Australian Government
Australian Centre for
International Agricultural Research

ACIAR wheat and maize projects in Afghanistan

ACIAR IMPACT ASSESSMENT SERIES 85

Research that works for developing countries and Australia

ACIAR wheat and maize projects in Afghanistan

Amir Jilani
Centre for International Economics

David Pearce
Centre for International Economics

Francesco Bailo
The University of Sydney

ACIAR
Research that works for developing countries and Australia

aciar.gov.au

2013

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 cooperation 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.

Where trade names are used this constitutes neither endorsement of nor discrimination against any product by ACIAR.

ACIAR IMPACT ASSESSMENT SERIES

ACIAR seeks to ensure that the outputs of the research it funds are adopted by farmers, policymakers, quarantine officers and other beneficiaries. In order to monitor the effects of its projects, ACIAR commissions independent assessments of selected projects. This series of publications reports the results of these independent studies. Numbers in this series are distributed internationally to selected individuals and scientific institutions, and are also available from ACIAR's website at <aciar.gov.au>.

Jilani A., Pearce D. and Bailo F. 2013. *ACIAR wheat and maize projects in Afghanistan*. ACIAR Impact Assessment Series Report No. 85. Australian Centre for International Agricultural Research: Canberra. 158 pp.

ACIAR Impact Assessment Series – ISSN 1832-1879 (print), ISSN 1839-6097 (online)

ISBN 978 1 922137 76 0 (print)
ISBN 978 1 922137 77 7 (PDF)

Editing by James Dixon
Design by Peter Nolan
Printing by Elect Printing

Cover: A field interview, north-western Afghanistan. (Photo: Agency for Technical Cooperation and Development)

Foreword

The Australian Centre for International Agricultural Research (ACIAR) has collaborated with Afghanistan since 2002. This report assesses the impact of three ACIAR projects undertaken by the International Maize and Wheat Improvement Center (CIMMYT) in Afghanistan between July 2002 and December 2011.

Afghanistan's recent social and political history has created challenges both for those undertaking ACIAR-funded projects and for those assessing them. Before 1978, Afghanistan was close to self-sufficiency in grains and even exported some of its agricultural produce. However, more than two decades of war have undermined the agricultural sector. Small-scale farmers currently lack access to improved adapted varieties, high-quality seed and fertiliser and have little knowledge of better production technologies. Irrigation systems, roads and markets have all sustained damage. The ACIAR projects attempted to address a few of these challenges and, in particular, the use of improved varieties of wheat and maize and high-quality seed in Afghanistan.

The report's authors highlight the difficulties they encountered in undertaking the assessment. The realities of life on the ground in Afghanistan meant that the team could not visit the country for one-to-one interviews with farmers. An initial desktop analysis yielded no satisfactory conclusions about the impact of the research. ACIAR therefore decided to augment the study with a detailed survey of farmers in Afghanistan, undertaken by four in-country non-government organisations and the interviewers they selected and trained.

Responses to the survey proved vital in what would otherwise have been an impossible impact assessment. They revealed that ACIAR wheat and maize project activities in Afghanistan delivered three key outputs: the identification, distribution and multiplication of superior wheat and maize varieties; the building of knowledge and technical skills; and the promotion of superior agricultural techniques.

While the cost–benefit analysis detailed in this report has been restricted to findings on wheat grown under irrigation, the authors confidently affirm that introducing improved wheat varieties has led to improved yields, and that the gain from adopting new varieties is substantial even after accounting for the extra costs of fertiliser and seed purchases.

Given the adverse security conditions in Afghanistan, it is difficult to make any predictions about the future adoption of improved varieties. Lack of security often means farmers have to postpone certain farming activities and delay visiting their farms for long periods. It also restricts farmers' travel to buy good quality seed, so they need to rely on local suppliers. Poor security affects farmers' livelihoods if they cannot take their product to markets because of unsafe roads and threats from warlords and armed groups.

Research programs can do little to overcome some of these deep-rooted challenges, but we need to account for the challenges to appreciate the complexity of development projects in countries like Afghanistan.

I wish to acknowledge the significant Food and Agriculture Organization project funded by the European Union within the Afghanistan seed sector, which helped to ensure the dissemination of CIMMYT's improved varieties. The costs of that project are included in the cost–benefit analysis.

Nick Austin
Chief Executive Officer, ACIAR

Contents

Tables

Figures

Abbreviations

ACIAR	Australian Centre for International Agricultural Research
ACTED	Agency for Technical Cooperation and Development
Afs	Afghanis (Afghan currency)
AREU	Afghanistan Research and Evaluation Unit
ARIA	Agricultural Research Institute of Afghanistan
CAGR	compounded annual growth rate
CHA	Coordination of Humanitarian Assistance
CIE	Centre for International Economics
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize and Wheat Improvement Center)
DAP	diammonium phosphate
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
GPS	Global Positioning System
MADERA	Mission d'Aide au Développement des Economies Rurales
MAIL	Ministry of Agriculture, Irrigation and Livestock of Afghanistan
NARS	National Agricultural Research System
NGO	non-government organisation
NPV	net present value
SAB	Solidarité Afghanistan Belgique

Acknowledgments

The authors are extremely grateful to the survey teams in the four commissioned organisations—the Agency for Technical Cooperation and Development, Coordination of Humanitarian Assistance, Mission d'Aide au Développement des Economies Rurales, and Solidarité Afghanistan Belgique. Their professionalism, commitment to the task and flexibility in responding to follow-up requests were outstanding. This analysis could not have been done without them.

Thanks also to Dr Rajiv Sharma from CIMMYT, who responded to numerous information requests and assisted the survey teams' training in the identification of wheat varieties.

Thanks to Jason Soon, who was involved in detail in the early phases of the project, particularly the initial analysis of ACIAR documentation and the examination of the history of yields in Afghanistan.

Executive summary

Afghanistan has been at war almost continuously for at least three decades. The implications for agricultural production and the welfare of smallholders have been devastating.

In 2002, ACIAR began what was to become a series of three projects focused mainly on improving wheat and maize yields through the identification and provision of better varieties. This report presents an economic impact assessment of the three projects.

The conduct of this impact assessment flows from the realities of life on the ground in Afghanistan. The assessment team was unable to visit Afghanistan, and visits with farmers (a typical approach for ACIAR assessments) were out of the question. Consequently, after a desktop analysis that was unable to draw conclusions about the impacts of the ACIAR-funded research, ACIAR decided to commission a detailed survey of farmers in Afghanistan.

Four Afghanistan-based non-government organisations (NGOs) selected through a competitive tender trained local interviewers to conduct the survey. Security was a paramount consideration throughout.

The survey responses proved to be extremely important in what would otherwise have been an impossible impact assessment.

Despite the usual challenges of surveys, compounded by difficulties with language, literacy, security and variety identification, the results show clearly that improved varieties increase yields and that, even accounting for additional fertiliser and seed costs, there is a substantial gain from adopting them.

Using the survey to infer the difference between the *with* and *without* research scenarios indicates that the ACIAR project varieties have improved net productivity by between 22% and 34%.

Taking into account all relevant spending, including two closely related FAO projects, the project yielded a benefit:cost ratio of between 5:1 and 25:1, depending on the assumptions used.

Importantly, statistical analysis of the survey results indicated that the probability that the research has increased supply productivity is between 65% and 79%.

The probability that projects break even (in net present value terms) by 2020 is between 59% and 69% (and between 65% and 77% by 2030).

1 Background

Between July 2002 and December 2011, ACIAR conducted three projects in Afghanistan focusing on sustainable wheat and maize production. This report presents an economic impact assessment of the three projects, which were undertaken by the International Maize and Wheat Improvement Centre (CIMMYT) on ACIAR's behalf.

The country

While all countries are unique in some sense, Afghanistan is not typical of ACIAR's partner countries:

- Afghanistan is a small, landlocked country with a population of around 35 million.
- Its climate is arid and semi-arid, with annual precipitation ranging from 100 mm to 400 mm. Most occurs in the winter and spring.
- Cold winters and hot summers contribute to the harsh climate in many parts of the country.
- Because of Afghanistan's steep topography and dry deserts, only 11% of its land is arable. Most of the arable land is in temperate ecological zones, but a few lowland areas have subtropical ecologies.
- Wheat is the major grain crop in Afghanistan, occupying about 80% of the total area planted to cereals. This is followed by rice or barley (depending on the year being considered) and then maize.

Afghanistan's recent political and social history (summarised in Figure 1) is unique, creating challenges for both undertaking and assessing ACIAR-funded projects.

The projects began after the latest battles in nearly three decades of continuous war. Before 1978, Afghanistan was close to self-sufficiency in grains (and even exported some of its agricultural produce). The war undermined its agricultural sector, but there were indications of some recovery by the mid-1990s due to international rebuilding efforts. The area under wheat and maize grew by 50% between 1996 and 1998, but that growth was not sustained.

Currently, the main constraints to wheat and maize production for small-scale farmers in Afghanistan are a lack of improved adapted varieties, poor availability of good-quality seed, lack of high-quality fertiliser, inadequate production technologies, and damaged irrigation, road and market infrastructure.

The three ACIAR projects have attempted to address some of the key issues relating to improved wheat and maize varieties and quality seed in Afghanistan.

This report

This report undertakes an economic impact assessment of the three ACIAR projects, which are summarised in Table 2 and discussed in detail in Chapter 2.

Because the security situation in Afghanistan prevented in-country travel and investigations by the assessment team, this impact assessment has followed a slightly different course from the usual approach taken by ACIAR.

An initial desktop analysis (the results of which are in Appendix 5) was unable to find any evidence of improvement in yields either in aggregate or in particular provinces involved in the projects. Because of the highly stochastic nature of yields, however, this did not allow any conclusions about the 'with' and 'without' research scenarios that form the basis of impact assessment.

Subsequently, ACIAR commissioned a detailed interview-based survey of farmers. The survey was undertaken by local NGOs, using locals to interview the farmers. The survey results are the basis of the impact assessment.

Not all the funding needed to produce the with-research outcomes was provided by ACIAR. A significant United Nations Food and Agriculture Organization (FAO) project in the Afghanistan seed sector, funded by the European Union (EU), helped to ensure the dissemination of improved varieties. The costs of that project are included in the cost–benefit analysis.

The three ACIAR projects are discussed in detail in Chapter 2. Chapter 3 describes the survey. Broad survey findings are set out in Chapters 4 and 5, while the use of the survey as the basis for cost–benefit analysis is discussed in Chapter 6.

Appendixes to this report, which are available online at <http://aciar.gov.au/publication/ias085>, but not in the printed version, provide additional detail:

- Appendix 1: The survey process and organisation
- Appendix 2: The survey instrument
- Appendix 3: Survey responses
- Appendix 4: Qualitative information from the survey NGOs
- Appendix 5: Detailed history of yield in Afghanistan.

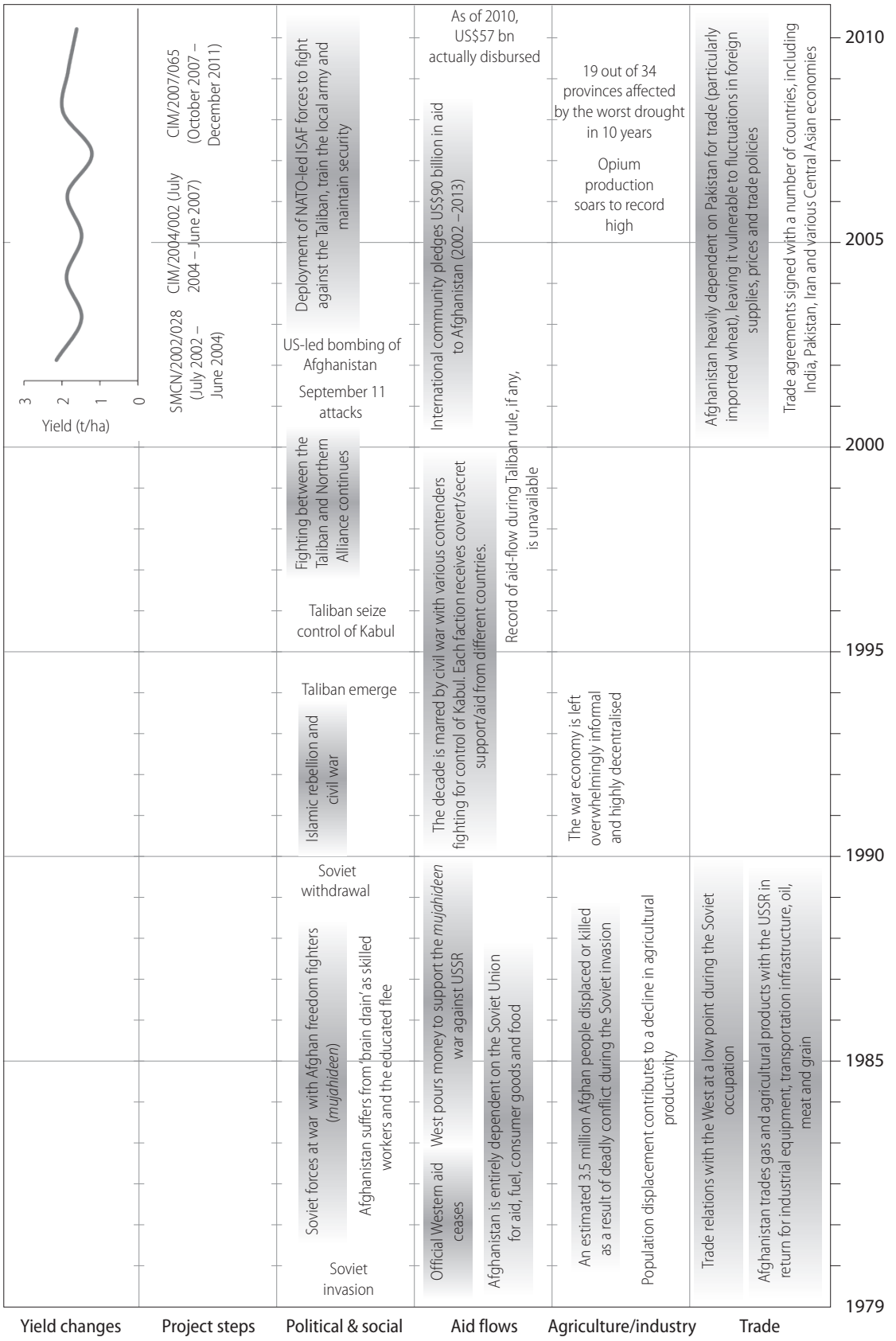


Figure 1. A timeline—Afghanistan yield outlook in the broader historical context. Source: Yield data from FAO.

2 The ACIAR projects, outputs and outcomes

The projects

Since 2002, ACIAR has managed three major wheat and maize projects in Afghanistan. The projects, undertaken by CIMMYT, were designed to increase yields of maize and wheat. Table 1 summarises the projects' key features.

The projects dealt with breeder, foundation and certified seed:

- Breeder seed comes from the breeding agency, but in small amounts.
- Foundation seed is multiplied from breeder seed to produce larger quantities.
- Certified seed has its genetic integrity ensured and is made available in the market.

The use of these designations maintains integrity of the genetics of the seed stock and provides guarantees about the seed's traits.

Table 1. ACIAR projects in Afghanistan

Project	Date	Budget (nominal)	Outputs	Outcome/impact
SMCN/2002/028 Stress-tolerant wheat and maize for Afghanistan—Seeds for Strength	July 2002 to June 2004	$1,000,000[a]	Emergency seed provision Identification of suitable new varieties of wheat Identification of short-season maize varieties Capacity built	Reported 50% increase in wheat yield
CIM/2004/002 Wheat and maize productivity improvement in Afghanistan	July 2004 to June 2007	$1,468,945[b]	Two new wheat varieties released New wheat and maize lines identified Capacity built	Expectation of future yield increase
CIM/2007/06 Sustainable wheat and maize production in Afghanistan	October 2007 to December 2011	$1,716,407[b]	Release of new wheat and maize varieties Capacity built	Potential yield increases Disease resistance

a Financial limitation.

b Includes CIMMYT contribution.

Source: ACIAR project documents.

Stress-tolerant wheat and maize for Afghanistan—Seeds for Strength

SMCN/2002/028

This project ran from 1 July 2002 to 30 June 2004. CIMMYT used its longstanding partnerships in the region to improve maize and wheat production systems by distributing seed of improved varieties and new cultivars to small farmers.

The project had the following objectives:

- immediate distribution of bread wheat varieties from neighbouring countries (such as India, Pakistan, Iran, Uzbekistan and Kyrgyzstan) into areas hit by drought and refugee displacement
- the multiplication, in a number of district locations, of varieties with known adaptation and acceptance by Afghan farmers
- targeting, dissemination and verification through
  - the clear definition of provincial target areas
  - the identification of farmers' needs and possible solutions using participatory methods
  - on-farm adaptive research to identify the best-adapted wheat varieties
  - the widescale promotion of better wheat varieties
- national and regional monitoring of the virulence of wheat yellow rust
- the repatriation of Afghan cereal landraces held by the Australian National Winter Cereals Collection and CIMMYT.

Wheat and maize productivity improvement in Afghanistan

CIM/2004/002

This project ran from 1 July 2004 to 30 June 2007 and had six objectives:

- Identify promising new wheat and maize lines by testing introduced germplasm sourced from CIMMYT and from the region (for example, Iran, Pakistan, Tajikistan and India).
- Release new improved varieties after demonstrating them, multiplying seed, verifying the varieties in farmers' fields and confirming that the new varieties are acceptable to consumers.
- Produce and disseminate high-quality breeder seed of current and new varieties of wheat and maize.
- Adapt and improve management practices for wheat and maize, including the new varieties, under local conditions.
- Promote new varieties and improved management practices through NGOs, which take seed and knowledge to farmers.
- Build Afghan capacity in wheat and maize improvement.

The Ministry of Agriculture, Irrigation and Livestock (MAIL) was in charge of breeder seed production, while NGOs and farmers played a major role in multiplying seed.

Capacity building focused on MAIL and local NGO personnel, used in-country and external resources, emphasised hands-on practical training, and took advantage of regular courses run by CIMMYT.

Sustainable wheat and maize production in Afghanistan

CIM/2007/065

This project ran from 1 October 2007 to 31 December 2011. Ultimately, it aimed to improve the livelihoods of Afghan smallholder farmers and their families by contributing to the development and adoption of improved, high-yielding wheat and maize varieties. One objective was that high-yielding varieties would comprise 60% of the irrigated wheat grown in Afghanistan by 2011–12, an increase of 5% from the start of the project.

The project had the following more specific objectives:

- Identify promising new wheat lines and adapted maize germplasm, mainly by testing germplasm introduced from CIMMYT nurseries and regional programs in Turkey, Iran, India, Nepal and Pakistan.
- Support the release of new, improved, higher yielding wheat and maize varieties after verifying

them in farmers' fields and confirming their acceptability to consumers.

- Support the production and dissemination of high-quality breeder seed of current and new varieties of wheat and maize.
- Identify agroecological zones for wheat and intensified cropping systems incorporating short-season maize.
- Support the evaluation and promotion of improved varieties and management practices for wheat under local conditions.
- Build capacity for wheat improvement in Afghanistan, with a focus on MAIL staff and NGO personnel.

