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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



2022

The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. ACIAR operates as part of Australia's international development assistance program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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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.

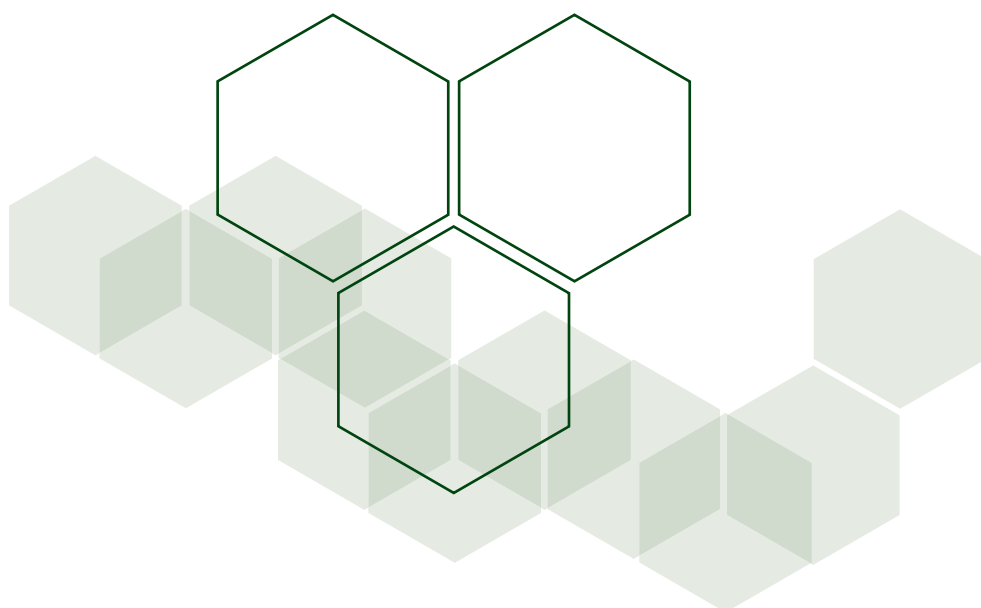
This report presents a suite of evaluations of the Agriculture Sector Linkages Program, conducted in Pakistan, and co-funded by the Department of Foreign Affairs and Trade (DFAT) and ACIAR from 2005 to 2015. The program was an opportunity for Australian agencies to partner with Pakistani researchers 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



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## Part 4: Mango projects

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## Abbreviations and acronyms

<b>ACIAR</b>	Australian Centre for International Agricultural Research
<b>ASLP</b>	Agriculture Sector Linkages Program
<b>AUD</b>	Australian Dollar
<b>AusAID</b>	Australian Agency for International Development
<b>AVCCR</b>	Agriculture Value Chain Collaborative Research Program
<b>CABI</b>	Centre for Agriculture and Bioscience International
<b>DFAT</b>	Department of Foreign Affairs and Trade
<b>DPP</b>	Department of Plant Protection (Pakistan)
<b>NARC</b>	National Agricultural Research Council (Pakistan)
<b>PHDEC</b>	Pakistan Horticulture Development and Export Company
<b>PKR</b>	Pakistan Rupee
<b>RPM</b>	Research Program Manager (ACIAR)
<b>SAU</b>	Sindh Agriculture University
<b>SMGE</b>	Sindh Mango Growers and Exporters
<b>SVVCP</b>	Strengthening Vegetable Value Chain in Pakistan Project
<b>TADEP</b>	Transformative Agriculture and Development Enterprise Program
<b>UAF</b>	University of Agriculture Faisalabad
<b>USAID</b>	United States Agency for International Development
<b>USD</b>	United States Dollar
<b>UNIDO/TRTA</b>	United Nations Industrial Development Organisation / Trade Related Technical Assistance

## 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 2 phases of the Agriculture Sector Linkages Program (ASLP) in Pakistan, which was a research-for-development program in 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)<sup>34</sup> 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 4.5.

Research projects within the ASLP that focused on improving mango production and mango value chains were:

- Phase 1: Development of integrated crop management practices to increase sustainable yield and quality of mangoes in Pakistan and Australia (HORT/2005/153) and Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan and Australia (HORT/2005/157).
- Phase 2: Integrated crop management practices to enhance value chain outcomes for the mango industry in Pakistan and Australia (HORT/2010/006) and Mango value chain improvement (HORT/2010/001).

The 2 mango projects aimed to increase the capacity of a range of industry, research and extension stakeholders in Pakistan.

The mango production projects were led by Queensland Primary Industries and Fisheries, while the value chain projects were led by the University of Queensland. The total ACIAR contribution for the production projects was AUD2,433,515, and for the value chain projects was AUD3,406,479.

This evaluation is Part 4 of a suite of evaluations of the ASLP. It examines the achievements of the mango projects, including project outputs, adoption and outcomes. It is not a comprehensive impact assessment. The evaluation aims to identify lessons that will inform the design and implementation of future ACIAR investments.



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



## Key findings

### 1

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

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**The evaluation team developed a suggested theory of change that covers the production and value chain projects.** A visual representation is at Appendix 4.2 and the key elements are:

- The projects used highly participatory, multidisciplinary approaches that aimed to include relevant stakeholders in research areas. This was expected to lead to new knowledge of mango markets and new scientific knowledge to improve fruit quality, as well as demonstration sites and demonstration value chains. Reflecting the systems approach taken by the projects, these outputs were closely linked and fed into and supported each other.
- The outputs were expected to lead to a number of outcomes. Growers, nurseries and value chain participants directly involved in the demonstration sites were expected to adopt ASLP best practices and increase income as a result. Other actors, particularly research organisations, extension services, and government agencies were expected to increase their understanding of, and capacity to implement, good production practices and value chain approaches.
- In turn, it was expected this would lead to an ongoing, well-targeted mango research program in Pakistan; improved extension services; and the dissemination of project results by a range of stakeholders. Ultimately, it was expected that the disseminated practices would be taken up across the mango industry, leading to better fruit quality, higher yields, increased demand for Pakistani mangoes, and increased incomes for growers and value chain participants.

**This theory of change implies there were 3 key assumptions** that needed to hold in order for change to come about in the expected way. The assumptions were:

- The projects would be able to reach all important actors in the mango industry, particularly commission agents and contractors, who act as 'middlemen' between growers and markets.
- Dissemination of project results by a range of stakeholders would lead to uptake by other industry stakeholders not directly involved in the projects.
- Appropriate support from Pakistani government agencies would be available in areas such as market access.

## Key findings (cont.)

### 2

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

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#### Outputs

The projects delivered a significant number of outputs that are consistent with this theory of change. For example, **the projects made substantial contributions to increasing scientific knowledge in mango production and value chains** in Pakistan, including research on orchard management practices, disease control and post-harvest fruit management. Research outputs were shared in a variety of ways, such as best practice manuals, pamphlets, and at least 81 scientific papers and conference papers.

**The projects also developed new technologies and practical approaches.** In particular, they established 8 modern nurseries, 29 integrated research sites, and 4 demonstration value chains:

- Punjab growers focused on fresh exports
- Punjab smallholders focused on fresh domestic sales through direct sales and marketing
- Sindh growers focused on fresh exports by sea freight to the UK/Europe
- Sindh women focused on local mango pickle sales.

In addition, **the projects conducted significant capacity-building work.** This was predominately done through the highly participatory approaches used for all research activities. Such participatory approaches were complemented by formal training in a wide range of pre- and post-harvest management and value chain approaches, both for direct project participants and the broader sector. A particular highlight in this area was the value chain projects' support to establish a world-class post-harvest research and teaching laboratory at the University of Agriculture Faisalabad (UAF).

#### Outcomes – immediate beneficiaries

**The projects achieved strong outcomes for immediate beneficiaries** – the nurseries, growers and value chain participants who were directly involved in project demonstration sites. The final report to ACIAR for the production projects (Bally 2019) states that one nursery has produced 35,000 high health trees. It also notes that, for growers using ASLP best practices, mango yields increased by 59% in 2009–10 and 65% in 2010–11, while orchard values increased between 2 and 6 times over 5 years from 2009 (Bally 2019). An important caveat here is that this data is for only a small number of farmers and may not have been collected in a systematic way.

Similarly, **outcomes for value chain participants are strong.** For Sindh growers focused on fresh exports, the projects facilitated export by sea freight of 330 tonnes of fresh mangoes to the UK, achieving an average price of USD2.72 per kilogram compared with an industry average of less than USD1 per kilogram for exports. Punjab smallholders were able to sell 43 tonnes of mangoes with a 20% net income increase for growers. In 2015, women from 2 villages were able to produce and sell more than 2,000 kilograms of pickles with a net profit of USD1,060.



### **Outcomes – broader mango sector**

As noted in the theory of change section, the projects aimed to influence broader change in Pakistan's mango sector. It is clear that the **projects demonstrated that value chain principles and approaches can work in Pakistan**. However, **when it comes to capacity outcomes, the picture is more mixed**. For example:

- A large number of Pakistani people have increased their individual capacity. At least 65 higher degrees (Masters and above) were achieved through the project, and the evaluation team received numerous examples of project collaborators who were building strong careers in horticulture.
- There is good evidence that the capacity of the post-harvest research and teaching laboratory at UAF – that was built during the project – has continued to improve. The laboratory has been able to attract additional funding and continues to conduct industry-focused, multidisciplinary research.
- The capacity of research institutions hosting modern nurseries has been built, but not to the desired extent. The final independent review of the production project found that the nurseries had not fully adopted best practices due to inadequate support and training (McEvelly and Laghari 2015a).
- There is insufficient data available to assess whether the capacity of extension services and the National Agricultural Research Council (NARC) was built, as no systematic monitoring data was collected.

**It is challenging to draw conclusions on whether higher-level outcomes – dissemination of project results and adoption by the broader industry – have been achieved.** On the positive side, training was conducted for a large number of industry stakeholders, and the ASLP projects were able to leverage other programs, such as the United Nations Industrial Development Organisation / Trade Related Technical Assistance (UNIDO/TRTA II) program to disseminate best practices. However, the projects' monitoring and evaluation was not designed to systematically collect data on such higher-level outcomes, making it difficult to draw robust conclusions.

## Key findings (cont.)

### 3

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

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**There were 4 factors that ensured the activities and outputs contributed to the outcomes achieved.**

First, the participatory research approaches previously described were key to ensuring all work responded to the needs of mango industry stakeholders and built their capacity. Second, interviewees identified that high quality scientific research was undertaken and this, combined with the participatory approach, ensured research outputs were relevant and useful to the sector. Third, the projects' systems-based approach was central to project success, as it ensured that project components were well-integrated and reinforced each other. Finally, the projects were able to leverage funding from other sources to support their outcomes. In particular, the UAF post-harvest laboratory was able to use the start provided by the ASLP project to secure funding from other sources, and so further strengthen its capacity and influence.

At the same time, **there were a number of barriers to the projects achieving more, particularly higher-level, outcomes related to sector-wide change.** Specifically, it appears that the theory of change assumptions did not hold. For example, despite good intentions, **the projects struggled to engage commercial agents and contractors from the mango industry.** These groups are powerful players in the system and, if projects are not able to change their behaviour in production practices and value chains, it is difficult to achieve widespread change in the mango industry.

**It is also questionable whether the projects did enough to support dissemination of project results** to support industry take-up. Basic enablers were not in place for details such as a communications plan for results and post-2015 maintenance of key knowledge documents. The value chain project also acknowledged that more research was needed to understand how to scale demonstration value chains.

Finally, **the projects struggled to get support from Pakistani government agencies** in areas such as market access and exports. This challenge is particularly difficult to overcome without ongoing resources and engagement with such government partners.


## 4

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

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The projects started during a period when addressing gender equity and social inclusion was not an explicit priority of Australia's overseas aid programs. This is reflected in the mango projects, **which did not have a strategy for addressing gender issues, or for considering marginalised groups such as people with disability or disadvantaged youth.**

Despite the lack of a gender equity strategy, **the projects were able to engage women in meaningful ways.** For example, the projects worked with women researchers and students, actively supporting their participation in training and conferences. The production project encouraged the strengthening of women's roles in production (such as, packing and weeding), including pay parity with male labourers. The value chain projects supported a value chain for women to produce and sell mango pickles.

**The projects, particularly in the second phase, were also appropriately pro-poor.** The production projects worked with medium-sized growers on demonstration sites, but used small plot sizes to show best practices could work on smallholder farms. Production project results were made available to smallholder growers through farmer field schools, and extension materials that were translated into local languages and used visual aids for growers with low literacy. The value chain projects also had one value chain specifically focused on smallholder farmers. Note, some interviewees felt the value chain projects could have had a greater focus on smallholder growers and reduced work with larger, export-focused growers.



## 5

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### How did management arrangements impact delivery of the project?

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The management arrangements were viewed positively by interviewees. Strong aspects of the management arrangements which facilitated project success were:

- **Strong relationships within and between mango projects.** Interviewees highlighted that there was clear communication and trust between project staff, particularly between the teams based in Australia and Pakistan, and this led to strong commitment to the projects. Strong in-country coordination by the Pakistan team was also in place.
- **Context-appropriate budget management arrangements.** Project funding was held by an international organisation to ensure the projects were not subject to inflexible Pakistan government funding systems. Project funding was also flexible, with budgets being re-allocated during annual planning processes and carefully overseen to avoid waste.

There are 2 areas where management arrangements inhibited project performance. First, **there were continual management changes** at the Pakistan Horticulture Development and Export Company (PHDEC), meaning oversight and support from this organisation was not as strong as expected of a key partner. Second, **the projects did not have strong monitoring and evaluation arrangements.** It is positive that the value chain project conducted its own impact assessment. But apart from this, data collection was not systematic or designed to understand higher-level outcomes, and no comparison groups were used, making it challenging to draw conclusions on project success (or otherwise).

## Key findings (cont.)

### 6

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

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The mango projects aligned well with the ASLP's 3 key objectives:

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

This evaluation also examined whether ASLP's 'programmatic' approach added value for the mango projects. **The projects benefited from being part of a larger program.** In particular, ASLP (and ACIAR) were able to create an enabling environment for the different mango projects to work together closely. This enabling environment, together with strong relationships and alignment of goals between the production and value chain projects, allowed the projects to successfully coordinate and collaborate.

In its second phase, ASLP introduced the social science project, which aimed to increase the engagement of the rural poor in the commodity-based projects (mango, citrus and dairy). **Collaboration between the mango projects and the social science projects was not as strong as anticipated**, with interviewees noting that the projects were not able to add significant value to each other's work. Reasons for this include that the purpose of the social science project was not clear or well-aligned with the commodity-based projects; that the different projects struggled to find common ground to work on; and that the different projects used very different methods and this added to the complexity when trying to collaborate.





## Conclusions and lessons learned

Overall, the mango projects achieved a significant number of outputs. They generated new scientific and market knowledge, and created multiple demonstration sites. This led to strong outcomes for direct participants in demonstration sites, and increased capacity for project collaborators and the UAF's post-harvest laboratory. However, it is difficult to assess the capacity changes for some organisations, as well as whether higher outcomes around dissemination and broad adoption by the industry have been achieved, due to the limits of projects' monitoring and evaluation systems.

The projects' achievements were supported by their participatory and systems-based approaches, and high-quality science. Strong relationships within and between project teams, as well as good budget management, also facilitated project success.

### Lessons learned

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

- **Projects need monitoring systems that systematically collect data on changes in capacity and broad uptake by industry.** This would allow projects and ACIAR to understand if the projects are making progress towards higher-level outcomes, and adjust approaches if needed.
- **ACIAR and project teams should design and implement projects with long-term sustainability in mind.** This includes conducting early thinking about what research, partners and systems are needed post-project, and a possible commitment to very long-term (for instance, 10-plus year) projects. This may increase the chances of adoption and use of project results by the broader industry.
- **The importance of appropriate project team membership cannot be underestimated.** Project teams require appropriate expertise, but also require like-minded team players who are open to interdisciplinary ways of working, are collaborative, and are able to build strong relationships across countries and projects. Consideration should also be given to integrating social science expertise into commodity-based teams.
- **Gender analysis and social inclusion analysis, and the development of gender and social inclusion strategies, should be undertaken at the start of project planning.** This will assist projects to develop a more strategic approach to influencing gender equity, to ensuring people with disability and other marginalised groups can benefit from projects, and to developing clear strategies that maximise poverty-reduction outcomes for smallholders. This holds true regardless of the research focus: even projects with an apparently narrow focus (for example, commodity production) can have potential consequences and opportunities related to gender and social inclusion.



