



Australian Government

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.

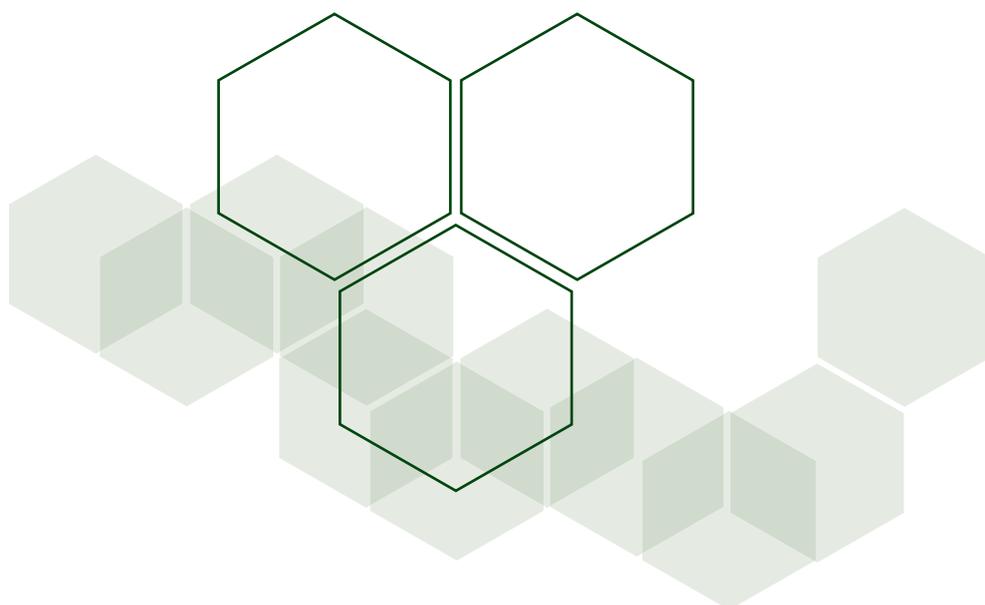
This report presents a suite of evaluations of the Agriculture Sector Linkages Program, conducted in Pakistan, and co-funded by the Department of Foreign Affairs and Trade (DFAT) and ACIAR from 2005 to 2015. The program was an opportunity for Australian agencies to partner with Pakistani researchers 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 2: Citrus 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>DFAT</b>	Department of Foreign Affairs and Trade
<b>FVDP</b>	Fruit and Vegetable Development Project (Government of Punjab)
<b>NARC</b>	National Agriculture Research Centre (Pakistan)
<b>NGO</b>	Non-government organisation
<b>ODA</b>	Official development assistance
<b>PHKN</b>	Pakistan Hoslamand Khawateen Network
<b>PKR</b>	Pakistan Rupee
<b>RPM</b>	Research Program Manager (ACIAR)
<b>TADEP</b>	Transformative Agriculture and Development Enterprise Program

## Acknowledgements

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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 the Punjab and Sindh provinces of Pakistan focused on enhancing selected agricultural value chains for the ultimate benefit of the rural poor. The program had 2 phases: Phase 1 ran from 2005 to 2010, and Phase 2 was implemented from 2011 to 2015. The program was funded by the Department of Foreign Affairs and Trade (DFAT)<sup>7</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 2.4.

Research projects within the ASLP that focused on Pakistan's citrus industry were:

- Phase 1: Increasing citrus production in Pakistan and Australia through improved orchard management techniques (HORT/2005/160)
- Phase 2: The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices (HORT/2010/002).

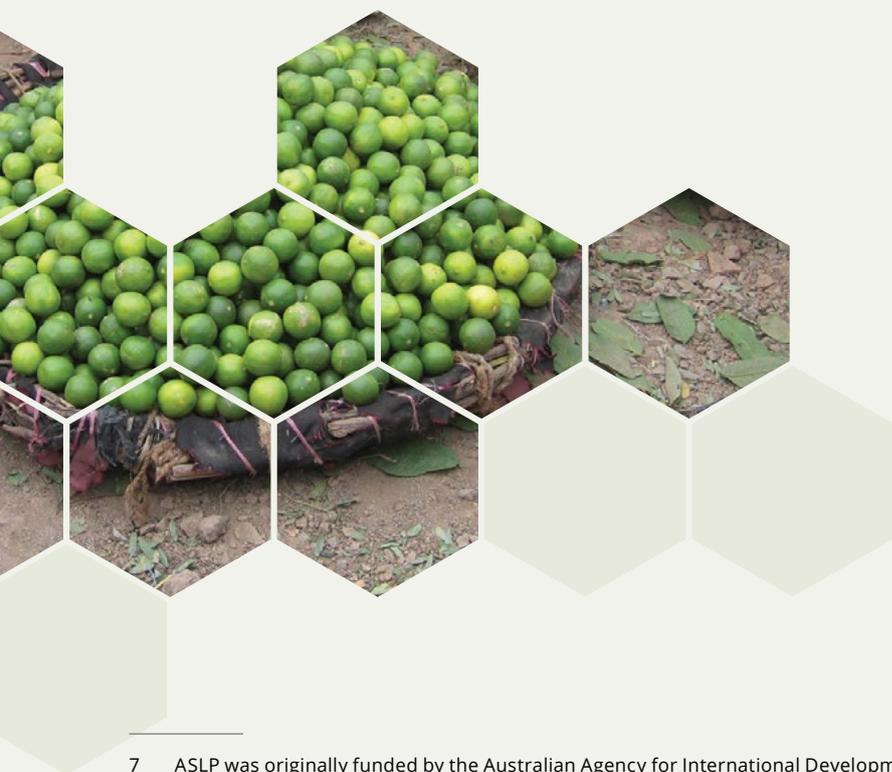
The 2 citrus projects aimed to assist Pakistan to achieve its goals of improving citrus production and increasing citrus exports, and focused on 3 main streams of work:

- introducing new citrus varieties to Pakistan
- improving orchard management by citrus growers
- improving nursery management by nursery people.

Integrated under each of these workstreams were activities to increase scientific research capacity and improve extension services in Pakistan.

The projects were led by Industry and Investment NSW<sup>8</sup> together with several collaborating partners from Pakistan. The total budget for both citrus projects was AUD2,974,541, with the Australian aid program contributing AUD2,058,574 of this total.

This evaluation is Part 2 of a suite of evaluations of the ASLP. It is a light touch evaluation which examines the achievements of the citrus 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.



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

8 At the time of the projects, the commissioned organisation was the NSW Government department, Industry and Investment NSW, of which the Department of Primary Industries was a part. At the time of publishing this report, the NSW Department of Primary Industries is part of the Department of Regional NSW.



## Key findings



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

The ASLP citrus projects did not have an articulated theory of change when they were developed. Based on document review and interviews, **the evaluation team developed a suggested theory of change covering the 2 projects.**

A visual representation is at Appendix 2.1 and the key elements are:

- The projects were expected to increase the citrus growing season in Pakistan by conducting high quality trials of citrus varieties and rootstock. This would be supported by project work in importing new citrus varieties, establishing screenhouses, and training Pakistani scientists.
- The projects were expected to improve orchard management by citrus growers, and nursery management by nursery people, by providing training to these groups and to the extension workers who support them. These groups were then expected to apply new knowledge, and share new knowledge with their neighbours, resulting in the adoption of modern orchard and nursery management practices.

**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:

1. Knowledge about improving citrus production needed to be locally adapted, packaged and delivered in a participatory manner to make it useful to scientists, growers and nursery people.
2. Existing and new citrus varieties in Pakistan would meet market demands at profitable prices, giving growers and nursery people an incentive to adopt new varieties and try new management practices.
3. The best way to encourage growers and nursery people to change following project completion would be through peer-to-peer learning.

## Key findings (cont.)

### 2

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

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##### **Under the workstream of introducing new citrus varieties, the projects achieved good results in terms of outputs, adoption and outcomes.**

Seven new varieties of citrus and 8 new rootstocks were introduced to Pakistan. The projects provided capacity building for Pakistani scientists (including postgraduate studies) and supporting infrastructure such as screenhouses, which together ensured high quality trials of these citrus varieties and rootstock could be implemented. Stakeholders reported that high quality trials are continuing, scientific papers have been published, scientists continue to apply their increased capacity, and at least one new citrus variety has been commercialised, demonstrating good outcomes in this area.

While there have been strong achievements in relation to new citrus varieties, it is important to note that **varietal evaluation and the eventual spread of new citrus varieties and rootstock takes a significant amount of time**. These long timeframes have implications for adoption and outcomes in other project areas, as discussed below.

**For improving both orchard management and nursery management, a number of notable outputs were delivered.** For example, the projects directly trained 5,700 citrus growers in modern orchard management practices, and 494 nursery people in modern nursery management. The citrus projects included significant training and a partnership with the Government of Punjab's Fruit and Vegetable Development Project to support extension services. This training was underpinned by the generation and packaging of scientific knowledge into user-friendly training packages.

Unfortunately, **there is little rigorous data available on whether these capacity-building activities led to adoption by end users and subsequent outcomes.**

No systematic data was collected during the projects, meaning the evaluation relies heavily on a small number of interviews and document review. The small number and intentional selection of these interviewees means they were unlikely to be representative of the broad experience of program participants.

##### **Data available from interviews and documents paints a mixed picture on adoption and outcomes.**

The majority of interviewees stated that citrus growers and nursery people adopted the practices promoted by the ASLP projects, that adoption continued post-2015, and that this led to higher quality fruit and greater incomes. There appears to have been particularly good adoption of furrow irrigation. The citrus projects partnered with a provincial flood rehabilitation scheme, leading to significant adoption of furrow irrigation by citrus growers and 'spillover' adoption by stone fruit growers. In addition, the projects' partnership with the Government of Punjab likely led to increased capacity in extension services.

**Strong adoption and outcomes are, however, disputed by some interviewees.** Some suggested adoption by growers has been limited post-2015 because insufficient support has been available, and because of financial barriers for growers (even considering the low cost of the promoted management techniques). For nursery management, one key informant stated that only low-cost nursery management practices (for example, new budwood techniques) had been widely adopted, while the projects' final independent review concluded that adoption by nurseries had been limited because of a lack of business case for higher-health trees.



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# 3

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

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Given mixed data on adoption and outcomes in orchard and nursery management, it is useful to revisit the assumptions underpinning the project's theory of change. The validity (or otherwise) of these assumptions will help inform a judgement on whether outcomes were achieved, and whether project activities contributed to this.

From interview data, **it appears that the first assumption around participatory training approaches held.** The projects were able to package scientific data into user-friendly formats, and the participatory training approaches used to deliver this information were highly valued by stakeholders. Interviewees reflected on how much they learned and how vital the hands-on training approaches were to the learning process.

However, **it is questionable whether the assumption that citrus varieties would meet market demands at profitable prices was valid.** The projects' final independent review raised issue with the fact that market analysis wasn't undertaken when selecting varieties to trial, and suggested that existing citrus varieties in Pakistan do not meet market needs and are low value. Without market signals and profitable products, there may be few incentives for growers and nursery people to adopt new management practices. That said, as previously noted, testing and introducing new citrus varieties and rootstock takes a significant amount of time. The incentives for growers and nursery people may change as more new varieties become widely available.