The project aimed to demonstrate at least five pre-release seed lines and two recently released varieties, and to support such initiatives as the FAO's seed production project.

Project outputs

ACIAR's guidelines for assessing the impacts of research activities identify three broad categories of outputs of research and development projects:

- Technologies—new and better products, processes and approaches.
- Capacity built—new scientific knowledge, new understanding and skills at the organisation and individual level, improved research infrastructure.
- Policy—knowledge, models and frameworks to aid policy and decision-making.

The ACIAR wheat and maize projects in Afghanistan delivered outputs in most of these categories.

Stress-tolerant wheat and maize for Afghanistan—Seeds for Strength (SMCN/2002/028)

Superior wheat and maize varieties

On-farm demonstrations and the selection of wheat and maize varieties with farmer participation were conducted at 15 sites near Kabul, Herat, Kandahar and Mazar-i-Sharif (ACIAR 2003). The selected seeds were multiplied in formal collaborations with MAIL, the FAO and Improved Seed Enterprises, and in informal partnerships with NGOs and farmers.

These activities resulted in superior strains of wheat and maize being more widely adopted. For example, the bread wheat variety MH-97 was identified as being adapted and acceptable for Afghan farming conditions. Three hundred tonnes of certified MH-97 seed was then procured from Pakistan and delivered to 9,000 farmers in 584 villages in 11 districts of four target provinces (Parwan, Kapisa, Baghlan and Kunduz). Additional amounts were also provided to farmer groups for distribution (ACIAR 2003).

The project also shipped nearly 350 tonnes of seed of seven adapted open-pollinated maize varieties to Afghanistan to be distributed to farmers for seed multiplication (ACIAR, no date).

Capacity built

- As a result of two workshops, staff from the FAO and the Aga Khan Development Network were trained in the multiplication of MH-97 wheat varieties and seed distribution and in conducting and managing seed trials and nurseries (ACIAR 2003).
- MAIL staff were trained in the application of bed planting technologies for irrigated and zero-till wheat production systems. CIMMYT conducted the training in Mexico (ACIAR 2003).
- Afghan researchers were trained in wheat improvement, with an emphasis on germplasm improvement research, crop protection and maize improvement. This training was also conducted by CIMMYT in Mexico (ACIAR 2003).
- Afghan researchers participated directly in CIMMYT Wheat Program germplasm development and research in Turkey (ACIAR 2003).
- Young Afghan agronomists were trained in agricultural research methodology in-country (ACIAR 2003).
- CIMMYT–Afghanistan focused on building strong collaborations with other partners active in

Afghanistan, including the Agricultural Research Institute of Afghanistan (ARIA). This included jointly conducted on-the-job training as well as everyday activities at research stations. This 'learning by doing' approach built the capacity of the National Agricultural Research System (NARS) (ACIAR 2003).

Altogether, a total of 15 Afghan crop researchers attended training in either Mexico or Turkey, while more than 100 local staff from ARIA, the FAO and NGOs attended in-country training.

In addition, regional monitoring helped to increase participants' knowledge of yellow rust virulence in wheat (ACIAR 2003).

Efforts were also made to make national program leaders aware of the importance of collecting, evaluating, using and maintaining local wheat germplasm (ACIAR 2003).

Wheat and maize productivity improvement in Afghanistan (CIM/2004/002)

Superior wheat and maize varieties

This project identified many wheat and maize varieties that were promising for yield or disease resistance and then distributed breeder or foundation seed.

In some cases, further testing was carried out before national release. For example, in 2008 alone, 558 promising wheat lines and 22 maize lines were identified for further testing. Of those, seven wheat lines and two maize lines were identified as potential candidates for official national release (ACIAR 2008).

Seed of Solh-02 and Gul-96 was distributed after being demonstrated to farmers as being superior in yield to local varieties (ACIAR 2006). Parva-2 and Solh-02 were released for commercial production (ACIAR 2005, 2007). Breeder seed was produced for the new wheat varieties Darulaman-07 and Ariana-07 (ACIAR 2008). The project also distributed 13 kg of seed with yellow rust resistance for farmers to evaluate.

The project distributed 140 kg of seed of promising maize varieties, from which 117 tonnes of maize was produced (ACIAR 2006). The use of open-pollinated maize was promoted by providing local language instruction on its multiplication (ACIAR 2007).

Superior agricultural techniques

The project identified new wheat and maize management practices and disseminated knowledge of them to farmers through the publication of technical materials, technical interactions with farmers and extension agents, seminars, conferences, workshops and field visits (ACIAR 2005). For example, the use and advantages of two-wheel tractors and local oxen-drawn implements were demonstrated and tested for possible modification for minimum tillage techniques.

Capacity built

- Seventy project participants, including Afghan farmers, local NGO workers and officers from research stations, gained knowledge about yellow rust and other constraints on agricultural development. They were also informed about CIMMYT's work on improved crop varieties, quality seed, variety evaluations and research methodologies (ACIAR 2003).
- CIMMYT conducted internal seminars and workshops to improve the technical skills and knowledge of collaborators (for example, in mentoring activities, the provision of technical information and field days). Young scientists, staff from the NARS and interested farmers attended (ACIAR 2006).
- Two training workshops on crop improvement, with special reference to wheat production in Afghanistan, were attended by local staff, teachers and students from participating organisations, including the FAO, the NARS, Mazar University and Baghlan University (ACIAR 2006).
- Travelling seminars visited various provinces to discuss the selection of disease-resistant lines. Participants included farmers and staff from the NARS, the FAO and CIMMYT (ACIAR 2006).
- CIMMYT trained ARIA, FAO and Aga Khan Foundation staff in maize and wheat improvement (ACIAR 2006).
- Analyses of replicated trials improved knowledge of gene–environment interactions in wheat and maize across Afghanistan (ACIAR 2005).

Sustainable wheat and maize production in Afghanistan (CIM/2007/06)

Superior wheat and maize varieties

This project identified many wheat and maize varieties that showed promise of greater yield or disease resistance, and followed this up by multiplying and distributing them and in some cases preparing them for national release.

For example, the project multiplied two new wheat varieties and three open-pollinated maize varieties of CIMMYT origin released formally in 2008 (ACIAR 2010).

CIMMYT/ARIA, Improved Seed Enterprises, the Afghanistan National Seed Organisation and other partners produced breeder, foundation, registered and certified wheat seed of recently released varieties (ACIAR 2010). The project distributed 750 kg of base seed of the new wheat variety Chonte #1 in Kabul, Nangarhar, Laghman and Parwan provinces for on-farm demonstrations.

The project promoted wheat lines with good disease resistance. Eleven lines that promised adult plant resistance to stem rust were identified and sown for multiplication (ACIAR 2010). Five varieties resistant to Ug99 stem rust were further tested and confirmed for yield and resistance and then multiplied in collaboration with ARIA (ACIAR 2010). In addition, 150 tonnes of the Ug99-resistant wheat variety Muqawim-09 was imported from Egypt and distributed for multiplication (ACIAR 2011a).

The project also produced base seed of the new maize varieties Mughazi and Zudras (Rampur 9433) (ACIAR 2011a).

In an attempt to identify agroecological zones for wheat and intensified cropping systems, the project also gathered information and developed GIS maps. In addition, the project helped to identify specific wheat variety needs based on agroecological and end-use requirements (ACIAR 2011a).

Capacity built

- Farmers and NGO staff were trained in agronomic management practices in key on-farm locations (ACIAR 2011a).
- Travelling seminars enhanced the capacity of technical staff and experts, shared knowledge and informed smallholder farmers of the benefits of improved crop management (ACIAR 2011a).
- The project ran in-country workshops and technical meetings and provided field manuals and other information in English and local languages. This included technical booklets on specific cereal diseases and pests, and guides to managing field trials (ACIAR 2011a).
- Researchers' capacity was increased through on-the-job training in crop improvement and the management of cropping systems (ACIAR 2011a).
- ARIA and MAIL staff trained abroad, including in India, Mexico, Turkey and Kenya, and attended courses and workshops on maize breeding, crop improvement, plant pathology, stem rust screening, conservation agriculture and project management (ACIAR 2011a).

Project outcomes

Outcomes are the changes in practice, products or policy that result from the adoption of project outputs. For these projects, one outcome was the release and adoption of new wheat and maize varieties.

Increased adoption of new and superior wheat and maize varieties

The three ACIAR projects resulted in the release of new spring wheat varieties in Afghanistan between 2002 and 2010. Four of the new wheat varieties have resistance to Ug99 wheat stem rust and accounted for about 9% of certified seed used in production during 2010–11 (ACIAR 2011a). The varieties released under the projects now account for close to 25% of total certified seed (ACIAR 2011b). This suggests that the ACIAR programs' attempts to promote the use of new wheat and maize varieties with better resistance and yield have had some success.

To further evaluate the diffusion of new wheat varieties, we looked at statistics on founder and breeder seed production for a selection of the new wheat varieties

introduced by the ACIAR projects over the 2003–2011 period (2003 was the earliest year for which such statistics were available). In particular, we looked at the seed production of Solh-02, Parva-2, Gul-96 and Lalmi-2 (production of Darulaman-07 and Ariana-07, the newest varieties, did not begin until 2010). The trends for breeder, foundation and certified seed production are shown in Figures 2, 3 and 4, respectively.

After 2007, there were substantial increases in breeder seed production of the new wheat varieties, with the exception of Parva-2, production of which increased only after 2008. The most significant increase was in production of Solh-02. For Solh-02, Gul-96 and Lalmi-2, the most significant increases were in 2008. This is consistent with the availability of Solh-02 and Parva-2. The spike in 2008 also reflected the start-up of breeder seed production and distribution around 2007.

The production of foundation seed appeared to be flat until around 2009, when it rose substantially. This may reflect a lag after foundation seed production of at least two of the varieties in 2007. However, the impact was not sustained for long, as production declined strongly after 2009.

Production of certified seed for the new wheat varieties was characterised by a series of peaks and troughs over the 2003–2010 period. There were peaks in production of all varieties in 2006, and again in 2008 and 2010.

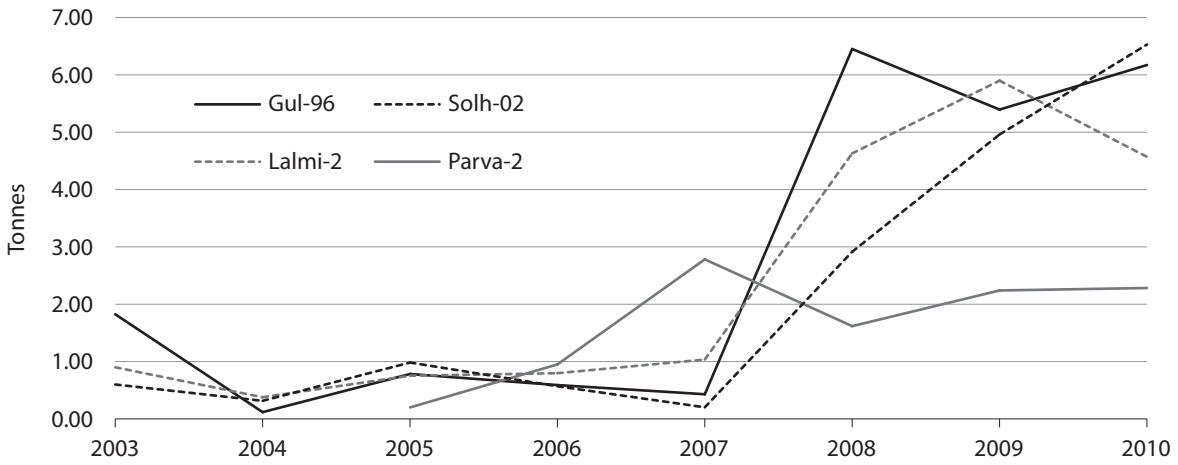


Figure 2. Breeder seed production of new wheat varieties. Data source: FAO.

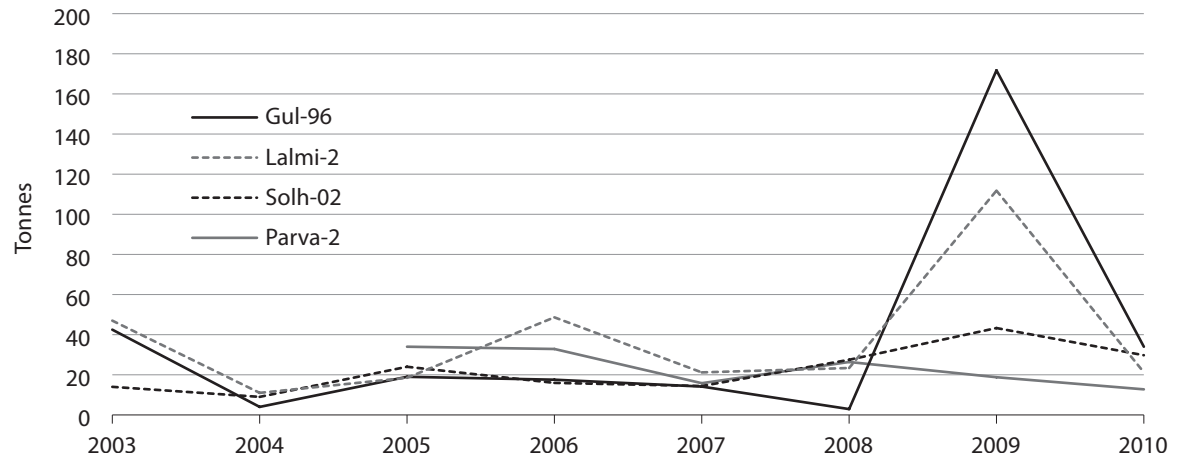


Figure 3. Foundation seed production of new wheat varieties. Data source: FAO.

Gul-96 had a more significant increase over the 2009–2010 period than the other varieties.

Figure 5 shows the compounded annual growth rate (CAGR) of breeder, foundation and certified seed production for the selected wheat varieties compared to the CAGR for all wheat varieties over the 2005–2010 period. We calculated growth rates only from 2005, as that was the earliest year when the impact of the programs on certified seed production would be evident.

These data show the following:

- Breeder seed production: the CAGRs for all the selected seeds were above the average for total breeder seed production. The highest CAGR was for Gul-96.
- Foundation seed production: the CAGRs for all the selected seeds were below the average for total foundation seed production, with the exception of Gul-96.

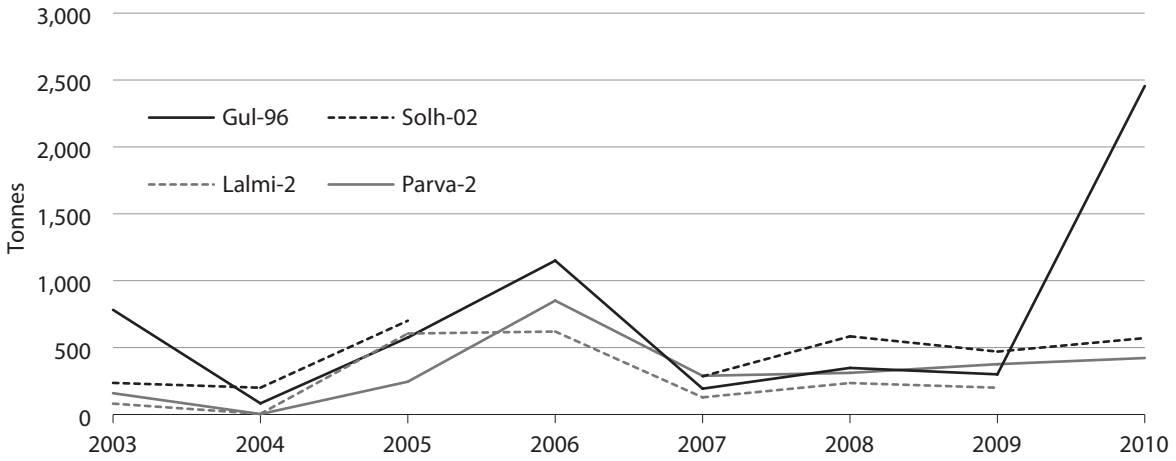


Figure 4. Certified seed production of new wheat varieties. Data source: FAO.

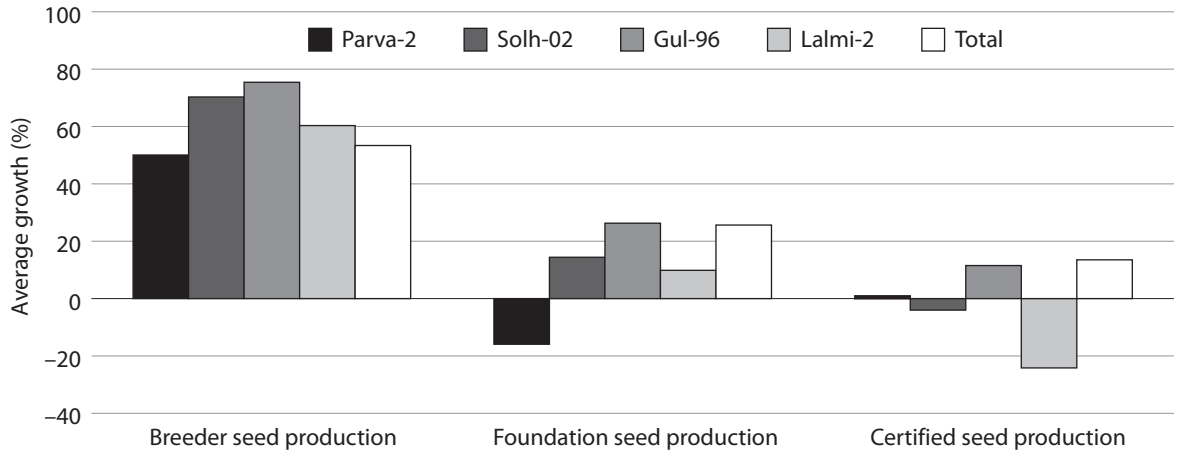


Figure 5. Compounded annual growth rate of seed production of new wheat varieties from 2005 to 2010. (a) Data for Lalmi-2 in 2010 were not available, so the compounded annual growth rate (CAGR) was calculated for 2005–2009. Because of gaps in data on Solh-2 and Lalmi-2 certified seed production, the CAGR was based on end-point data rather than a year-to-year geometric average. Data source: FAO.

- Certified seed production: the CAGR for the selected varieties was below the average for total certified seed production.

The wider use of these seeds may also have long-term positive implications for yields. It has been estimated that up to a 33% increase in yield can be achieved using improved wheat varieties, and another 28% increase can come from using certified seed (MAIL 2011).

Reduced cultivation of opium

There is evidence that the cultivation of opium declined significantly in some areas because of the increased value of legitimate crops fostered by ACIAR programs. For example, we estimate that opium cultivation fell by an average of almost 16% per year in Laghman Province over the 2005–2010 period. Over the same period, other provinces that were the target of ACIAR programs and had high opium cultivation in 2005 also recorded significant falls, ranging from an average of 33% per year to an average of 87% per year. By contrast, opium production for Afghanistan as a whole over the period declined by 0.71% per year.

Aggregate evidence of impact

The initial research for this impact assessment involved examining available time-series information on wheat and maize yields. Details of that investigation are in Appendix 5. Some basic summary information is provided here.