# 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)<sup>35</sup>, a research-for-development program funded by DFAT<sup>36</sup>, 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 4.5.

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. Individual evaluations have been conducted on the citrus, mango and dairy projects under ASLP.

This project-level evaluation assesses the 4 ASLP projects that focused on the mango industry:

- the 2 projects that focused on mango production (HORT/2005/153 and HORT/2010/006)
- the 2 projects that focused on mango value chains (HORT/2005/157 and HORT/2010/001).

35 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.

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

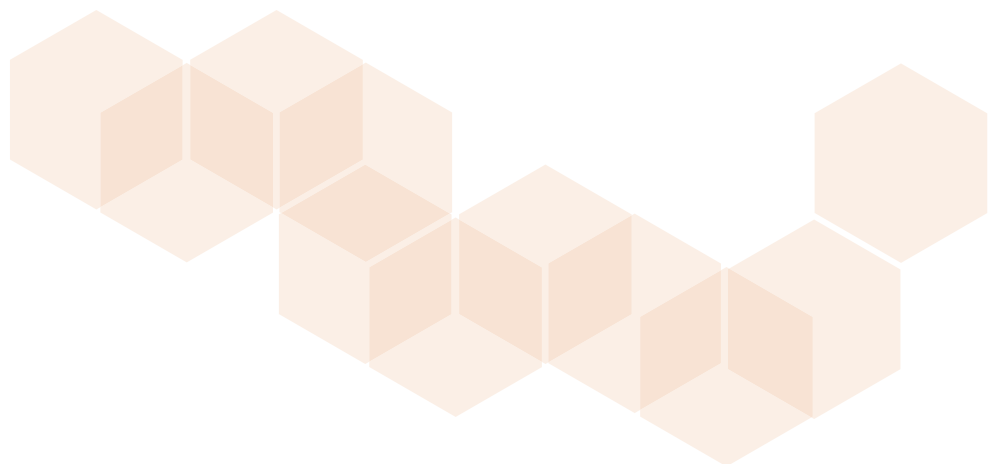


The evaluation provides an assessment against the following key evaluation questions:

1. What was the projects' theory of change and how did this evolve during implementation?
  - Was the theory of change appropriate to the 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?
  - Was the theory of change appropriate to the project context and desired results?
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 project management arrangements impact delivery of the project?
  - What other factors influence 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?

## Audience

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 collected through a thematic analysis of the key project documents, particularly project annual and final reports, and the mid-term and final project reviews. Semi-structured interviews were also undertaken with 8 project stakeholders<sup>37</sup> and ACIAR staff. Stakeholders were intentionally selected in consultation with ACIAR. Interviews were conducted using Zoom and WhatsApp.

Systematic 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 (Table 9).

Preliminary findings were shared and tested in a project validation workshop involving the stakeholders previously consulted. Stakeholders were also given the opportunity to provide written comments on a draft executive summary. 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 9** ACIAR project outcome assessment terminology

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

37 The list of stakeholders consulted is at Appendix 4.3.



## Limitations

The evaluation team relied heavily on pre-existing documentation provided by ACIAR and the project team. These documents were of varying quality. Unfortunately, there were insufficient evaluation resources to explore third-party data or reporting that may have provided additional useful information.

There were limitations on stakeholder consultations. Direct consultations mostly focused on ACIAR staff and implementing partners, and only a very small number of program beneficiaries could be interviewed. As primary data collection was restricted to online interviews, the evaluators had limited ability to build rapport with participants and interpret non-verbal communication. In addition, the length of time since projects were completed in 2015 may have made it challenging for interviewees to provide accurate data. 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 and the evaluation team. This means they were not a representative sample of project participants. Given the selection process, and the length of time since the project ended, it is also likely that respondent experiences fall at the positive end of the spectrum, meaning 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 identities of any project stakeholders 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.

## Overview of projects

Project number	Production projects		Value chain projects	
	HORT/2005/153	HORT/2010/006	HORT/2005/157	HORT/2010/001
Project title	Development of integrated crop management practices to increase sustainable yield and quality of mangoes in Pakistan and Australia	Integrated crop management practices to enhance value chain outcomes for the mango industry in Pakistan and Australia	Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan and Australia	Mango value chain improvement
Collaborating institutions	Queensland Department of Primary Industries and Fisheries National Agricultural Research Council Ayub Agricultural Research Institute Agricultural Research Sindh Pakistan Horticulture Development and Export Board Directorates of Extension Services of Punjab and Sindh provinces	Queensland Department of Primary Industries and Fisheries National Agricultural Research Council Ayub Agricultural Research Institute Agricultural Research Sindh Pakistan Horticulture Development and Export Board Directorates of Extension Services of Punjab and Sindh provinces	The University of Queensland The Queensland Department of Primary Industries and Fisheries The Western Australia Department of Agriculture and Food The University of Agriculture Faisalabad Pakistan Horticulture Development and Export Board	The University of Queensland The Queensland Department of Agriculture Fisheries and Forestry The Western Australia Department of Agriculture and Food The University of Agriculture Faisalabad Pakistan Horticulture Development and Export Board
Project leaders	Dr Chrys Akem, Queensland Department of Primary Industries and Fisheries Dr Iftikhar Ahmad, National Agricultural Research Council	Dr Chrys Akem and Dr Ian Bally, Queensland Department of Primary Industries and Fisheries Dr Iftikhar Ahmad, National Agricultural Research Council	Associate Professor Ray Collins, University of Queensland Mr Muhammad Iqbal, Pakistan Horticulture Development Export Board	Professor Ray Collins, University of Queensland Mr Razzaq Malkana, Pakistan Horticulture Development and Export Company
Duration	January 2007 to September 2010	October 2010 to September 2015	December 2006 to September 2010	December 2010 to November 2015
Funding	AUD1,132,044	AUD1,301,468	AUD1,452,929	AUD1,953,550
Countries	Australia and Pakistan			
Commodities	Mango			
Related projects	Mango value chain projects (see next column)		Mango production projects (see previous column)	



## Context

Mangoes are one of Pakistan's more important fruit crops. Mango orchards have almost doubled over the last 2 decades to 170,700 hectares in 2014–15 (Mangan and Ruthbah 2018). In 2013–14, Pakistan produced 1.65 million tonnes of mangoes and exported around 5% of these, at a value of USD50million (Collins, Sun and Ayyaz 2015). The main mango growing areas are Punjab and Sindh provinces (Mangan and Ruthbah 2018).

The Pakistan mango industry faces a number of challenges. The average price received per kilogram for exports is one of the lowest in the world. This is largely due to the combination of poor-quality fruit, poor post-harvest technologies and ineffective marketing practices (Collins, Sun and Ayyaz 2015). Factors that contribute to this situation include significant losses due to disease and pests, poor handling and storage, variable productivity due to different orchard management practices, and market access challenges. In addition, a survey of mango farmers in Sindh found that the majority of farmers sell their fruit to contractors or commission agents at the flowering stage. These contractors are then responsible for orchard management, harvesting and sales. As a result, growers have few incentives to invest in good orchard management and disease control, contributing to poor quality fruit (Mangan and Ruthbah 2018).

## The projects

Consistent with the importance of the mango industry in Pakistan, each ASLP phase supported 2 mango projects focused on mango production and value chains:

- Phase 1: Development of integrated crop management practices to increase sustainable yield and quality of mangoes in Pakistan and Australia (HORT/2005/153) and Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan and Australia (HORT/2005/157).
- Phase 2: Integrated crop management practices to enhance value chain outcomes for the mango industry in Pakistan and Australia (HORT/2010/006) and Mango value chain improvement (HORT/2010/001).

The projects aimed to improve the quality of mangoes and demonstrate value chain principles in Pakistan.

For Phases 1 and 2, the **production** projects' aims were:

- To facilitate the establishment and spread of 'clean' mango nurseries to ensure high quality planting materials were available.
- To develop improved orchard management practices (pre-harvest).
- To develop improved strategies for the detection and management of field diseases and pests.

For Phases 1 and 2, the **value chain** projects' aims were:

- To improve the quality of mangoes (this project focused on post-harvest practices to avoid duplication with the production projects).
- To research and develop Pakistani domestic markets and selected export markets, and use the findings to inform fruit quality, value chain development and *capacity-building* activities.
- To work with value chain participants (including smallholders) to demonstrate the benefits of value chain approaches.

These objectives were underpinned by 2 key ways of working. **Both projects had a strong emphasis on capacity building.** Participatory approaches (in which a variety of stakeholders were involved in research and implementation of research practices) and formal training were used to build capacity.

**The projects, and particularly the value chain projects, also had a strong systems-based approach.**

In this approach, all parts of the project were seen as an integrated system in which different activities supported and reinforced each other. This systems-based approach was represented by a project concept shown at Appendix 4.1.

# Findings

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

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### Projects' theory of change

In 2005, when the mango projects were first designed, the use of theory of change was limited in Australia's aid program. Consequently, it is not surprising that the **documentation of the mango projects' does not include a theory of change** to articulate how the projects expected change to happen, or how activities would lead to outputs and outcomes. To its credit, the value chain projects had a 'project concept', outlining how different components of the project were linked in a systems-based approach (see Appendix 4.1).

Drawing on documents and discussion with stakeholders, **the evaluation team developed a suggested theory of change**. This covers both the production and value chain projects, given how closely they were linked. A visual representation of the theory of change is at Appendix 4.2.

**The projects' theory was that project success was dependent on highly participatory, multidisciplinary research.** This research should include a variety of stakeholders, including growers, researchers, and extension services. It should cover a vast range of topics (for example, pre-harvest orchard and nursery management, post-harvest disease control, markets, and mango value-added products) and be complemented by more formal training where necessary.

**If this participatory research was successful, then a number of outputs were expected to flow.** These outputs included new knowledge of mango markets and new scientific knowledge to improve fruit quality, as well as demonstration sites and demonstration value chains. Reflecting the systems approach taken by the projects, these outputs were expected to be closely linked and support each other.

**If these outputs were relevant to, and successfully supported, the mango industry, then a number of outcomes were expected as a result.** Growers, nurseries and value chain participants directly involved in the demonstration sites were expected to adopt ASLP best practices and increase yields and/or incomes as a result. Other actors, particularly research organisations, extension services, and government agencies were expected to increase their understanding of and capacity to implement good production practices and value chain approaches.

**If such actors did increase their understanding and capacity, it was expected that a number of changes would take place.** These included implementation of a well-targeted mango research program in Pakistan; improved extension services grounded in participatory approaches; and the dissemination of project results by a wide variety of stakeholders. Ultimately, it was expected that the practices disseminated would be taken up across the mango industry, leading to better fruit quality, higher yields, increased domestic demand for high quality Pakistani mangoes, increased international market share for Pakistani mangoes, and increased incomes for growers and value chain participants.

### Appropriateness of the theory of change

There was some evolution of the theory of change over the course of the mango projects. For example, **the projects had an increasingly pro-poor focus over time.** For example, the documents from the Phase 2 project were more explicit in describing the projects' focus on small to medium growers.

The theory of change was **underpinned by a number of assumptions that needed to hold true in order for change to happen as anticipated.** These assumptions included:

- The projects would be able to reach all significant players in the mango industry, including the commission agents and contractors who are powerful 'middlemen'. Project proposals for both the production and value chain projects outlined a need to include these commission agents and contractors in project activities, given their significant role in orchard management, harvesting, and linking produce to markets.
- The dissemination of project results by Pakistani project stakeholders (for example, growers, extension services, researchers, and government organisations) would lead to uptake of the ASLP practices by other industry stakeholders not directly involved in the project. Project documentation appears to assume that this dissemination would continue after the projects were completed.
- Appropriate support from Pakistan government agencies would be available. This was particularly important for long-term impacts around exports, where government agencies play a key role in market access and biosecurity.





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

This section discusses the outputs and outcomes the projects achieved using the theory of change as a framework. To summarise, **it is clear that the projects achieved significant outputs**, making substantial contributions to increasing scientific knowledge in mango production and markets, developing new technologies and approaches through demonstration sites and demonstration value chains, and implementing significant *capacity-building* work.

**This led to strong outcomes – such as increased yields and incomes – for immediate beneficiaries** who were involved in demonstration sites and demonstration value chains. **Outcomes for other stakeholders were more mixed.** Individual Pakistani project collaborators increased their capacity, as did the post-harvest laboratory at the University of Agriculture Faisalabad (UAF). Nursery institutions increased their capacity, but not to the extent preferred. A lack of systematic monitoring data makes it difficult to draw robust conclusions on whether the capacity of extension services improved, and whether project results were disseminated and taken up by other industry stakeholders.

### Outputs

Based on the participatory approach taken, the projects achieved a number of outputs in the areas of scientific knowledge, technologies/practices, and capacity building. Although different outputs have been categorised under different headings, in reality the systems-based nature of the projects means many of the outputs were closely linked to each other and are not easily placed in a single category.

#### Scientific knowledge

**The projects made substantial contributions to increasing scientific knowledge in mango production and value chains in Pakistan.** Key examples include:

- Nursery management: Recommendations for suitable potting mix were developed.
- Germplasm: A germplasm repository at the mango research station in Punjab was established; new rootstock was tested to determine its suitability for Pakistan; and rootstock and cultivar resistance to salinity and diseases was tested.
- Orchard management: Significant research was conducted on pruning, nutrition, disease and pest management, orchard floor management, and integration of management techniques.
- Field and post-harvest diseases and pests: A large amount of research was conducted on diseases and pests, and management options for them. These included, mango sudden death syndrome<sup>38</sup>, mango malformation disease, gall midge, dendritic spots, and mango stem end rots.
- Post-harvest management: Research was conducted in areas such as skin colour development; the role of orchard management on post-harvest disease development; low temperature chilling injury; the effects of ethylene on ripening<sup>39</sup>; fungicides for controlling post-harvest diseases; fruit fly management; and the effects of extended hot water treatment.

The **scientific knowledge developed was shared through a variety of physical outputs**, such as:

- A nursery best practice manual, produced together with the ASLP citrus projects.
- A best practice orchard management manual titled, 'Recommendations for Good Orchard Management in Pakistan', which was translated into Urdu.
- Incorporation of project best practices into the UNIDO/TRTA II Code of Practice, covering farm management, mango production, post-harvest management and processing (noting that miscommunication meant the ASLP project teams were not able to review the Code and were not acknowledged in it).
- Eight nursery pamphlets, 8 disease management pamphlets, 9 orchard management pamphlets, and 12 technical guides covering value chain issues (such as, pre- and post-harvest management; mango skin colour guides; mango defects guide; and market research reports).
- Scientific papers. For the mango production project, this included 22 journal articles, 6 conference proceedings, 4 conference posters, 7 articles for local language journals, and 9 published abstracts. For the value chains project, this included 13 published research papers and 20 papers presented at international conferences.

38 The Phase 1 production project determined the causal agent for mango sudden death syndrome; a significant achievement given researchers previously had diverse views on the disease's cause.

39 Pakistani growers commonly used calcium carbide for ripening, which can cause severe health problems, making the research and adoption of ethylene ripening a very notable achievement.