**It is also questionable whether the third assumption (post-project peer-to-peer learning) held.** Post-2015, there was no active institutional home for the *capacity-building* activities of the projects, and interviewees noted that demand for expertise to assist growers outstripped supply. Without ongoing access to training or expertise, it appears unlikely that peer-to-peer learning alone would sustain or increase adoption or outcomes after 2015.

Considering the points under evaluation questions 2 and 3, it appears likely that a small number of growers and nursery people have successfully adopted the practices and achieved improved incomes as a result. It also appears likely that a small number of extension workers continue to use the knowledge to support the citrus industry. However, with no systematic data available, **it is challenging to make a confident assessment of whether the projects' activities translated into widespread outcomes for citrus growers and nursery people, or strong ongoing capacity in extension services.** Given the length of time needed to test and make new citrus varieties widely available, and the lack of an active post-project institutional home for training activities, some enabling conditions for widespread adoption appear to be lacking. This, however, may change as more citrus varieties become available in the future.

## Key findings (cont.)

4

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

The ASLP citrus projects were developed in 2005. At that time, aid projects had less focus on gender, marginalised groups or social aspects of research. This is reflected in the citrus projects, **which did not have a strategy for addressing gender issues, or for considering marginalised groups such as people with disabilities or disadvantaged youth.**

Despite the absence of a gender strategy, **a small number of women were able to benefit from the project.** For example, during the Phase 2 project, a women's empowerment activity resulted in the training of 22 poor women in backyard nursery management techniques. These women continue to run backyard nurseries and support other women in their local areas. Interviewees and documents reported increased incomes and empowerment for these women.

**The Phase 2 project was also 'pro-poor', or inclusive of poorer farmers.** The project employed suitable strategies to reach smallholder farmers, such as:

- promoting low-cost practices
- using farmer field schools to reach large numbers of smaller growers
- using small demonstration sites to show modern practices could be effective on small plots.

At the same time, interviewees highlighted that many growers continued to face financial barriers to adoption; such financial barriers are likely to constrain the achievements of ACIAR projects.

5

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

**The Phase 1 project experienced relationship challenges between the teams based in Australia and Pakistan.** The main Pakistan-based collaborator did not have sufficient time to engage with the project and his duties did not appear to be well deputised. This, combined with a difficult security situation in Pakistan that made it very challenging for the Australia-based team to visit, likely hampered the performance of the project. Fortunately, **the Phase 2 project was able to overcome many of these challenges.** It hired 2 in-country project coordinators and provided them with strong project ownership, resulting in improved performance.

ACIAR also experienced challenges in its management role. In particular, **mismatched reporting expectations between ACIAR and the program funder, DFAT meant ACIAR staff were often focused on meeting DFAT reporting needs** and so had less time to engage in project and program oversight.


## 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 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 citrus projects appeared to reasonably align with the ASLP goals.** As discussed above, the projects enhanced the capacity of the citrus research, supported extension systems, and had a pro-poor approach. They could, however, have been designed to undertake significantly more work on market linkages. Only 2 small pieces of market linkages work were undertaken (a trial of a 'quality payment system' and a value chain scoping study). As previously noted, the projects' final independent review raised significant questions about whether more should have been done to link project activities to markets. This would likely have increased the projects' alignment with the ASLP goals, and potentially increased project effectiveness.

This evaluation also examined whether ASLP's 'programmatic' approach added value to the citrus projects. **The projects certainly benefited in minor ways from being part of a larger program.** For example, the citrus projects collaborated with the mango projects on a nursery manual.

**However, the potential for significant value-add was not realised.** In particular, there was little substantive interaction between the citrus projects and ASLP's Phase 2 social science project; they were described as 'disconnected and with their own agendas'. This was likely to the detriment of both projects. The citrus projects, for example, could have used data from the social science project to better understand the challenges in rural communities or to assess whether the citrus projects were contributing to change for poor and marginalised groups, and women.

## Conclusion and lessons learned

Overall, **the results of the ASLP citrus projects are mixed**. In relation to introducing new citrus varieties, the projects achieved strong outputs, adoption and outcomes and contributed to the commercialisation of at least one new citrus variety. The projects' participatory, hands-on training approach was viewed very positively by stakeholders. The Phase 2 project was also pro-poor and achieved good outcomes for a small number of nursery women.

In orchard and nursery management, good outputs were achieved and it appears likely that some growers and nursery people adopted the ASLP practices. However, the lack of systematic data means it is difficult to draw robust conclusions on whether widespread adoption and outcomes have been achieved. Some enabling conditions for widespread adoption, such as an active long-term institutional home for training activities and market links for products, appear to be lacking – noting that the long-term timeframe for introducing new citrus varieties means market demands may improve in the future. In addition, the potential value-add of the ASLP 'programmatic' approach was not realised, particularly because of the lack of links between the citrus and social science projects.

### Lessons learned

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

1. From their inception, **projects need monitoring systems that allow for the ongoing collection of data that can inform judgements on adoption and outcomes**. Ideally, data collection would focus on a model of behaviour change that is outlined in a project's theory of change. This would allow project staff and ACIAR to understand whether project beneficiaries are changing their behaviour as expected, create confidence that project activities are leading to adoption and outcomes, or inform program improvements where necessary.
2. **ACIAR and project teams should design and implement projects with long-term sustainability in mind**. Developing a post-project communications plan, and identifying and working with a partner who can act as an active long-term home for training and extension activities, can help ensure local people can benefit from project work beyond the life of the project.
3. **Gender analysis and social inclusion analysis, and the development of corresponding 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 and women's empowerment, and to ensure people with disabilities and other marginalised groups can benefit from projects.
4. **ACIAR and project teams should design projects with market linkages in mind**. This should apply even when the most pressing issues are related to commodity production. Ensuring there is a viable market for the high-quality products produced (and/or explicit strategies to foster future market development), and that market information is made available to producers, will likely enhance the success of production activities since project beneficiaries will see clear incentives to adopt new approaches and technologies.
5. **ACIAR should consider specific strategies to ensure projects benefit from being part of a broader program**. Such strategies could include allocating sufficient time and resources to cross-project collaboration; developing program structures that incentivise cross-project collaboration; and selecting project teams that are open to collaborative, interdisciplinary ways of working.



# 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>9</sup>, a research-for-development program funded by DFAT<sup>10</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 2.4.

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

### Purpose

The program-level evaluation has 5 key purposes:

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

### Scope

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

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

- Increasing citrus production in Pakistan and Australia through improved orchard management techniques (HORT/2005/160)
- The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices (HORT/2010/002).

9 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.

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

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

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

## 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. Eleven semi-structured interviews were also undertaken with 15 project stakeholders (noting some were group interviews) and 2 semi-structured interviews were completed with ACIAR staff. Stakeholders were intentionally selected in consultation with ACIAR and the project leader. 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 (see Table 1).

Preliminary findings were shared and tested in a project validation workshop involving the stakeholders previously consulted. A separate discussion on preliminary findings was also held with ACIAR Canberra staff, and detailed written comments were submitted by the project leader. 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 1** ACIAR project outcome assessment terminology

Outputs	Next user	Outcomes
<b>Scientific knowledge:</b> New knowledge or current knowledge tested in other conditions, locations, etc.	<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>	<b>Scientific achievement:</b> Researchers use scientific knowledge outputs to make new discoveries or do their work differently
<b>Technologies:</b> New or adapted technologies and products that offer added value to intended end users		<b>Capacity built:</b> Project partners or stakeholders use enhanced capacity to do something differently
<b>Practices:</b> New practices and processes		<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
<b>Policy:</b> Evidence for policy formulation		
<b>Capacity-building:</b> Short courses, academic training, coaching and mentoring		

## Limitations

The evaluation team relied heavily on pre-existing documentation provided by ACIAR and the project team. These documents were of varying quality. Documentation generally focused on project outputs, with little evidence on adoption and outcomes. At the same time, there were insufficient evaluation resources to explore third party data or reporting that might provide additional useful information.

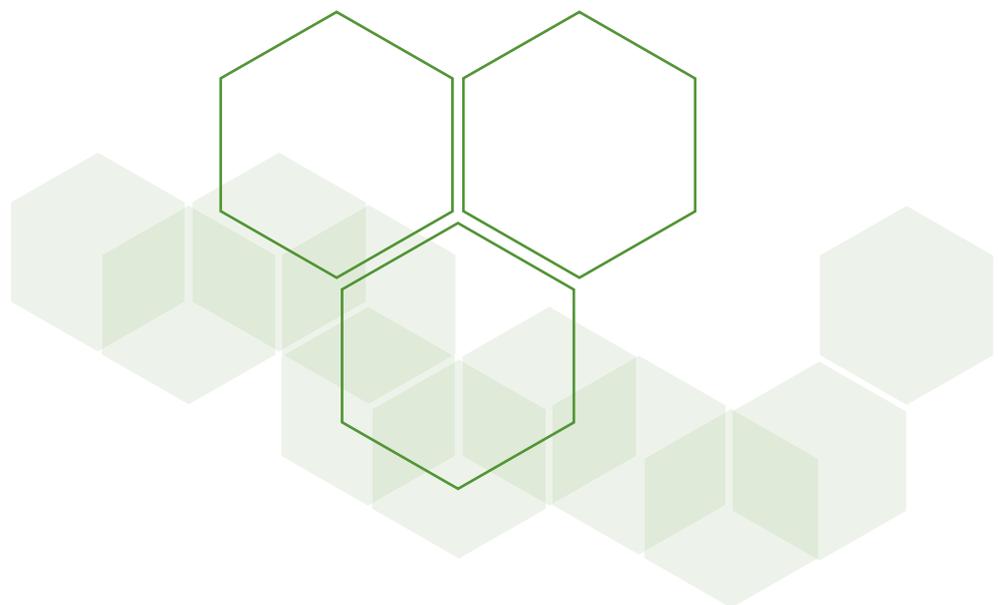
There were limitations on stakeholder consultations. Direct consultations mostly focused on ACIAR staff and implementing partners, and only a very small number of program beneficiaries could be interviewed. As primary data collection was restricted to online interviews, the evaluators had limited ability 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 selected by ACIAR and the project leader. This means they were not a representative sample of project participants. Given the intentional 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 identity of any program beneficiaries involved in the evaluation have been protected. Key informants in professional roles may be referred to by their position title in the report where explicit consent has been obtained; otherwise they are referred to as a representative of the organisation they work with.



## Overview of projects

	Production projects	Value chain projects
Project number	HORT/2005/160	HORT/2010/002
Project title	Increasing citrus production in Pakistan and Australia through improved orchard management techniques	The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices
Collaborating institutions	Industry and Investment NSW <sup>a</sup> National Agriculture Research Centre, Pakistan University of Agriculture, Faisalabad (Punjab, Pakistan) Citrus Research Institute, Sargodha (Punjab, Pakistan) Agricultural Research Institute, Tarnab (Peshawar, Pakistan) Fruit and Vegetable Development Project (Punjab, Pakistan)	
Project leaders	Dr Tahir Khurshid, Industry and Investment NSW Dr Iftikhar Ahmad, National Agriculture Research Centre	
Project duration	April 2007 to December 2010	April 2011 to September 2015
Funding	AUD1,136,726 (Australian aid program contribution: AUD729,865)	AUD1,837,815 (Australian aid program contribution: AUD1,328,709)
Countries	Australia and Pakistan	
Commodities	Citrus	
Related projects	(see next column)	(see previous column)

(a) At the time of the projects, the commissioned organisation was the NSW Government department, Industry and Investment NSW, of which the Department of Primary Industries was a part. At the time of publishing this report, the NSW Department of Primary Industries is part of the Department of Regional NSW.