The long history of yields in Afghanistan

Figure 6 illustrates a number of key points about yield changes in Afghanistan from the early 1960s to 2012:

- Panel A compares wheat yields in India and Afghanistan. While Indian farmers had steadily increasing yields and a highly significant yield growth rate, in Afghanistan the picture was more complicated. Yields remained basically unchanged until around 2002–03.
- As Panel B shows for wheat (and as Panel C shows for maize), there was no significant change in irrigated or overall yields from around 2002–03. (The appearance of a trend in later years in irrigated wheat yields is an illusion; the growth rate was not statistically different from zero.)
- Panel B shows a step change in overall wheat yields in Afghanistan after 2002–03 compared with the long-term historical series. This change was a statistically significant yield increase of at least 0.14 t/ha (95% CI 0.2 t/ha to 0.4 t/ha).
- While Indian wheat yields increased by around 230% over the period, the increase in Afghanistan was between 20% and 40% and occurred only in recent years.
- There was a similar story for maize yields. An apparent step change around 2002–03, while significantly different from zero, has a much wider confidence interval (95% CI 0.06 t/ha to 0.8 t/ha) than is the case for wheat.

The considerably smaller wheat yields in Afghanistan compared to India do not necessarily imply that the ACIAR projects have had little impact in raising wheat yields. The projects may have prevented a decline in yields or boosted yields substantially above what they would otherwise have been. The high variability of Afghan yields does not allow the construction of a counterfactual from time-series data.

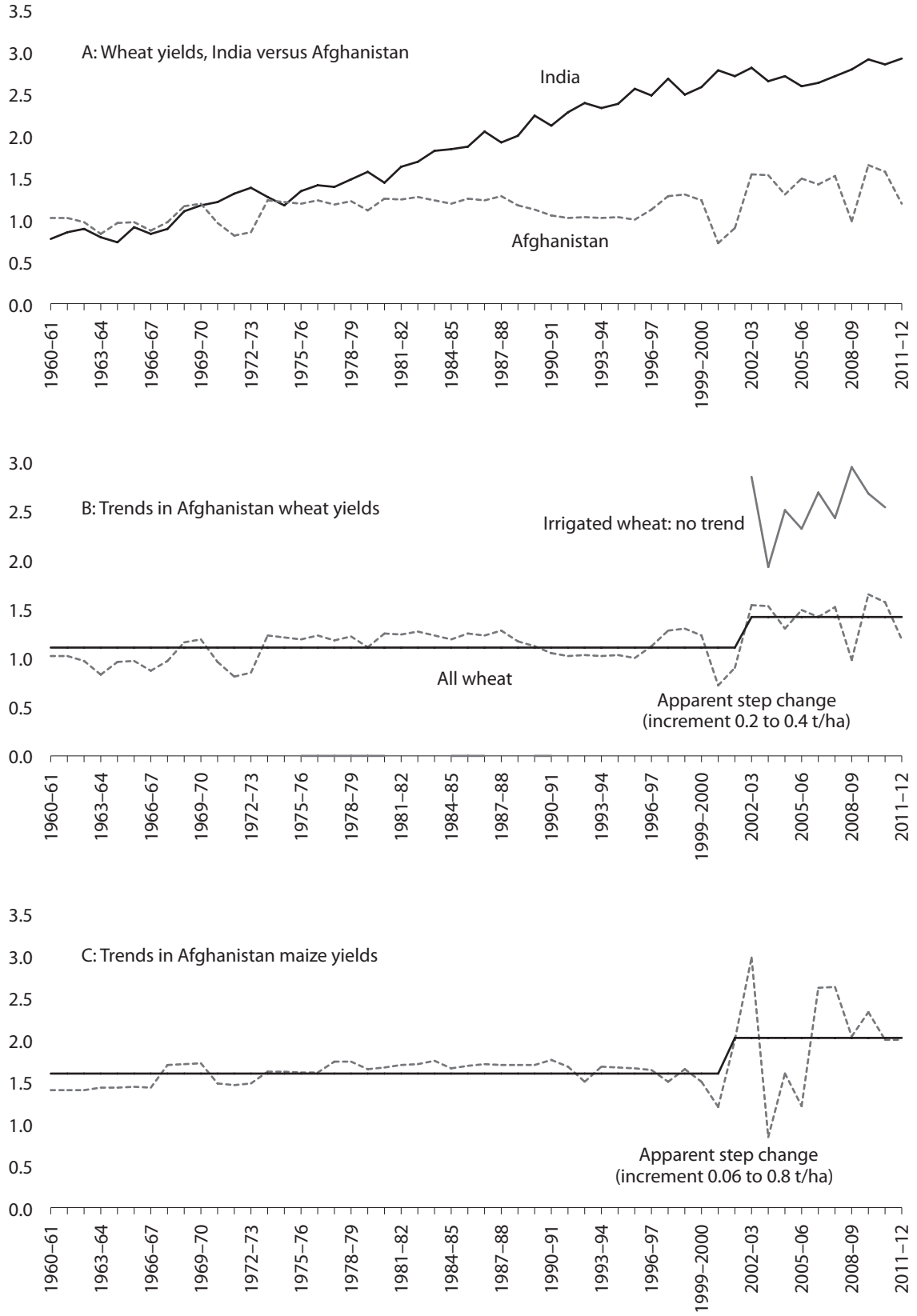


Figure 6. Wheat and maize yields in perspective, 1960–61 to 2011–12. Data sources: United States Department of Agriculture and FAO.

3 A custom survey

Because only limited aggregate time-series data were available to measure the impacts of the ACIAR projects, ACIAR commissioned an interview-based survey of farmers to collect information about the use of improved varieties, the factors that affect that use and the economic benefits from using the improved varieties.

Appendix 1 describes the survey process and organisation in detail, while Appendix 2 includes the survey instrument in English, Dari and Pashto. The key features are set out here.

Covering 466 households, the ACIAR-funded survey provided a snapshot of maize and wheat producers in seven provinces of Afghanistan and their response to the release of improved varieties (Table 2). Results from the survey allow us to not only establish a baseline for yields of different varieties of maize and wheat, but also to identify the factors driving yield differences in Afghanistan.

Importantly, the sampling and the survey coverage were constrained by the security situation in some provinces. Therefore, the sample population was limited to farmers living in areas that the partner NGOs deemed safe to reach. Moreover, the security situation dictated whether field surveyors visited farmers in their fields or conducted the interviews in the village centre.

Background of respondents

Virtually all of the 466 surveyed households (465) were headed by male farmers. The one female farmer in the survey indicated that she earned a total farm income that was above the sample average, but she did not own her own land. This is in some ways indicative of the situation of many women in Afghanistan—despite playing active roles in agricultural production within the household, very few own productive assets such as land or livestock.

The average age of farmers was 45 (Table 3). Most had never had any formal education, and very few had more than five years of schooling. Importantly, education was found to be a statistically significant factor in influencing yields, particularly when yield was regressed on age, education, training and farm area. Respondents' training in good farming practices was also limited: only 73 of the 466 respondents had receiving training within the past five years. Among those who had received training, the average duration of the training was just over one month.

Table 2. Survey coverage

Province	NGO conducting field work	Number of farmers interviewed
Kunduz	ACTED	66
Baghlan	ACTED	66
Takhar	ACTED	66
Balkh	CHA	70
Laghman	MADERA	66
Nangarhar	MADERA	66
Kabul	SAB	66

ACTED = Agency for Technical Cooperation and Development
CHA = Coordination of Humanitarian Assistance
MADERA = Mission d'Aide au Développement des Economies Rurales
SAB = Solidarité Afghanistan Belgique.

Source: CIE.

Table 3. Background of farmers

	Age	Years of formal education	Duration of training (months)	Number of family members	Total farm income (Afghanis)	Total farm cost (Afghanis)	Total farm income from other sources (Afghanis)
n	466	316	71	466	450	444	205
Mean	45.57	4.91	1.21	12.33	171,116	74,475	105,459
Median	45	4	1	10	120,000	40,000	70,000
Mode	45	0	1	10	100,000	50,000	50,000

Source: ACIAR survey.

4 Varieties in Afghanistan: the broad picture

This chapter summarises the aggregate farm information from the survey as well as key qualitative information about improved wheat and maize seeds. The survey responses shed light on whether farmers were aware of improved seed, factors influencing or limiting the use of improved varieties, and key sources of seed for farmers. We also broadly examine the adoption and yield performance of improved varieties.

Aggregate farm information

Wheat is the main cereal crop in Afghanistan, and was grown by all farmers in the survey. Most farmers grow it as a subsistence crop on small plots of irrigated or rainfed land. Wheat covers approximately 32% (2.6 million hectares) of Afghanistan's total arable land, 70% of its cultivated land, and 80% of the area planted to cereals (USDA FAS 2011). Other popular crops among survey respondents included vegetables (257 farmers), maize (159 farmers) and oilseeds (107 farmers) (Figure 7). Further analysis of these figures revealed that about 18% of farmers produced only one crop, 47% produced two crops and 24% produced three crops. Very few farmers produced four or more crops (Figure 8).

Most farmers split their wheat production between irrigated and rainfed land, but on average a much larger proportion is grown on rainfed land (Table 4). When asked whether they had access to sufficient irrigation water, 259 farmers replied 'yes', while 201 farmers responded in the negative.

Fertilisers are important, particularly in environments and regions where the natural fertility of the soil is

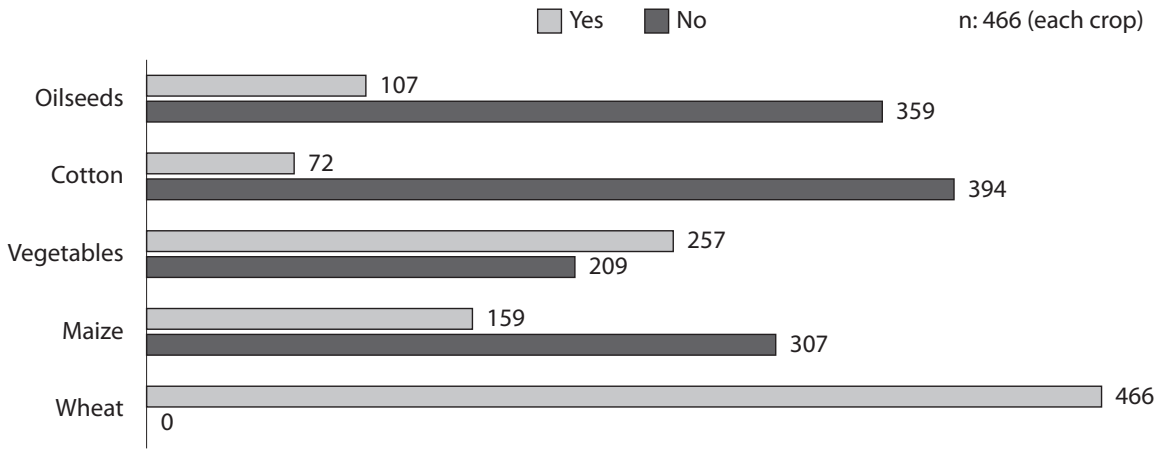


Figure 7. Crops produced. Data source: ACIAR survey.

limited. This is particularly the case in Afghanistan, where soils are formed under arid and semi-arid climatic conditions. The two main types of chemical fertilisers used in Afghanistan are diammonium phosphate (DAP, 'black' fertiliser) and urea ('white' fertiliser) (Madden and Bell 2012ab). DAP is the world's most widely used phosphorus fertiliser, and is commonly applied before planting (Madden et al. 2012). DAP has a high phosphorus content, equal to 46%, but also contains nitrogen equivalent to 18% (Madden and Bell 2012ab). Urea, on the other hand, has the highest nitrogen content of the nitrogenous fertilisers, equal to 46%, and can be applied before, during and after planting (Madden et al. 2012). The cost differential is also quite significant: DAP cost farmers in our survey almost twice as much as urea (Figures 9 and 10).

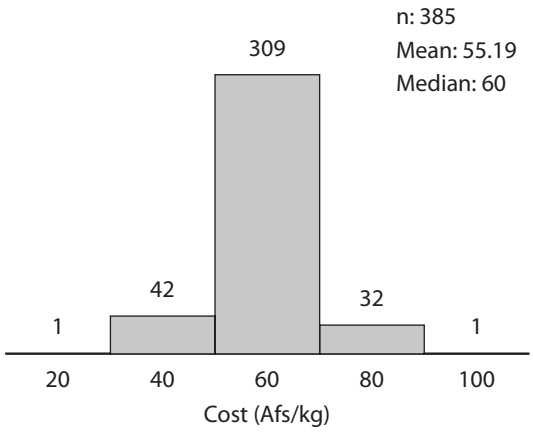


Figure 9. Cost of DAP fertiliser. Data source: ACIAR survey.

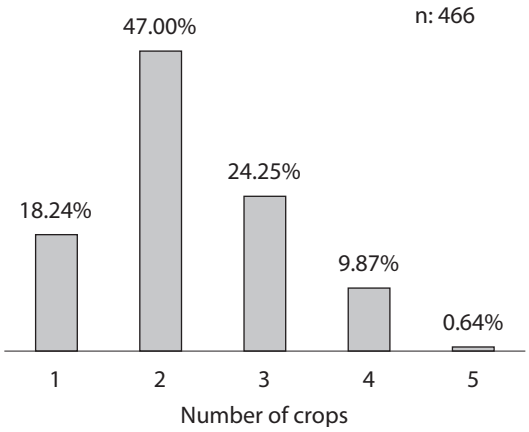


Figure 8. Percentage of farmers producing one or more crops. Data source: ACIAR survey.

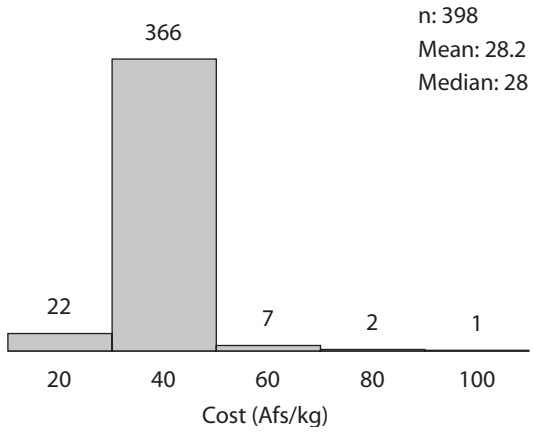


Figure 10. Cost of urea. Data source: ACIAR survey.

Table 4. Distribution of land areas (jeribs)

	Total farm area for crops	Irrigated area for crops	Rainfed area for crops	Irrigated land planted to wheat	Rainfed land planted to wheat
n	466	466	466	466	466
Mean	26.84	9.79	17.16	7.35	12.1

Note: 1 jerib = 0.2 hectares.

Source: ACIAR survey.

Improved wheat seed

Forty-three per cent of farmers were unaware of the wheat seed varieties released through the ACIAR project, and only 52% had planted those varieties at least once in their lifetime. Ignorance about ACIAR project varieties was most prevalent among farmers in Baghlan (75%), Takhar (64%) and Kabul (50%). In Balkh, however, all farmers were aware of the varieties and had planted them at least once. Similarly, a high proportion (70%) of farmers in Nangarhar were aware of and had planted them. Asked whether they planted other improved wheat seed varieties, 65% of farmers (304) answered 'no'. Perhaps this reflects the continuing use and popularity of local seed varieties among farmers at the national level. In Kunduz and Takhar, however, a large proportion of farmers had planted other improved varieties (65% and 74%, respectively).

Around three-quarters (341) of the surveyed farmers believed that improved wheat seed also provided higher yields, and 'higher yield' was noted as one of the most important reasons for planting them (Figure 11). Not surprisingly, a significant number of farmers had increased plantings of improved seed in recent years.

In a survey of the seed market in Afghanistan conducted by the FAO, 92% of farmers who grew local varieties similarly believed that improved varieties of irrigated wheat were better; of those who grew rainfed wheat, 81% thought improved varieties were better than local varieties (Kugbei and Shahab 2007). In another study looking at the results from wheat seed programs in five villages in Afghanistan, villagers believed that improved wheat seed was advantageous, irrespective of their wealth (Coke 2004). There appears to be a consensus among farmers in Afghanistan that having access to and planting improved seed varieties benefits them.

To shed light on the motivation for planting improved seed, farmers surveyed for the ACIAR projects were asked to rank the importance to them of higher yield, water-use efficiency, breadmaking quality, insect resistance and disease resistance (Figure 11).

Figure 12 shows the difference in yield reported by farmers. On average, improved seed yielded 63% more than local seed. When asked which factors limited their use of improved varieties, 316 farmers cited lack of awareness of the availability of seed (Figure 13).

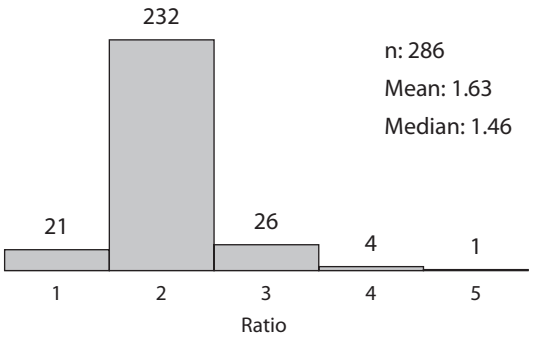


Figure 12. Ratio of yield after use of improved seed to yield before use of improved seed. Note: Data based on stated yield. Data source: ACIAR survey.

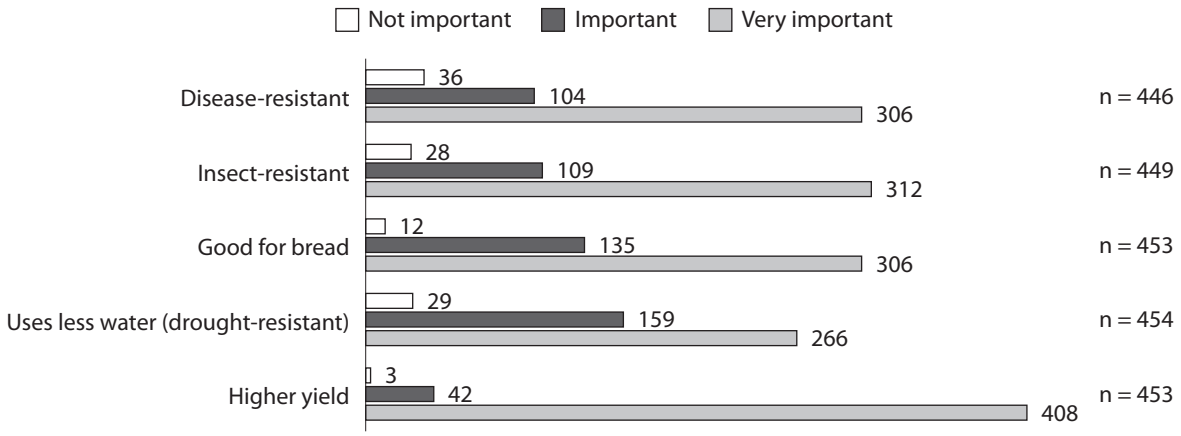


Figure 11. Factors determining planting of improved seed varieties. Data source: ACIAR survey.