### *New technologies or practical approaches*

**To demonstrate new technologies or practical approaches, the projects established multiple demonstration and best practice sites and value chains.** These sites were used to both conduct and implement findings from much of the research. The key demonstration activities included:

- Eight modern nurseries at 6 major mango institutions.
- Twenty-four integrated research sites in Punjab and 5 integrated research sites in Sindh to study and test orchard management practices.
- Four value chains. As per the value chains projects' systems approach, the formation of these value chains drew heavily on many other project outputs, such as research conducted on markets and value-add products, implementation of good practice in orchard and post-harvest management, and training of stakeholders. The 4 value chains were:
  - Punjab growers focused on fresh exports: Growers in Punjab were supported to export mangoes to Europe and Asia (China and Malaysia).
  - Punjab smallholders focused on fresh domestic sales: In this value chain, a cluster of 6 smallholder farmers (each with less than 5 hectares of land) worked cooperatively to improve the quality of their fruit. The farmers jointly marketed and sold their fruit directly to consumers, using e-commerce (for example, Facebook), home delivery, and a promotional and sale stall.
  - Sindh growers focused on fresh exports to the UK/Europe<sup>40</sup>: Sindh Mango Growers and Exporters (SMGE) was supported to directly export fresh mangoes to the UK and Europe. Considerable work on sea freight exporting was undertaken.
  - Sindh women focused on local mango pickle sales: Drawing on research conducted by the Sindh Agriculture University, this value chain project trained and supported women from 2 villages to process and sell mango pickles.

### **The value chain projects developed new technologies and practices to enable exports.**

These included:

- Sea freight technology and protocols for sea freight shipment of Pakistani mangoes to the UK/Europe (conducted as part of the SMGE demonstration value chain). The project successfully developed approaches that enable transit times of up to 40 days, with 5- to 7-day shelf life in stores, which is considered global best practice.
- Technical guidance for establishing and accrediting hot water treatment facilities in Punjab.
- Export protocols for the China market.

**The value chain project also supported significant research on mango value-add products.** Sindh Agriculture University (SAU) developed 21 different value-add products and identified 3 products (pickle, dried mango slices, and mango powder) that have potential for village-level production. SAU also conducted supply chain analysis of the mango pickle industry to build a marketing plan for this product. These research outputs were directly linked to the demonstration value chain of Sindh women developing mango pickle.

### **The value chain project also deepened understanding of mango markets and consumers.**

Outputs included:

- Market research on domestic (for example, Karachi, Faisalabad) and export markets (for example, UK, Europe, China and Malaysia).
- Market development undertaken, evaluated and documented for Chinese and Malaysian markets.

### **Capacity building**

The projects took a highly participatory approach to all research and implementation of activities with a view to increasing the capacity of all stakeholders involved. **These participatory approaches were supplemented by formal training, specific capacity support for some organisations, and support for Pakistani students to complete higher degrees.**

Specific outputs included:

- Establishment of a world-class post-harvest research and teaching laboratory at UAF. In particular, the mango projects provided basic equipment, training for staff and students, and support for research related to the mango projects.
- Twenty training sessions on nursery management covering 1,500 participants.
- More than 100 training events on orchard best management practices for 6,233 participants.

<sup>40</sup> These growers formed and operated under a company known as the Sindh Mango Growers and Exporters (SMGE).

- In Phase 2 of the value chain projects, 1,919 males and 146 females were trained in a variety of areas, including post-harvest skills and technologies, market research, and producing value-added products. The participants included growers, contractors, commission agents, exporters, importers, government research and extension staff.
- Training on mango market research for 29 participants from universities, provincial extension and market services, Pakistan Horticulture Development and Export Company (PHDEC) and industry.
- ‘Walking the Chain’ value chain training conducted for 40 undergraduate students.
- A sea freight technology workshop for 150 participants.
- A large number of university degrees were obtained by students associated with the project. For the mango production projects, this included 8 PhDs; 6 MPhils; 21 MScs; 20 BSc (Hons) and 27 BScs. The value chains projects supported 4 PhDs and 26 MScs.

### Adoption and outcomes – immediate beneficiaries

As outlined in the theory of change, the projects sought to achieve adoption and outcomes for 2 main groups. The first group were the growers, nurseries and value chain participants directly involved in the projects, for example, as growers on demonstration sites or participants in a demonstration value chain. Adoption and economic/social outcomes for this group are discussed in this section. The second group was the broader mango industry, including extension services, researchers, growers, nurseries and value chain participants not directly involved in the project.

The participatory approaches used in the mango projects meant nurseries, growers and value chain participants were closely involved in research and in testing new approaches. This means that **participation and adoption were generally the same thing, ensuring high adoption rates.** In other words, participants in demonstration activities adopted the approaches because they were being trialled at their farms, nurseries, or businesses.

There is also **evidence that production best practices were adopted by growers surrounding demonstration farms.** A study conducted in 2013 by the mango production project randomly selected 50 farmers located within a 5-kilometre radius of demonstration sites. The study found that, for the 12 ASLP best practices, half had been adopted by at least 60% of farmers, and 2 of those had been adopted by over 90% of farmers (Fateh n.d.).

For the farmers, nurseries and value chain participants directly involved in the projects, **the outcomes achieved are significant, with some being sustained beyond 2015.**

An outcome from the establishment of the **8 modern nurseries** has been increased availability of high health trees. The production project final report notes that the oldest commercial nursery has produced 35,000 high health plants over 5 seasons, while another nursery exported 35,000 high health plants to the Middle East (Bally 2019).

Mango production project reports also note **good outcomes for growers involved in the production projects.** The production projects’ final report states that, for farmers using ASLP production best practices, mango yields increased by 59% in 2009–10 and 65% in 2010–11. The final report also includes data stating that farmers’ orchard values increased between 2 and 6 times over 5 years (Bally 2019). An important caveat is that the data presented in the reports appears to be based on only a small number of farmers with relatively large farms (at least 55 acres). In addition, interviewees reflected that such data was collected by field staff through informal approaches, rather than in a systematic or rigorous manner. Consequently, such results should be treated with a degree of caution.

It also appears that **the outcomes for participants in the demonstration value chains up to 2015 were strong.** Results for these participants largely come from an impact assessment conducted by the value chain project, meaning the findings are likely to be reliable (Ayyaz et al. 2016).<sup>41</sup> Post-2015, interview data and document review suggest some outcomes have been sustained while others have not.

41 One caveat is that the impact assessment did not have a comparison or control group. This means that we cannot say with certainty that any outcomes were due to the value chain projects, as it is possible that other growers who did not participate in the projects may have experienced similar changes.

For the **growers focused on fresh exports**, the project facilitated the SMGE to export 330 tonnes of mangoes by sea freight to the UK from 2012 to 2015. These exports used on-farm and post-harvest systems developed and supported by the value chain projects. The impact assessment reported that the mangoes achieved an average price of USD2.72 per kilogram, compared with an industry average for exports of less than USD1 per kilogram. The overall export earnings were reported as USD900,000. Interviews demonstrated that the SMGE company continues to operate up to 2021, noting that some interviewees highlighted ongoing challenges and that sea freight transporting may have reduced.

**The value chain projects facilitated 5 trial shipments to China and one trial shipment to Malaysia.** The value chain projects experienced challenges in expanding exports to China because Chinese regulations required mangoes to undergo hot water treatments. There was only one hot water treatment plant in Pakistan and so the project designed micro on-farm hot water treatment plants. At the time the value chain project was wrapping up in 2015, these hot water treatment plants were being registered by Pakistan's Department of Plant Protection (DPP) for export and it was hoped that this would lead to increased exports to China. Interviewees noted that air freight exports to China were continuing up to 2021, with the mango value chain project being key to initiating this market.

For the **Punjab smallholders focused on fresh domestic sales**, the growers were able to sell 43 tonnes of mangoes across 2014 and 2015 at an average price of PKR96 per kilogram, compared with PKR52 per kilogram for similar mangoes in traditional markets. This resulted in a gross return of more than USD20,000 and a 20% net increase in income for the farmers involved. Interviews indicate that this value chain has not continued to operate post-2015 as the key grower leading the value chain left the area.

For the **Sindh women focused on local mango pickle sales**, in 2014, 12 women from one village produced more than 500 kilograms in pickles, generating USD350 in income. In 2015, across 2 villages, women produced more than 2000 kilograms of pickles with a net profit of USD1,060. The women also received repeat orders from 40–50 customers in 2015. In 2018, CABI conducted a follow-up study and found the women's pickle business in one village was continuing to operate effectively. Women had used their profits to re-invest in the business and to buy other assets such as a sewing machine and a computer. The CABI report indicated the second village was not successfully continuing with the pickle business due to multiple challenges such as internal coordination and finances.

The value chain projects also **contributed to positive outcomes for workers in the mango industry**. The impact assessment report highlights that mango growers hired more agricultural graduates as farm managers, while workers trained in improved packing practices charged 20% higher wages. One grower also reported increasing the number of labourers hired for seasonal work (Ayyaz et al. 2016).

### **Adoption and outcomes – broader mango sector**

As outlined in the projects' theory of change, the projects not only aimed to achieve outcomes for the growers, nurseries and value chain participants directly involved in the projects, they also aimed to influence change in the broader mango sector in Pakistan. This section of the report discusses whether these broader outcomes were achieved.

In the ACIAR outcome area of 'innovation enabled', it is clear the projects **demonstrated that value chain principles could work in Pakistan** and provided the foundations for value chain thinking in Pakistan. One interviewee highlighted that the projects resulted in a cohort of Pakistanis who understood the multidisciplinary, value chain oriented way of thinking. The good results achieved for value chain participants are evidence of this.

In the ACIAR **outcome area of 'capacity built', the projects achieved mixed results**. It is clear that the capacity of a number of individual Pakistanis has been increased. For example, a large number of Pakistanis achieved higher degrees with the projects' support. There were multiple examples of Pakistani researchers involved in the project who are building strong careers in horticulture, both within and outside Pakistan. In addition, the final independent review for the value chain projects found that the projects led to a handful of highly competent Pakistani nationals who could be leaders in value chain projects (McEvelly and Laghari 2015b).

For institutions, it is a more mixed picture on whether institutional capacity has been built. **In some cases, it is very difficult to assess changes in institutional capacity**. For example, the final independent review for the value chain project found that, although NARC understood the importance of value chain research and development, the independent team was unable to assess whether this translated into increased capacity to deliver value chain projects (McEvelly and Laghari, 2015b).



The projects also sought to increase the capacity of Pakistan's extension services, aiming for an outcome of improved extension services grounded in participatory approaches. Unfortunately, **this review has not been able to access data or interview representatives of Pakistan's extension services to inform a judgement on whether their capacity has increased.** Other interviewees indicated that quality extension services are a gap in the mango sector and that it is difficult to access specialist extension advice on horticulture. However, given the diverse government partners that provide extension services, and the limited data available for this review, there is insufficient evidence to conclude whether the capacity of extension services changed as a result of the projects.

For some institutions, **capacity appears to have been built, but not to the desired extent.** The production projects established 8 modern nurseries at 6 mango research institutions, with these nurseries producing high health plants at the time of project completion. At the same time, the final independent review for the production project found that 'several of the demonstration nurseries at research institutions had neither fully adopted best practices nor fully understood the principles of managing potting media' (McEvilly and Laghari 2015:5), due to inadequate training and support for Pakistani personnel.

On the positive side, **there is good evidence that capacity of the post-harvest laboratory research and teaching laboratory at UAF was enhanced during the projects, and has likely improved further after the projects.** During the ASLP projects, the laboratory was able to benefit from ASLP equipment and training. From this basis, both during and after the ASLP projects, the laboratory has been able to:

- attract additional funding and research projects from the Government of Punjab and international donors
- continue to collaborate with the mango industry, other researchers, marketers, and the extension system on post-harvest research
- expand its research to other horticulture commodities.

Based on the strong capacity of the laboratory, the ASLP projects have made a substantial contribution to an outcome of an ongoing, well-targeted mango research program that has continued after 2015.

In the long-term, the mango projects aimed to use the increased capacity of a range of partner organisations, an improved research program, and an improved extension system to disseminate the projects' best practices and value chain approaches. This could contribute to sector-wide change in the mango industry, with greater adoption of better production practices and value chain approaches and resulting improved mango quality, sales and exports.

Given the limited resources for this review, **it is challenging to draw robust conclusions on whether these higher-level outcomes have been achieved.**

Some work was done to share the project results with a wide audience. Training was held with large groups to share project results, and multiple conference papers were delivered. The projects were also able to leverage other programs to disseminate best practices. For example, the production projects worked with the Punjab Fruit and Vegetable Project's Farmer Field Schools to disseminate best practices. UNIDO/TRTA II, USAID and Nestlé also used project outputs in manuals and training. A small number of interviewees reflected that the ASLP production and post-harvest practices continued to be used and have spread in Pakistan, while others felt that, while there was a good knowledge basis in the country, there had not been significant widespread change. Given this mixed interview data and the lack of systematic monitoring data on higher-level outcomes, this evaluation has not been able to reach defensible conclusions on the achievement (or otherwise) of such outcomes.

Table 10 summarises adoption of project outputs, while Table 11 summarises capacity built through the projects.

**Table 10** Levels of adoption of key project outputs

Project	New technologies or practical approaches	New scientific knowledge	Knowledge or models for policy and policymakers
ASLP mango production and value chain projects	Nf – Value chain approaches (applies to growers, nurseries, and value chain participants) NF – Participatory, multidisciplinary research (applies to mango research community)	Nf – Best practice production and post-harvest management (applies to growers, nurseries, and value chain participants)	O – Value chain approaches <sup>a</sup>

## 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

(a) The value chain projects demonstrated that value chain approaches can be successful in Pakistan. This could be very useful for policymakers, but influencing policy was not part of the projects' design or implementation.

**Table 11** Capacity built relevant to project outcomes

Who	Skills and knowledge
Nursery-hosting institutions	<ul style="list-style-type: none"> <li>• Best practice nursery management</li> <li>• Improved potting media</li> </ul> Note, findings that capacity was built but likely not to the extent desired
Growers on production project demonstration sites	<ul style="list-style-type: none"> <li>• Best practice orchard management in areas such as pruning, nutrition, and orchard floor management</li> <li>• Disease and pest management, particularly for mango sudden death syndrome and mango malformation disease</li> </ul>
Demonstration value chain participants	<ul style="list-style-type: none"> <li>• Production best practices, where relevant</li> <li>• Post-harvest management in areas such as skin colour, ripening, and post-harvest disease and fruit fly control</li> <li>• Market research and market development</li> <li>• Value-added mango products</li> <li>• Export protocols, for example, in sea freight</li> </ul>
Research / academic community in Pakistan	<ul style="list-style-type: none"> <li>• Market research and market development</li> <li>• Value chain thinking and approaches</li> <li>• Nursery management</li> <li>• Orchard management</li> <li>• Disease and pest management</li> <li>• Post-harvest management</li> </ul>
Key project stakeholders – PHDEC and NARC	<ul style="list-style-type: none"> <li>• Understanding of value chain principles and approaches</li> </ul>



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

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Based on interviews and document reviews, 4 factors have been identified that ensured activities and outputs contributed to the projects' outcomes. These factors were:

- the participatory research approaches
- high quality science
- the systems-based approach
- the leveraging of other projects and funding.

The projects also experienced factors that hindered its achievements, particularly in terms of higher-level outcomes. Specifically, it appears that the assumptions underpinning the projects' theory of change did not hold.

#### Factors contributing to success

One of the key factors contributing to the projects' success was the **participatory approach used for research**. The projects were highly participatory, involving a wide range of stakeholders in research and implementation. This ensured that the projects responded to the needs of the industry and built the capacity of all the stakeholders involved. For the participants in demonstration sites and demonstration value chains, the participatory approach also ensured high adoption rates for ASLP best practices and value chain principles.

A second factor in project success was the **high quality of research conducted**. It is clear from document review and interviews that the projects completed significant scientific research which responded directly to key issues in the Pakistan mango sector. These research outputs underpinned many of the projects' outcomes and so were central to overall project success.

A third factor was the **systems-based approach** implemented by the projects. This approach, which looked at the whole mango system from production to sales, differentiated the mango projects from other ASLP commodity-based projects. The production and value chain projects were well-integrated and linked directly to one another, ensuring each project facilitated the others' success. The systems-based approach also created incentives for project participants to adopt ASLP best practices. For example, by linking growers to markets, growers could see the direct benefits of changing their production and post-harvest practices. This contributed to high adoption rates and the outcomes achieved for project participants.

Finally, the projects were able to **leverage other funding and projects to support their outcomes**.

A good example is the UAF post-harvest laboratory. Following the start provided by ASLP, it was able to secure funding from other sources, and so further strengthen its capacity and influence. The projects were also able to share the ASLP best practices more widely through other projects, such as the UNIDO/TRTA II program.