### Context

Pakistan is a predominately rural and agriculture-based society. In 2010, 68% of the population lived in rural areas and were directly or indirectly reliant on agriculture for their livelihood. At that time, agriculture contributed 13% to GDP and employed 42% of the labour force (Khurshid 2014).

Within agriculture, citrus is an important commercial horticultural crop. In 2010, Pakistan was the sixth largest producer of mandarin in the world and almost a third of fruit producing land was dedicated to citrus. Kinnow, the dominant variety of mandarin, accounted for almost 62% of total production in 2010. Oranges are also produced, albeit in much smaller quantities (Khurshid 2014).

Pakistan has a strong domestic market for citrus. There is also potential for increased exports – in 2010, around 10% of produce was exported. The Government of Pakistan has set ambitious targets to increase citrus exports and export earnings (Khurshid 2014).

## The projects

Consistent with the importance of citrus in Pakistan and the Government of Pakistan's export aspirations, ASLP supported 2 citrus projects across 2 phases:

- Phase 1: Increasing citrus production in Pakistan and Australia through improved orchard management techniques (2007–2010) (HORT/2005/160).
- Phase 2: The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices (2011–2015) (HORT/2010/002).

Both projects were led by Industry and Investment NSW. The leading Pakistan partner was the National Agriculture Research Centre (NARC) and there were multiple other Pakistani collaborating partners.

The specific objectives of the Phase 1 project were:

1. To improve nursery production practices and production incorporating quality assurance procedures for maintaining disease-free material and to introduce germplasm to extend the marketing season based on the climatic suitability to specific growing areas.
2. To demonstrate 'best practice' orchard management focusing on tree spacing, crop management, nutrition and irrigation management.
3. To enhance research, extension and production capacity of Pakistan citrus institutions and industry.

Phase 2 retained focus on introducing new germplasm and varieties, and orchard and nursery management. The objectives were adjusted, and an additional objective added related to a supply chain scoping study. The final objectives for the Phase 2 project were:

1. To introduce germplasm and develop germplasm evaluation capacity to extend the marketing season and assist in improving nursery production practices for maintaining and multiplying clean material.
2. To improve basic crop management practices, to examine the current irrigation practices and to assess the adaptability of pressurised irrigation systems.
3. To enhance the citrus crop management research, extension and production capacity of Pakistan citrus institutions and industry, and extend pro-poor benefit flows.
4. To carry out a scoping study in Pakistan and Kinnow-importing countries for the development of a citrus supply chain project (2015–2020).<sup>11</sup>

In practice, it is helpful to think about the projects as supporting 3 main streams of activities. The first stream consisted of activities to support the **introduction of new citrus varieties into Pakistan**. Specific activities included introducing varieties and germplasm, testing these new plant materials, building supporting infrastructure such as screenhouses, and building the capacity of Pakistani scientists and the research system.

The second stream **involved activities to support improved orchard management by citrus growers**. This included, for example, generating new and packaging existing scientific knowledge on orchard management, and training citrus growers in modern management practices. Training was predominately provided through farmer field schools and focused on practices such as crop management, canopy management, tree reworking, plant nutrition, and irrigation.

This stream of work also included a trial of a 'quality payment system'. Under this trial, 5 farmers were supported to grow high quality citrus crops and to sell these directly to markets, cutting out the wholesalers who traditionally buy citrus fruit in Pakistan.

The third stream of work focused on **improved nursery management by nursery people**. Activities included training nurserymen and nurserywomen in modern orchard practices, including new budwood/grafting techniques, disease-free plant propagation and plant nutrition.

This workstream also included activities with the women's empowerment non-government organisation (NGO) Pakistan Hoslamand Khawateen Network (PHKN). Representatives from the NGO received training in nursery management techniques. They went on to train women in their network to generate income from backyard nursery activities.

Both the orchard management and nursery management workstreams **included efforts to improve the capacity of Pakistan's extension services**. This included, for example, providing training to, and training packages for, extension staff who could then on-train and share their knowledge with growers and nursery people.

<sup>11</sup> Note, a citrus supply chain project for 2015–2020 did not eventuate.



# 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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### Project theory of change

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

A visual representation of the theory of change is at Appendix 2.1. This represents the theory of change at the end of the citrus projects, meaning any project evolutions have been incorporated.

The theory of change can be considered through 2 main lenses: scientific knowledge related to new varieties of citrus, and orchard and nursery management.

Under the topic area of **new varieties of citrus**, the theory of change shows that the key activities were to work with Pakistani scientists to select and import new citrus varieties and rootstocks. Training for scientists, as well as greenhouse infrastructure, would be provided to support this. This was expected to lead to high quality trials of citrus varieties and rootstock and, in turn, this would lead to identification of more citrus varieties for Pakistan and an extension of the growing season.

The **orchard and nursery management** topic took a different pathway to change. The initial focus was to identify existing scientific knowledge and conduct participatory research to adapt this to local conditions, as well as to generate new scientific knowledge. This was then packaged into user-friendly training modules. This was complemented by the creation of best practice demonstration sites as well as trials of the quality payment system.

Training for extension services, growers, and nurserymen and nurserywomen in these areas would then be conducted. This training took multiple forms, including study tours to Australia and Thailand, in-field training by Australia-based project staff, and farmer field schools.

The results, or outputs, of this training would be that extension staff, growers, and nurserymen and nurserywomen would have increased knowledge of modern management techniques and payment systems. These groups were also expected to share this knowledge with their peers.

It was then expected that these groups would apply their increased knowledge and adopt the modern techniques. This, in turn, would lead to more disease-free planting material and an increased supply of high quality citrus fruit. Staff who worked in extension services were also expected to increase their capacity and support the citrus industry on an ongoing basis.

### Appropriateness of the theory of change

There was some evolution of the theory of change over the course of the 2 citrus projects. For example, the projects had an increasingly pro-poor focus over time. The project documentation for the first phase project highlighted that its focus was on medium to large citrus growers. This, however, evolved in the second phase to place a greater emphasis on small to medium growers, with a corresponding greater focus on using farmer field schools to reach such growers.

Consistent with this, the partners and key activities for the projects changed over time. The first phase focused on working with the research institutions, while the second phase was more outward looking with a greater focus on extension services and external organisations. There was also no mention of activities involving women in the project's first phase. This evolved in the second phase, where the nurserywomen's activity with PHKN was introduced. These evolutions are appropriate and consistent with the increasingly pro-poor focus of the projects.

The suggested theory of change is underpinned by a number of assumptions about how activities lead to outputs and outcomes:

- The first main assumption was that knowledge on citrus production needed to be locally adapted, packaged and delivered in a participatory manner to make it useful to scientists, growers and nursery people. Accordingly, the projects used training techniques, including study tours to Thailand and Australia, farmer field schools, demonstration sites, and direct training of extension and scientific staff by Australian project staff.
- A second key assumption in the theory of change was that citrus varieties in Pakistan (both new and existing) would meet market demands at profitable prices, thereby giving growers and nursery people an incentive to adopt new varieties and try new management practices. The underlying idea is that increased knowledge alone is not enough to change grower and nursery people's behaviour, and that incentives are also required.
- A third assumption of the theory of change is that the best way to encourage growers and nursery people to change following project completion would be through organic peer-to-peer learning.

The suggested theory of change is relatively simplistic about how behaviour change will happen for growers and nursery people. It outlines that increased knowledge will lead to the adoption of new behaviours, based on an assumption that people have price incentives to change (as outlined above). For future project theories of change, it would be useful for ACIAR and project teams to more deeply consider how adoption of new practices happens and how behaviour change can be brought about, drawing on existing models of behaviour change. Such models should be explicitly incorporated into project designs and theories of change to ensure they guide project activities and monitoring.



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

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### Outputs

The ASLP citrus projects delivered a considerable number of outputs. These can be categorised under 3 major topics: new citrus varieties<sup>12</sup>, orchard management, and nursery management.

#### **New citrus varieties**

Under this topic, the projects delivered a number of outputs related to **scientific knowledge**. These included:

- the introduction and trials of 7 new citrus varieties and 8 new rootstocks
- associated infrastructure to support the generation of scientific knowledge, such as screenhouses and mother blocks
- 4 journal/conference papers.

In addition, **capacity building** for scientists was delivered. For example, training was provided to scientists and extension staff on varietal evaluation, and on the collection of yield and quality data. Eleven Pakistani students completed or are undertaking higher degrees on topics related to the project, using project collaborators as supervisors.

#### **Orchard management**

In the area of orchard management, project outputs included significant **capacity-building** activities for growers. The projects partnered with the farmer field schools run by the Fruit and Vegetable Development Project (FVDP) and also conducted study tours to Australia and Thailand. They also demonstrated alternative payment systems for growers (the quality payment system) and conducted a range of communication outreach activities through newsletters, SMS, and radio and television talks. According to the Phase 2 final report, the projects directly trained 5,700 citrus growers in modern orchard management techniques such as pruning, fruit thinning, plant nutrition, pest control and irrigation.

These *capacity-building* activities were underpinned by the generation and packaging of existing **scientific knowledge** into user-friendly formats. For example, the project developed phenological calendars for Kinnow mandarins and blood oranges for growers, and collected data to demonstrate the benefits of different irrigation systems. It also developed 8 training packages on nursery management, irrigation management and crop management for use by extension services. Eight journal/conference papers related to orchard management were also produced during the projects.

#### **Nursery management**

Similar to orchard management, nursery management activities focused on **capacity building** and its underpinning **scientific knowledge**. The projects trained 494 nurserymen and nurserywomen in modern practices such as chip budding, pest control, and plant nutrition. One conference paper on nursery management was also delivered.

Specifically for nurserywomen, representatives from women's empowerment NGO PHKN received training in nursery management techniques. They went on to train women in their network, with a total of 22 women trained to assist them to undertake backyard nursery activities and generate income from these.

As noted in the introductory section, **capacity building for extension workers** was integrated into the orchard management and nursery management workstreams. The FVDP was run by the Government of Punjab, and the partnership between this and the citrus project likely built the capacity of FVDP's extension staff. Capacity-building activities often focused on training for extension staff to ensure they could provide quality on-training to growers and nursery people. For example, the Phase 2 final report notes that 30 district officers were trained in crop management, while throughout the projects a number of study tours to Australia and Thailand were conducted. Further, the nursery manual and 8 training packages referred to above were developed for extension staff to use when delivering training to growers and nursery people.

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12 This includes activities focused on citrus varieties, rootstock, budstock and germplasm.

## Adoption

Although the projects delivered a number of outputs, the data on the adoption of these outputs is mixed. This is particularly the case for orchard management and nursery management.