Farmers in Afghanistan tend to save their own seed for many crops (Kugbei and Shabab 2007). This is reflected in the response of 381 farmers (84%) in the survey.

Relief agencies are also an important source of free seed for many farmers. In contrast, only 18% saw the local market as a 'very important' source of seed (Figure 14).

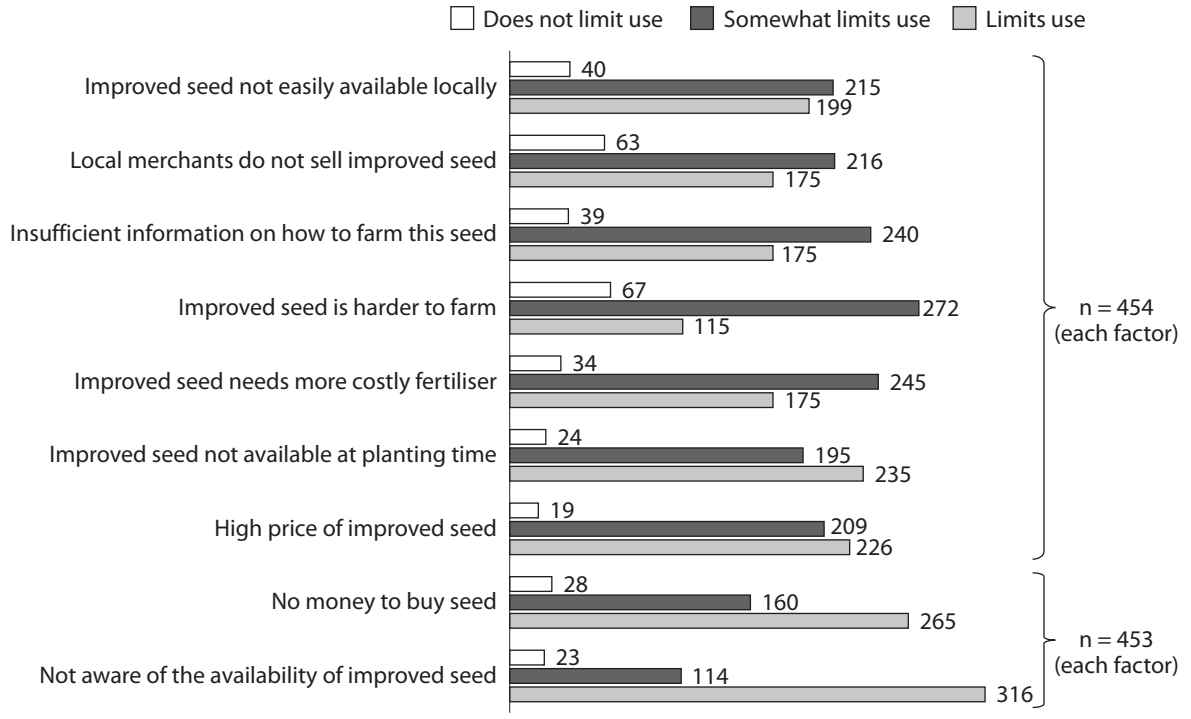


Figure 13. Factors limiting the use of improved seed. Data source: ACIAR survey.

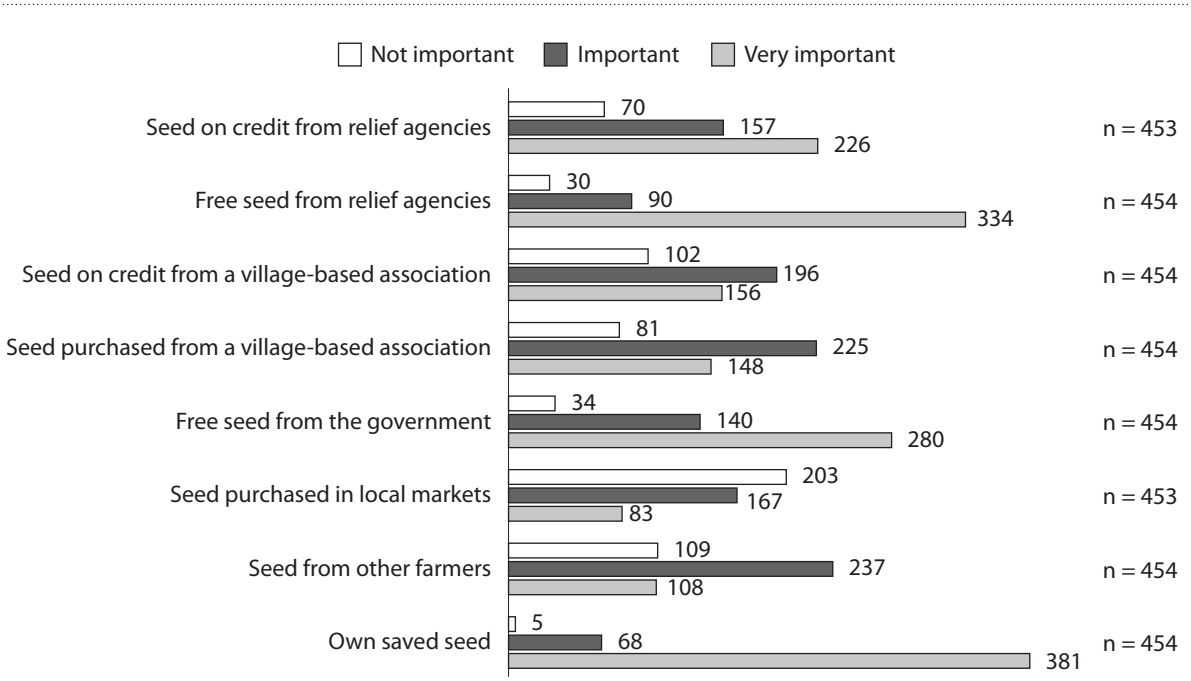


Figure 14. Important sources of seed. Data source: ACIAR survey.

Adoption of improved varieties

The adoption of improved varieties can be measured in two ways:

- as the proportion of farmers using at least one improved variety (whether or not they also plant a local variety), compared with the proportion using only local varieties
- as the area planted to improved varieties, compared with the area planted only to local seed varieties.

We can estimate adoption at the aggregate level, ignoring the different take-up of improved varieties under irrigated and rainfed systems. This provides an overall picture of the adoption of improved varieties across the provinces in the survey. However, given the significant differences in yields between irrigated and rainfed wheat, it is also useful to disaggregate the results and measure adoption separately for each of the two farming systems. It is worth noting that as the replacement rate of seed for rainfed wheat is often lower than for irrigated wheat, the adoption of improved varieties will be relatively slower as well.

Adoption measured by proportion of farmers

In aggregate, there appears to be a relatively high level of adoption of improved varieties by farmers. Two hundred and eighty farmers indicated that they had used at least one improved variety, while 186 farmers had used only local varieties (Figure 15).

The take-up of improved seed varieties also varied significantly between 43% for rainfed wheat and 65% for irrigated wheat (Figures 16 and 17).

Adoption measured by proportion of total area planted to wheat

The area planted to irrigated wheat using local seed was almost identical to the area planted to improved seed varieties. In other words, improved wheat varieties covered about half of the total irrigated wheat area in the survey sample. In the case of rainfed wheat, the ratio was skewed in favour of local seed (Figures 18 and 19).

Improved varieties consisted of both ACIAR-project and non-ACIAR-project varieties. One particularly popular variety among the myriad non-ACIAR varieties was Zard Dana, which was introduced from Pakistan

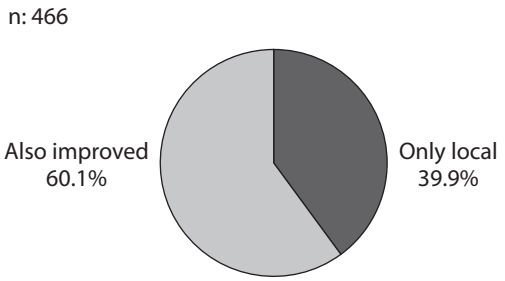


Figure 15. Proportion of farmers using only local varieties or at least one improved variety (irrigated plus rainfed). Data source: ACIAR survey.

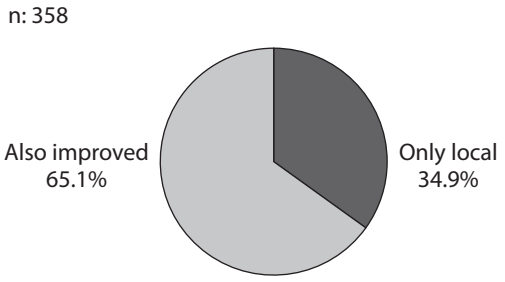


Figure 16. Adoption rate for improved varieties for wheat (irrigated). Note: The take-up of improved varieties ('Also improved') was based on whether the farmer had used at least one improved variety. Some farmers had also planted a second improved variety. Data source: ACIAR survey.

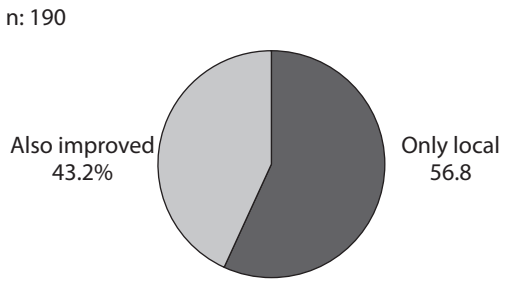


Figure 17. Adoption rate for improved varieties for wheat (rainfed). Note: The take-up of improved varieties ('Also improved') was based on whether the farmer had used at least one variety. Some farmers also planted a second improved variety. Data source: ACIAR survey.

over 10 years ago (Figure 20). Zard Dana has been identified as a 'dominant' variety in a number of reports, including the EU's technical review of the seed sector in Afghanistan (IAK and AFCI 2012). While there is a question about whether Zard Dana can still be classified as an improved variety, it remains very popular among farmers and returns higher average yields than other local varieties, according to farmers in our survey.

Wheat yields

Because of the arid climate, the productivity of wheat varies significantly between irrigated and rainfed areas in Afghanistan. Wheat yields in certain irrigated areas are up to three times higher than in rainfed areas. However, survey responses revealed that using an improved variety resulted in a higher mean yield than using a local variety, regardless of the area (Table 5). On average, the mean yield from using local varieties in irrigated areas was 450 kg/jerib (2.25 t/ha). In contrast, the average yield using improved varieties in irrigated areas ranged between 596.85 kg/jerib (2.98 t/ha) and 636.10 kg/jerib (3.18 t/ha).

Based on total production and total area (weighted average yields), the productivity of improved varieties as reported by survey respondents was lower, falling to the 2.33–2.60 t/ha range for irrigated wheat (Table 6). Local varieties, on the other hand, produced a weighted average yield of 2.07 t/ha. This indicates that, while improved varieties are popular among farmers and are

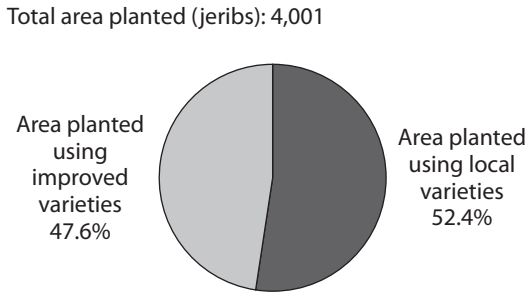


Figure 18. Adoption of improved varieties, by proportion of area planted (irrigated wheat). Data source: ACIAR survey.

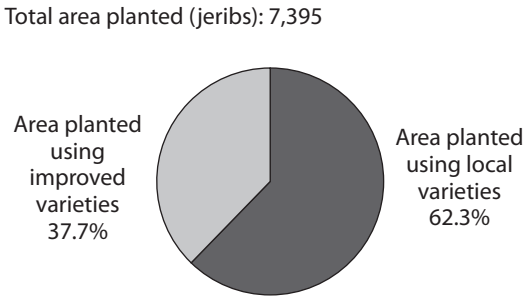


Figure 19. Adoption of improved varieties, by proportion of area planted (rainfed wheat). Data source: ACIAR survey.

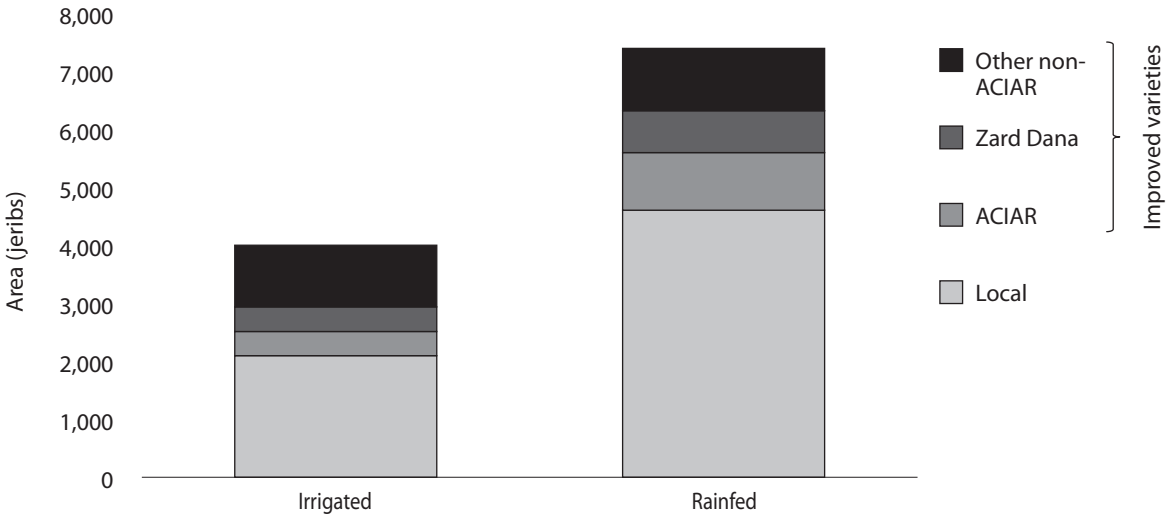


Figure 20. Areas planted to ACIAR and non-ACIAR wheat varieties. Note: 'Other non-ACIAR' includes all improved varieties, excluding Zard Dana and ACIAR varieties. Data source: ACIAR survey.

often regarded as 'better' than local varieties, they do not always return significantly higher yields.

There was also significant variation in wheat productivity across provinces. For example, the weighted average yield for irrigated wheat in Nangarhar, an eastern province bordering Pakistan, was 3.02 t/ha, while the weighted average in Baghlan (in the north) was 1.87 t/ha. Table 7 and Figure 21 compare the weighted average yields for irrigated and rainfed wheat in seven provinces.

Table 5. Yields, by wheat variety (t/ha)

	Irrigated			Rainfed		
	Local variety	**Improved variety 1**	**Improved variety 2**	**Local variety**	**Improved variety 1**	**Improved variety 2**
n	213	233	36	178	82	22
Mean	2.25	2.98	3.18	1.34	1.78	1.44
Median	2.19	2.80	2.50	1.05	1.75	1.40

Note: The survey instrument allowed farmers to provide information on 'Improved variety 1' and 'Improved variety 2' in order to gain as much information as possible, particularly from farmers who were using more than one improved variety.

Source: ACIAR survey.

Table 6. Weighted average wheat yields

	Irrigated			Rainfed		
	Local variety	**Improved variety 1**	**Improved variety 2**	**Local variety**	**Improved variety 1**	**Improved variety 2**
n	213	233	36	178	82	22
Weighted average yield (kg/jerib)	414.97	519.53	465.25	275.36	339.81	210.79
Weighted average yield (t/ha)	2.07	2.60	2.33	1.38	1.70	1.05

Source: ACIAR survey.

Table 7. Irrigated wheat yields, by province

Province	**Mean (kg/ jerib)**	**Mean (t/ha)**	**Total production (kg)**	**Total area (jeribs)**	**Weighted average (kg/ jerib)**	**Weighted average (t/ ha)**
Baghlan	416.72	2.08	142115	379	374.97	1.87
Balkh	482.02	2.41	85366	227	376.89	1.88
Kabul	560.46	2.80	157036	347	453.21	2.27
Kunduz	480.14	2.40	718400	1718	418.16	2.09
Laghman	615.51	3.08	166562	290	575.34	2.88
Nangarhar	623.43	3.12	337742	559	604.19	3.02
Takhar	497.57	2.49	330045	686	481.12	2.41

Note: Wheat yields include all local and improved varieties.

Source: ACIAR survey.

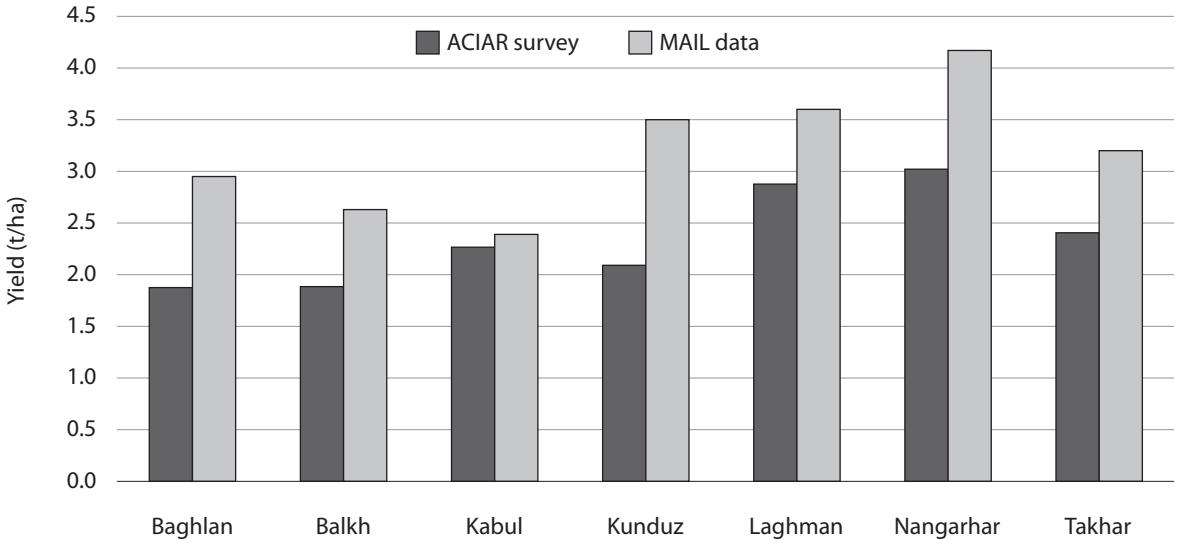


Figure 21. Weighted average yields of irrigated wheat, by province. Data source: ACIAR survey and MAIL data based on May 2012 provisional estimates.

Data from the ACIAR survey and the Afghanistan Ministry of Agriculture, Irrigation and Livestock (MAIL) identify Nangarhar as the most productive wheat-growing province for both irrigated and rainfed wheat. In contrast, Kabul was the least productive province in 2012, according to MAIL data. However, the ACIAR survey identified Baghlan (for irrigated wheat) and Takhar (for rainfed wheat) as the provinces with the lowest weighted average yields.