#### Barriers to success

At the same time, **there were a number of barriers to the projects achieving more, particularly higher-level outcomes related to sector-wide change**. Specifically, it appears that the theory of change assumptions did not hold.

For example, despite good intentions, **the projects struggled to engage commercial agents and contractors from the mango industry**. These 'middlemen' are powerful agents in the mango industry in Pakistan who buy fruit from growers at the orchard flowering stage. Post-purchase, they are generally responsible for orchard management, harvesting and sales. As project documents outline, many of these agents and contractors benefit from the existing system and so have a vested interest in resisting change to it. At the design phase, the mango projects aspired to work with commercial agents and contractors but ultimately struggled to do so, and were only able to reach a small number of such 'middlemen' who were interested in disrupting existing systems. Changing the behaviour of such entrenched actors is very challenging and likely a long-term endeavour. At the same time, without working with these actors it is very difficult for growers to engage with the market signals that would incentivise them to change the pre- and post-harvest practices, and for the projects to contribute to sector-wide change.

It is also **questionable whether the projects did enough to support dissemination of project results to support industry take-up**. As noted in the final independent reviews of the projects, there was no communication strategy to inform the dissemination of results, or a plan for the ongoing maintenance and distribution of the projects' guidelines, manuals and protocols after 2015. This review could also not identify attempts to influence governments or policymakers about the successful value chain approaches. In its reporting, the value chain project also acknowledged that more research was needed to understand how to scale demonstration value chains. This knowledge would be needed to underpin any genuine attempts to scale-up project results to the broader mango sector.

Finally, **the projects struggled to get support from Pakistan government agencies** in areas such as market access and exports. For example, the projects needed Pakistan government assistance to certify hot water treatment plants, which would then enable mangoes treated in these plants to be exported to the UK/Europe. It was challenging to obtain this support, noting this challenge is particularly difficult to overcome without ongoing resources to engage with such government partners.

A key lesson for ACIAR is that projects should be **designed and implemented with long-term sustainability in mind**. The projects may have more successfully achieved higher-level outcomes if a number of factors were in place.

These include:

- early research on how successful scale-up might be implemented
- identification of partners to be the long-term ‘home’ of project outputs
- systems for the ongoing maintenance and dissemination of project outputs
- project engagement with government agencies and sector actors needed for long-term success.

Further, ACIAR could also consider whether longer projects (such as 10-plus years) may be beneficial, given the long-term timeframes needed to change the behaviour of some industry actors and to achieve scale-up.<sup>42</sup>

A summary of factors that influenced adoption of project outputs is provided in Table 12.

**Table 12** Factors influencing adoption and impact

	Factor	Key findings
Knowledge	Do potential users know about the outputs?	Immediate users knew about the outputs. It is questionable whether the broader sector is aware of or can access the outputs.
	Is there continuity of staff in organisations associated with adoption?	PHDEC experienced staff turnover, which may influence long-term sustainability.
	Are outputs complex in comparison with the capability of users?	Best practice production techniques are not complex and should be achievable for many growers. Value chain approaches are complex and strong leadership is required for them (noting the projects developed a cadre of potential leaders in value chain thinking).
Incentives	Are there sufficient incentives to adopt the outputs?	The value chain approach provided direct incentives to adopt production and post-harvest outputs. However, the involvement of contractors/commission agents can prevent growers from accessing market signals, meaning incentives to change are not clear to growers. There was insufficient demand from growers for high health trees, reducing incentives for nurseries to adopt best practices.
	Does adoption increase risk or uncertainty?	Adopting a value chain approach creates risk for participants given it is outside normal practice in Pakistan.
	Is adoption compulsory or effectively prohibited?	Not identified as a constraint for these projects.
Barriers	Do potential users face capital or infrastructure constraints?	Government agency cooperation is needed for export-focused value chains, and there may be significant constraints if such cooperation cannot be obtained. Some smallholder growers may experience capital constraints to implementing best practices (for example, fertiliser, start-up costs for value chains).
	Are there cultural or social barriers to adoption?	The production and value chain approaches are new and there may be resistance from older family members who control family farms and nursery businesses.

<sup>42</sup> Note, ACIAR, as an Australian Government agency, is subject to the funding strategy determined by the government of the day. Such government strategy is not within ACIAR control and may constrain the ability of ACIAR to commit to long-term projects.



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

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It is important to note that the ASLP mango projects were developed in 2005. At the time, there was much less focus on gender, marginalised groups or social aspects of research in research-for-development programs. This is reflected in the mango projects, which did not have strategies for addressing gender issues, or for considering marginalised groups such as people with disability or people facing disadvantage.

However, **despite the lack of strategies in these areas, the projects engaged meaningfully with women and included poorer smallholder farmers.**

The projects employed appropriate approaches to link with these groups. For future projects, more deliberate and thorough gender analysis and social inclusion analysis could further increase project effectiveness by identifying appropriate entry points and possible barriers to adoption that might need to be overcome.

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

### Gender equality

Generally speaking, women play a limited role in the mango industry in Pakistan. Interviews noted that women's engagement with nurseries and orchards was limited, and that reaching women was challenging – particularly in Punjab – due to cultural practices.

**The ASLP mango projects did not have a documented gender equity strategy.** Project documentation is 'gender blind'; it does not address gender issues, power dynamics or the roles of women in the mango industry, noting that ACIAR project documentation at the time did not request this information from projects.

Despite the lack of recognition of gender issues, **the mango projects did involve women in meaningful ways:**

- The projects worked with female researchers and students by supporting their participation in training and conferences. Project documents for the value chain projects state the projects will 'positively discriminate in favor of women on project team activities such as postharvest and market research [and] highlight the existing role of women in the project team at seminars and conferences' (Collins 2014:22).
- Interviewees highlighted that the production projects considered the key roles of women in mango production (for example, packing, weeding, collecting dropped fruit) and encouraged the strengthening of these roles. This included encouraging growers to pay female and male labourers equal rates – noting it is not clear if this parity was achieved, with the value chain impact assessment report stating that female labour was considered by growers to be 'cheap'.
- The value chain projects specifically worked with women to develop the pickles value chain. This resulted in considerable benefits for the women involved, some of which appear to have been sustained beyond 2015.

**The projects also faced barriers to involving women in deeper ways.** Women's relatively limited roles in the mango industry meant there were fewer opportunities to engage with them. Interviewees also highlighted that it is expected that training for village women be conducted by female trainers. However, finding female trainers with appropriate skills was challenging and this further limited opportunities available for women. A small number of interviewees also expressed the view that, as agricultural scientists, project teams were not well-placed to engage with or attempt to change social structures in Pakistan.



## Social inclusion

This section of the report focuses on the extent to which the mango projects were 'pro-poor', or inclusive of poorer smallholder farmers. The review did not identify any mango project activities that addressed the needs of marginalised groups, such as people with disability, ethnic or religious minorities, or disadvantaged youth.

The first phase of the mango projects had a greater focus on medium to large mango growers. This changed in the second phase after the projects' mid-term reviews, which recommended that more attention should be paid to smallholder farmers.

**The mango production projects aimed to work directly with medium to large growers while ensuring that the project results were available to smallholders.** This strategy appears to have been suitable and effective. For example, the production projects undertook research and demonstration work on medium to large farms. This was appropriate, as such farmers had more resources and were able to take on the risks associated with research. At the same time, the demonstration sites on these farms were also relatively small – for example, around one acre – so that it could be shown that the production methods could work on smallholder farms. The production projects' planning also highlighted that increased productivity in commercial orchards would likely benefit rural labourers through increased employment opportunities. This appears to have been the case.

**The production projects aimed to ensure project results were available to smallholder farmers.** The results were included in farmer field schools and recorded in extension materials, which were translated into local languages, and made use of visual aids to assist growers with low literacy.

A number of interviewees highlighted that, although project results were shared with smallholder farmers, **many faced resource constraints to adopting new practices.** This is supported by a study conducted by the production project team (Fateh n.d.). It showed that, for farmers surrounding demonstration plots, adoption of practices increased as education level increased, and that wealthier farmers adopted more practices than poorer farmers. While it is clear that project results were available to smallholder farmers, there is a lack of project data to inform a judgement on whether broader groups of smallholder farmers (for example, those who participated in farmer field schools) actually benefited from the projects.

**The value chain projects also increased their focus on smallholder farmers over time.** In the Phase 2 project, a 'pro-poor' approach was seen as a key enabler for project success. The value chain projects put the propoor approach into practice by supporting a demonstration value chain focused on direct marketing by smallholders, and on value-addition by women.

**The value chain projects also worked with larger, more sophisticated growers.** The project's initial focus was on international markets and larger producers, which was required to develop the production and quality protocols to reach distant markets, open up new export opportunities and generate increased foreign exchange. Some of the value chain projects' greatest successes appear to be with this type of grower.

It is interesting to reflect on whether the value chain projects struck the right balance between supporting smallholders and working with larger, export-focused growers. Some interviewees felt that more could have been done to support more smallholders. Continually reflecting on the right balance will be important for other future value chain projects.

The successes and challenges in gender and social inclusion highlight lessons for future ACIAR projects. Although women and poorer smallholders were reached in the mango projects, **projects can be more effective by conducting gender and social inclusion analysis at project commencement.** In addition, where projects have explicit poverty reduction objectives and seek to engage smallholders, clear strategies need to be built to maximise outcomes for this target group. This is true regardless of project focus, as even projects with an apparently narrow commodity-based focus can have opportunities and consequences related to gender, social inclusion and poverty reduction. Such analysis can identify appropriate entry points and potential barriers for adoption, and consider early strategies to overcome such barriers.



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

Overall, **the management arrangements for the mango projects were effective and enabled the smooth functioning of the projects.** Particularly strong aspects of the management arrangements that facilitated project success included the strong relationships within the mango projects, and the appropriate budget management arrangements. The projects experienced challenges related to staff turnover at a key Pakistani partner, and would have benefited from improved monitoring and evaluation arrangements.

### Relationships within the mango projects

The majority of interviewees highlighted that **strong relationships were key to the mango projects' success.** Within the individual projects, project staff members noted that there was very good communication and trust between the teams based in Australia and Pakistan. In the production projects, for example, the team leader based in Australia would speak to the Pakistan-based project coordinator every 2 weeks. These project staff would engage in joint planning, and the Pakistani coordinator was also given autonomy to implement broad strategies as needed. Interviewees also reflected that this strong communication and trust led to mutual respect, close relationships and a sense that all team members were valued. This, in turn, contributed to excellent team commitment to the projects.

The strong relationships between the teams based in Australia and Pakistan were also **supported by strong coordination by team members based in Pakistan.** Interviewees noted that having in-country coordinators with continuous oversight of the projects was vital for project success. These in-country coordinators were able to implement strong project oversight when Australian team members were unable to travel to Pakistan for security reasons. They also implemented strong communication with other Pakistan-based team members (for example, researchers and extension workers). The mid-term review for ASLP Phase 2 highlighted good project management by the project teams, with interviews also highlighting strong communication between project coordinators and other Pakistani team members (for example, researchers and extension workers).

### Budget management arrangements

Interviews highlighted that the **projects' budget management arrangements were vital to the projects' success.** Key features included:

- Funds were held in Pakistan by an international organisation, rather than by a Pakistan government entity. This ensured that funds were easily accessible and not subject to restrictive government processes (for example, needing to procure goods from registered government suppliers). The projects paid a fee to the international organisation, but this was considered worthwhile due to the flexibility provided.
- The projects used context-appropriate budget management systems. For example, value chain projects would develop an annual work plan and a budget for this workplan, which provided annual flexibility in activity budget allocations. The project leader would review activity budgets to ensure unnecessary items were not included and value-for-money principles were adhered to. The projects also asked partner institutions to agree to budgets so that it was clear how much funding would flow to research teams. This led to effective budget management as well as savings that were re-directed to the projects' impact assessment activity.

### Management challenges

There were 2 areas where management arrangements inhibited project performance. **There were continual senior management changes at one of the key partner organisations** – the PHDEC. Interviewees reflected that this slowed project progress, as it could take time for PHDEC to appoint replacement staff. Continual changes also meant PHDEC was not as strong as expected providing oversight and support to the projects.

**The projects did not have strong monitoring and evaluation arrangements.** This is not surprising. Similar to the gender and social inclusion, monitoring and evaluation was not a clear focus for ACIAR projects when the mango projects commenced. It is positive that the value chain project conducted its own impact assessment, and this contributed to our current understanding of project success. Apart from this, data collection was not systematic or designed to understand higher-level outcomes, and no comparison groups were used. This makes it difficult for project leaders to understand progress during projects and adjust accordingly; for projects and ACIAR to report results to funders for accountability purposes; and for projects and ACIAR to draw conclusions on project success, in areas such as capacity and industry adoption. A lesson is that future ACIAR projects should collect such data to inform program improvements and accountability.

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

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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 ASLP mango projects demonstrate good alignment with each of these goals**, noting the lack of systematic monitoring data makes it difficult to assess project contributions to achieving these goals.

This review also examined the extent to which the ASLP 'programmatic' approach added value to the mango projects. **The value chain and production projects benefited from being part of ASLP**, as the program enabled close collaboration between the 2 project areas. At the same time, **collaboration between the mango and social science projects was not as strong as anticipated** – likely to the detriment of all projects.

### Capacity of research and extension systems

**There is good alignment between the mango projects and the goal of enhancing the capacity of Pakistan's research and extension systems.** The projects contributed to a better research capacity, particularly through support to the UAF post-harvest research laboratory. While efforts were made to increase extension capacity, the lack of systematic data precludes a robust assessment of whether this was achieved.

### Poverty alleviation for smallholder farmers

**The mango projects were appropriately pro-poor and were well-aligned with the ASLP goal of supporting smallholder farmers.** The production projects had appropriate strategies in place to ensure project results were available to smallholder farmers, while the value chain projects implemented one demonstration value chain specifically focused on smallholders.

Given it was not possible for the value chain projects to scale-up value chains, and the lack of data on the adoption of ASLP best practices by smallholders outside the demonstration sites, it is challenging to make a robust assessment of whether the projects resulted in wider adoption or outcomes for smallholder farmers. Greater poverty alleviation may have been achieved with more targeted gender and social inclusion analysis for the projects.

### Supporting value chains

**It is clear that the projects explicitly supported value chains**, given the focus of the value chain projects and the links between the production and value chain projects. The projects also achieved outcomes in this area by demonstrating that value chain approaches could function in Pakistan.

One area where perhaps more value chain work could have been undertaken was for nurseries in the production projects. The production projects' final independent review highlighted that more work was needed to convince farmers of the benefits of high health trees, and through this, create greater incentives for more nurseries to adopt ASLP nursery management practices.

### Programmatic level value-add


**ASLP put in place a small number of processes to facilitate a 'programmatic' approach.** In both phases, a key approach was an annual meeting of project teams in Australia. These annual meetings were designed to help build relationships and foster collaboration between the different project teams. Joint trainings were also conducted with all project teams in areas such as communication skills, and extension theory and methods.

A further approach was added for ASLP's second phase, when the social science project (ASEM/2010/003) was added to the program. This project, which was run by a team from the University of Canberra, aimed to:

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

Based on interviews, **it is clear that the 2 mango projects collaborated well with each other.** One project team member stated that 'all the achievements in the value chain project were really supported by the production project'. Interviewees described how the projects:

- had joint meetings in Australia and Pakistan
- worked together to jointly determine what each project should focus on to avoid duplication
- referred any problems that were identified to the project best placed to address them
- used some of the same farms and growers in Phase 2, where appropriate.



It is also clear **that this collaboration was enabled by the projects coming under the ASLP umbrella.**

There were clearly natural linkages and goal alignment between the projects. However, the ASLP/ACIAR teams also drove collaboration to ensure it actually took place, for example, by facilitating the annual ASLP meetings. In some interviewee views, the close interaction between the production and value chain projects would not have taken place without ASLP, given the projects had different partners in Pakistan and that production and value chain projects have not traditionally worked together.