### *New citrus varieties*

Based on interviews with key stakeholders, it appears that new scientific processes are being adopted in Pakistan. Interviewees reflected that scientific trials of new varieties and rootstocks are ongoing, and that this ongoing testing is supported by the scientific, nursery and grower communities. The trials include scientists working with nurseries and growers to conduct field testing. Further, the screenhouses and motherblocks developed by the projects continue to be used.

While ongoing adoption in this area is positive, it is important to note that varietal evaluation and the eventual spread or commercialisation of new citrus varieties and rootstocks takes a significant amount of time. One interviewee noted it took 40–50 years for Pakistan's most common citrus variety, Kinnow, to be widely used by farmers. These long timeframes have implications for adoption and outcomes in other project areas, as discussed below.

### *Orchard management*

There is mixed data on whether the modern orchard management practices promoted by the ASLP citrus projects have been adopted by growers.

On one side, the majority of stakeholders interviewed stated that farmers were adopting the new orchard management techniques. They cited, for example, low-cost techniques such as tree pruning, fruit thinning, and furrow irrigation as practices that were becoming more widespread and accepted.<sup>13</sup> This is supported by project documentation, which claims good adoption of a number of practices.

Some interviewees claimed quite impressive adoption rates. The ASLP projects partnered with a provincial flood rehabilitation project to implement furrow irrigation and, according to 2 interviews, this resulted in significant adoption. One interviewee stated that 4,000 growers adopted furrow irrigation. Another outlined that almost 100% of the 4,049 hectares under citrus in Khyber Pakhtunkhwa are under furrow irrigation. In addition, it was shared that through work with the flood rehabilitation project, benefits had spilled over to the stone fruit industry. For example, virtually 100% of the 5,600 hectares of stone fruit orchards in Peshawar had adopted furrow irrigation.<sup>14</sup>

Another interviewee was involved in the quality payment system trial. He stated that 60%–70% of growers in his area had adopted systems to sell their fruit directly to markets. A further interviewee outlined that quality payment systems had also spilled over to stone fruit orchards, with 1,200 acres of stone fruit orchards in Peshawar using the quality payment system.

The stakeholders interviewed claimed that adoption happened by growers seeing others using good practices, learning from these growers, and then adopting the practices themselves.

On the other hand, doubts around adoption were raised by some interviewees and by the final independent review of the project. These interviewees felt that, while adoption was taking place at the end of the project in 2015, it was likely to have decreased since then given the lack of ongoing training and support. Interviewees also highlighted that there were financial barriers to adoption, with the majority of small farmers unable to access the financial resources to adopt new practices. This applied even to the low-cost management techniques listed above. The final independent review also reported that Pakistan's canal system inhibited the adoption of alternative irrigation techniques, stating that 'widespread adoption of furrow irrigation cannot be expected without a clearer understanding of the operational constraints of the canal systems' (McEville and Laghari 2015:18).

### *Nursery management*

Similar to orchard management, there is mixed data on adoption of improved nursery management techniques. Again, interviewees stated that nurseries continued to adopt the practices promoted by ASLP, and to share their knowledge with other nursery people and growers. This included nurserywomen, with interviewees from the PHKN stating that women continued to engage in backyard nursery activities. PHKN had also set up 10 nursery management support groups, each with 5–6 members. The 22 women trained by ASLP act as leaders of these groups and so are able to continually share their knowledge.

13 The projects also conducted research on higher cost management techniques, such as drip irrigation. However, given the higher costs involved it is not expected that there would be widespread adoption of such techniques.

14 Note interviewees shared these figures, noting the evaluation team have not cited any studies/data that reinforce these claims.



This position is somewhat supported by interviewees from the university system. One interviewee felt that adoption by nurseries had been mixed and depended on the resources required to change practices. As a result, low-cost practices such as new budwood techniques had been adopted as routine practice in most nurseries. Medium-cost practices, for example using polybags and compost for plant propagation, had some uptake. High-cost practices, such as building screenhouses to propagate disease-free plants, had very low adoption rates.

A different perspective was provided by the final independent review. It noted that 'adoption of better practices by nurseries is very limited. There has been little concerted effort to create a compelling business case for growers to demand high-health trees' (McEvelly and Laghari 2015:15).

Under both orchard and nursery management, extension services appear to have adopted training provided by the citrus projects. At the conclusion of Phase 2, the project presented the 8 training packages and the nursery manual it produced to the NARC. Much of this information still appeared on the NARC website in late-2020.<sup>15</sup> The projects' partnership with the Government of Punjab's FVDP appears likely to have increased the capacity of government extension services. Interviewees also provided a small number of notable examples of people who had received training through ASLP and continued to use their expertise to provide extension services to growers and nursery people.

## Outcomes

For new citrus varieties, there are good indications of strong outcomes. However, for orchard management and nursery management, outcome achievement is uncertain given the mixed data available.

### *New citrus varieties*

There are outcomes in 2 areas under the topic of new citrus varieties: innovation enabled and capacity built.

ASLP citrus projects' work on new citrus varieties has **enabled innovation** in Pakistan. Of particular note is that one variety of mandarin, Daisy, has been tested and found suitable for Pakistan, and is now being produced commercially. The introduction of this new variety has also increased the citrus growing season in Pakistan.

In addition, interviewees highlighted that further varieties of citrus and rootstock continue to be tested. Researchers also noted they are in the process of completing registration for new citrus varieties (for example, Salustiana) and rootstock (for example, Carrizo), which would allow these to be made widely available. This represents a significant achievement for the ASLP citrus projects.

The citrus projects have also **built capacity** of Pakistani scientists. The final independent review stated that, although it was hard to quantify, they judged that the project had increased the knowledge and skills of researchers. The review did highlight some concerns with the overall capacity of research institutes. However, the ongoing work on new citrus varieties since the end of the projects in 2015 suggests that the ASLP projects have built ongoing scientific capacity. Further, students who commenced higher degrees under the projects' auspices have continued with their studies, with such students publishing at least 6 citrus-related articles in peer-reviewed journals.

### *Orchard management and nursery management*

Rigorous data on outcomes achieved in orchard management and nursery management was difficult to obtain. Unfortunately, no systematic data appears to exist that would support conclusions on achievement of outcomes under these topics.

Project documentation and interviews with project stakeholders revealed a patchwork of claims on innovation being enabled and capacity being built. Claims include that:

- 80% of fruit produced using ASLP techniques is A-grade, compared to 30%–40% of fruit produced that does not use ASLP techniques.
- Growers have earned an additional PKR7,300 per acre for fruit produced under furrow irrigation, compared to fruit produced under flood irrigation (Khursid et al. 2015:44).
- For growers who participated in the quality payment system, increases in grower returns of 33%–50% of income was reported.
- For nurseries that adopt new practices, the final project report stated the sale price of seedlings increased from PKR35 to PKR100. Similarly, in an interview, a nurseryman stated he had been able to increase the price of his seedlings from PKR50–60 to PKR200.
- For nurserywomen from PHKN, the final project report stated that their profit margin increased by 50%.

<sup>15</sup> See, for example, <http://www.parc.gov.pk/index.php/en/component/content/category/156-aslp-project>, accessed 05 October 2020.

For extension staff, it is similarly difficult to obtain systematic data on whether the extension system was sustainably supporting the citrus industry at the end of the project, or continues to sustainably support Pakistan’s citrus industry today. Interviewees highlighted a small number of examples of staff trained through ASLP who continue to provide extension services in Pakistan. They also highlighted that research institutions continued to make support available. However, interviews also outlined that demand for such services outstripped what was available, while a number of interviewees highlighted that they were most likely to learn about new practices from their peers.

## Discussion

The data above suggest there have been positive results from the projects. However, a key point to note is that there was no systematic data available on adoption and outcomes, and the available data comes from a small number of interviewees and project staff. As previously noted, these interviewees are unlikely to be representative of all participants in the projects. Overall, the lack of systematic data makes it challenging to make a robust assessment of the extent of adoption and outcomes.

Table 2 summarises adoption of project outputs, while Table 3 summarises capacity built through the projects.

**Table 2** Levels of adoption of key project outputs

Project	New technologies or practical approaches	New scientific knowledge	Knowledge or models for policy and policymakers
ASLP citrus projects	Nf – Orchard management Nf – Nursery management NF – Extension staff	NF – New citrus varieties, including scientific capacity	Not applicable

Notes:

O No uptake by either initial or final users

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

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

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

**Table 3** Capacity built relevant to project outcomes

Who	Skills and knowledge
Citrus growers and nursery managers	<ul style="list-style-type: none"> <li>Best practice orchard and nursery management, for example, pruning, irrigation, nutrition</li> </ul>
Extension services (government and private)	<ul style="list-style-type: none"> <li>Best practice orchard and nursery management, for example, pruning, irrigation, nutrition</li> </ul>
Research / academic community in Pakistan	<ul style="list-style-type: none"> <li>Individual capacity built through higher degrees (11 students)</li> <li>Identifying and testing new citrus varieties and rootstock</li> </ul>

Note: There appear to be positive results from the citrus projects for stakeholders, but systematic data on capacity outcomes is not available.



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

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#### **Factors influencing adoption and impact**

In considering the factors that influenced adoption and impact of project outputs, it is helpful to consider the projects' theory of change and the extent to which the assumptions underpinning it are valid. Through this, we see that the participatory training approaches used in the project were valued by stakeholders and influenced how well knowledge was shared. However, other key assumptions around the projects' links to markets and how outputs would be disseminated post-project do not appear to have held.

#### ***Participatory training approaches***

One of the projects' assumptions was that knowledge should be locally adapted, packaged and delivered in a participatory manner to make it useful to scientists, extension staff, growers and nursery people. The participatory approaches used included study tours to Thailand and Australia, farmer field schools, demonstration sites, and direct training by Australian project staff of extension and scientific staff.

Interviews with stakeholders confirmed that these approaches were very effective in sharing knowledge with scientists, growers and nursery people. Interviewees who had participated in study tours reflected on how much they had learned and how influential these tours were for them, even many years after they had completed them. Further, interviewees noted how Australia-based project staff visited Pakistan regularly in the Phase 2 project and directly delivered training to scientists and extension workers in the field. This hands-on approach seems to be relatively unusual and, combined with the strong technical and teaching skills of the Australia-based project staff, led many stakeholders to view this knowledge sharing approach as highly effective.

Finally, staff of the FVDP described a highly participatory, grower-centred approach to farmer field schools, combined with the use of best practice demonstration sites. This is consistent with good development practice. Such participatory, hands-on training approaches are likely to have contributed to the achievement of the projects' outputs.

#### ***Market links***

A second key assumption in the theory of change is that citrus varieties in Pakistan (both new and existing) meet market demands at profitable prices, thereby giving growers and nursery people an incentive to change varieties and management practices.

The validity of this assumption is questionable. For example, the trialling and testing of new varieties did not consider market needs, while questions were raised about the demand for Kinnow, a relatively seedy mandarin.

The final external review raised the lack of market links as a significant issue. The program reviewers questioned why market analysis wasn't undertaken as part of selection of new varieties to trial, and suggested existing varieties in Pakistan do not meet market needs and are low-price. They also highlighted that 'there is little point in continuing to run nursery training courses until there is market demand (i.e. from growers) for high-health trees. An economic analysis of the cost: benefit of high-health vs traditional trees may assist' (McEvilly and Laghari 2015:15).