As expected, the productivity of rainfed wheat was significantly lower than that of irrigated wheat in all provinces (Table 8 and Figure 22). With the exception of Nangarhar, yields in all provinces were under 1.5 t/ha (note that that MAIL did not report any wheat production or area details for Nangarhar). The ACIAR survey also found only seven observations (7 farmers) in Nangarhar providing this information. Although Table 8 and Figure 22 include yield data on rainfed wheat coming out of Nangarhar (based on a handful of responses in ACIAR's survey), the results cannot be considered representative, particularly as the province is 100% irrigated, according to MAIL data (MAIL 2012).

Table 8. Rainfed wheat yields, by province

Province	Mean (kg/jerib)	Mean (t/ha)	Total production (kg)	Total area (jeribs)	Weighted average (kg/jerib)	Weighted average (t/ha)
Baghlan	208.22	1.04	318,498	1,142	278.89	1.39
Balkh	313.06	1.57	347,715	1,224	284.02	1.42
Kunduz	310.39	1.55	1,271,507	4,383	290.10	1.45
Nangarhar	485.71	2.43	24,880	52	478.46	2.39
Takhar	303.55	1.52	376,985	1,546	243.85	1.22

Source: ACIAR survey.

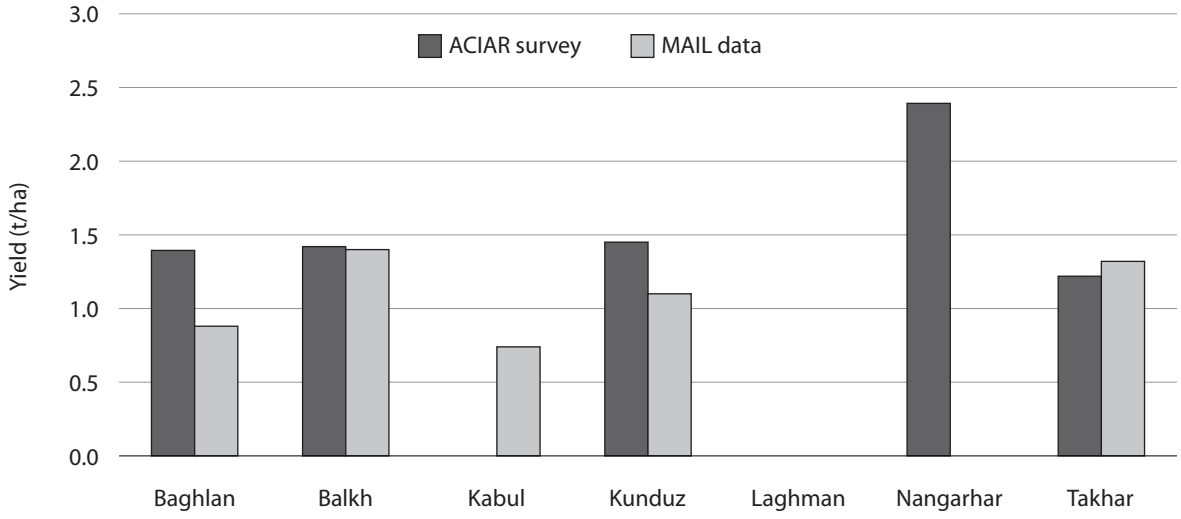


Figure 22. Weighted average yields of rainfed wheat, by province. Data source: ACIAR survey and MAIL data based on May 2012 provisional estimates.

Improved maize seed

Along with wheat and barley, maize is an important cereal crop in Afghanistan. Historically, however, poor access to improved seed and the high price of inputs such as fertiliser have limited maize production (Sharifi and Bell 2012). The survey results indicated that 155 farmers produced maize. Of those, 115 planted only local maize varieties and 40 planted improved varieties (32 planted only improved varieties and 8 planted both).

However, at the national level there was a high level of ignorance about ACIAR and non-ACIAR improved maize varieties among survey respondents. For example, 85% of the were unaware of the new varieties developed and released as a result of the ACIAR project and only 53 (14%) had planted an ACIAR project variety at least once in their lifetime. When asked whether they believed that improved seed gave higher yields, 185 farmers (54%) answered 'no'. In contrast, they were far more optimistic about the yield potential of improved wheat varieties: 341 (73%) believed that improved wheat seed produced higher yields.

Forty-seven farmers had increased their planting of improved maize seed in recent years. Of those, 45 provided an indication of the percentage improvement in yield from adopting the new varieties (Figure 23).

Adoption of improved maize seed

Among the 40 surveyed farmers who had planted improved maize varieties, Sarhad-1 was the most popular improved variety and had been planted by 17 farmers (Figure 24). One ACIAR variety, Rampur (also known as Zudras), appeared in the survey responses, but it was planted by only one farmer. The area planted to maize using improved varieties was 298.5 jeribs (59.7 ha), or 34.1% of the total area planted to maize. Most plantings of maize used local varieties (Figure 25).

Performance of improved maize varieties

Improved maize varieties performed moderately better at the national level, with a mean yield of 2.64 t/ha. The mean yield for local varieties was 2.41 t/ha, albeit with a higher standard deviation. The average application rates of fertiliser were very similar for improved and local varieties (Table 9).

Most surveyed farmers who grew maize were in Balkh, Laghman and Nangarhar. No farmers in Kabul and Kunduz produced maize, while only eight in Takhar planted the crop.

In the absence of any representative information on ACIAR project maize varieties, it is not possible to perform a cost–benefit analysis for maize.

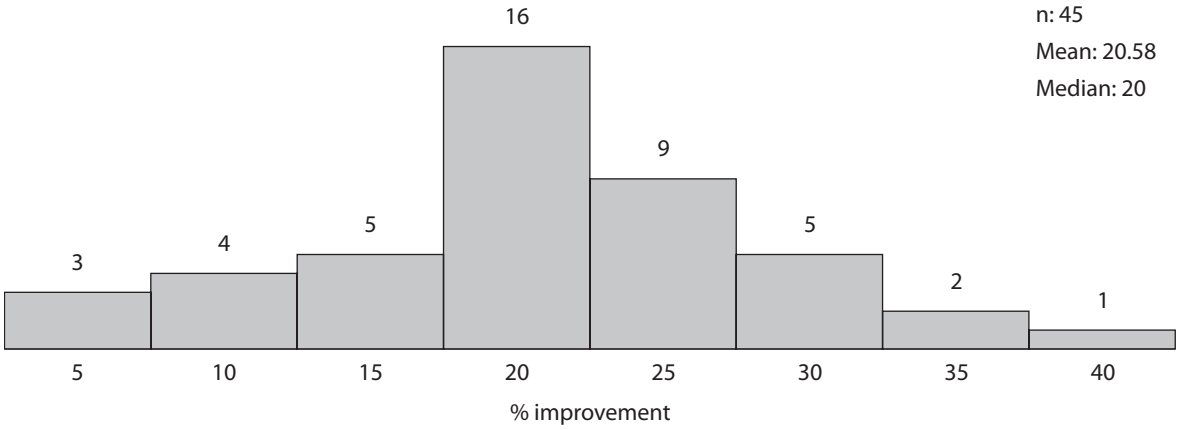


Figure 23. Percentage improvement in yield from planting new improved maize varieties. Data source: ACIAR survey.

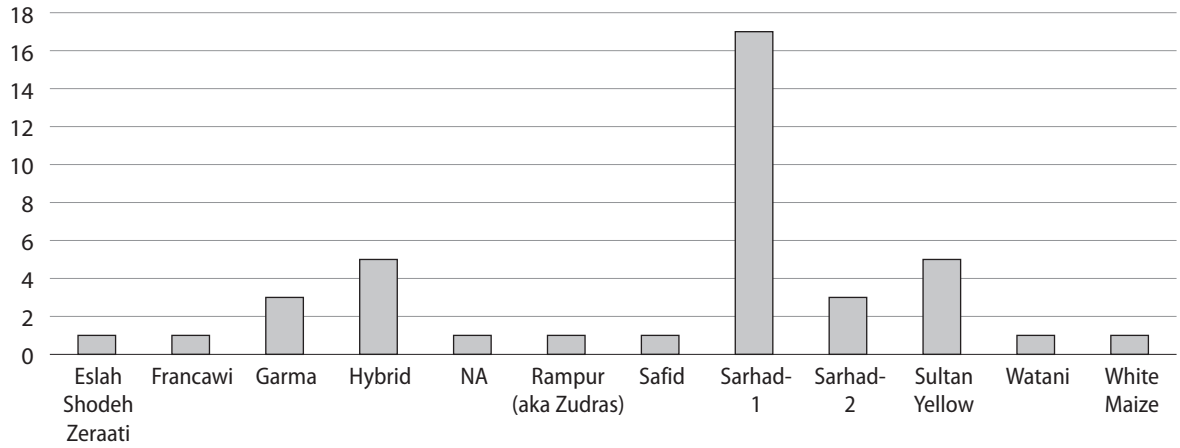


Figure 24. Maize varieties identified as improved and their frequency of use by the sample population (n = 40). NA = name not known to farmer. Data source: ACIAR survey.

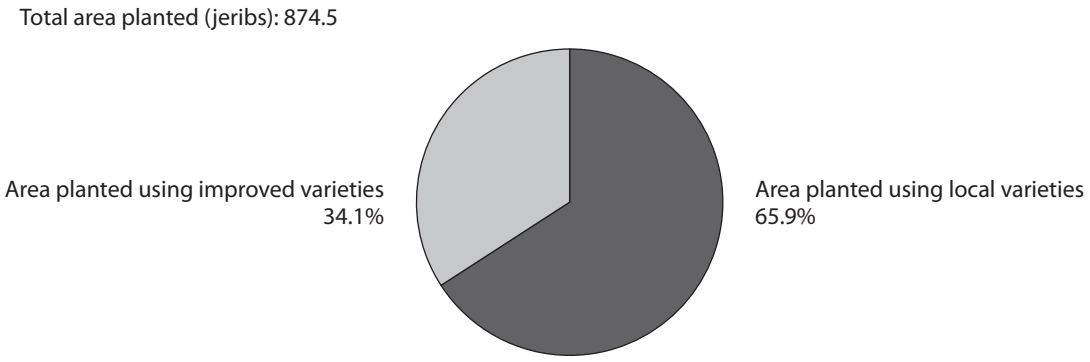


Figure 25. Adoption, by proportion of area planted to maize. Data source: ACIAR survey.

Table 9. Comparison of mean and weighted average yields of maize

	Local	Improved
n	121	40
Mean yield (t/ha)	2.41	2.64
Standard deviation	1.34	0.81
Production (kg)	240,932	145,708
Area (jeribs)	576	298.5
Weighted average (kg/jerib)	418.28	488.13
Weighted average (t/ha)	2.09	2.44
Average DAP application (kg/jerib)	23.77	22.72
Average urea application (kg/jerib)	39.48	40.83

Source: ACIAR survey.

5 The adoption and performance of the ACIAR wheat varieties

This chapter looks at the adoption and performance of improved wheat seed varieties, with a particular focus on how ACIAR varieties compared with those from other sources.

The survey instrument identified 9 ACIAR wheat varieties, 13 non-ACIAR varieties that had been catalogued by the FAO, and 21 other non-ACIAR varieties (Figure 26). The origin and precise identification of the 21 other varieties (including whether a name refers to more than one variety) remain unclear or unknown in some cases.

For example, Zard Dana, a popular and dominant variety in many surveys, was originally released in Afghanistan in 1993 but has been out of the seed supply chain for many years now. However, farmers still tend to call any zard (amber coloured) grain variety 'zard dana'. In a market study funded by the EU during 2007 and 2008, 'Zardana' was identified as an extremely popular local variety, particularly in the northern region of Afghanistan (Kugbei 2011). Zard Dana is therefore a useful benchmark in our analysis, despite often being classified as a local variety.

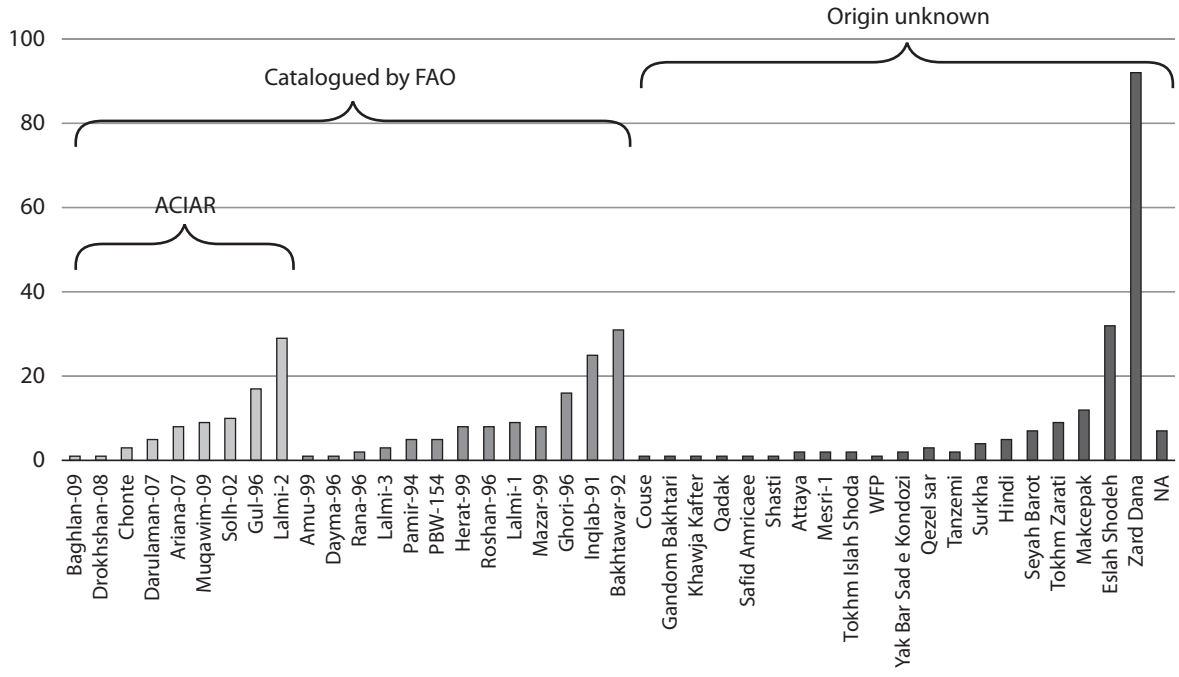


Figure 26. Wheat varieties identified as 'improved' by interviewees and their frequency of use within the sample population (n = 297). NA = name not known to farmer. Data source: ACIAR survey.

Figures 27 and 28 show the adoption rates for improved varieties based on the area planted to wheat. Although the adoption rate for the nine ACIAR project varieties was much lower than that for local varieties, it was higher than that for Zard Dana (which may include a number of varieties). This was despite the high popularity and use of Zard Dana among survey respondents.

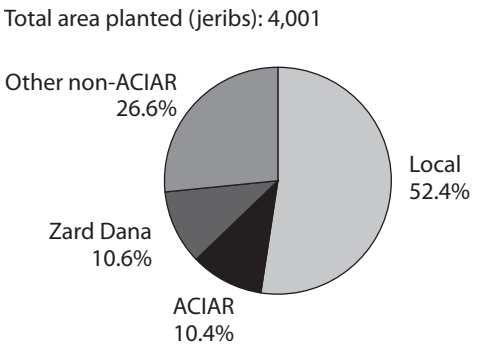


Figure 27. Adoption, by proportion of area planted to wheat (irrigated). Note: 'Other non-ACIAR' includes all improved varieties excluding Zard Dana and ACIAR varieties. Data source: ACIAR survey.

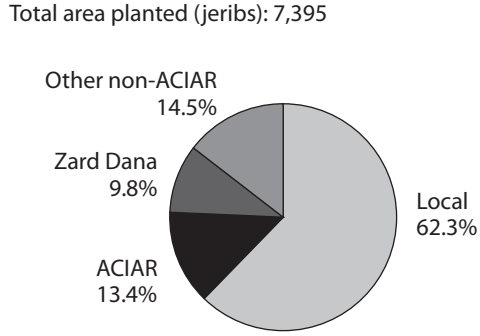


Figure 28. Adoption, by proportion of area planted to wheat (rainfed). Note: 'Other non-ACIAR' includes all improved varieties excluding Zard Dana and ACIAR varieties. Data source: ACIAR survey.

Comparative performance

The performance of wheat varieties can be determined by comparing the yield and cost. We can also observe the rates of fertiliser application for the different varieties. For higher rates of fertiliser application, it is important to determine the additional benefit in yield relative to the additional cost of fertiliser.

The influence of improved varieties on yields of wheat

Irrigated wheat

Given that improved wheat varieties cover approximately half of the total irrigated wheat area in the sample and 38% of the rainfed area, it is possible to estimate their influence on yield (assuming all other factors affecting production remain constant). We can compare the mean yields of ordinary farmers who used ACIAR project varieties with the mean yields of those who used local or other improved non-ACIAR varieties. That comparison can be done for varieties used in both irrigated and rainfed areas. Importantly, however, this is a simple comparison of the average yield among farmers who use similar varieties. Because of the significant variation in production and area planted, including among farmers using the same variety, we can also compute the weighted average yield to get a better indication of the productivity of different seed varieties.

The mean yield for irrigated wheat using improved seed varieties was 602.10 kg/jerib or 3.01 t/ha. To compare yields, we omitted outliers (including yields of wheat from local varieties) that were farther than 2 standard deviations from that mean, after which the mean yield of local seed varieties was 429.86 kg/jerib or 2.15 t/ha (Figure 29). In contrast, ACIAR varieties provided an average wheat yield of 597.04 kg/jerib (2.99 t/ha), an increment of nearly 39%. The results also indicate that the mean yield of ACIAR varieties was higher than the mean yields of other non-ACIAR varieties, including Zard Dana.

ACIAR varieties also performed relatively well based on total production and total area planted. The weighted average yield for ACIAR varieties was 2.73 t/ha in irrigated systems (Table 10). This figure was obtained only after two particular outliers were identified (in addition to those farther than 2 standard deviations from the mean). Two farmers who planted ACIAR varieties Lalmi-2 and Ariana-07 in Kunduz had exceptionally low yields (0.44 t/ha and 0.4 t/ha, respectively) that were also significantly lower than yields from local varieties. However, when asked in

an earlier section of the survey form to report on yields before and after planting improved varieties, both farmers indicated a higher yield after the use of improved seed varieties. The total area planted by the two farmers to these two ACIAR varieties (presumably overstated or misreported) was 180 jerib (36 ha). For the purposes of comparison, the average area planted to irrigated wheat per farmer was in the range of 14 and 21 jeribs in Kunduz and 7 and 10 jeribs nationally. Because of these two outliers, the weighted average yield of ACIAR varieties was dragged down to 2.03 t/ha. Accordingly, after crosschecking for any transcription errors, these outlier observations had to be excluded.

The weighted average yield from local varieties (2.01 t/ha) was significantly lower than from ACIAR varieties. In contrast, non-ACIAR varieties, excluding Zard Dana, had a weighted average yield almost identical to that of ACIAR varieties (Figure 30). However, the non-ACIAR varieties seemed to require slightly less fertiliser on average than any other variety.