Unfortunately, **collaboration between the mango projects and the Phase 2 social science project was not as strong as anticipated.** The mango projects' Phase 2 proposals outlined strong aspirations for working with the social science project, for example, to seek their assistance to engage smallholders, women and commission agents, and ensure project benefits extended to the poor and marginalised.

There is some evidence of the social and mango projects working together. For example:

- The final report for the value chain projects mentions that value chain projects worked with the social science project to facilitate training of village women in pickle production and marketing.
- Some community centres established by the social science project appear to have been linked with value chain and production initiatives in the same villages.

However, both project documents and interviews outlined **that collaboration between the social science and mango projects was less than ideal.** The general view from interviewees was that the mango and social science projects were not able to add significant value to each other's work. A number of explanations for this were provided, including:

- The purpose of the social science project was unclear and it was 'tacked on' to ASLP. There were also different views and expectations on entry points and what success might look like for the social project.
- The objectives of the mango and social science projects were not well aligned. Mango project members felt the data collected by the social science project was too general to be helpful.
- The projects struggled to find common ground where they could work easily together. This was likely exacerbated by the social science project starting in Phase 2 after the mango projects had established partners and sites. The social science project also required some time to come to grips with the program and be in a position to support other projects.

- The social science and mango projects had different research approaches and this made collaboration more challenging, as illustrated by this quote from the final report for the mango value chain project: 'The value chain research approach was more active and interventionist while the social project's approach emphasised observation, description and reflection, with a tendency to avoid direct involvement in actions to improve situations being studied. This reliance on two different methodologies, while entirely defensible for each project, added a further layer of complexity in terms of working to mutually agreeable timetables' (Collins, Sun and Ayyaz 2015:38).
- A small number of interviewees felt that the relationships between mango and social science projects were not open or trusting, as the social science project was overly critical and not supportive of the mango projects.

A key lesson from the strong relationships within projects, the strong relationships between projects, and the challenges between the mango and social science projects is that the **importance of appropriate team membership cannot be underestimated.** This is particularly true for multidisciplinary and/or systems-based approaches that require close cooperation across many disciplines. Such teams require appropriate expertise, but also require like-minded team players who are open to interdisciplinary ways of working, are collaborative, and are able to build strong relationships across countries and projects. Project team members also stated a strong preference for having all expertise – including in social sciences – integrated into a single team to ensure all team members are working towards the same goals.

## Conclusions and lessons learned

Overall, the mango projects achieved a significant number of outputs. They generated new scientific and market knowledge, and created multiple demonstration sites. This led to strong outcomes for direct participants in demonstration sites, and increased capacity for project collaborators and the University of Agriculture Faisalabad (UAF) post-harvest laboratory. However, it is difficult to assess the capacity changes for some organisations, as well as whether higher outcomes around dissemination and broad adoption by the industry have been achieved, due to the limits of the projects' monitoring and evaluation systems.

The projects' achievements were supported by participatory and systems-based approaches, and high-quality science. Strong relationships within and between project teams, as well as good budget management, also facilitated project success.

### Lessons learned

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

- 1. Projects need monitoring systems that systematically collect data on changes in capacity and broad uptake by industry.** This would allow projects and ACIAR to understand if, during their lifetime, the projects are making progress towards higher-level outcomes. If progress is not being made as desired, adjustments could be made as required. Systematic monitoring systems would also ensure more data was available to make a case for whether outcomes have been achieved in the long-term.
- 2. ACIAR and project teams should design and implement projects with long-term sustainability in mind.** This could include early research on how successful scale-up might be implemented; identification of partners to be the long-term 'home' of project outputs; systems for the ongoing maintenance and dissemination of project outputs; and project engagement with government agencies and sector actors who are needed for long-term success. Further, ACIAR could also consider whether longer projects (for instance, 10-plus years) may be beneficial, given the long-term timeframes needed to change the behaviour of some industry actors and to achieve scale-up.
- 3. Gender analysis and social inclusion analysis, and the development of gender and social inclusion strategies, should be undertaken at the start of project planning.** This will assist projects to develop a more strategic approach to influencing gender equity, to ensuring people with disability and other marginalised groups can benefit from projects, and to developing clear strategies which maximise poverty-reduction outcomes for smallholders. This holds true regardless of the research focus: even projects with an apparently narrow focus (for example, commodity production) can have potential consequences and opportunities related to gender and social inclusion.
- 4. The importance of appropriate project team membership cannot be underestimated.** This is particularly true for multidisciplinary and/or systems-based approaches that require close cooperation across many disciplines. Such teams require appropriate expertise, but also require like-minded team players who are open to interdisciplinary ways of working, are collaborative, and are able to build strong relationships across countries and projects. Consideration should also be given to integrating social science expertise into commodity-based teams.





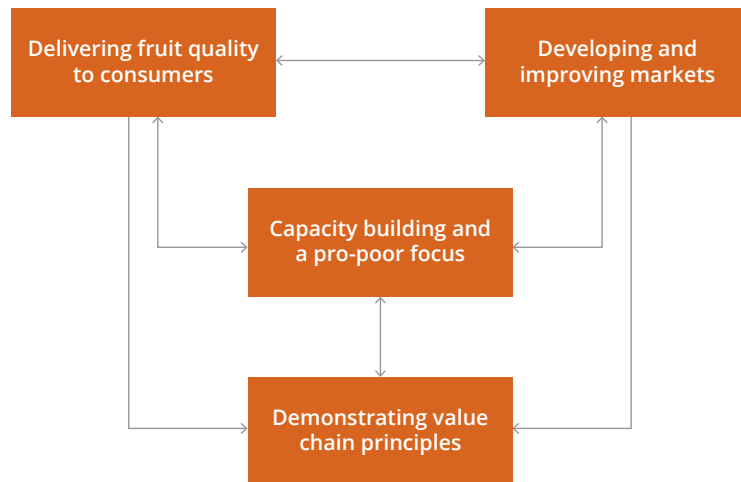
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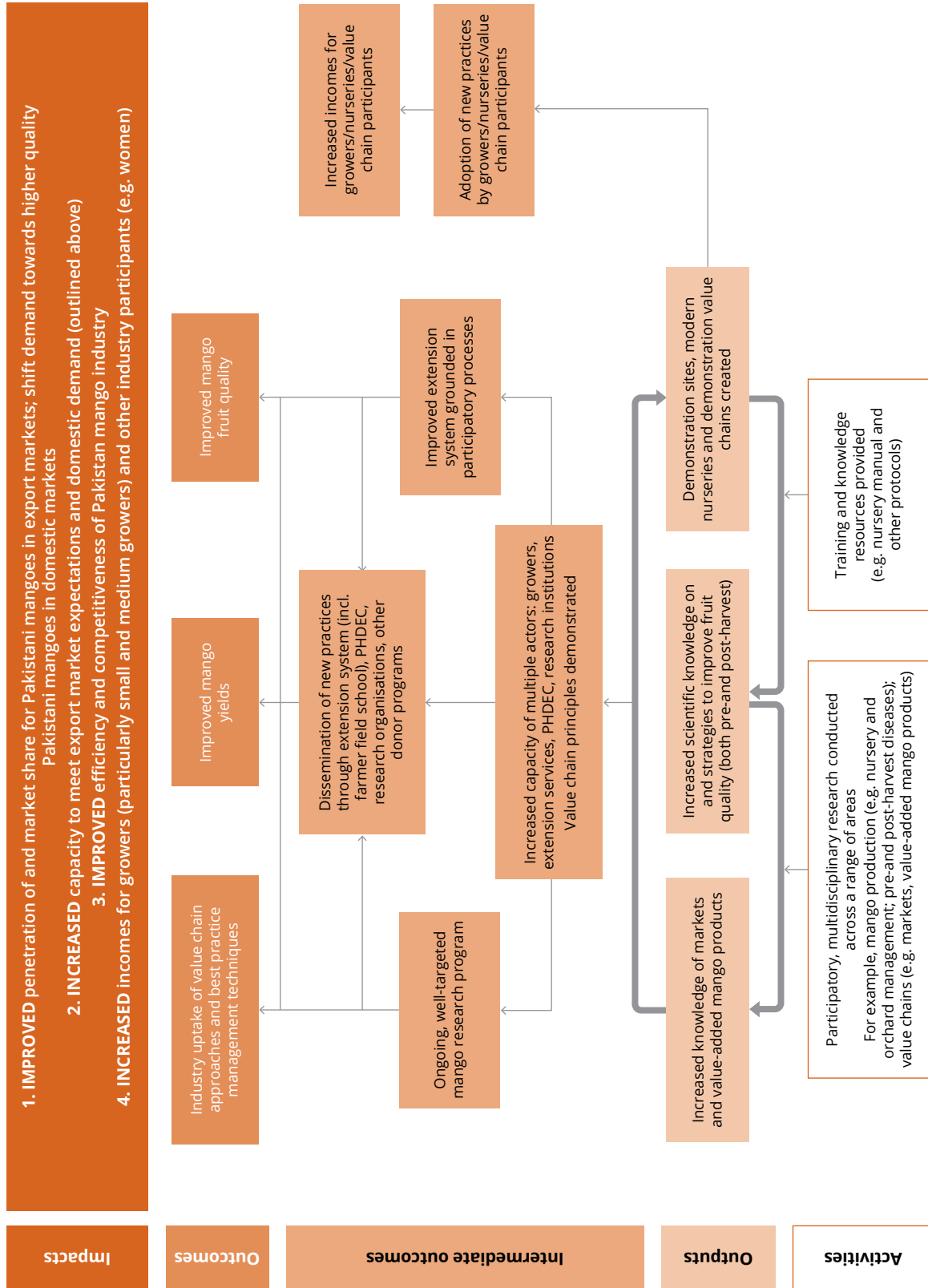
# Appendixes

## Appendix 4.1: Value chain projects' concept



Source: Collins R (2014) *Project proposal: Mango value chain improvement (variation July 2014)*.

## Appendix 4.2: Theory of change





## Appendix 4.3: Stakeholders consulted

Name	Title	Organisation or location
Dr Ian Bally	Project Leader – Production	Queensland Department of Primary Industries
Mr Tariq Khan	President	Mango Grower Association Multan
Mr Hadi Leghari (written inputs only)	Project collaborator	Asim Farm Sindh
Professor Ray Collins	Project Leader – Value Chains	University of Queensland
Dr Aman Malik	Head of Post-harvest Laboratory	University of Agriculture Faisalabad
Mr Sohail Ayaz	Project Coordinator – Value Chains	Based in NARC for the projects
Mr Mohmmod Shad	Grower	Sindh Mango Growers and Exporters
Dr Greg Johnson	Consultant and Program Coordinator (Phase 1)	ACIAR (formerly)
Dr Kazmi Munawar	Project Coordinator – Production (Phase 1) ACIAR Country Manager, Pakistan (Phase 2)	ACIAR



## Appendix 4.4: 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
<p>1. What was the project's theory of change; and how did this evolve during implementation?</p> <ul style="list-style-type: none"> <li>- Was the theory of change appropriate to the project context and desired results?</li> </ul>	<ul style="list-style-type: none"> <li>Documented theory of change at project commencement</li> <li>Information on subsequent changes</li> <li>Information on project context</li> <li>Perspectives of key stakeholders regarding appropriateness of the theory of change</li> </ul>	<ul style="list-style-type: none"> <li>Project concept / design documents and variations</li> <li>Project progress reports, annual plans etc</li> <li>Key stakeholders (project managers and collaborating partners, program manager/ coordinator, government authorities, producers, businesses)</li> </ul>	<ul style="list-style-type: none"> <li>Desk review of available documents</li> <li>Interviews with key stakeholders</li> <li>Triangulation of findings from different sources</li> <li>Project verification workshops</li> </ul>
<p>2. What outcomes (intended and unintended) has the project achieved or contributed to?</p> <ul style="list-style-type: none"> <li>- What was the unique knowledge contribution of the project/cluster that was/is expected to influence practice/policy?</li> <li>- To what extent is there evidence of adoption of new practices based on research process and findings?</li> </ul>	<ul style="list-style-type: none"> <li>Robust, documented evidence of progress towards planned outputs and outcomes (including progress along adoption pathways), and any unintended consequences</li> <li>Theory of change assessment from KEQ1</li> <li>Perspectives of key stakeholders, to test/validate written reporting, including 'next users' of research outputs</li> </ul>	<ul style="list-style-type: none"> <li>Annual and/or final reports</li> <li>Mid-term and/or final reviews</li> <li>Key stakeholders (as above)</li> </ul>	<ul style="list-style-type: none"> <li>Desk review of available documents</li> <li>Interviews with key stakeholders</li> <li>Triangulation of findings from different sources</li> <li>Project verification workshops</li> <li>ACIAR progress assessment and analysis tools (e.g. Table 9 and Table 10)</li> </ul>
<p>3. How did project activities and outputs contribute to the outcomes achieved?</p> <ul style="list-style-type: none"> <li>- To what extent and how did they differ from what was planned?</li> </ul>	<ul style="list-style-type: none"> <li>Theory of change assessment from KEQ1</li> <li>Documented evidence of impact pathways, as per KEQ2</li> <li>Perspectives of key stakeholders including 'next users' of research outputs</li> </ul>	<ul style="list-style-type: none"> <li>Annual and/or final reports</li> <li>Mid-term and/or final reviews</li> <li>Key stakeholders (as above)</li> </ul>	<ul style="list-style-type: none"> <li>Documentation review, stakeholder interviews, triangulation, verification workshops</li> <li>Analysis of adoption and impact pathways, including 'next users' (e.g. Table 9 and Table 10)</li> </ul>

## Appendix 4.4: 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"> <li>– How did the project impact men and women differently?</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence of analysis/awareness of the potential gender equity issues that may impact on the project</li> <li>• Evidence of steps taken to address the issues identified</li> <li>• Evidence of level of participation of women and men in research activities</li> <li>• Evidence on 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)</li> <li>• Perspectives of key stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>• Documented gender strategy or analysis (if available)</li> <li>• 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</li> <li>• Any existing gender audits or inclusion-focused reviews</li> <li>• Key stakeholders (as above)</li> </ul>	<ul style="list-style-type: none"> <li>• Documentation review, stakeholder interviews, triangulation, verification workshops</li> <li>• Gender analysis to explore the level and type of participation of men and women, and influence on positive or harmful gender norms</li> </ul>
<p>5. How did management arrangements impact delivery of the project?</p> <ul style="list-style-type: none"> <li>– What other factors influenced project performance?</li> </ul>	<ul style="list-style-type: none"> <li>• Any existing reporting and commentary on management arrangements</li> <li>• Perspectives of key stakeholders</li> <li>• Evidence of contextual factors external to the project that may have impacted performance</li> </ul>	<ul style="list-style-type: none"> <li>• Annual and/or final reports</li> <li>• Mid-term and/or final reviews</li> <li>• Key stakeholders (as above)</li> </ul>	<ul style="list-style-type: none"> <li>• Documentation review, stakeholder interviews, triangulation, verification workshops</li> <li>• ACIAR progress assessment tools (e.g. Table 11)</li> </ul>
<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"> <li>– To what extent has the programmatic approach added value at project level?</li> </ul>	<ul style="list-style-type: none"> <li>• Assessment of KEQs 1–5</li> <li>• Information on program goal and approach</li> <li>• Relevant existing reporting and commentary</li> <li>• Perspectives of key stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>• Annual and/or final reports</li> <li>• Mid-term and/or final reviews</li> <li>• Key stakeholders (as above)</li> </ul>	<ul style="list-style-type: none"> <li>• Assessment of consistency and value-add, based on analysis for KEQs 1–5 and supplementary program-level documentation, stakeholder interviews and verification workshops</li> </ul>



## Appendix 4.5: 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 4.6: Project team members

#	Team member	Gender	International/National researcher
<b>Production projects – HORT/2005/153 and HORT/2010/006</b>			
1	Dr Chrys Akem	M	International
2	Bob Williams	M	International
3	Tony Cooke	M	International
4	Ian Bally	M	International
5	Rowland Holmes	M	International
6	Lisa Still	F	International
7	Kerry-Lee Stockdale	F	International
8	Jan Dean	F	International
9	Dr Iftikhar Ahmad	M	National
10	Munawar Kazmi	M	National
11	Tariq Malik	M	National
12	Muhammad Ikhlaq	M	National
13	Dr Atta Soomro	M	National
14	Igrar A Khan	M	National
15	Abdul Buriro	M	National
16	Ahmad Mubarik	M	National
17	Hadi Leghari	M	National
18	Lindy Coates*	F	International
19	Tony Cooke*	M	International
20	Dr Ian Newton	M	International
21	Paula Boccalatte	F	International
22	Faisal Sohail Fateh	M	National
23	Khalid Mahmood	M	National
24	Dr Saeed Shafqat	M	National
25	Dr Kazi Memon	M	National
26	Yousif Channa	M	National
27	Asif Iqbal	M	National
<b>Value chain projects – HORT/2005/157 and HORT/2010/001</b>			
28	Ray Collins	M	International
29	Tony Dunne	M	International
30	Jodie Campbell	F	International
31	Dr Peter Hofman	M	International
32	Terry Campbell	M	International
33	Lee Barker	M	International



## Appendix 4.6: Project team members (cont.)

#	Team member	Gender	International/National researcher
34	Rod Jordan	M	International
35	Peter Johnson	M	International
36	Muhammad Iqbal	M	National
37	Dr Aman Ullah Malik	M	National
38	Dr Khalid Mustafa	M	National
39	Majid	M	National
40	Asif	M	National
41	Mr Nizamani	M	National
42	Mahmood Shah	M	National
43	Tim Sun	M	International
44	Peter Hofman	M	International
45	Leigh Barker	M	International
46	Lindy Coates*	F	International
47	Tony Cook*	M	International
48	Greg Johnson	M	International
49	Dr Barbar Ehsan Bajwa	M	National

\* Part of both value chain and production project series.