At the same time, it takes a significant amount of time for new citrus varieties to be tested and made widely available to growers, and market conditions can change over time. Therefore, a full market viability analysis prepared in advance of varietal development may be of limited value unless updated periodically. While the final external review identified demand issues with existing citrus varieties, it is possible that as further citrus varieties become commercially available in the future, they may meet this assumption and provide greater incentives for growers and nursery people to change practices.

### Post-project knowledge dissemination

A third assumption of the theory of change is that the best way to encourage growers and nursery people to change following project completion is through peer-to-peer learning. With the end of the ASLP projects in 2015 and the FVDP (which ran farmer field schools) in 2016, it is not clear that there was an active institutional home or continuation for training packages developed. This issue was highlighted by the final external review, which noted that there was no communications plan to develop and maintain resources, creating doubt about the future of extension programs.

Without a concerted training or communications plan, it appears unlikely that peer-to-peer learning alone would be sufficient to sustain or increase adoption or outcomes for nursery people and growers. It also means there may not have been clear direction for the ongoing and widespread use of ASLP training packages in extension services. See Table 4 for a summary of factors influencing adoption and impact.

**Table 4** Factors influencing adoption and impact

	Factor	Key findings
Knowledge	Do potential users know about the outputs?	The participatory nature of the training provided is likely to have resulted in knowledge transfer. However, the lack of a communications plan at project-end and the reliance on informal peer-to-peer learning means post-project knowledge sharing and contribution to extension capacity may be limited.
	Is there continuity of staff in organisations associated with adoption?	Not identified as a constraint for these projects.
	Are outputs complex in comparison with the capability of users?	Not identified as a constraint for these projects. Interviewees noted that the nursery and orchard management practices being promoted were relatively simple to implement.
Incentives	Are there sufficient incentives to adopt the outputs?	The projects' lack of market links raised doubts about whether growers and nursery people have sufficient incentives to adopt new management practices. At the same time, it takes significant time for new citrus varieties to become available. When new varieties are available, incentives for growers and nursery people to change may increase.
	Does adoption increase risk or uncertainty?	Risk or uncertainty related to new practices were overcome through the use of 'demonstration plots' to show effectiveness.
	Is adoption compulsory or effectively prohibited?	Not identified as a constraint for these projects.
Barriers	Do potential users face capital or infrastructure constraints?	The adoption of some modern orchard and nursery management techniques came with capital and infrastructure requirements. Interviewees indicated that, although low-cost orchard management practices were promoted, many growers face financial constraints to implementing them. Resource requirements for some nursery management practices varied depending on the practice, with higher adoption for lower cost practices.
	Are there cultural or social barriers to adoption?	There are significant cultural and social barriers to women's involvement in the citrus industry. These were largely not considered or addressed in the project.



## Discussion

Considering the data reported above, it appears likely that a small number of growers and nursery people have successfully adopted the practices and achieved improved incomes as a result. It also appears likely that a small number of extension workers continue to use the knowledge to support the citrus industry. However, with no systematic data available, it is unknown whether the projects' activities have translated into widespread outcomes for citrus growers and nursery people, or strong ongoing capacity in extension services. Given the length of time needed to test and make new citrus varieties widely available, and the lack of an active post-project institutional home for training activities, some enabling conditions for widespread adoption appear to be lacking. This, however, may change as more citrus varieties become available in the future.

The challenges of establishing adoption and outcomes for growers, nursery people and extension workers highlights a key lesson for future ACIAR programs: **from their inception, projects need monitoring systems that allow for the ongoing collection of data that can inform judgements on adoption and outcomes.** Ideally, data collection would focus on a model of behaviour change that is outlined in a project's theory of change. This would allow project staff and ACIAR to understand whether project beneficiaries are changing their behaviour as expected. This, in turn, can create confidence that project activities are leading to adoption and outcomes, or inform program improvements where necessary.<sup>16</sup>

A further lesson is that **ACIAR and project teams should design and implement projects with long-term sustainability in mind.** The lack of an active institutional home for training activities and a post-project communications plan means that extension staff may not have continued to benefit post-project. In turn, this means that support for growers and nursery people to adopt practices may not have been as accessible as would be desirable. Considering long-term sustainability at project inception will increase the likelihood of benefits for local people beyond the life of the project.

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<sup>16</sup> Note, both of these issues were highlighted in the 2013 ASLP mid-term review, which highlighted that projects needed to provide clearer 'impact pathways' and put sufficient effort into collecting evidence on their likely impact.

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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 citrus 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 citrus projects, which did not have strategies for addressing gender issues, or for considering marginalised groups, such as people with disabilities or people facing disadvantage. However, despite the lack of strategies in these areas, the Phase 2 projects positively benefited a small number of women and were inclusive of poorer smallholder farmers.

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

### Gender equity

Women appear to play a very limited role in the citrus industry in Pakistan. Interviewees noted that women generally did not work in nurseries or orchards due to cultural barriers and the physical nature of the work.

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

Despite the lack of recognition of gender issues, the projects did involve women in 2 meaningful ways. First, female scientists and students were involved in many aspects of the projects. Interviewees reflected that there did not appear to be substantive barriers to equity between men and women in the science and academic aspects of the project.

Second, a women's empowerment activity was included in the second phase project. This activity was largely driven by the initiative of the project leader, who identified an opportunity to do more in gender equity and actively sought an NGO partner for this work.

In this activity, the project worked with the local women's NGO PHKN. Women from the network were trained in nursery management techniques. They then provided on-training to 22 poor women from local villages to conduct nursery activities in their backyards. Further, these 22 women now lead around 10 nursery support groups of around 5–6 women, with each group sharing their knowledge of nursery practices. The work undertaken – backyard-based nursery activities – is appropriate to the context, as it allows women to work in the privacy of their homes.

Although quantitative data on the activity outcomes is not available, PHKN representatives described the results as 'very positive' for the women involved. They noted the income obtained from selling seedlings is not large, but it is helpful in the context of the poverty of the households involved. This positive view is supported by the final external project review, which noted the activity effectively empowered women and supported small home businesses.

While the success of the nurserywomen activities is clear, it only reached a small number of women and assisted with relatively small-scale businesses. The citrus projects reached a significantly larger number of men, and possibly resulted in significantly better results for some men given the relatively larger scale of their farm and nursery businesses. A key lesson highlighted by PHKN representatives was that **women's training and business needs should be included from the start of project planning to ensure better depth and breadth of women's involvement.**



## Social inclusion

This section of the report focuses on the extent to which the citrus projects were 'pro-poor', or focused on poorer smallholder farmers. Stakeholders were not aware of any citrus project activities that addressed the needs of marginalised groups, such as people with disabilities, ethnic or religious minorities, or disadvantaged youth.

The Phase 1 citrus project focused on 'medium to large growers' and so cannot be considered pro-poor. This changed in the Phase 2 project, with project documentation explicitly stating that 'small to medium growers' would be targeted.

In interviews, some senior project staff noted confusion about what is meant by a 'pro-poor' approach. They felt ACIAR did not have a clear definition of this, and that greater guidance on pro-poor approaches from ACIAR would be beneficial. That notwithstanding, the Phase 2 project employed appropriate strategies to reach smallholder farmers. For example:

- The project promoted low-cost practices such as pruning, fruit thinning, and furrow irrigation.
- The project aimed to reach large numbers of small to medium farmers through farmer field schools.
- To support training and farmer field schools, the project set up good practice demonstration sites. These demonstration sites were often on a small plot within the farm of a medium-sized grower. This was an appropriate strategy as:
  - medium-sized growers were able to take on the risk associated with trialling modern practices
  - the small size of the plots demonstrated the modern practices could be effective on smallholder farms.

Despite the pro-poor approaches, a number of interviewees highlighted that many growers still face financial barriers to adopting new orchard management practices. One interviewee said that up to 90% of farmers face financial challenges. Other interviewees noted that where growers did not have sufficient resources to implement practices, they modified them to suit the resources available (for example, by reducing the amount of fertiliser used). Smallholder farmers' financial challenges are likely to continue to constrain the achievements of ACIAR projects, and ACIAR and project teams should continue to design projects with these constraints in mind.

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

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The management arrangements for the projects experienced both challenges and successes. The Phase 1 project experienced challenges in the relationship between the teams based in Australia and Pakistan, but lessons were learned and the management arrangements improved in the second phase. The role of ACIAR in project management was improved through the establishment of a Pakistan country office. At the same time, the ACIAR management role was hindered by challenges with the program funder.

### Relationship between Australia- and Pakistan-based teams

There were significant management challenges in the relationship between the teams based in Australia and Pakistan. In particular, it appears there was inadequate management support from Pakistan counterparts, particularly in the first phase project. The final external review report noted that 'reliable and proactive in-country project leadership with excellent linkages with the Australian project leader was needed. However, this was clearly lacking. While this was counterbalanced by the in-country experience of the Pakistani-born Australian project leader, the dysfunction acted as a drag on the project' (McEvilly and Laghari 2015:4).

There are 2 key factors that may have contributed to this situation. First, in the first phase project, the security situation in Pakistan deteriorated significantly. It was very difficult for Australia-based staff to visit Pakistan and, during any visits, they could not visit the field. This made it challenging to build appropriate relationships between project staff.

Second, the main Pakistan-based collaborator held a senior role at a Pakistani research organisation. His existing research and workload meant he did not have sufficient time to engage with the citrus projects. At the same time, his roles did not appear to be deputised well to other team members, and it was difficult to hold him accountable given his existing senior position. As a result, the Australia-based project leader took on far more in-depth management of the project, a challenging role to play from Australia.

The management situation improved for the Phase 2 project. Drawing on lessons learned from the first phase, 2 in-country project coordinators were hired. These staff were dedicated to coordination and collaboration of project activities. The project focused on hiring young, motivated staff who were open to new ideas and could be held accountable for their performance. This also necessitated a shift in the role of the Australia-based project leader, as it became important for him to delegate greater responsibility and ownership to staff in Pakistan. Overall, the strategy of hiring in-country project coordinators and providing them with strong project ownership appears to have been an effective strategy for improving project performance in Pakistan.

Fortunately, the security situation in Pakistan improved later in the projects, allowing more visits to Pakistan by Australia-based staff. This helped build relationships, including when Australia-based staff were able to provide more hands-on training.

### ACIAR role in project management

Interviewees noted that ACIAR did not always have staff resources to support projects, and the program overall, to an ideal level. A key reason for this was the mismatched expectations between ACIAR and the program funder, DFAT. It appears these organisations had quite different terminology and expectations about what the projects should achieve. The ASLP mid-term review noted that DFAT expectations were often unrealistic, as it expected broad productivity improvements that a research-for-development project was unlikely to fulfil. Interviewees also highlighted that DFAT had reporting expectations that ACIAR struggled to meet. As a result, ACIAR staff were often very focused on meeting DFAT reporting needs, and so had less time to engage in project and program oversight.