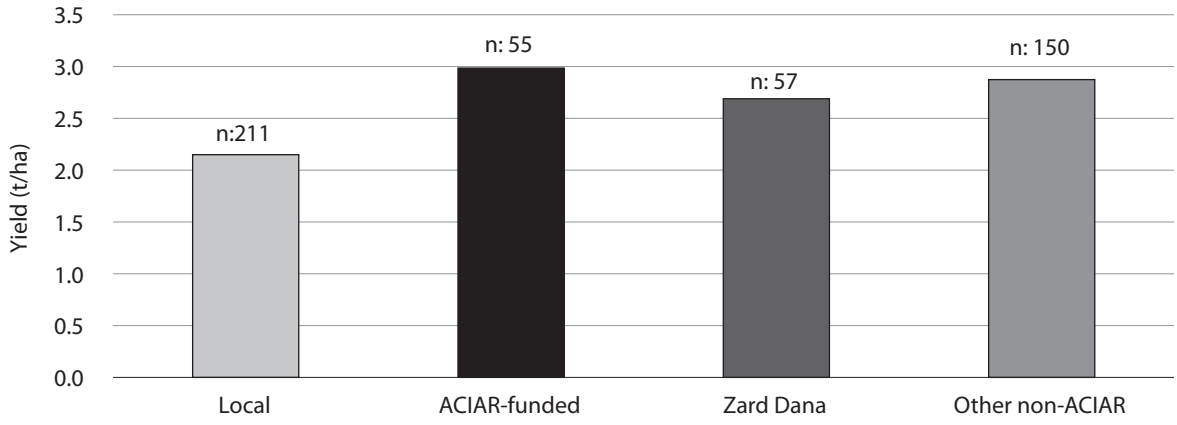


Figure 29. Wheat yields obtained by farmers in irrigated areas. n = number of observations per variety. Note: No distinction is made between 'Improved variety 1' and 'Improved variety 2' (i.e. the figure brings together all varieties listed under the same name). Data source: ACIAR survey.

Table 10. Comparison of mean and weighted average yields of irrigated wheat

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved varieties
n	211	55	57	150	262
Mean yield (t/ha)	2.15	2.99	2.69	2.87	2.86
Production (kg)	841,890	227,220	204,317	580,889	1,012,426
Area (jeribs)	2,096.50	416.50	424.50	1,063.50	1,904.50
Weighted average (kg/jerib)	401.57	545.55	481.31	546.20	531.60
Weighted average (t/ha)	2.01	2.73	2.41	2.73	2.66
Average DAP application	34.29	37.84	46.84	30.02	35.32
Average urea application	45.75	48.36	53.77	45.54	47.92
Outliers	2	3	0	4	7

Note: Omitted outliers included any observations where the yield was greater than 2 standard deviations from the mean yield of all improved varieties (i.e. greater than 1,204.2 kg/jerib or 6.02 t/ha).

Source: ACIAR survey.

It is also worth noting that the mean yield across varieties was greater than the weighted average yield. This suggests that some farmers were producing more wheat relative to the area planted than others.

Rainfed wheat

Yields of rainfed wheat across Afghanistan have historically been low because of the arid climate. Low and variable rainfall has meant a strong reliance on irrigation to meet crop water requirements, despite the low efficiency of many existing irrigation systems.

For rainfed wheat, the mean yield using all improved varieties including Zard Dana was 341.79 kg/jerib (1.71 t/ha). Yields greater than 2 standard deviations from the mean were disregarded. The average yield of all varieties in rainfed areas was very low at 214.21 kg/jerib (1.07 t/ha) for local varieties and 236.72 kg/jerib (1.18 t/ha) for ACIAR varieties (Figure 31). Although Zard Dana performed moderately better with a mean yield of 262.78 kg/jerib (1.31 t/ha), the highest mean yield of 345.16 kg/jerib (1.73 t/ha) was obtained by farmers who used other non-ACIAR varieties.

Results based on weighted average yields similarly show ACIAR varieties performing slightly better than local varieties (Table 11). However, ACIAR varieties lag behind both Zard Dana and other non-ACIAR varieties in productivity. The highest weighted average yield was also obtained by non-ACIAR varieties, excluding Zard Dana, at 1.50 t/ha (Figure 32). While fertiliser

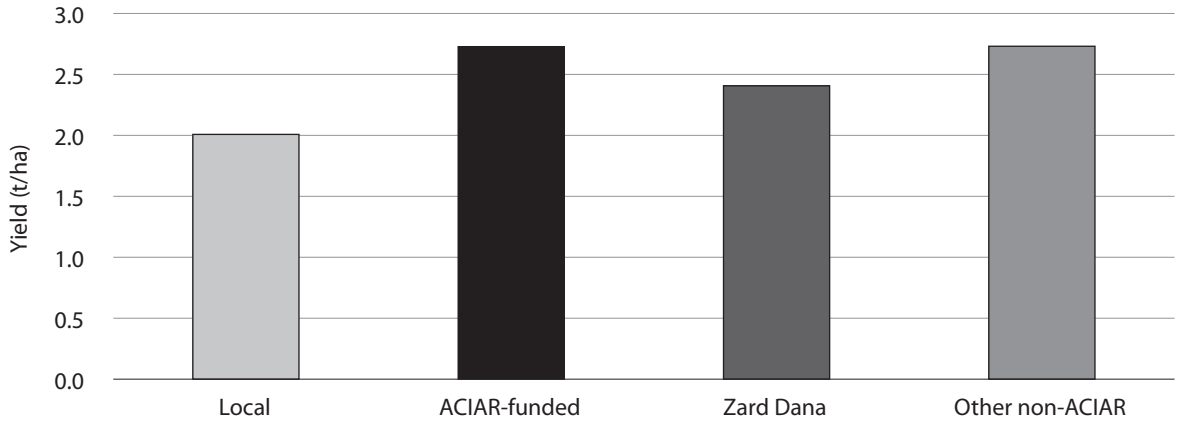


Figure 30. Weighted average yield across varieties (irrigated wheat). Data source: ACIAR survey.

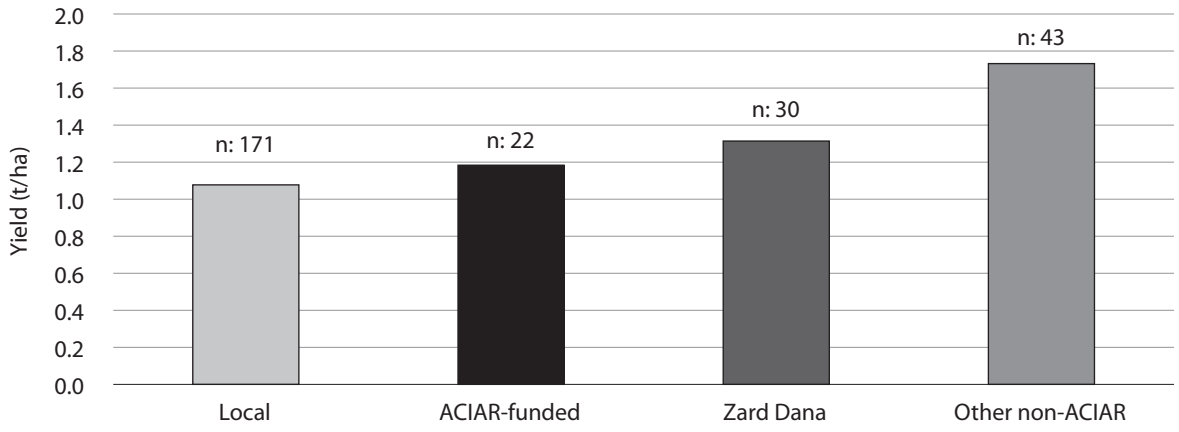


Figure 31. Wheat yields obtained by farmers in rainfed areas. n = denotes the total number of observations per variety. Note: No distinction is made between 'Improved variety 1' and 'Improved variety 2' (i.e. the figure brings together all varieties listed under the same name). Data source: ACIAR survey.

application rates appeared high, very few farmers used any fertiliser in rainfed areas with local or improved varieties. Only 26 farmers used DAP with local varieties, while 50 farmers applied urea with those varieties. Similarly, of the farmers planting an improved variety, only 44 used DAP while 48 applied urea. These findings support the general view that farmers in rainfed areas use very little chemical fertiliser to grow their wheat crops.

Table 11. Comparison of mean and weighted average yields of rainfed wheat

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved varieties
n	171	22	30	43	95
Mean yield (t/ha)	1.07	1.18	1.31	1.73	1.47
Production (kg)	1,020,669	229,094	197,390	322,508	748,992
Area (jeribs)	4,605	993	722	1,075	2,790
Weighted average (kg/jerib)	221.64	230.71	273.39	300.01	268.46
Weighted average (t/ha)	1.11	1.15	1.37	1.50	1.34
Average DAP application	40.04	46.83	43.67	34.48	39.73
Average urea application	37.92	46.77	44.70	40.20	42.92
Outliers	8	2	3	4	9

Note: Omitted outliers included observations where the yield was greater than 2 standard deviations from the mean yield of all improved varieties (i.e. greater than 683.58 kg/jerib or 3.41 t/ha). The average application rates of fertiliser included only fertiliser users; blank fields or '0s' were omitted.

Source: ACIAR survey.

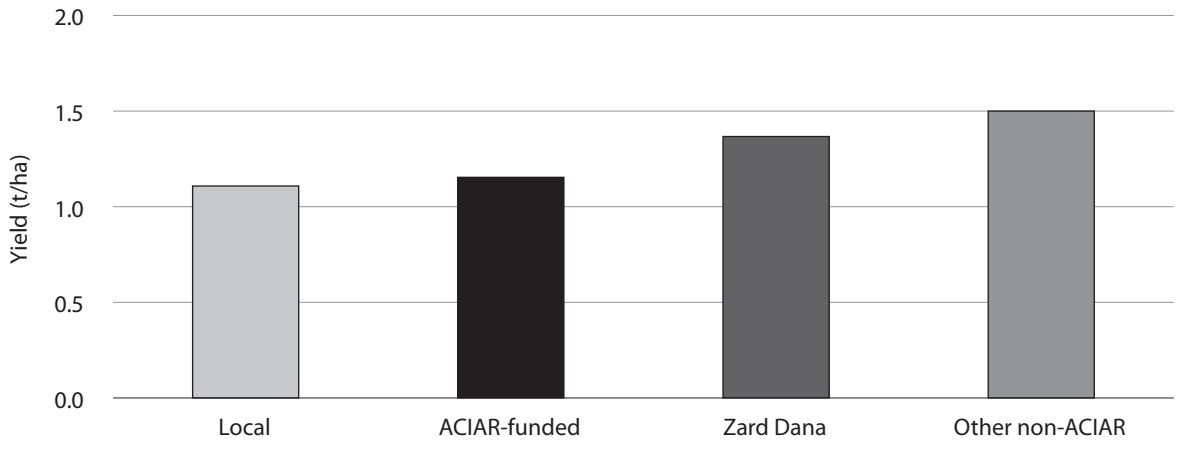


Figure 32. Weighted average yield, by variety (rainfed wheat). Data source: ACIAR survey.

Comparative cost

In addition to comparing yields, it is useful to compare the performance of seed varieties against costs. If two seed varieties provide similar yields, the cost of acquiring each type may be an important factor influencing adoption. For irrigated wheat, ACIAR varieties cost farmers approximately 8 Afghanis (Afs)/kg more on average than local varieties (Figures 33 and 34).

For irrigated wheat, the results indicated the following:

- ACIAR varieties cost approximately 55% more on average and produced a weighted average yield that was 36% higher than local wheat varieties.
- Zard Dana cost about 46% more on average than local varieties and produced a weighted average yield that was 20% higher than local varieties.
- Other non-ACIAR varieties cost around 92% more on average than local varieties and yielded 36% more than local varieties.

For rainfed wheat, the cost differentials across varieties were smaller:

- ACIAR varieties cost only 5% more on average and returned a weighted average yield that was 3.6% higher than local varieties.

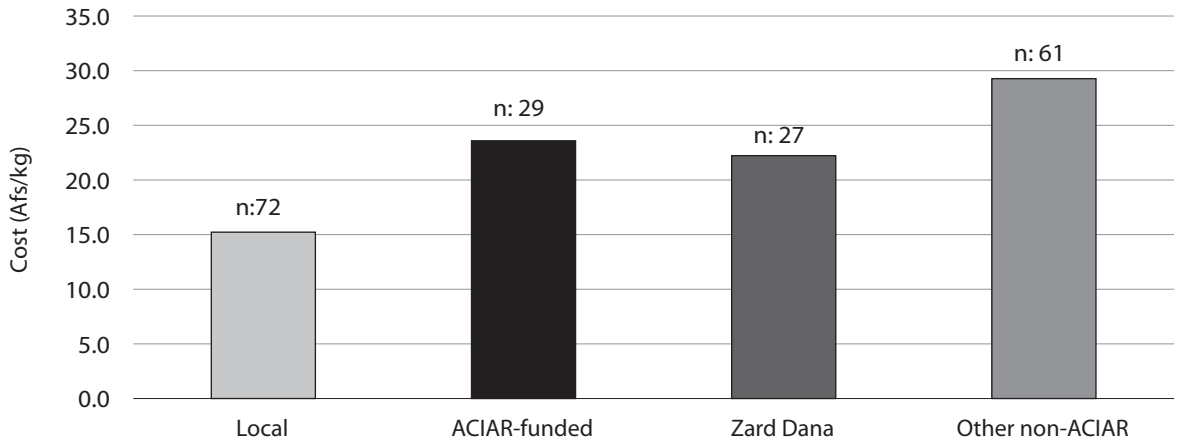


Figure 33. Average cost of seed for irrigated wheat. Note: Figure represents the average cost of seed (if purchased). Responses of '0' were omitted. Data source: ACIAR survey.

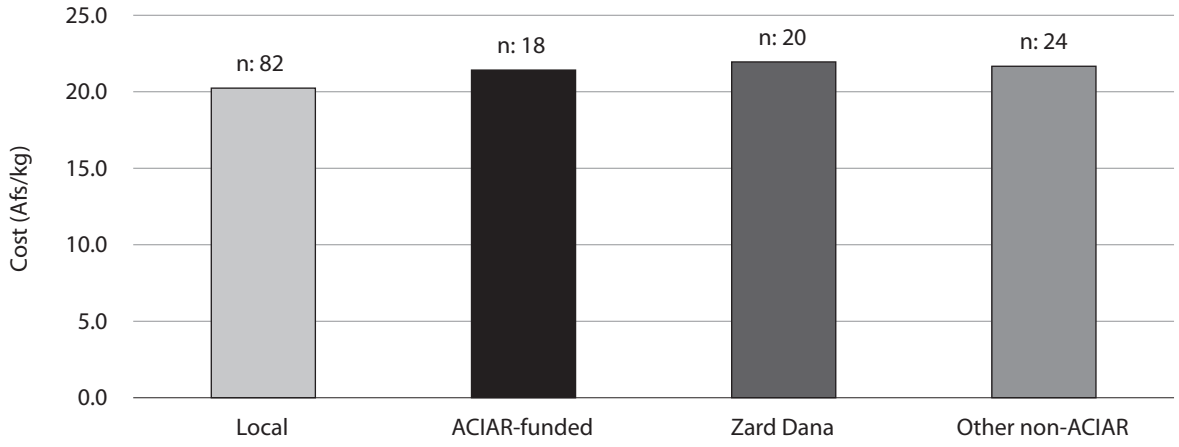


Figure 34. Average cost of seed for rainfed wheat. Note: Figure represents the average cost of seed (if purchased). Responses of '0' were omitted. Data source: ACIAR survey.

- Zard Dana cost 8% more on average and produced a weighted average yield 23% higher than local varieties.
- Other non-ACIAR varieties cost 6% more and produced a weighted average yield approximately 35% higher than local varieties.

Fertiliser application

Because of poor natural soil fertility in Afghanistan, the use of fertiliser is quite common. However, the application rates for fertilisers can differ depending on a number of factors, including the seed variety used. We can calculate whether the use of a particular variety was associated with higher fertiliser application (Figures 35 and 36).

Fertiliser application rates to different varieties do not help to explain differences in yields among varieties. Other non-ACIAR varieties, excluding Zard Dana, for example, used less black and white fertiliser than local varieties in irrigated areas and yet had significantly higher yields. ACIAR varieties, on the other hand, used more fertiliser in these areas than local varieties and returned higher yields, as would be expected. Similarly, regression results did not find the application rates for black and white fertiliser statistically significant.

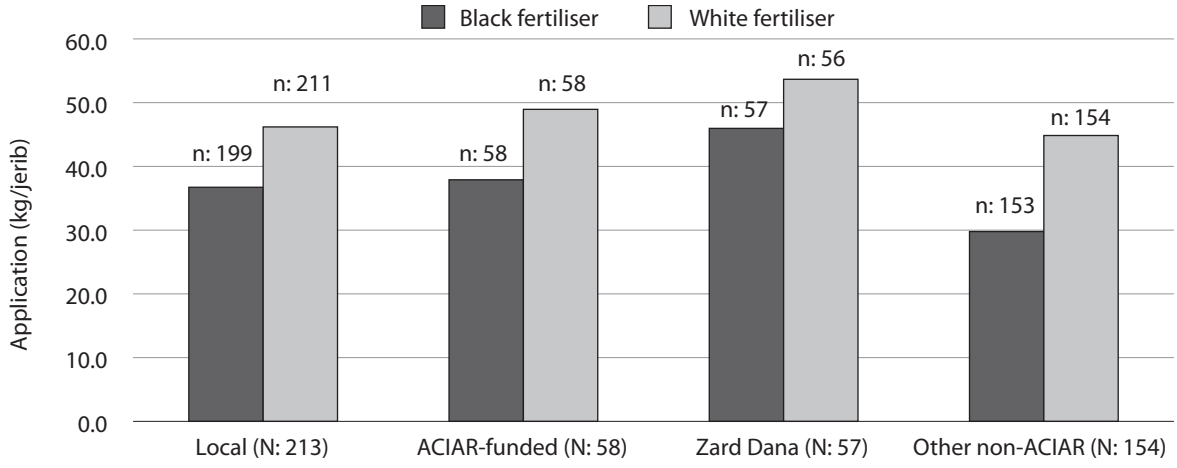


Figure 35. Average fertiliser application rates for irrigated wheat. N = the number of farmers who planted the variety; n = the number of farmers who applied the fertiliser. Data source: ACIAR survey.