## Appendix 4.7: Research outputs

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Abdul J, Malik AU, Anwar R, Ayub M, Rajwana IA, Amin M, Khan AS and Saeed M (2011) 'Effect of combined application of fungicides and hot water quarantine treatment on postharvest diseases and quality of mango fruit', <i>Pakistan Journal of Botany</i> , 43(1):65–73. <b>Impact factor: 0.947</b>	Abdul (Male, Pakistan) Malik (Male, Pakistan) Anwar (Male, Pakistan) Ayub (Male, Pakistan) Rajwana (Male, Pakistan) Amin (Male, Pakistan) Khan (Male, Pakistan) Saeed (Male, Pakistan)
Abro MA, Marri SA, Kumar L, Pussio GB, Jatoi GH (2014) 'Behaviour of <i>Fusarium nivale</i> causal agent of mango malformation against different culture media and range of different temperatures and in-vitro control', <i>European Academic Research Journal</i> , 2(8):10089–10113.	Abro (Male, Pakistan) Marri (Male, Pakistan) Kumar (Male, Pakistan) Pussio (Male, Pakistan) Jatoi (Male, Pakistan)
Amin M, Malik A, Khalid MS and Anwar R (2013) 'Fruit harvest maturity indicators for mango cultivars 'Sindhri' and 'Samar Bahisht Chaunsa'', <i>Acta Horticulturae</i> , 992:561–567.	Amin (Male, Pakistan) Malik (Male, Pakistan) Khalid (Male, Pakistan) Anwar (Male, Pakistan)
Amin M, Malik AU, Khan AS and Javed N (2011) 'Potential of fungicides and plant activator for postharvest disease management in mangoes', <i>International Journal of Agriculture and Biology</i> , 13:671–676. <b>Impact factor: 0.940</b>	Amin (Male, Pakistan) Malik (Male, Pakistan) Khan (Male, Pakistan) Javed (Male, Pakistan)
Arif AM, Malik MT, Hussain N, Ahmad I and Bally ISE (2015) 'Management of Mango Decline using Thiophanate Methyl and Plant Activators through a Macro Infusion System', <i>Acta Horticulturae</i> , 1105:35–38.	Arif (Male, Pakistan) Malik (Male, Pakistan) Hussain (Male, Pakistan) Ahmad (Male, Pakistan) Bally (Male, Australia)
Asif I, Fateh FS, Munawar KR, Chrys AN, Bhar PG and Nazim LH (2011) 'Trend of mango sudden death syndrome (MSDS) in relation to fungal microflora and nematodes fauna in Punjab, Pakistan', <i>Pakistan Journal of Nematology</i> , 29(1):45–51.	Asif (Male, Pakistan) Fateh (Male, Pakistan) Munawar (Male, Pakistan) Chrys (Male, Australia) Bhar (Male, Pakistan) Nazim (Male, Pakistan)
Asma R, Shazia I and Ahmad I (2013) 'Study on incidence, molecular characterization and pathogenesis of different fungi associated with sudden death of mango', <i>International Journal of Agronomy and Plant Production</i> , 4(Special Issue):3485–3488.	Asma (Female, Pakistan) Shazia (Female, Pakistan) Ahmad (Male, Pakistan)
Collins R and Iqbal M (2011) 'Integrating postharvest, marketing and supply chain systems for sustainable industry development: the Pakistan mango industry as work-in-progress', <i>Acta Horticulturae</i> , 895:91–97.	Collins (Male, Australia) Iqbal (Male, Pakistan)
Dunne A and Johnson P (2011) 'The rapid supply chain appraisal approach: A case study of Pakistan mangoes to the United Kingdom', <i>Acta Horticulturae</i> , 895:107–112.	Dunne (Male, Australia) Johnson (Male, Australia)



Peer-reviewed journal articles	
Publication	Author (gender, nation)
Fateh FS, Kazmi MR, Ahmed I and Ashraf M (2006) 'Ceratozystis Frimbriata isolated from Vascular Bundles of Declining Mango Trees in Sindh, Pakistan', <i>Pakistan Journal of Botany</i> , 38(4):1257–1259.	Fateh (Male, Pakistan) Kazmi (Male, Pakistan) Ahmad (Male, Pakistan) Ashraf (Male, Pakistan)
Hafeez O, Malik AU, Khan AS, Rehman A and Javaid QA (n.d.) 'Impact of different packaging types and low temperature shipping durations on fruit quality and marketability of Pakistani mangoes', <i>International Journal of Agriculture and Biology</i> , 14:47–54.	Hafeez (Male, Pakistan) Malik (Male, Pakistan) Khan (Male, Pakistan) Rehman (Male, Pakistan) Javaid (Male, Pakistan)
Hainzer K, Best T and Brown P (2019) 'Local value chain interventions: a systematic review', <i>Journal of Agribusiness in Developing and Emerging Economies</i> , 9(4):369–390.	Hainzer (Male, Australia) Best (Female, Australia) Brown (Male, Australia)
Iqbal N and Shafqat S (2012) 'Isolation of mango quick decline fungi from mango bark beetle, <i>Hypocryphalus mangiferae</i> S.(Coleoptera: Scolytidae)', <i>The Journal of Animal Science</i> , 22:644–648.	Iqbal (Male, Pakistan) Shafqat (Male, Pakistan)
Iram S and Abrar S (2014) 'Isolation and Molecular Characterization of <i>Lasiodiplodia theobromae</i> by SSR Markers', <i>International Journal of Agronomy and Plant Production</i> , 5(1):31–36. <b>Impact factor: 0.467</b>	Iram (Female, Pakistan) Abrar (Female, Pakistan)
Iram S and Abrar S (2015) 'Pathological and molecular characterization of post harvest fungal pathogens of mango', <i>International Journal of Agronomy and Plant Production</i> . <b>Impact factor: 0.467</b>	Iram (Female, Pakistan) Abrar (Female, Pakistan)
Iram S and Ahmad I (2013) 'Major post-harvest diseases of mango and their management', <i>International Journal of Agronomy and Plant Production</i> , 4(12):3470–3484. <b>Impact factor: 0.467</b>	Iram (Female, Pakistan) Ahmad (Male, Pakistan)
Iram S, Rasool A and Ahmad I (2014) 'Comparison of Incidence, Prevalence and Severity of Post-Harvest Fungal Diseases in Pakistan improved integrated management orchards and conventional practices blocks', <i>International Journal of Science and Engineering Research</i> , 5(10):1274–1284. <b>Impact factor: 3.2</b>	Iram (Female, Pakistan) Rasool (Male, Pakistan) Ahmad (Male, Pakistan)
Jabbar A, Malik AU, Maqbool M, Amin M, Saeed M and Hameed R (2012) 'Anti-sap chemicals and hot water quarantine treatment effects on storage life and fruit quality of mango cv. Samar Bahisht Chaunsa', <i>Pakistan Journal of Botany</i> , 44(2):757–64. <b>Impact factor: 0.907</b>	Jabbar (Male, Pakistan) Malik (Male, Pakistan) Maqbool (Male, Pakistan) Amin (Male, Pakistan) Saeed (Female, Pakistan) Hameed (Female, Pakistan)

## Appendix 4.7: Research outputs (cont.)

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Jabbar A, Malik AU, Saeed M, Malik OH, Amin M, Khan AS, Rajwana IA, Saleem BA, Hameed R and Mazhar MS (2011) 'Performance of hot water phytosanitary treated mangoes for intended export from Pakistan to Iran and China', <i>International Journal of Agriculture and Biology</i> , 13:645–651. <b>Impact factor: 0.940</b>	Jabbar (Male, Pakistan) Malik AU (Male, Pakistan) Saeed (Female, Pakistan) Malik OH (Male, Pakistan) Amin (Male, Pakistan) Khan (Male, Pakistan) Rajwana (Male, Pakistan) Saleem (Male, Pakistan) Hameed (Female, Pakistan) Mazhar (Male, Pakistan)
Johnson P, Malik AU, Malik OH and Campbell J (2013) 'Issues and advances in commercializing sea-freight technology of mangoes', <i>Acta Horticulturae</i> , 992:75–85.	Johnson (Male, Australia) Malik AU (Male, Pakistan) Malik OH (Male, Pakistan) Campbell (Female, Australia)
Kazmi MR, Fateh FS and Jabeen A (2008) 'Role of general mango-orchard management in disease development', <i>Science Technology and Development</i> , 27(3&4):42–44.	Kazmi (Male, Pakistan) Fateh (Male, Pakistan) Jabeen (Female, Pakistan)
Kazmi MR, Fateh FS, Majeed K, Kashkhely AM, Hussain I and Jabeen A (2005) 'Incidence and etiology of mango sudden death phenomenon in Pakistan', <i>Pakistan Journal of Phytopathology</i> , 17(2):154–458.	Kazmi (Male, Pakistan) Fateh (Male, Pakistan) Majeed (Male, Pakistan) Kashkhely (Male, Pakistan) Hussain (Male, Pakistan). Jabeen (Female, Pakistan)
Khan AS, Malik AU, Raza SA, Asad HU, Amin M and Razzaq K (2014) 'Locality and orchard management influence fruit quality of low temperature stored mangoes', <i>International Journal of Fruit Science</i> , 14(3):327–340.	Khan (Male, Pakistan) Malik (Male, Pakistan) Raza (Male, Pakistan) Asad (Male, Pakistan) Amin (Male, Pakistan) Razzaq (Male, Pakistan)
Khaskheli MI, Jiskani MM, Soomro MH, Talpur MA and Poussio GB (2011) 'Prevalence of mango sudden decline/death syndrome (MSDS) on various varieties at the orchards of different age in the vicinity of Tando Qaiser, Hyderabad, Sindh', <i>Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences</i> , 27(2):160–167.	Khaskheli (Male, Pakistan) Jiskani (Male, Pakistan) Soomro (Male, Pakistan) Talpur (Male, Pakistan) Poussio (Male, Pakistan)



Peer-reviewed journal articles	
Publication	Author (gender, nation)
Malik AU, Hafeez O, Johnson P, Campbell JA, Amin M, Saeed M, Mazhar MS, Schouten S and Adeel J (2010) 'Toward developing a sea-freight supply chain for delivering Pakistani mangoes to European supermarket: a private-public sector model', <i>Acta Horticulturae</i> , 880:83–89.	Malik (Male, Pakistan) Hafeez (Male, Pakistan) Johnson (Male, Australia) Campbell (Female, Australia) Amin (Male, Pakistan) Saeed (Female, Pakistan) Mazhar (Male, Pakistan) Schouten (Male, the Netherlands) Adeel (Male, Pakistan)
Malik MT, Khan SM, Khan MA, Dasti AA, Kazmi, Grewal AG and Awan MZ (2010) 'Confirmation of the capability of <i>Ceratocystis fimbriata</i> to cause mango sudden death syndrome in Pakistan', <i>Pakistan Journal of Phytopathology</i> , 22(2):120–125.	Malik (Male, Pakistan) Khan SM (Male, Pakistan) Khan MA (unknown) Dasti (unknown) Kazmi (Male, Pakistan) Grewal (Male, Pakistan) Awan (Male, Pakistan)
Malik MT, Munaza R, Atiq-ur-Rehman, Bally I and Amae M (2014) 'Chemical and cultural management of dieback disease of mango in Pakistan', <i>Acta Horticulturae</i> , 1111:363–368.	Malik (Male, Pakistan) Munaza (unknown) Atiq-ur-Rehman (Male, Pakistan) Bally (Male, Australia) Amae (Male, Pakistan)
Malik AU, Umar M, Hameed R, Amin M, Asad HU, Hafeez O and Hofman PJ (2013) 'Phytosanitary irradiation treatments in relation to desapping and processing types affect mango fruit quality', <i>Acta Horticulturae</i> , 1012:681–692.	Malik (Male, Pakistan) Umar (Male, Pakistan) Hameed (Female, Pakistan) Amin (Male, Pakistan) Asad (Male, Pakistan) Hafeez (Male, Pakistan) Hofman (Male, Australia)
Masood A, Saeed S, Erbilgin N and Jung Kwon Y (2010) 'Role of stressed mango host conditions in attraction of and colonization by the mango bark beetle <i>Hypocryphalus mangiferae</i> Stebbing (Coleoptera: Curculionidae: Scolytinae) and in the symptom development of quick decline of mango trees in Pakistan', <i>Entomological Research</i> , 40(6):316–327.	Masood (Male, Pakistan) Saeed (Male, Pakistan) Erbilgin (Male, Pakistan) Jung Kwon (unknown)
Masood A, Saeed S, Iqbal N, Malik MT and Kazmi MR (2010) 'Methodology for the evaluation of symptoms severity of mango sudden death syndrome in Pakistan', <i>Pakistan Journal of Botany</i> , 42(2):1289–1299.	Masood (Male, Pakistan) Saeed (Male, Pakistan) Iqbal (Male, Pakistan) Malik (Male, Pakistan) Kazmi (Male, Pakistan)

## Appendix 4.7: Research outputs (cont.)

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Masood A, Saeed S, Mahmood A, Malik SA and Hussain N (2012) 'Role of nutrients in management of mango sudden death disease in Punjab, Pakistan', <i>Pakistan Journal of Zoology</i> , 44(3):675–83.	Masood (Male, Pakistan) Saeed (Male, Pakistan) Mahmood (Male, Pakistan) Malik (Male, Pakistan) Hussain (Male, Pakistan)
Masood A, Saeed S, Silveira SF, Akem CN, Hussain N and Farooq M (2011) 'Quick decline of mango in Pakistan: survey and pathogenicity of fungi isolated from mango tree and bark beetle', <i>Pakistan Journal of Botany</i> , 43(3)1793–1798.	Masood (Male, Pakistan) Saeed (Male, Pakistan) Silveira (Male, Brazil) Akem (Male, Australia) Hussain (Male, Pakistan) Farooq (Male, Pakistan)
Mazhar MS, Amin M, Malik AU, Campbell J and Johnson P (2011) 'Improved harvest and desapping practices affect mango fruit quality along the supply chains', <i>International Journal of Agriculture and Biology</i> , 13(5):776–780. <b>Impact factor: 0.940</b>	Mazhar (Male, Pakistan) Amin (Male, Pakistan) Malik (Male, Pakistan) Campbell (Female, Australia) Johnson (Male, Australia)
Mazhar MS, Collins R, Campbell JA, Malik AU, Johnson P, Dunne A, Sun X and Amin M (2010) 'Managing mango fruit quality through the supply chain: a Pakistan case study', <i>Acta Horticulturae</i> , 880:117–124.	Mazhar (Male, Pakistan) Collins (Male, Australia) Campbell (Female, Australia) Malik (Male, Pakistan) Johnson (Male, Australia) Dunne (Male, Australia) Sun (Male, Australia) Amin (Male, Pakistan)
Meer H, Iram S, Ahmad I, Fateh FS and Kazmi MR (2013) 'Identification and characterization of post harvest fungal pathogens of mango from domestic markets of Punjab', <i>International Journal of Agronomy and Plant Production</i> , 4(4):650–658. <b>Impact factor: 0.467</b>	Meer (Male, Pakistan) Iram (Female, Pakistan) Ahmad (Male, Pakistan) Fateh (Male, Pakistan) Kazmi (Male, Pakistan)
Memon N, Bally ISE, Fateh FS, Memon M and Kumar L (2017) 'Raising healthy seedling rootstocks of mango', <i>Acta Horticulturae</i> 1183:139–144.	Memon N (Female, Pakistan) Bally (Male, Australia) Fateh (Male, Pakistan) Memon M (Female, Pakistan) Kumar (Male, Pakistan)