Interviewees also highlighted that ACIAR did not open a Pakistan country office until towards the end of ASLP. An ACIAR in-country presence helped to raise its profile, ensuring stakeholders understood that ASLP was overseen by ACIAR. The ACIAR in-country presence also ensured it could build and leverage broader relationships with the Pakistani government, and link to other donor programs. While the absence of ACIAR in Pakistan earlier in the program was not highlighted as a problem, it appears that overall program success could have been enhanced by an in-country office.



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

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

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

### Capacity of research and extension systems

There is good alignment between the citrus projects and the goal of enhancing the capacity of Pakistan's research and extension systems. The projects have contributed to a better research capacity. 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 Phase 2 project was well aligned with the ASLP goal of supporting smallholder farmers. To summarise, the Phase 2 project had a number of appropriate strategies to reach and address the needs of smallholder farmers, noting that the lack of systematic data means it is challenging to make a robust assessment of whether this resulted in widespread changes in practices in this group.

### Supporting value chains

There is a mixed picture on the extent to which the citrus projects were aligned with and contributed to a goal of supporting value chains.

On one hand, the projects largely focused on citrus production; that is, improving the quantity and quality of fruit. Interviewees noted there were clear reasons for this focus on production: Pakistan needed to improve significantly in this area and there were key pieces of work to be done. Without improvements in production, it would not be possible to improve market linkages.

At the same time, the projects conducted minimal work on connecting products to markets. Two main activities were undertaken. First, a quality payment system was trialled in the Phase 2 project. Under this trial, a small number of farmers were supported to implement best practice orchard management techniques. They were also linked directly to markets in order to sell their produce without the wholesalers that are commonly used in Pakistan. The trial appears to have been successful, with reporting indicating growers increased their profit margins by up to 50%. At the same time, the trial was small and only involved 5 farmers.

Second, a value chain scoping study was conducted towards the end of the Phase 2 project. The purpose was to consider value chain issues that could form the basis of a follow-up citrus project (note this follow-up project did not eventuate).

At the same time, the final independent review raised significant questions about whether more should have been done to link project activities to markets. Serious concerns were raised about whether new and existing varieties of citrus would meet market demands at profitable prices, which appears to be a fundamental issue for the success of the citrus projects. The lack of market demand for high-health nursery products was also raised as a barrier to the adoption of modern nursery management techniques. Further, interviewees highlighted that the projects focused on 'production first', with the idea that market links should come after that. Interviewees questioned this, suggesting an approach which simultaneously addressed production and markets would be more effective.

Overall, the project design could have included significantly more work on value chains and market linkages. This would have increased the alignment of the projects with the ASLP goals.

A key lesson for ACIAR is **that projects should be designed with market linkages in mind**. This should apply even when the most pressing issues are related to commodity production. Ensuring there is a viable market for the high-quality products produced (and/or explicit strategies to foster future market development), and that market information is made available to producers, will likely enhance the success of production activities since project beneficiaries will see clear incentives to adopt new approaches and technologies.

## Programmatic level value-add

This review also examined the extent to which ASLP's 'programmatic' approach added value for the citrus project. From the evidence available, it is clear that while the citrus projects benefited in minor ways from being part of a larger program, the potential for significant value-add was not realised.

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.

A further approach was added for ASLP's second phase, when the 'social project' 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.

The citrus project received some relatively minor benefits from the above strategies. For example:

- it collaborated with the mango projects on a manual to improve nursery management, and on training for nurserymen and nurserywomen
- it could access small additional funds for conferences or events.

Interviewees also reflected that, while the benefits to the citrus projects were minor, the project experienced no disadvantages from being part of ASLP.

It appears there was significant potential for much greater value-add for the citrus projects from coming under the ASLP umbrella. Greater value-add might have been possible with better commodity and geographic alignment. Interviewees highlighted that the dairy project, with its focus on livestock, had little in common with the horticulture projects. The citrus and mango projects were geographically dispersed and had different seasons and harvest times.

The greatest unrealised potential came from the lack of collaboration between the citrus project and the social project. The proposal for the Phase 2 citrus project (in 2010) planned strong engagement with the new social project, stating that outcomes from the social project would be used to inform the citrus project and that this would inform the citrus project's strategies for engaging with marginalised groups. Joint workshops, activities and sharing of staff between the different projects were also envisioned.

Unfortunately, very little substantive interaction between the 2 projects took place, likely to the detriment of both projects. It seems there was good potential for the citrus project to use data from the social project to better understand the challenges facing rural communities, and to better understand if the citrus project was contributing to change for poor and marginalised groups, and women. However, one interviewee described the citrus and social projects as 'disconnected' and with their own agendas. The final independent review noted collaboration between the 2 projects was minimal.

There are a number of factors that appear to have contributed to the lack of collaboration between the ASLP projects, particularly the social and the commodity-based projects. For example:

- The social project did not commence until Phase 2 of ASLP, when the other projects, their approaches and their geographic locations, were already well established.
- The program and projects had insufficient time and resources devoted to encouraging and facilitating collaboration between projects. There appears to have been an assumption that Australia-based annual meetings would naturally lead to relationship building and collaboration in Pakistan, an assumption that does not appear to have held.
- The ACIAR ASLP program manager had insufficient time to facilitate collaboration or consider systems/incentives for collaboration, given the challenges they faced working with DFAT.
- There appeared to be misunderstandings from the beginning about what each project would do and what collaboration might look like.
- Social scientists and commodity-based scientists worked in silos and struggled to understand each other's potential value-add.

The challenges highlight an important lesson for ACIAR: that **specific strategies should be considered to ensure projects benefit from being part of a broader program**. Such strategies could include:

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



## Conclusions and lessons learned

Overall, **the results of the ASLP citrus projects are mixed**. In relation to introducing new citrus varieties, the projects achieved strong outputs, adoption and outcomes, and contributed to the commercialisation of at least one new citrus variety and to increased scientific capacity in Pakistan. The projects' participatory, hands-on training approach was viewed very positively by stakeholders. The Phase 2 project was also pro-poor and achieved good outcomes for a small number of nurserywomen.

In orchard and nursery management, good outputs were achieved, and it appears likely that some growers, nursery people and extension staff adopted and promoted the ASLP practices. However, the lack of systematic data makes it challenging to make a robust assessment of whether widespread adoption and outcomes have been achieved, or whether capacity of extension staff has been sustained.

Some enabling conditions for widespread adoption, such as an active long-term institutional home for training activities and a lack of market links for products, appear to be lacking – noting that the long-term timeframe to introduce new citrus varieties means market demands may improve in the future. In addition, the potential value-add of the ASLP 'programmatic' approach was not realised, particularly because of the lack of links between the citrus and social science projects.

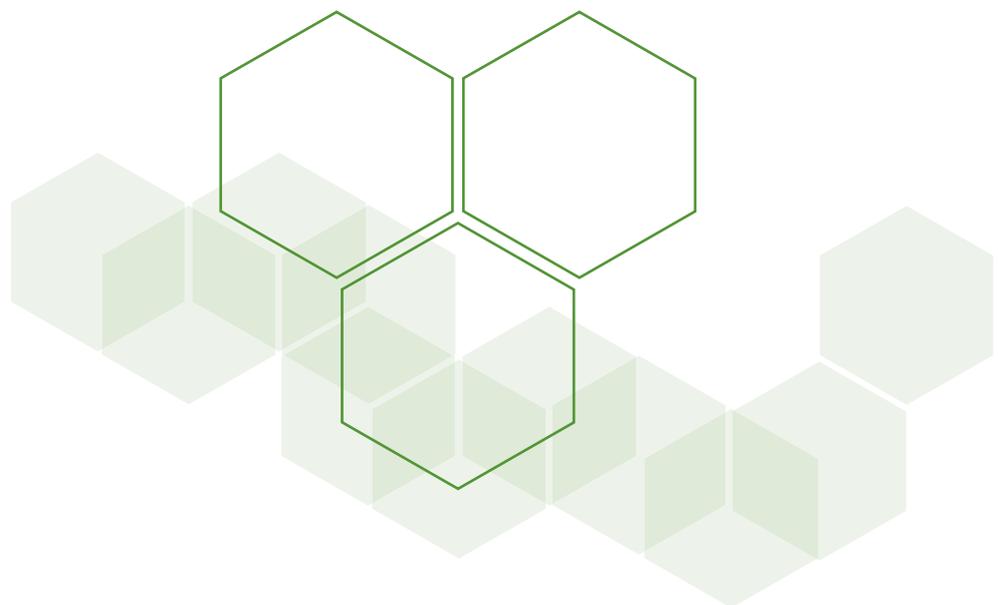
### Lessons learned

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

- 1. From their inception, projects need monitoring systems that allow for the ongoing collection of data that can inform judgements on adoption and outcomes.** Ideally, data collection would focus on a model of behaviour change that is outlined in a project's theory of change. This would allow project staff and ACIAR to understand whether project beneficiaries are behaving, and changing behaviour, as expected. This, in turn, can create confidence that project activities are leading to adoption and outcomes, or inform program improvements where necessary.
- 2. ACIAR and project teams should design and implement projects with long-term sustainability in mind.** Developing a post-project communications plan, and identifying and working with a partner who can act as an active long-term home for training and extension activities, can help ensure local people can benefit from project work beyond the life of the project.
- 3. Gender analysis and social inclusion analysis, and the development of corresponding gender and social inclusion strategies, should be undertaken.** This will assist projects to develop a more strategic approach to influencing gender equity and women's empowerment, and to ensuring people with disabilities and other marginalised groups can benefit from projects.
- 4. ACIAR and project teams should design projects with market linkages in mind.** This should apply even when the most pressing issues are related to commodity production. Ensuring there is a viable market for the high quality products produced (and/or explicit strategies to foster future market development), and that market information is made available to producers, will likely enhance the success of production activities since project beneficiaries will see clear incentives to adopt new approaches and technologies.
- 5. ACIAR should consider specific strategies to ensure projects benefit from being part of a broader program.** Such strategies could include allocating sufficient time and resources to cross-project collaboration; developing program structures that incentivise cross-project collaboration; and selecting project teams that are open to collaborative, interdisciplinary ways of working.

