Influence of zinc Nutrition and biofortification of alfalfa', [MSc thesis], University of Agriculture, Faisalabad.	Zahid (Male, Pakistan)

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