**Peer-reviewed journal articles**

Publication	Author (gender, nation)
<p>Memon M, Dalwani MB, Memon KS, Fateh FS, Bally ISE, Memon N, Akhtar MS, Sheikh SA, Pusio GB and Chachar Q (2017) 'Sulphur stocks in 'Sindhri' mango soils in Sindh, Pakistan, in relation to leaf tissue analysis', <i>Acta Horticulturae</i>, 1183:167-174.</p>	<p>Memon M (Female, Pakistan)            Dalwani (unknown)            Memon KS (Male, Pakistan).            Fateh (Male, Pakistan)            Bally (Male, Australia)            Memon N (Female, Pakistan)            Akhtar (unknown)            Sheikh (unknown)            Pusio (Male, Pakistan)            Chachar (unknown)</p>
<p>Memon M, Goraya AA, Memon KS, Fateh FS, Bally ISE, Kazmi MR, Sheikh SA, Channa MY and Sial TA (2017) 'Nutrient evaluation of 'Sindhri' mango orchards at two growth stages', <i>Acta Horticulturae</i> 1183:213-220.</p>	<p>Memon M (Female, Pakistan)            Goraya (unknown)            Memon, K. S. (Male, Pakistan)            Fateh (Male, Pakistan)            Bally (Male, Australian)            Kazmi (Male, Pakistan)            Sheikh (Female, Pakistan)            Channa (Male, Pakistan)            Sial (unknown)</p>
<p>Naqvi SAH, Perveen R, Malik MT, Malik O, Umer UD, Wazeer MS, Rehman A, Majid T and Abbas Z (2014) 'Characterization of symptoms severity on various mango cultivars to quick decline of mango in district Multan', <i>International Journal of Bioscience</i>, 4(11):157-163.</p>	<p>Naqvi (Male, Pakistan)            Perveen (Female, Pakistan)            Malik MT (Male, Pakistan)            Malik O (Male, Pakistan)            Umer (Male, Pakistan)            Wazeer (Male, Pakistan)            Rehman (Male, Pakistan)            Majid (Male, Pakistan)            Abbas (Male, Pakistan)</p>
<p>Poussio GB, Kazmi MR, Akem C and Fateh FS (2010) 'First record of <i>Ceratocystis fimbriata</i> associated with shisham (<i>Dalbergia sissoo</i>) decline in Pakistan', <i>Australasian Plant Disease Notes</i>, 5(1):63-65.</p>	<p>Poussio (Male, Pakistan)            Kazmi (Male, Pakistan)            Akem (Male, Australia)            Fateh (Male, Pakistan)</p>
<p>Rajwana I, Amin M, Khan A and Saeed M (2011) 'Effect of combined application of fungicides and hot water quarantine treatment on postharvest diseases and quality of mango fruit', <i>Pakistan Journal of Botany</i>, 43(1):65-73.  <b>Impact factor: 0.907</b></p>	<p>Rajwana (Male, Pakistan)            Amin (Male, Pakistan)            Khan (Male, Pakistan)            Saeed (Female, Pakistan)</p>



## Appendix 4.7: Research outputs (cont.)

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Rajwana LA, Malik AU, Bally ISE, Kazmi MR, Kham MI, Rajawana EA and Mahmood K (2013) 'Trends and challenges in mango nursery production in Pakistan', <i>Acta Horticulturae</i> , 992:63–68.	Rajwana (Male, Pakistan) Malik (Male, Pakistan) Bally (Male, Australia) Kazmi (Male, Pakistan) Kham (Male, Pakistan) Rajawana (Male, Pakistan) Mahmood (Male, Pakistan)
Rashid A, Iram S and Ahmad I (2014) 'Molecular characterization of <i>Ceratocystis manginecans</i> sp. from mango in Pakistan', <i>Pakistan Journal of Agricultural Sciences</i> , 51(4):901–905. <b>Impact factor: 1.054</b>	Rashid (Male, Pakistan) Iram (Female, Pakistan) Ahmad (Male, Pakistan)
Raza SA, Khan AS, Malik AU, Amin M, Asad HU and Razzaq K (2013) 'Respiration rate, physico-chemical fruit quality and consumer acceptability for Fajri mango under different storage temperatures', <i>Pakistan Journal of Agricultural Sciences</i> , 50(4):585–590. <b>Impact factor: 1.240</b>	Raza (Male, Pakistan) Khan (Male, Pakistan) Malik (Male, Pakistan) Amin (Male, Pakistan) Asad (Male, Pakistan) Razzaq (Male, Pakistan)
Shafqat S, Khan MI and Masood A (2011) 'Symptom development after artificial inoculation of <i>Botryodiplodia theobromae</i> , a possible causal organism to quick decline in mango trees', <i>Pakistan Journal of Agricultural Science</i> , 48(4):289–294.	Shafqat (Male, Pakistan) Khan (Male, Pakistan) Masood (Male, Pakistan)
Shafqat S, Masood A and Khan SM (2012) 'Diseased plants as a source of dissemination of mango sudden death disease in healthy mango plants', <i>Pakistan Journal of Phytopathol</i> , 24(1):21–25.	Shafqat (Male, Pakistan) Masood (Male, Pakistan) Khan (Male, Pakistan)
Sun X, Collins R, Dunne A, Bajwa B, Mazhar S and Iqbal M (2011) 'A whole of supply chain approach to developing a new market for Pakistan mangoes: The case of China', <i>Acta Horticulturae</i> , 895:277–282.	Sun (Male, Australia) Collins (Male, Australia) Dunne (Male, Australia) Bajwa (Male, Pakistan) Mazhar (Male, Pakistan) Iqbal (Male, Pakistan)
Syed RN, Mansha N, Khaskheli MA, Khanzada MA and Lodhi AM (2014) 'Chemical control of stem end rot of mango caused by <i>Lasiodiplodia theobromae</i> ', <i>Pakistan Journal of Phytopathology</i> , 26(2):201–206.	Syed (Male, Pakistan) Mansha (Male, Pakistan) Khaskheli (Male, Pakistan) Khanzada (Male, Pakistan) Lodhi (Male, Pakistan)



Conference proceedings	
Publication	Author (gender, nation)
Ali Z (28 September – 2 October 2015) 'Evaluation of acoustic firmness technology for non-destructive maturity and ripeness assessment of mangoes', <i>International Mango Symposium</i> , Darwin, Australia.	Ali (Male, Pakistan)
Amin A, Malik A, Razzaq K, Ullah S, Raza S, Khan A and Naseer M (2014) 'Influence of low temperature storage and exogenous ethylene treatment on physico-chemical fruit quality of Sindhri and Samar Bahisht Chaunsa mangoes', <i>4th International and 13th National Conference of Plant Scientists</i> , Saheed Benazir Bhutto University, KPK, Pakistan. (peer-reviewed)	Amin (Male, Pakistan) Malik (Male, Pakistan) Razzaq (Male, Pakistan) Ullah (Male, Pakistan) Raza (Male, Pakistan) Khan (Male, Pakistan) Naseer (Male, Pakistan)
Amin M (28 September – 2 October 2015) 'Dynamics of under skin browning and management prospects under low temperature stored mangoes', <i>International Mango Symposium</i> , Darwin, Australia.	Amin (Male, Pakistan)
Amin M (28 September – 2 October 2015) 'Orchard practices and fruit peel mineral contents influence postharvest disease development and severity of stem end rot in mangoes', <i>International Mango Symposium</i> , Darwin, Australia.	Amin (Male, Pakistan)
Amin M (28 September – 2 October 2015) 'Pre-cooling duration significantly affects post-storage skin colour development, enzymatic activities and organoleptic properties of S.B. Chaunsa mango', <i>International Mango Symposium</i> , Darwin, Australia.	Amin (Male, Pakistan)
Amin M, Malik AU, Asad H, Azeem F, Khalid MS and Khalid S (2014) 'Tree and fruit biological factors associated with mango fruit maturation', <i>XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014)</i> , Brisbane, Australia.	Amin (Male, Pakistan) Malik (Male, Pakistan) Asad (Male, Pakistan) Azeem (Male, Pakistan) Khalid (Male, Pakistan) Khalid (Female, Pakistan)
Ayyaz S (28 September – 2 October 2015) 'Direct marketing of fresh mango: a case study of mango smallholder in Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Ayyaz (Male, Pakistan)
Collins R (28 September – 2 October 2015) 'An integrated approach for developing value added horticultural products at village level in developing countries: a case study of producing and marketing mango pickle by women in a poor village in Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Collins (Male, Australia)
Dunne T (28 September – 2 October 2015) 'New market segment development—the challenges facing exporters from developing countries', <i>International Mango Symposium</i> , Darwin, Australia.	Dunne (Male, Australia)
Fateh F, Ahmed I, Malik T, Bally ISE, Mehmood A and Kazmi, MR (2014) 'Factors affecting the adoption of good mango orchard management practices in Pakistan', <i>IHC2014</i> , Brisbane, Australia.	Fateh (Male, Pakistan) Ahmed (Male, Pakistan) Malik (Male, Pakistan) Bally (Male, Australia) Mehmood (Male, Pakistan) Kazmi (Male, Pakistan)

## Appendix 4.7: Research outputs (cont.)

Conference proceedings	
Publication	Author (gender, nation)
Fetah FS, Ahmad I, Mallik MT and Bally I (17–22 August 2014) 'Factors affecting adoption of good orchard management practices in Pakistan', <i>29th International Horticultural Congress</i> , Brisbane, Australia.	Fetah (Male, Pakistan) Ahmad (Male, Pakistan) Mallik (Male, Pakistan) Bally (Male, Australia) Arif, A. M. (Male, Pakistan) Kazmi, M. R. (Male, Pakistan)
Fateh F, Kazmi M, Akem C, Iqbal A and Bhar G (29 September – 1 October 2009) 'Mango Sudden Death Syndrome Assessment in Various Mango Growing Districts of Punjab, Pakistan', <i>17th Australasian Plant Pathology Society Conference</i> , Newcastle, Australia.	Fateh (Male, Pakistan) Kazmi (Male, Pakistan) Akem (Male, Australia) Iqbal (Male, Pakistan) Bhar (Male, Pakistan)
Fiaz M, Malik A, Amin M, Khan A, Rehman A, Alam M, Hofman P and Johnson P (2014) 'Production locality influences postharvest disease development and quality in mangoes', <i>XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014)</i> , Brisbane, Australia.	Fiaz (Male, Pakistan) Malik (Male, Pakistan) Amin (Male, Pakistan) Khan (Male, Pakistan) Rehman (Male, Pakistan) Alam (Male, Pakistan) Hofman (Male, Australia) Johnson (Male, Australia)
Ibell P, Bally I, Wright C and Maddox C (28 September – 2 October 2015) 'Does soil applications of fulvic acid applied with potassium sulphate influence mango fruit quality?', <i>XI International Mango Symposium</i> , Darwin, Australia.	Ibell (Female, Australia) Bally (Male, Australia) Wright (Female, Australia) Maddox (Female, Australia)
Ibell P, Bally I, Wright C and Maddox C (28 September – 2 October 2015) 'When is the best time to apply postharvest Nitrogen fertiliser?' <i>XI International Mango Symposium</i> , Darwin, Australia.	Ibell (Female, Australia) Bally (Male, Australia) Wright (Female, Australia) Maddox (Female, Australia)
Khan A (28 September – 2 October 2015) 'Exogenous application of PUT, SA, OA and CaCl <sub>2</sub> delayed fruit ripening and maintaining fruit quality of 'Samar Bahisht Chaunsa' mango', <i>International Mango Symposium</i> , Darwin, Australia.	Khan (Male, Pakistan)
Kumbhar M (28 September – 2 October 2015) 'Impact of mango preservation technology training on knowledge and adoption of rural women in Sindh Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Kumbhar (Male, Pakistan)
Kumbhar M (28 September – 2 October 2015) 'Study of mango marketing system in selected districts of Sindh Province, Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Kumbhar (Male, Pakistan)
Lodhi A (28 September – 2 October 2015) 'Influence of fungicide treatments on mango stem end rot development in commercial export consignments and colony growth of <i>Lasiodiplodia theobromae</i> ', <i>International Mango Symposium</i> , Darwin, Australia.	Lodhi (Male, Pakistan)
Lodhi A (28 September – 2 October 2015), 'Monitoring of postharvest diseases and pathogens in mango export farms of Sindh, Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Lodhi (Male, Pakistan)



Conference proceedings	
Publication	Author (gender, nation)
Malik A (28 September – 2 October 2015) 'Mango value chain development through postharvest research and development—a developing country case study', <i>International Mango Symposium</i> , Darwin, Australia.	Malik (Male, Pakistan)
Malia A, Amin M and Asad U (2014) 'Advances and challenges in value chain development in 'Kinnow' mandarin and mango industries of Pakistan', <i>XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes</i> (IHC2014), Brisbane, Australia.	Malik (Male, Pakistan) Amin (Male, Pakistan) Asad (Male, Pakistan)
Malik A, Javed H, Amin M, Hofman P, Khan A and Amjad A (2014) 'Impact of pre-cooling and cold storage on post-storage peel colour development & other physico-chemical and physiological attributes of mango cv. Samar Bahisht Chaunsa', <i>4th International and 13th National Conference of Plant Scientists</i> , Saheed Benazir Bhutto University, KPK, Pakistan. (peer-reviewed)	Malik (Male, Pakistan) Javed (Hafiz, Pakistan) Amin (Male, Pakistan) Hofman (Male, Australia) Khan (Male, Pakistan) Amjad (Female, Pakistan)
Mallik M, Rana M, Rehman A, Ammar M and Bally I (17–22 August 2014) 'Cultural and chemical management of dieback disease in mango in Pakistan', <i>29th International Horticultural Congress</i> , Brisbane, Australia.	Mallik (Male, Pakistan) Rana (Male, Pakistan) Rehman (Male, Pakistan) Ammar (Male, Pakistan) Bally (Male, Australia)
Mehdi M (28 September – 2 October 2015) 'Opportunities and constraints in building improved domestic mango value chains in Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Mehdi (Male, Pakistan)
Poussio GB, Baloch NM, Kumar L, Bally I, Fateh FS, Soomro MA, Kazmi MR and Channa MY (2016) 'Effect of integrated management practices on the yield of mango in ASLP – demonstration block', <i>Acta Horticultrae</i> – proceedings of Darwin International Mango Symposium.	Poussio (Male, Pakistan) Baloch (Male, Pakistan) Kumar (Male, Pakistan) Bally (Male, Pakistan) Fateh (Male, Pakistan) Soomro (Male, Pakistan) Kazmi (Male, Pakistan) Channa (unknown)
Poussio GB, Bally I, Kumar L, Fateh FS, Kazmi M, Jiskani MM, Channa MY and Memon AJ (2013) 'Culture sensitivity test of <i>Ceratocystis fimbriata</i> associated with mango sudden decline (MSD) (poster)', ICPP, China.	Poussio (Male, Pakistan) Bally (Male, Australia) Kumar (Male, Pakistan) Fateh (Male, Pakistan) Kazmi (Male, Pakistan) Jiskani (Unknown, Pakistan) Channa (Male, Pakistan) Memon (Female, Pakistan)
Quershi A, Galea V, Akem C, Atkin E and Bally I (25–28 November 2013) 'The effect of postharvest hot fungicide dip and exogenous ethylene gas application on the incidence of dendritic spot and stem end rot in Kensington Pride (KP) mangoes', <i>19th Australian Plant Pathology Conference</i> , Auckland, New Zealand.	Quershi (Female, Pakistan) Galea (Male, Australia) Akem (Male, Australia) Atkin (Female, Australia) Bally (Male, Australia)