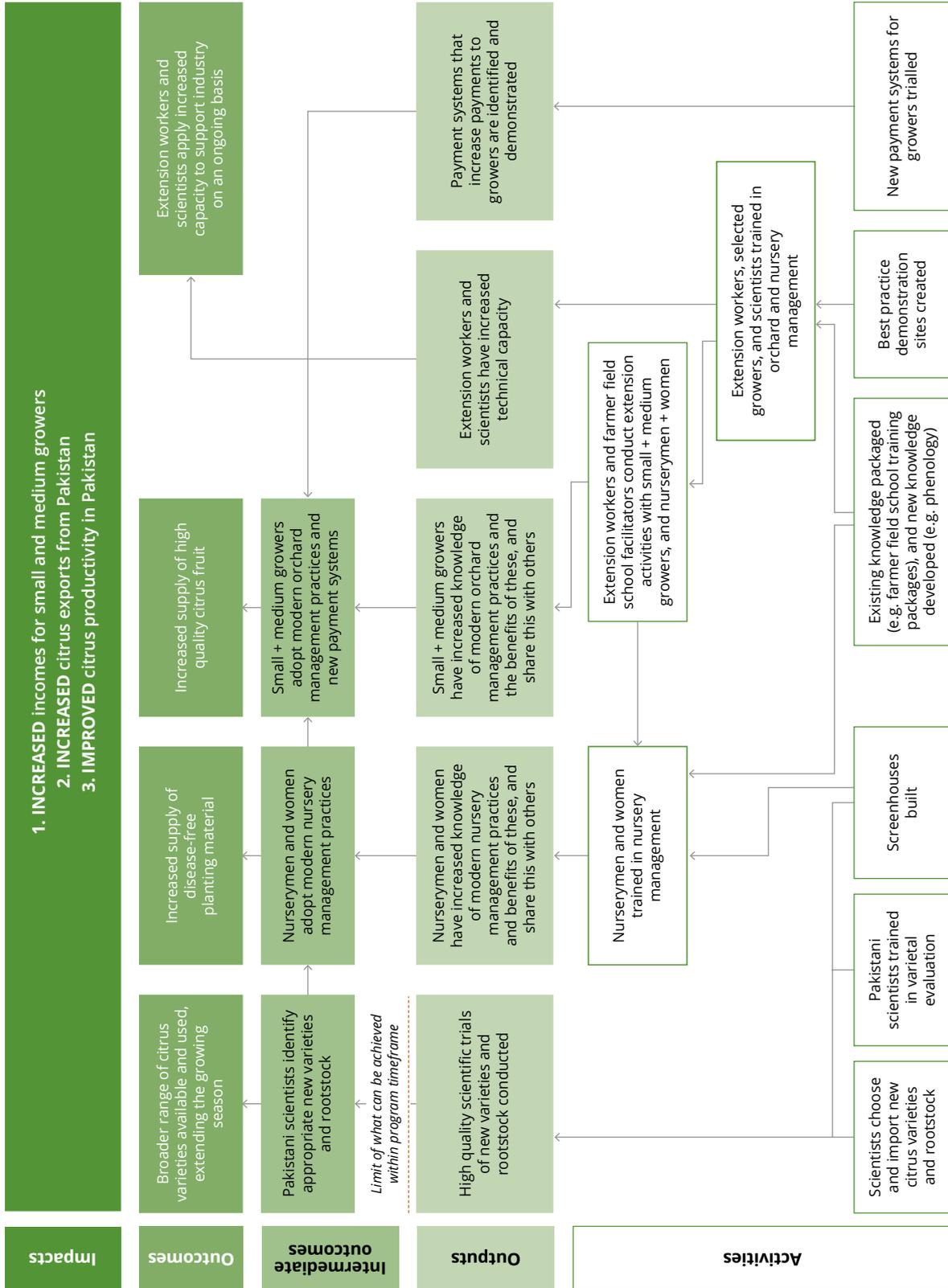
## References

- ACIAR and AusAID (2013) *Agriculture Sector Linkages Program – Phase II. Mid-term Review*, DFAT, Canberra, accessed 8 December 2021.
- Department of Foreign Affairs and Trade (2017) *DFAT Monitoring and Evaluation Standards*, DFAT, Canberra, accessed 8 December 2021.
- Khurshid T (2014) *Project proposal: The enhancement of citrus value chains production in Pakistan and Australia through improvement orchard management practices*, May 2014 variation (not published).
- Khurshid T, Donovan N, Falivene S, Ali W and Tahir T (2015) *Final report: The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management practices*, ACIAR, Canberra, accessed 8 December 2021.
- McEvelly G and Laghari H (2015) *Final review: HORT/2010/002: The enhancement of citrus value chains production in Pakistan and Australia through improved orchard management techniques* (not published).



# Appendixes

## Appendix 2.1: Theory of change



## Appendix 2.2: Stakeholders consulted

Name	Title	Organisation or location
Dr Tahir Khurshid	Project Leader	NSW Department of Primary Industries
Mr Nisar Naeem	Senior Research Officer	KP Agriculture Research Pakistan
Mr Abdul Rehman	Research Officer	Citrus Research Institute, Sargodha
Mr Asif Ali Khan	Agriculture Extension Specialist	Fruit and Vegetable Development Project
Dr Ghulam Nabi	Professor Department of Horticulture	KP Agriculture University
Dr Jaffar Jaskani	Professor Department of Horticulture	University of Agriculture Faisalabad
Dr Shazia Ahmad	Professor	Fatima Jinnah Woman University, Rawalpindi
Mr Iffar Kalsoom		PHKN
Ms Tehmina Afzaal		PHKN
Mr Mian Ayaz	Citrus Grower	Peshawar
Mr Hamad Ahmed	Progressive Grower	Sargodha region
Mr Muhammad Ilyas Warriach	Progressive Grower	Sargodha
Mr Hastam Khan	Nursery person	Tarnab Peshawar
Mr Muhamad Afzal	Nursery person	Sargodha
Mr Abdul Ghafoor	Freelance Consultant	Sargodha
Dr Kazmi Munawar	Country manager, Pakistan	ACIAR
Mr Gerard McEvelly	Aik Saath Program Coordinator	ACIAR



## Appendix 2.3: Project evaluation framework

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

Key Evaluation Question	Evidence/information required	Data sources	Data collection and analysis approach
1. What was the project's theory of change; and how did this evolve during implementation? <ul style="list-style-type: none"> <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>
2. What outcomes (intended and unintended) has the project achieved or contributed to? <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 1 and Table 2)</li> </ul>
3. How did project activities and outputs contribute to the outcomes achieved? <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 1 and Table 2)</li> </ul>

## Appendix 2.3: Project evaluation framework (cont.)

Key Evaluation Question	Evidence/Information required	Data sources	Data collection and analysis approach
<p>4. What strategies were adopted to address gender equity and social inclusion and how effective were these?</p> <ul style="list-style-type: none"> <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 of changes in women's and men's control of assets, resources and decision-making, and gender equity (e.g. through impacts on female researchers; gendered knowledge generation; influence on inclusivity within partner organisations)</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, for example, 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</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 2.4: ASLP goals

ASLP ran for 2 phases between 2005 and 2015.

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

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

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

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

## Appendix 2.5: Project team members

#	Team member	Gender	International/National researcher
1	Dr Tahir Khurshid	M	International
2	Mr Jeremy Giddings	M	International
3	Dr Nerida Donovan	F	International
4	Mr Graeme Sanderson	M	International
5	Mr Steven Falivene	M	International
6	Mr Andrew Creek	M	International
7	Dr Iftikhar Ahmad	M	National
8	Dr Haffez-ur-Rehman	M	National
9	Mr Altaf-ur-Rehman	M	National
10	Mr Nawab Khan	M	National
11	Dr M Jaskanu	M	National
12	Dr Abdul Samad	M	National
13	Mr Ghulam Nabi	M	National
14	Mr Mian Majeed	M	National
15	Dr Abdul Aziz	M	National
16	Dr Muhammad Raza	M	National
17	Mr Adul Rahman	M	National
18	Mr Ghulam Nabi	M	National
19	Dr Mohammad Jaskani	M	National
20	Mr Asif Khan	M	National
21	Mr Khaloon	M	National



## Appendix 2.6: Research outputs

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Ali W, Khurshid T, Giddings J and Nabi G (2016) 'The effect of furrow and flood irrigation systems on water use efficiency and yield of sweet orange orchards in Pakistan', <i>Acta Horticulturae</i> , 1128:151–153.	Ali (Male, Pakistan) Khurshid (Male, Australia) Giddings (Male, Australia) Nabi (Male, Pakistan)
Donovan NJ, Khurshid T, Falivene SG and Bowes J (2016) 'Improving citrus nursery production practices in Pakistan under an Australian aid program', <i>Acta Horticulturae</i> , 1128:161–164.	Donovan (Female, Australia) Khurshid (Male, Australia) Falivene (Male, Australia) Bowes (Male, Australia)
Jaskani MJ, Shafqat W, Tahir T, Khurshid T, Ur-Rahman H and Saqib M (2016) 'Effect of rootstock types on leaf nutrient composition in three commercial citrus scion cultivars of Pakistan under the ASLP Citrus Project', <i>Acta Horticulturae</i> , 1128:131–136.	Jaskani (Male, Pakistan) Shafqat (Male, Pakistan) Tahir (Male, Pakistan) Khurshid (Male, Australia) Ur-Rahman (Male, Pakistan) Saqib (Male, Pakistan)
Khan, MA, Khurshid T and Asif MU (2016) 'Extension activities of a citrus project in Pakistan with assistance from the Australian aid program', <i>Acta Horticulturae</i> , 1128:193–196.	Khan (Male, Pakistan) Khurshid (Male, Australia) Asif (Male, Pakistan)
Khurshid T, Hardy S, Sanderson G and Baxter L (2008) 'To optimise citrus production through management techniques under agriculture sector linkages program (ASLP/ ACIAR) in Pakistan, Bhutan and Australia', <i>Proceedings of International Society of Citriculture</i> , 1:492–494.	Khurshid (Male, Australia) Hardy (Female, Australia) Sanderson (Male, Australia) Baxter (Male, Australia)
Nisar N, Samad A, Nabi G and Khurshid T (2016) 'Evaluation of sweet orange ( <i>Citrus sinensis</i> ) scion cultivars on 'Bigarade' rootstock in Malakand division under the ASLP Citrus Project', <i>Acta Horticulturae</i> , 1128:197–202.	Nisar (Male, Pakistan) Samad (Male, Pakistan) Nabi (Male, Pakistan) Khurshid (Male, Australia)
Rehman M, Singh Z and Khurshid T (2018) 'Alleviation of chilling injury induced by cold quarantine treatment in Midnight Valencia and Lane Late sweet orange fruit', <i>Australian Journal of Crop Science</i> , 12(10):1616. <b>Impact factor: 0.55</b>	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia)
Rehman M, Singh Z and Khurshid T (2018) 'Methyl jasmonate alleviates chilling injury and regulates fruit quality in 'Midnight' Valencia orange', <i>Postharvest Biology and Technology</i> , 141:58–62.	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia)
Rehman M, Singh Z and Khurshid T (2018) 'Pre-harvest spray application of abscisic acid (S-ABA) regulates fruit colour development and quality in early maturing M7 Navel orange', <i>Scientia Horticulturae</i> , 229:1–9.	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia)
Rehman M, Singh Z and Khurshid T (2018) 'Pre-harvest spray application of prohexadione-calcium and paclobutrazol improves rind colour and regulates fruit quality in M7 Navel oranges', <i>Scientia Horticulturae</i> , 234:87–94.	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia)
Rehman M, Singh Z and Khurshid T (2019) 'Nitric oxide fumigation alleviates chilling injury and regulates fruit quality in sweet orange stored at different cold temperatures', <i>Australian Journal of Crop Science</i> , 13(12):1975–1982.	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia)