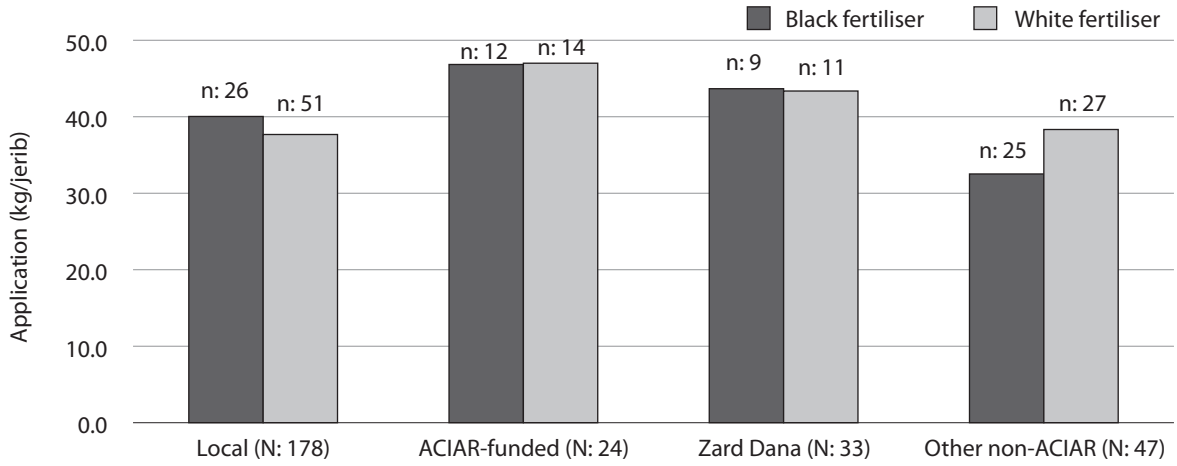


Figure 36. Average fertiliser application rates for rainfed wheat. N = the number of farmers who planted the variety; n = the number of farmers who applied the fertiliser. Data source: ACIAR survey.

Factors driving differences in yield

The influence of location on yields of wheat

A closer examination revealed the strong influence of location on yields of irrigated and rainfed wheat. Salient features identified by disaggregating the results included the following:

- ACIAR varieties outperformed all other varieties in Baghlan, Laghman and Takhar, based on weighted average yields of irrigated wheat.
- In Kabul, ACIAR varieties and other non-ACIAR improved varieties (excluding Zard Dana) produced a weighted average yield of 3.30 t/ha for irrigated wheat.
- No farmers used ACIAR varieties on irrigated land in Balkh or Nangarhar.
- In rainfed systems, ACIAR varieties were only used in Kunduz and Takhar, where they yielded lower than local and all other improved varieties.
- No farmers grew rainfed wheat in Kabul and Laghman.

Tables 12–18 compare weighted average yields for all irrigated wheat varieties in the project areas; Tables 19–23 make the same comparison for rainfed wheat.

Irrigated wheat

Table 12. Comparison of mean and weighted average yields of irrigated wheat in Baghlan

	Local	ACIAR-funded	Non-ACIAR	All improved
n	31	2	8	10
Mean yield (t/ha)	1.84	4.34	2.46	2.83
Production (kg)	100,595	6,940	34,580	41,520
Area (jeribs)	285.00	8.00	86.00	94.00
Weighted average (kg/jerib)	352.96	867.50	402.09	441.70
Weighted average (t/ha)	1.76	4.34	2.01	2.21
Average DAP application (kg/jerib)	31.74	37.50	26.75	28.90
Average urea application (kg/jerib)	40.39	62.50	41.00	45.30
Outliers excluded	0	0	0	0

Source: ACIAR survey.

Table 13. Comparison of mean and weighted average yields of irrigated wheat in Balkh

	Local	Non-ACIAR
n	17	21
Mean yield (t/ha)	1.42	2.45
Production (kg)	32,643	51,683
Area (jeribs)	125.00	101.00
Weighted average (kg/jerib)	261.14	511.71
Weighted average (t/ha)	1.31	2.56
Average DAP application (kg/jerib)	36.35	33.14
Average urea application (kg/jerib)	42.59	38.57
Outliers excluded	1	1

Source: ACIAR survey.

Table 14. Comparison of mean and weighted average yields of irrigated wheat in Kabul

	Local	ACIAR-funded	Non-ACIAR	All improved
n	25	21	20	41
Mean yield (t/ha)	1.67	3.27	3.39	3.33
Production (kg)	41,596	43,245	58,625	101,870
Area (jeribs)	181.00	65.50	89.00	154.50
Weighted average (kg/jerib)	229.81	660.23	658.71	659.35
Weighted average (t/ha)	1.15	3.30	3.29	3.30
Average DAP application (kg/jerib)	17.96	26.90	26.40	26.66
Average urea application (kg/jerib)	35.60	49.52	49.75	49.63
Outliers excluded	0	0	2	2

Source: ACIAR survey.

Table 15. Comparison of mean and weighted average yields of irrigated wheat in Kunduz

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved
n	37	14	6	23	45
Mean yield (t/ha)	2.28	2.38	2.44	2.57	2.49
Production (kg)	312,168	148,010	61,342	180,480	389,832
Area (jeribs)	767.00	294.00	134.00	342.00	770
Weighted average (kg/jerib)	407.00	503.44	457.78	527.72	506.28
Weighted average (t/ha)	2.03	2.52	2.29	2.64	2.53
Average DAP application (kg/jerib)	34.30	42.07	38.00	30.11	35.23
Average urea application (kg/jerib)	44.71	48.57	42.17	44.09	45.31
Outliers excluded	0	2	0	1	1

Source: ACIAR survey.

Table 16. Comparison of mean and weighted average yields of irrigated wheat in Laghman

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved
n	43	5	17	21	43
Mean yield (t/ha)	2.79	3.68	3.21	3.41	3.36
Production (kg)	88,666	8,925	36,100	32,871	77,896
Area (jeribs)	159.50	11.00	52.50	66.50	130.00
Weighted average (kg/jerib)	555.90	811.36	687.62	494.30	599.20
Weighted average (t/ha)	2.78	4.06	3.44	2.47	3.00
Average DAP application (kg/jerib)	39.51	48.40	33.71	35.00	36.05
Average urea application (kg/jerib)	54.14	71.00	48.59	52.33	53.02
Outliers excluded	0	0	0	0	0

Source: ACIAR survey.

Table 17. Comparison of mean and weighted average yields of irrigated wheat in Nangarhar

	Local	Non-ACIAR
n	19	53
Mean yield (t/ha)	2.52	2.92
Production (kg)	103,892	216,210
Area (jeribs)	199.00	360.00
Weighted average (kg/jerib)	522.07	600.58
Weighted average (t/ha)	2.61	3.00
Average DAP application (kg/jerib)	27.26	26.62
Average urea application (kg/jerib)	37.89	40.32
Outliers excluded	0	0

Source: ACIAR survey.

Table 18. Comparison of mean and weighted average yields of irrigated wheat in Takhar

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved
n	39	13	34	4	51
Mean yield (t/ha)	2.01	2.69	2.47	1.76	2.47
Production (kg)	162,330	20,100	106,875	6,440	133,415
Area (jeribs)	380.00	38.00	238.00	19.00	295.00
Weighted average (kg/jerib)	427.18	528.95	449.05	338.95	452.25
Weighted average (t/ha)	2.14	2.64	2.25	1.69	2.26
Average DAP application (kg/jerib)	43.74	46.92	53.50	44.50	51.12
Average urea application (kg/jerib)	56.15	35.38	58.24	82.50	54.31
Outliers excluded	1	1	0	0	1

Source: ACIAR survey.

Rainfed wheat

Table 19. Comparison of mean and weighted average yields of rainfed wheat in Baghlan

	Local	Non-ACIAR
n	46	2
Mean yield (t/ha)	0.74	1.75
Production (kg)	144,498	21,000
Area (jeribs)	957	55
Weighted average (kg/jerib)	150.99	381.82
Weighted average (t/ha)	0.75	1.91
Average DAP application (kg/jerib)	n.a.	n.a.
Average urea application (kg/jerib)	30.53	25.00
Outliers excluded	2	0

n.a. = farmers were not able to estimate answers.

Source: ACIAR survey.

Table 20. Comparison of mean and weighted average yields of rainfed wheat in Balkh

	Local	Non-ACIAR
n	51	18
Mean yield (t/ha)	1.29	1.83
Production (kg)	257,391	23,924
Area (jeribs)	1,088.00	61.00
Weighted average (kg/jerib)	236.57	392.20
Weighted average (t/ha)	1.18	1.96
Average DAP application (kg/jerib)	10.00	10.00
Average urea application (kg/jerib)	28.75	15.00
Outliers excluded	1	2

Source: ACIAR survey.

Table 21. Comparison of mean and weighted average yields of rainfed wheat in Kunduz

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved
n	34	18	10	18	47
Mean yield (t/ha)	1.37	1.23	1.51	1.49	1.39
Production (kg)	424,065	221,054	120,350	266,454	607,858
Area (jeribs)	1,475.00	933.00	365.00	929.00	2,227.00
Weighted average (kg/jerib)	287.50	236.93	329.73	286.82	272.95
Weighted average (t/ha)	1.44	1.18	1.65	1.43	1.36
Average DAP application (kg/jerib)	48.32	46.83	49.00	43.50	45.88
Average urea application (kg/jerib)	47.95	49.00	49.00	43.43	46.64
Outliers excluded	3	0	1	2	3

Source: ACIAR survey.

Table 22. Comparison of mean and weighted average yields of rainfed wheat in Nangarhar

	Local	Non-ACIAR
n	2	5
Mean yield (t/ha)	2.38	2.45
Production (kg)	16,900	7,980
Area (jeribs)	35.00	17.00
Weighted average (kg/jerib)	482.86	469.41
Weighted average (t/ha)	2.41	2.35
Average DAP application (kg/jerib)	28.80	28.80
Average urea application (kg/jerib)	57.40	57.40
Outliers excluded	0	0

Source: ACIAR survey.

Table 23. Comparison of mean and weighted average yields of rainfed wheat in Takhar

	Local	ACIAR-funded	Zard Dana	Other non-ACIAR	All improved
n	37	4	20	2	26
Mean yield (t/ha)	0.87	0.96	1.22	1.31	1.18
Production (kg)	177,815	8,040	77,040	3,150	88,230
Area (jeribs)	1,050.00	60.00	357.00	13.00	430.00
Weighted average (kg/jerib)	169.35	134.00	215.80	242.31	205.19
Weighted average (t/ha)	0.85	0.67	1.08	1.21	1.03
Average DAP application (kg/jerib)	25.00	n.a.	25.00	n.a.	25.00
Average urea application (kg/jerib)	27.50	20.00	34.67	n.a.	31.00
Outliers excluded	2	2	2	0	4

n.a. = farmers were not able to estimate answers.

Source: ACIAR survey.

Incidence of rust

Biological stressors, such as wheat rusts (a group of diseases caused by fungal pathogens), adversely affect wheat yields across the globe. Common wheat rusts are stem rust (also called black rust), stripe rust (also called yellow rust) and leaf rust (also called brown rust) (FAO 2008). Although all three are present wherever wheat is grown, they can be controlled by planting resistant varieties of wheat (FAO 2008). The performance of improved wheat varieties therefore depends on their ability to resist rust and maintain stable yields.

The most recent and heightened risk to Afghanistan's wheat production has come from a new stem rust race, Ug99, which can cause up to a 20% reduction in national annual production (Khanzada et al. 2012). Individual farmers and villagers can potentially lose up to 80% of wheat production due to localised epidemics (Khanzada et al. 2012). This will inevitably drive wheat prices up and threaten food and income security. Based on typical weather patterns and prevailing winds, the countries most at risk from the Ug99 strain include Afghanistan, India and Pakistan (FAO 2008).

While all the ACIAR project varieties are reported as resistant to stripe (yellow) rust, it is uncertain whether they are all resistant to stem (black) rust (Table 24). One particular variety, Chonte #1, released by MAIL in Afghanistan, was supposedly stem rust resistant. However, field observations and analysis in Sindh (southern Pakistan) found Chonte #1 to be highly susceptible to a new stem rust race Kiran-virulence (Khanzada et al. 2012). As a result, further multiplication and dissemination of Chonte #1 has been discontinued in Pakistan. Khanzada et al. (2012) therefore suggest that any further multiplication of this variety in Afghanistan should also be banned to reduce the risk of spreading the pathogen. The potential risk associated with Chonte #1 becoming susceptible to Ug99 further threatens sustainable wheat production in Afghanistan.

Table 24. Wheat varieties and rust resistance

Variety	Resistance to	Sources
Baghlan-09	Ug99 (stem rust)	Obaidi et al. (2011) and Singh et al. (2011)
Drokshan-08	Yellow rust	Nianne et al. (2011)
Chonte	Ug99 (stem rust)	Obaidi et al. (2011) and Singh et al. (2011)
Darulaman-07	Yellow rust	Nianne et al. (2011)
Ariana-07	Yellow rust	Nianne et al. (2011)
Muqawim-09	Ug99 (stem rust)	Obaidi et al. (2011) and Singh et al. (2011)
Solh-02	Yellow rust	Nianne et al. (2011)
Gul-96	Yellow rust	Nianne et al. (2011)
Lalmi-2	Yellow rust	Nianne et al. (2011)
Mazar-99	Yellow rust	Nianne et al. (2011)
Ghori-96	Yellow rust	Nianne et al. (2011)
Inqlab-91	Yellow rust	Nianne et al. (2011)
Bakhtawar-92	Yellow rust	Nianne et al. (2011)
Koshan-09	Ug99 (stem rust)	Obaidi et al. (2011) and Singh et al. (2011)

6 Cost–benefit analysis

This chapter brings together the estimated benefits and costs associated with the three projects in a cost–benefit analysis using the survey results and a number of possible 'with-research' and 'without-research' scenarios. The analysis aimed to encapsulate the diverse range of potential yields and cost components within benefit:cost ratios. The without-research scenarios were intended to capture the most likely counterfactuals. In other words, what would farmers be using had there been no recent research and investment in new improved varieties?

Background

Wheat yields revealed in the ACIAR-funded survey showed significant diversity at the national and provincial levels in Afghanistan. For example, ACIAR project varieties performed better than all non-ACIAR improved varieties in some provinces and lagged behind in others. There was also considerable variation in wheat yields depending on whether farmers planted one or more varieties.

In the case of irrigated wheat:

- farmers who planted only ACIAR varieties produced the highest mean yield of 546 kg/jerib (2.99 t/ha)
- farmers who planted only non-ACIAR varieties (excluding Zard Dana) had the second highest mean yield
- those who planted only Zard Dana had a lower mean yield of 541 kg/jerib (2.7 t/ha)
- farmers who planted more than one variety generally had lower yields from each variety, with the exception of two farmers who planted ACIAR varieties with Zard Dana and reported yields averaging 700 kg/jerib (3.5 t/ha).

While it is difficult to identify precisely what drove these results, it is clear that ACIAR and other improved varieties performed better than local varieties of irrigated wheat at both the national and provincial levels.

There is also some ambiguity about whether to classify the identified variety 'Zard Dana' as a new improved variety in the with-research scenario or perhaps as an old improved variety along with local varieties in the without-research scenario. Zard Dana was originally released in Afghanistan in 1993 under the name 'Zardana 89' but has now been out of the seed supply chain for many years. If farmers are in fact using this variety, it is likely to have lost its original quality and genetic potential over time, because they tend to use their own saved seed repeatedly. In that case, Zard Dana would be best left as an 'old' improved, indigenous seed in the without-research scenario. Alternatively, farmers may be unaware of the precise name of the new improved variety they are using and simply refer to it as a zard (amber coloured) dana (seed). As several new improved varieties are amber coloured, including the ACIAR project variety Solh-02, it may be reasonable to include Zard Dana in one of the with-research scenarios as well.

Alternative with- and without-research scenarios

The choice of with- and without-research scenarios requires an understanding of how the surveyed farmers were planting different seed varieties. As the Venn diagram in Figure 37 shows, farmers planted either one, two or three varieties. Twenty-three farmers planted only ACIAR varieties, 27 planted only Zard Dana, 88 planted only other non-ACIAR varieties, and 122 used only local varieties. With the exception of those planting only local varieties, these farmers also reported some of the highest mean yields within their variety subsets. For example, farmers planting only other non-ACIAR varieties had a higher yield on average than farmers who planted both other non-ACIAR varieties and local varieties.

The combinations in which farmers planted different seed varieties allowed us to establish a number of possible with- and without-research scenarios for the cost–benefit analysis. In Figure 38, each cell of the matrix contains two comparisons:

- where the with- and without-research varieties were the *only* varieties planted
- where the with- and without-research varieties were planted, irrespective of whether they were planted along with another variety (*mixed*).

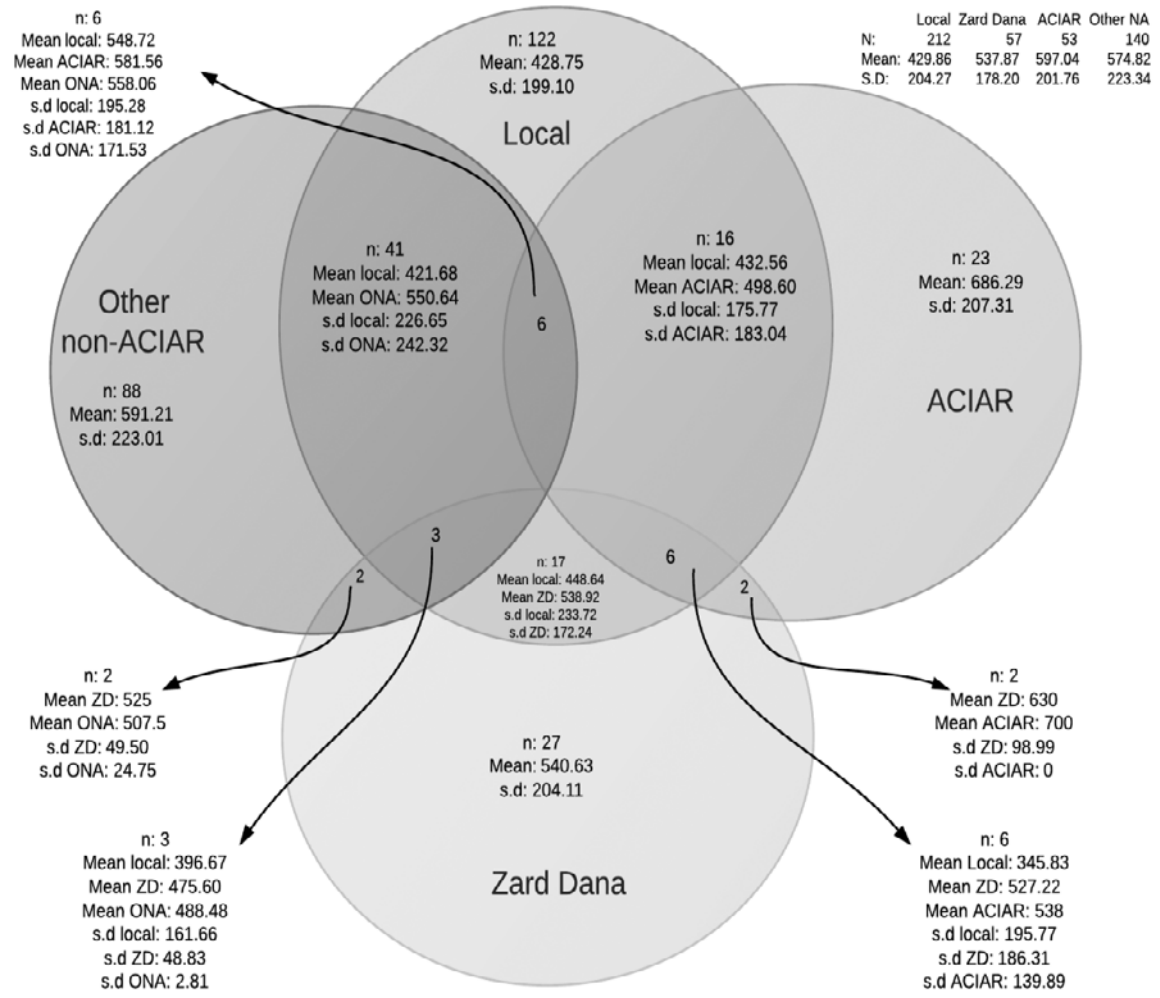


Figure 37. Plantings of irrigated wheat seed varieties

		With-research		
		ACIAR	ACIAR + other non-ACIAR	ACIAR + other non-ACIAR + Zard Dana
Without-research	Local	Only Mixed	Only Mixed	Only Mixed
	Local + Zard Dana	Only Mixed	Only Mixed	n.a. n.a.