## Appendix 4.7: Research outputs (cont.)

Conference proceedings	
Publication	Author (gender, nation)
Quershī A, Galea V, Akem C, Atkin E and Bally I (25–28 November 2013) 'The effect of bagging on the incidence of dendritic spot and stem end rot in Kensington Pride (KP) mangoes', <i>19th Australian Plant Pathology Conference</i> , Auckland, New Zealand.	Quershī (Female, Pakistan) Galea (Male, Australia) Akem (Male, Australia) Atkin (Female, Australia) Bally (Male, Australia)
Rajwana IA, Malik AU, Bally I, Kazmi M, Ikhlaq M and Rajwana EA (2013) 'Trends and Challenges in Mango Nursery Production in Pakistan', <i>Acta Horticulturae</i> 992:63–68 (conference proceedings). (peer-reviewed)	Rajwana (Male, Pakistan) Malik (Male, Pakistan) Bally (Male, Australia) Kazmi (Male, Pakistan) Ikhlaq (Male, Pakistan) Rajwana (Male, Pakistan)
Rehman A (28 September – 2 October 2015) 'Research and development in mango postharvest disease management in Pakistan', <i>International Mango Symposium</i> , Darwin, Australia.	Rehman (Male, Pakistan)
Ul Haq I, Ghaffar A and Umar H (28 September – 2 October 2015) 'Standardization of potting media for the rapid growth of mango nursery plants', <i>XI International Mango Symposium</i> , Darwin, Australia.	Ul Haq (Male, Pakistan) Ghaffar (Male, Pakistan) Umar (Male, Pakistan)



University theses	
Publication	Author (gender, nation)
Abrar S (2014) 'Genetic variability among post-harvest fungal pathogens of <i>Mangifera indica</i> L. by molecular marker' [Master thesis], Jinnah Women University, Rawalpindi.	Abrar (Female, Pakistan)
Amin M (2012) 'Integrated approaches for improving fruit quality and shelf life of two commercial mango cultivars of Pakistan', [Master thesis], Faisalabad University of Agriculture, Pakistan.	Amin (Male, Pakistan)
Amin MA (2013) 'Effectiveness of different traps as a monitoring tools for mango blossom and leaf gall midges', [MSc thesis], Bahauddin Zakariya University, Multan.	Amin (Male, Pakistan)
Arain RH (n.d.) 'Evaluation of fertilizer practices on NPK nutrition of mango', [MSc thesis], Sindh Agricultural University, Tandojam.	Arain (Male, Pakistan)
Babbar SH (2014) 'Macronutrient evaluation in mango orchards of Kotri', [MSc thesis], Sindh Agricultural University, Tandojam.	Babbar (Male, Pakistan)
Badar H (2015) 'Value chain performance improvement for sustainable mango industry development in Pakistan', [Master thesis], UQ Gatton, Australia.	Badar (Male, Pakistan)
Bux M (2004) 'Sulphur status in soil and plant tissue of mango orchards in some districts of Sindh', [MSc thesis], Sindh Agricultural University, Tandojam.	Bux (Male, Pakistan)
Dahar GY (n.d.) 'Physiological studies of <i>Ceratocystis frimbriata</i> causal agent of MSD and its in-vitro control', [MSc thesis], Plant pathology, Sindh Agricultural University, Tandojam.	Dahar (Male, Pakistan)
Dalwani M (2014) 'Sulphur in soil and plant tissue of mango orchards in Sindh', [MSc thesis], Sindh Agricultural University, Tandojam.	Dalwani (Male, Pakistan)
Faiz H (n.d.) 'Management of mango diseases anthracnose and blossom blight by ecofriendly methods', [PhD thesis], Fatima Jinnah Women University, Rawalpindi.	Faiz (Female, Pakistan)
Feroze F (n.d.) 'Raising productive seedling rootstocks and grafts of Mango', [PhD thesis], Sindh Agricultural University, Tandojam.	Feroze (Female, Pakistan)
Fida S (2014) 'Isozymes and biocontrol analysis of <i>Collectotrichum</i> isolates from diseased mangoes', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Fida (Female, Pakistan)
Goraya AH (2013) 'NPK nutrition of mango at pre & post harvest stages', [MSc thesis], Sindh Agricultural University, Tandojam.	Goraya (Male, Pakistan)
Gullai S (2014), 'Analysis of Protein and Biocontrol Agent of Stem End Rot Fungi of <i>Mangifera indica</i> L', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Gullai (Female, Pakistan)
Jatoi SA (n.d.) 'Macronutrients in mango orchards of Khairpur Mir's Sindh', [MSc thesis], Sindh Agricultural University, Tandojam.	Jatoi (Male, Pakistan)
Kakar N (2014), 'Boron status in soil and plant tissue of mango orchards in Sindh', [MSc thesis], Sindh Agricultural University, Tandojam.	Kakar (Male, Pakistan)
Kausar R (2014) 'Genetic diversity among isolates of <i>Colletotrichum</i> species of <i>Mangifera indica</i> L. by molecular marker', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Kausar (Female, Pakistan)
Khaliq H (2014) 'Survey for damage assessment of Cecid flies on mango in Southern Punjab. Department of Plant and Environment Protection', [Master thesis], The University of Agriculture, Peshawar.	Khaliq (Male, Pakistan)
Kumar M (2014) 'Macronutrients in mango orchards of lower Sindh', [MSc thesis], Sindh Agricultural University, Tandojam.	Kumar (Male, Pakistan)
Majeed F (2015) 'Management of mango midges through irrigation schedule', [MSc thesis], Bahauddin Zakariya University, Multan.	Majeed (Male, Pakistan)



## Appendix 4.7: Research outputs (cont.)

University theses	
Publication	Author (gender, nation)
Malik A (n.d.) 'Current status of mango pre-harvest diseases with respect to environmental factors', [PhD thesis], Fatima Jinnah Women University, Rawalpindi.	Malik (Female, Pakistan)
Malik H (2014) 'Evaluation of controlled atmosphere and modified atmosphere conditions for the transport of mangoes to distant markets', [PhD thesis], Punjab Agricultural Research Board, Punjab.	Malik (Male, Pakistan)
Mansoor AA (2014) 'Primary macronutrients in mango orchards of lower Sindh', [MSc thesis], Sindh Agricultural University, Hyderabad.	Ansari (Male, Pakistan)
Mari SA (n.d.) 'Internship, Behaviour of <i>Fusarium nivale</i> at different temperature, nutrient media in vitro and their control, Plant Pathology', [Master thesis], Sindh Agricultural University, Tandojam.	Mari (Male, Pakistan)
Meer H (2012) 'Post harvest fungal spoilage in local Markets of Punjab', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Meer (Male, Pakistan)
Mehdi M (2012) 'Evaluating the effectiveness of a whole of chain approach in rural industry development in developing countries: A case of Pakistan mango industry', [Master thesis], UQ Gatton, Australia.	Mehdi (Male, Pakistan)
Muhammad W (2011) 'Monitoring and management of mango gall midges through sticky coloured traps', [MSc thesis], Bahauddin Zakariya University, Multan.	Muhammad (Male, Pakistan)
Naeem G (2012) 'Efficacy of Different Fungicides on Post Harvest Fungal Disease (StemEnd Rot) Pathogen of Mango', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Naeem (Female, Pakistan)
Quershi A (2014) 'The Epidermology of Dendritic spot and Stem-end-rot of mango', [Master thesis], University of Queensland, Brisbane, Australia.	Quershi (Female, Pakistan)
Rajpar IR (2014), 'Evaluation of boron in mango orchards of lower Sindh', [Master thesis], Department of Soil Science, Sindh Agricultural University.	Raipar (Male, Pakistan)
Rana M (2012) 'Studies on die back disease of mango', [MSc thesis], Bahauddin Zakariya University, Multan.	Rana (Female, Pakistan)
Rasheed A (n.d.) 'Pathogenic and genetic characterization of strains of Ceratocystics affecting mangoes in Pakistan', [PhD thesis], Fatima Jinnah Women University, Rawalpindi.	Rasheed (Female, Pakistan)
Rashid O (2013) 'Pathological and Molecular Characterization of Post-Harvest Fungal Pathogens of Mango', [Master thesis], Fatima Jinnah Women University, Rawalpindi.	Rashid (Female, Pakistan)
Rizwan M (2013) 'Assessment of economic losses incurred by mango gall Midges', [MSc thesis], Bahauddin Zakariya University, Multan.	Rizwan (Male, Pakistan)
Solangi Y (n.d.) 'Survey and identification of different fungi associated with decline plants in Sindh', [MSc thesis], Plant Pathology, Sindh Agricultural University, Tandojam.	Solangi (Male, Pakistan)
Tahir M (n.d.) 'Detection, Quantification and Molecular Characterization of <i>Fusarium</i> spp. associated with malformation in mango orchards of Punjab and Sindh', [PhD thesis], Fatima Jinnah Women University, Rawalpindi.	Tahir (Female, Pakistan)
Talha (2012) 'Studies on mango malformation disease in Multan', [Master thesis], Bahauddin Zakariya University, Multan.	Talha (Male, Pakistan)
Ullah AH (n.d.) 'Improving the efficiency of mango breeding', [Master thesis], James Cook University, Cairns, Australia.	Ullah (Male, Pakistan)
Zubair (2012) 'Monitoring of inoculum load of <i>Fusarium mangiferae</i> in improved and traditional mango orchard', [MSc thesis], Bahauddin Zakariya University, Multan.	Zubair (Male, Pakistan)



Associated publications and seminars	
Publication	Author (gender, nation)
Akem C, Holmes R, Pinese B, Bally I, Cooke A, Johnson G and Morton J (2006) <i>Assessment of mango diseases, pest and production problems in Pakistan</i> , Queensland Department of Primary Industries and Fisheries, Brisbane, Australia.	Akem (Male, Australia) Holmes (Male, Australia) Pinese (Male, Australia) Bally (Male, Australia) Cooke (Male, Australia) Johnson (Male, Australia) Morton (Male, Australia)
Anon (2014) <i>Codes of Practice of Mango Farming and Processing – A guide book to help address the critical control points along the supply chain</i> , UNIDO - TRTA II, Faisalabad, Pakistan.	Various
Bally ISE (2007) <i>Training Award mentors report – Ijaz Rajawana</i> , Crawford Foundation, Canberra.	Bally (Male, Australia)
Bally ISE (2008) Dr. Ian Bally at Mango Research Station, Shujubad, Multan (Part-1), <i>ASLP Activities</i> , F. a. V. project, Multan, Pakistan, YouTube 9:11 min.	Bally (Male, Australia)
Bally I, Donovan N, Kurshid T and Falvine S (2013) <i>Training of Pakistani Nurserymen in Australia</i> , report to Agriculture Sector Linkage program, Agricultural Capability Fund.	Bally (Male, Australia) Donovan (Female, Australia) Kushid (Male, Australia) Falvine (Male, Australia)
Bally ISE and Kazmi MR (2009) <i>An experiment on the right time for pruning Chuansa variety</i> , Islamabad, Pakistan, NARC.	Bally (Male, Australia) Kazmi (Male, Pakistan)
Bally ISE, Kazmi MR, Iqbal A and Fateh FS (22 April 2008) 'Guidelines for Developing Modern Nursery, Mango Nursery Management', <i>ASLP mango orchard management project update seminar</i> , Sindh Horticultural Research Institute, Mirpurkhas, Pakistan, ASLP 1–7.	Bally (Male, Australia) Kazmi (Male, Pakistan) Iqbal (Male, Pakistan) Fateh (Male, Pakistan)
Holmes R (2007) <i>ASLP Australian Mango Industry Familiarisation Tour for Pakistan Delegates</i> , Canberra, Australian Centre for International Agricultural Research.	Holmes (Male, Australia)
Jabeen A, Kazmi MR and Akem C (2009) <i>Review: Sudden Death Phenomenon in Mango</i> .	Jabeen (Female, Pakistan) Kazmi (Male, Pakistan) Akem (Male, Australia)
Johnson GI, Akem C, Weinert M, Kazmi MR, Fateh FS, Abdul R, Iftikhar S and Cooke AW (2012) <i>Handbook for a Workshop on Diagnosis &amp; Control of Mango Postharvest Diseases</i> , NARC, Islamabad, Pakistan, ACIAR.	Johnson (Male, Australia) Akem (Male, Australia) Weinert (Male, Australia) Kazmi (Male, Pakistan) Fateh (Male, Pakistan) Abdul (Male, Pakistan) Iftikhar (Female, Pakistan) Cooke (Male, Australia)
Khan MI (2012) <i>Catalogue of mango germplasm</i> , Mango Research Station, Shujubad, Pakistan.	Khan (Male, Pakistan)
Kazmi MR (2009) <i>Key for early detection of Mango Sudden Death Syndrome (MSDS) and its Management</i> , ASLP, Mango Project, National IPM Programme, NARC, Islamabad.	Kazmi (Male, Pakistan)
Kumar L (2012) 'Mango sudden death and their management after rain flood in Sindh', <i>National Mango Souvenir</i> .	Kumar (Male, Pakistan)

## Appendix 4.7: Research outputs (cont.)

Associated publications and seminars	
Publication	Author (gender, nation)
Malik AU, Khan MA and Chan K (2014) <i>Codes of practice for mango farming &amp; processing</i> , Trade Related Technical Assistance programme (TRTA II) United Nations Industrial Development Organisation (UNIDO).	Malik (Male, Pakistan) Khan (Male, Pakistan) Chan (Male, Japan)
Poussio G (2012) 'January and February activities in mango orchards', <i>Monthly Sindh Zraiat</i> , January:32.	Poussio (Male, Pakistan)
Poussio G (2012) 'Intercropping and uses of irrigation in mango orchard', <i>Monthly Sindh Zraiat</i> , November:24.	Poussio (Male, Pakistan)
Poussio G (2012) 'December activities in mango orchards', <i>Monthly Sindh Zraiat</i> , December:24.	Poussio (Male, Pakistan)
Poussio G (2013) 'December activities in mango orchards', <i>Monthly Sindh Zarait Magazine</i> , December.	Poussio (Male, Pakistan)
Poussio G (2013) 'The role of irrigation and intercropping in mango orchards', <i>Monthly Sindh Zarait Magazine</i> , January.	Poussio (Male, Pakistan)
Poussio G (2014) 'February activities in mango orchards', <i>Monthly Sindh Zarait Magazine</i> , January.	Poussio (Male, Pakistan)
Poussio GB et al. (2015) 'Influence of different fungicides and Plant extracts against <i>Ceratocystis fimbriata</i> associated with mango sudden decline (MSD)', accepted in Indian Journal.	Poussio (Male, Pakistan)
Rajpur I and Khaskhely (2015) <i>Evaluating salinity tolerance of mango rootstocks</i> , Project Brief, Centre for Biosaline Agriculture, Department of Soil Science, Faculty of Crop Production, Sindh Agricultural University.	Rajpur (Male, Pakistan) Khaskhely (Male, Pakistan)
Rajwana IA (2007) <i>Training Award Awardees end-of-training report – Ijaz Rajwana</i> , Crawford Foundation, Canberra.	Rajwana (Male, Pakistan)
Saeed S, Saeed Q, Amin MA and Rizwan M (2012) <i>Identification, monitoring and damage assessment of cecid flies of mango</i> , Department of Entomology, Faculty of Agricultural Science and Technology, Bahauddin Zakariya University.	Saeed, S (Male, Pakistan) Saeed, Q (Male, Pakistan) Amin (Male, Pakistan) Rizwan (Male, Pakistan)

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