## Appendix 2.6: Research outputs (cont.)

Peer-reviewed journal articles	
Publication	Author (gender, nation)
Rehman M, Singh Z, Khurshid T, Malekipoor R and Tokala VY (2021) 'Preharvest spray application of methyl jasmonate promotes fruit colour and regulates quality in M7 Navel orange grown in Medireranean climate', <i>Australian Journal of Crop Science</i> , 15:387–393.	Rehman (Male, Pakistan) Singh (Male, Australia) Khurshid (Male, Australia) Melekipoor (Male Australia) Tokala (Male, India)
Zaheer I, Iftikhar S, Khurshid T, Ahmad KS and Gul MM (2020) 'Isolation and ITS-rDNA based molecular characterization of plant pathogenic fungal species in postharvest citrus fruits', <i>Sydowia</i> , 71:267–278.	Zaheer (Female, Pakistan) Iftikhar (Female, Pakistan) Khurshid (Male, Australia) Ahmad (Female, Pakistan) Gul (Female, Pakistan)
Conference proceedings	
Publication	Author (gender, nation)
Ahmad I, Khurshid T, Jaskani J, Naeem N, Nabi G, Hayat A, Tahir T, Ali W and Ur-Rahman H (2014) 'Enhancement of citrus industry through improved production practices in Pakistan under the AusAid Program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Ahmad (Male, Pakistan) Khurshid (Male, Australia) Jaskani (Male, Pakistan) Naeem (Male, Pakistan) Nabi (Male, Pakistan) Hayat (Male, Pakistan) Tahir (Male, Pakistan) Ali (Male, Pakistan) Ur-Rahman (Male, Pakistan)
Ahmed R, Khurshid T, Rahman A, Rahman AU, Hayat A and Zaka M (2014) 'The Comparison of Furrow and Flood Irrigation system in 'Kinnow' mandarin under an Australian aid program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Ahmed (Male, Pakistan) Khurshid (Male, Australia) Rahman, A (Male, Pakistan) Rahman, AU (unknown) Hayat (Male, Pakistan)
Donovan N, Khurshid T and Falivene S (2014) 'Improving citrus nursery production practices in Pakistan under the Australian aid program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Donovan (Female, Australia) Khurshid (Male, Australia) Falivene (Male, Australia)
Falivene S, Khurshid T, Tahir T, Wajid A and Kazmi M (2004) 'Introduction of a more effective 'Kinnow' mandarin fruit payment system in Pakistan under Australian Aid project', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Falivene (Male, Australia) Khurshid (Male, Australia) Tahir (Male, Pakistan) Wajid (Male, Pakistan) Kazmi (Male, Pakistan)
Khan M, Khurshid T, Shahbaz M and Ahmad S (2014) 'The extension activities of citrus project in Pakistan with assistance from the Australian aid program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Khan (Male, Pakistan) Khurshid (Male, Australia) Shahbaz (Male, Pakistan) Ahmad (Male, Pakistan)
Khurshid T (2012) 'Enhancement of citrus value chain production in Pakistan and Australia under the AusAid program', <i>Proceedings of the International Society of Citriculture</i> , Valencia, Spain.	Khurshid (Male, Australia)
Khurshid T (2014) 'The Response of Phenological Stages to Climatic Extremes and its Effects on Citrus Production and Quality', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Khurshid, T (Male, Australia)



Conference proceedings	
Publication	Author (gender, nation)
Khurshid T (9–12 October 2015) 'An update of the ACIAR Pakistan project', <i>ACIAR project leaders conference</i> , Brisbane.	Khurshid (Male, Australia)
Khurshid T (2017) 'Citrus nursery management and production practices in Pakistan', <i>Proceedings of the 11th International Society of Citrus Nursery Congress</i> , Mildura, Australia.	Khurshid (Male, Australia)
Khurshid T (2018) 'Recent development in citrus production technology and export production opportunities', <i>Pakistan Horticulture Expo</i> , Lahore. (Invited to speak by the Chief Minister of Punjab)	Khurshid (Male, Australia)
Khurshid T, Rahman H and Ahmad I (2008) 'Increasing citrus production through orchard management techniques under Agriculture Sector Linkages Program', <i>Australian Society of Horticultural Science Conference</i> , Gold Coast.	Khurshid (Male, Australia) Rahman (Male, Pakistan) Ahmad (Male, Pakistan)
Khurshid T, Jaskani M, Nabi G, Tahir T, Ali W, Rahman A, Khan M and Rahman H (2012) 'Enhancement of citrus value chain production in Pakistan and Australia under the AusAid Program', <i>International Society of Citriculture Science Conference</i> , Valencia, Spain.	Khurshid (Male, Australia) Jaskani (Male, Pakistan) Nabi (Male, Pakistan) Tahir (Male, Pakistan) Ali (Male, Pakistan) Rahman, A (Male, Pakistan) Khan (Male, Pakistan) Rahman, H (Male, Pakistan)
Khurshid T, Sanderson G and Donovan N (2012) 'The evaluation of Chinese rootstock for tree growth, yield and quality of Lane Late oranges grown in Australia', <i>International Society of Citriculture Science Conference</i> , Valencia, Spain.	Khurshid (Male, Australia) Sanderson (Male, Australia) Donovan (Female, Australia)
Muhammad J, Shafqat W, Tahir T, Khurshid T and Rahman H (2014) 'Effect of rootstock types on leaf mineral composition in three commercial citrus scion varieties of Pakistan', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Muhammad (Male, Pakistan) Shafqat (Male, Pakistan) Tahir (Male, Pakistan) Khurshid (Male, Australia) Rahman (Male, Pakistan)
Nisar N, Nabi G, Samad A and Khurshid T (2014) 'Evaluation of sweet orange ( <i>Citrus sinensis</i> ) scion varieties on Bigarade rootstock in Malakand district under the ASLP citrus project', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Nisar (Male, Pakistan) Nabi (Male, Pakistan) Samad (Male, Pakistan) Khurshid, T (Male, Australia)
Tahir T, Falivene S and Khurshid T (2014) 'Hand thinning in 'Kinnow' mandarin to increase the size and quality of fruit under the ASLP citrus project in Pakistan with assistance from the Australian aid program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Tahir (Male, Pakistan) Falivene (Male, Australia) Khurshid (Male, Australia)
Ur-Rahaman H, Nabi G, Ali I, Tahir T and Ahmed M (2014) 'Effect of Orchard Floor Management Practices on Soil Properties, Growth and Yield of 'Kinnow' ( <i>Citrus reticulata</i> Blanco)', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Ur-Rahaman (Male, Pakistan) Nabi (Male, Pakistan) Ali (Male, Pakistan) Tahir (Male, Pakistan) Ahmed (Male, Pakistan)
Wajid A, Khurshid T, Naeem N, Samad A, Nabi G and Giddings J (2014) 'The effect of furrow and flood irrigation system on water use efficiency and yield of sweet orange under ASLP citrus project with assistance from Australian aid program', <i>International Society of Horticultural Science Conference</i> , Brisbane, Australia.	Wajid (Male, Pakistan) Khurshid (Male, Australia) Naeem (Male, Pakistan) Samad (Male, Pakistan) Nabi (Male, Pakistan) Giddings (Male, Australia)

## Appendix 2.6: Research outputs (cont.)

University thesis	
Publication	Author (gender, nation)
Adiya Z (n.d.) <i>Management of Citrus Canker Disease by Plant Extracts</i> , Fatima Jinnah Women University, Rawalpindi.	Adiya (Male, Pakistan)
Afzal S (2013) <i>Response of 'Rough Lemon' (Citrus jambhiri L) seedling against different potting media</i> [MSc thesis], University of Agriculture, Faisalabad.	Afzal (Female, Pakistan)
Fatima N (n.d.) <i>Effect of fruit thinning on quality and profitability of 'Kinnow' mandarin (Citrus reticulata Blanco)</i> [PHD thesis], University of Agriculture, Faisalabad.	Fatima (Female, Pakistan)
Iram Z (n.d.) <i>Aggressiveness analysis and molecular characterization of pathogens associated with citrus fruits of Khanpur</i> , Fatima Jinnah Women University, Rawalpindi.	Iram (Female, Pakistan)
Iram Z (n.d.) <i>Isolation and characterization of post-harvest fungal pathogens of citrus varieties from the domestic markets of Rawalpindi and Islamabad</i> , Fatima Jinnah Women University, Rawalpindi.	Iram (Female, Pakistan)
Iram Z (n.d.) <i>Molecular Identification and Pathogenicity of fungi Associated with Citrus Fruit Diseases of Sargodha Orchards</i> , Fatima Jinnah Women University, Rawalpindi.	Iram (Female, Pakistan)
Javeria N (n.d.) <i>Prevalence incidence and severity of citrus from the domestic markets of Rawalpindi and Islamabad</i> , Fatima Jinnah Women University, Rawalpindi.	Javeria (Female, Pakistan)
Khan A (n.d.) <i>Identification and characterization of fungal pathogen associated with citrus fruit disease of Sargodha orchards</i> , Fatima Jinnah Women University, Rawalpindi.	Khan (Female, Pakistan)
Khan U (n.d.) <i>Molecular Characterization of citrus canker pathotypes</i> , Fatima Jinnah Women University, Rawalpindi.	Khan (Female, Pakistan)
Madiha T (n.d.) <i>Detection, Quantification and Molecular characterization of Fusarium species associated with Malformation in Mango Orchards of Punjab and Sindh</i> , Fatima Jinnah Women University, Rawalpindi.	Madiha (Male, Pakistan)
Malik I (2013) <i>Response of sweet orange cultivars budded on citrus rootstocks under the climatic conditions of Peshawar</i> [MSc thesis], University of Agriculture, Peshawar.	Malik (Male, Pakistan)
Naeem M (2014) <i>Response of Lemon cultivars to Cox Orange mandarin rootstock</i> [BSc thesis], University of Agriculture, Peshawar.	Naeem (Male, Pakistan)
Rahman Z (2014) <i>Growth responses of the Australian sweet orange varieties on different rootstocks in the climatic conditions of Peshawar</i> [MSc thesis], University of Agriculture, Peshawar.	Rahman (Male, Pakistan)
Rehman M (2012) <i>Performance of citrus rootstocks in different potting media under the screenhouse conditions</i> [MSc thesis], University of Agriculture, Peshawar.	Rehman (Male, Pakistan)
Saman F (n.d.) <i>Identification of Skin Disorders of Citrus reticulata by Classical and Molecular Method</i> , Fatima Jinnah Women University, Rawalpindi.	Saman (Female, Pakistan)
Shafqat W (2014) <i>Effect of Rootstock types on leaf nutrient composition of three Citrus Scion varieties</i> [MSc thesis], University of Agriculture, Faisalabad.	Shafqat (Male, Pakistan)
Shireen F (n.d.) <i>Effect of chemical thinning on growth and fruit quality of 'Kinnow' mandarin Citrus reticulata Blanco</i> [MSc thesis], University of Agriculture, Faisalabad.	Shireen (Female, Pakistan)
Sumyia I (n.d.) <i>Assessment and molecular characterization of citrus canker causing pathotypes</i> , Fatima Jinnah Women University, Rawalpindi.	Sumyia (Female, Pakistan)
Ullah R (2012) <i>Influence of Gibberellic acid on fruit set and growth of sweet orange</i> [MSc thesis], University of Agriculture, Peshawar.	Ullah (Male, Pakistan)
Zarafshan S (n.d.) <i>Assessment and control of Huanglongbing disease of citrus</i> , Fatima Jinnah Women University, Rawalpindi.	Zarafshan (Female, Pakistan)

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