Figure 38. Matrix of with- and without-research scenarios. n.a. = not applicable.

This matrix implies 10 different with- and without-research scenarios, depending on:

- the treatment of Zard Dana (in the with- or without-research scenarios)
- whether a single or mixed selection of varieties is chosen
- whether other non-ACIAR improved varieties are included in the with-research scenario.

A good argument can be made for any of these combinations, so in the analysis below we used all 10 to provide a solid indication of the variability of results.

Measuring research benefits

In a relatively small country such as Afghanistan, the benefits of research can be modelled using a modified version of the small open economy model introduced by Alston et al. (1998). In that model, our case-study economy cannot influence international prices for wheat significantly, so we assumed a fixed or constant sale price of wheat. This was a reasonable assumption because Afghanistan is a small landlocked country with mainly mountainous terrain and an arid to semi-arid climate. It also remains heavily dependent on countries such as Pakistan and, more recently, Kazakhstan for supplies of wheat and is therefore vulnerable to fluctuations in foreign supplies, prices and trade policies (Persaud 2012).

Survey results were a useful proxy for the research-induced change in costs from adopting new improved varieties. For each of the 10 cases presented in Table 25, we calculated the vertical shift in the supply curve, indicating the change in the marginal cost of production. In our model, research causes the supply curve to shift down, lowering the marginal cost of production and thereby increasing the production of wheat. Because Afghanistan cannot influence the world price significantly, the change in economic surplus is all producer surplus. In other words, the benefits of research accrue entirely to the producers of wheat.

In this 'small country' model, the formula for research benefits from a $K\%$ vertical shift in the supply curve is simply:

$$\Delta PS = \Delta TS = Pw.Qo.K(1 + 0.5K\varepsilon)$$

where the sale price of wheat is the constant world price, Qo is the initial quantity of production, K is the proportionate fall in cost expressed as a percentage, and ε is the supply elasticity, which has been set at 1 over the duration of our analysis.

It is important to understand the research-induced change in marginal cost and how it is calculated. The initial without-research price or cost is held fixed.

This can then be expressed in Afghanis (Afs/jerib) terms by multiplying the initial cost (Afs/kg) with the without-research yield (kg/jerib) in a particular year. Any increase in yield from adopting new improved varieties in that year will result in a lower cost of wheat per kilogram. The relative difference between the initial cost and the new lower cost is given by *K*.

However, there may also be some incremental costs as a result of adopting the with-research varieties. These could include higher seed cost, higher fertiliser costs, or both. The relative difference between the initial cost and the new cost adjusted for any incremental seed and fertiliser costs is given by *K'*.

Table 25 shows the computed *K* and *K'* under each scenario.

The smallest value for *K'* (Case 6) was around two-thirds of the largest value (Case 1). This suggests a surprisingly narrow range of outcomes, given the very large variation in scenarios.

This provided some confidence that the choice of with- and without-research scenarios based on survey results might not be the most important factor determining the evaluation of the research.

Further sensitivity and statistical analysis, provided below, illustrated this point.

Adoption paths for the improved varieties

According to the survey results, 10.41% of the total irrigated wheat area in 2012 was planted to ACIAR project varieties. When ACIAR varieties were the only varieties planted by farmers, they covered 1.88% of the total irrigated wheat area. If we assume that all new improved varieties will eventually cover 80% of the total irrigated wheat area in the selected provinces, and the 2012 ratios are maintained (ACIAR varieties cover 10%, other non-ACIAR varieties 27%, Zard Dana 11% and local varieties 52%), ACIAR varieties are likely to cover approximately 20% of this area. We therefore defined two adoption curves that started close to 0% and reached a maximum of 20%, using their respective 2012 adoption rates. The first curve represents the adoption path when ACIAR project varieties were planted alone (ACIAR only; Figure 39) and the second when ACIAR project varieties were planted *overall*, irrespective of whether they were planted with another variety (ACIAR mixed; Figure 40). We maintained these adoption paths for all 'only' and 'mixed' cases to ensure that adoption was not overestimated if other varieties were introduced into the with-research mix.

The adoption curve is important because it helped us to understand the likely adopted area and thus the implicit production of wheat attributed to ACIAR project varieties in selected provinces over time.

Table 25. Research-induced change in marginal cost of production

	Without research	With research	K	K'
Case 1	Local only	ACIAR only	0.375	0.343
Case 2	Local mixed	ACIAR mixed	0.280	0.256
Case 3	Local only	ACIAR + other non-ACIAR only	0.297	0.285
Case 4	Local mixed	ACIAR + other non-ACIAR mixed	0.260	0.259
Case 5	Local only	ACIAR + other non-ACIAR + ZD only	0.282	0.252
Case 6	Local mixed	ACIAR + other non-ACIAR + ZD mixed	0.248	0.227
Case 7	Local + ZD only	ACIAR only	0.346	0.331
Case 8	Local + ZD mixed	ACIAR mixed	0.242	0.241
Case 9	Local + ZD only	ACIAR + other non-ACIAR only	0.264	0.272
Case 10	Local + ZD mixed	ACIAR + other non-ACIAR mixed	0.220	0.244

ZD = Zard Dana.

Source: ACIAR data and CIE calculations.

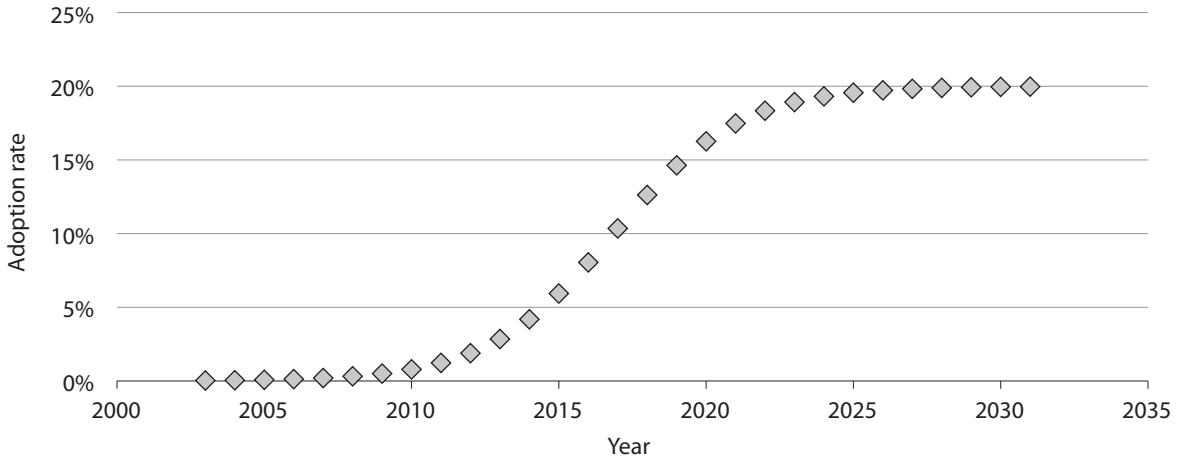


Figure 39. Adoption path: ACIAR varieties only. Data source: ACIAR survey and CIE calculations.

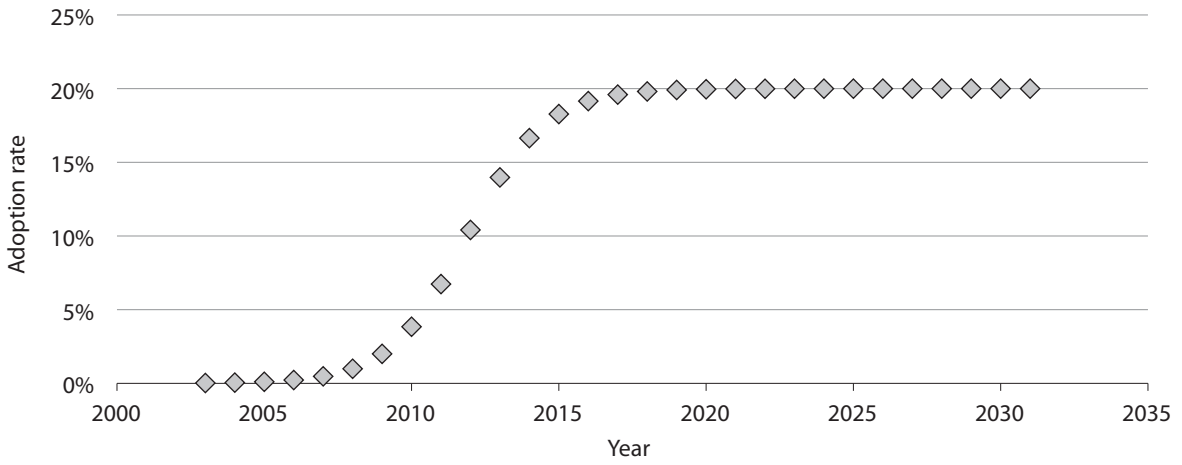


Figure 40. Adoption path: ACIAR mixed. Data source: ACIAR survey and CIE calculations.

We applied the adoption profiles to the total population irrigated area of all 10 provinces targeted by ACIAR programs. Although the survey was strictly representative of only seven of those provinces, we extrapolated to include the area planted to irrigated wheat in the remaining three provinces as well. We could reasonably assume that the dissemination and adoption of improved varieties across the 10 targeted provinces was similar over time. If the ACIAR survey had covered other provinces of Afghanistan, the benefits attributed to ACIAR wheat programs could potentially be much greater, even if the adoption rate were the same. In the absence of more detailed information on improved varieties, particularly in the south and south-west, it was difficult to justify including the whole of Afghanistan in the cost–benefit analysis.

The production of certified seed in 2011 was 24,136 tonnes (MAIL 2012). Given the average application rate reported in the survey (0.175 t/ha), the maximum area that could be sown to wheat using certified seed was only 137,920 ha (based on 2011 production figures from MAIL). This was obviously significantly smaller than the total irrigated wheat area, not only in Afghanistan as a whole (1,150,000 ha in 2011 and 1,167,000 ha in 2012) but also in the 10 provinces selected in our analysis (Table 26).

It is useful to understand the general order of magnitude of benefits from research in a given year. The total area planted to new improved wheat varieties in 2012, assuming an adoption rate of 10.41%, was 56,735 ha. The average wheat yield from local varieties was estimated to be 2.14 t/ha in 2012, while the mean yield from new improved varieties was 2.86 t/ha (an increase of 34%). The benefit to producers could then be approximated by multiplying the change in yield by the area and the sale price of wheat (A$354/ton). This equated to benefits of approximately A$14,447,954 in 2012 (Table 27).

Table 26. Total area planted to irrigated wheat in targeted provinces

	Targeted provinces included in ACIAR-funded survey	**Targeted provinces not included in ACIAR-funded survey**
	Balkh	Badakshan
	Baghlan	Parwan
	Kunduz	Herat
	Takhar	
	Kabul	
	Nangarhar	
	Laghman	
Total irrigated wheat area in 2012 ('000 ha)	401	144
% of total targeted area	74	26

Note: Adoption rates were applied to the total area in all 10 provinces (545,000 ha in 2012).

Source: MAIL data 2012—provisional estimates.

Table 27. Approximation of benefit to producers in 2012

	Snapshot in 2012
Total area planted to irrigated wheat in selected provinces (ha)	545,000
Adoption rate (%)	10.41
Adopted area (ha)	56,735
Average yield from local varieties (t/ha)	2.14
Average yield from new improved varieties (t/ha)	2.86
Change in production (t)	40,849.2
Price ($/tonne)	353.69
Benefit to producers ($)	14,447,954

Note: Yield data as under Case 6.

Source: CIE.

Research costs

Research costs in the cost–benefit analysis had to include all relevant costs that went into developing the seed industry in Afghanistan. In addition to the three ACIAR projects, two EU-funded projects implemented by the FAO were critical in providing farmers with access to quality certified seed and re-establishing the seed sector in the country. The objective of the two EU supported projects—Strengthening National Seed Production Capacity (2003–2006) and Variety and Seed Industry Development (2007–2011)—was to enhance agricultural productivity and ensure food security in Afghanistan by strengthening the capacity and quality of the national seed sector (FAO 2011). Key achievements of these projects included:

- more than 60,000 tonnes of certified seed produced and distributed to farmers nationwide between 2008 and 2011
- 11 new wheat varieties introduced since 2007, including four Ug99 stem rust-resistant ones, resulting in a substantial increase in national wheat production
- seed legislation enacted and national seed policy adopted
- 95 private seed enterprises established in 28 provinces, covering more than 80% of the country
- national seed association formed and three regional committees established to represent enterprises across the country
- seed production and conditioning equipment procured, installed and operated
- seed marketing channels initiated and promotional activities undertaken.

In our analysis, we distributed the total funding from the first EU project ($5,905,649—originally in 2003 $US) evenly over the years from 2003 to 2006. Funding from the second EU project was $12,947,874 (2007 $US) and was similarly allocated evenly over the years from 2007 to 2011. Monthly exchange rates were averaged over the year to produce an annual exchange rate for each year, which we used to convert EU-funded project costs to Australian dollars. Importantly, the EU projects did not focus solely on wheat and maize, and funding was also directed towards other activities and crops. However, the cost–benefit analysis included the total costs under the two EU projects because of difficulties in disaggregating the precise destinations of funding. In this way, total costs may have been overestimated. However, this should provide greater confidence in the net benefits determined by the analysis.

Any economic assessment of costs must also recognise the time value of money. Because the ACIAR and EU projects date back to 2002, it was important to first classify costs in real 2012 dollars to adjust for inflation (using an inflation factor of 2.5%). The real (in 2012) project costs were then readjusted in present value terms. This was because any research costs incurred in the past had to be brought forward, as those funds could have been earning interest in the intervening time. Table 28 summarises the adjusted research costs for the ACIAR and EU-funded projects.

Benefit:cost ratios for all scenarios

We computed benefit:cost ratios for all 10 scenarios based on the present value streams of benefits and costs. The ratios were tightly contained between 10:1 and 15:1, particularly when all incremental costs were taken into account. This indicated that for every $1 spent on improving agricultural productivity and food security in Afghanistan, $15 worth of benefits were potentially realised. Figure 41 highlights the benefit:cost ratios under different with- and without-research scenarios.

While Case 1 (ACIAR seed only against local seed only) provided the highest benefit:cost ratio under both *K* and *K'*, it is difficult to imagine farmers being confronted with only that binary option. If the choice were simply between a high- and a low-yielding variety, assuming all other factors were held constant, farmers would rationally plant the higher yielding variety.

However, a range of factors affect whether or not farmers plant a particular variety, including their awareness and the availability, accessibility, affordability and reliability of seed. When asked to list factors limiting the use of improved seed, 316 (70%) of surveyed farmers identified 'lack of awareness on the availability of improved seeds'

Table 28. Summary of ACIAR and EU adjusted program costs

	ACIAR (A$)	EU (US$)	Exchange rate (US$/A$)	EU (A$)	ACIAR adjusted (2012 A$)	EU adjusted (2012 A$)	Present value of ACIAR costs (A$)	Present value of EU costs (A$)	Present value of total costs (A$)
2002	500,000		0.546		640,042		1,042,561		1,042,561
2003	500,000	1,476,412	0.657	2,246,006	624,431	2,804,954	968,698	4,351,404	5,320,103
2004	238,500	1,476,412	0.736	2,005,019	290,589	2,503,994	429,332	3,699,539	4,128,871
2005	550,445	1,476,412	0.761	1,941,222	654,306	2,424,320	920,674	3,411,261	4,331,936
2006	456,500	1,476,412	0.757	1,949,445	529,400	2,434,590	709,447	3,262,583	3,972,030
2007	444,411	2,589,575	0.843	3,071,279	502,810	3,474,871	641,727	4,434,913	5,076,641
2008	599,644	2,589,575	0.853	3,037,595	661,895	3,436,760	804,537	4,177,403	4,981,940
2009	661,744	2,589,575	0.799	3,242,406	712,626	3,668,485	824,954	4,246,730	5,071,684
2010	234,108	2,589,575	0.920	2,814,934	245,960	3,184,839	271,171	3,511,285	3,782,456
2011		2,589,575	1.041	2,488,361		2,815,352		2,956,119	2,956,119
Total	4,185,352	18,853,523		22,796,267	4,862,060	26,748,164	6,613,102	34,051,239	40,664,341

Note: EU (US$) costs from 2003 to 2006 are in $2003. Costs from 2007 to 2011 are in $2007.

Source: ACIAR and FAO project documents (FAO 2013a, FAO 2013b and FAO 2013c).

as a key factor. Similarly, affordability was an important factor, as 216 farmers suggested that they had little or no money to buy improved seed. It is not surprising, then, that 'free seed from relief agencies' and 'own saved seed' were two of the most important sources of seed for farmers in our survey. This suggests that the decision to plant improved varieties is often circumstantial and that farmers may find it optimal to plant more than one variety. Furthermore, because no one improved variety is consistently higher yielding, it may be appropriate to bundle different new improved varieties together in the with-research scenarios.

Cases 6 and 10 provided a reasonable representation of the performance of new improved varieties. In Case 6, the with-research varieties could or could not be planted alone, and could include ACIAR-funded, Zard Dana and other non-ACIAR varieties. The counterfactual under Case 6 was the use of local varieties. Case 10, on the other hand, placed Zard Dana and local varieties in the without-research scenario and included ACIAR and non-ACIAR varieties in the with-research scenario. It is interesting to note that the benefit:cost ratio under *K'* was higher than under *K* when we moved from Case 6 to Case 10 (Figure 42). This reflected the slightly higher costs associated with Zard Dana.

Case 6: A closer examination

The estimated benefits from ACIAR- and EU-funded programs under Case 6, in which the vertical supply curve shift is given by *K'*, are shown in Table 29. The table shows the change in producer surplus (total surplus) and thus the benefit to farmers over time, assuming a maximum adoption rate of 20%. Following ACIAR guidelines, we converted all future benefits beyond 2030 to an annuity, indicating the indefinite continuation of benefits beyond a steady state. Importantly, even a perpetuity (an annuity under which benefits or costs continue forever) has a finite present value as long as there is a non-zero discount rate.

We estimated that these projects would deliver benefits of A$279.7 million Over the 30-year period from 2002 to 2031, plus an additional A$196 million in perpetuity, yielding total benefits worth A$475.7 million, expressed in 2012 dollars and in present value terms using a discount rate of 5% (a discount rate of 25.25% would have generated a net present value of 0 or a benefit:cost ratio of 1). The estimated benefits significantly exceeded the costs of all the ACIAR and EU projects, which were

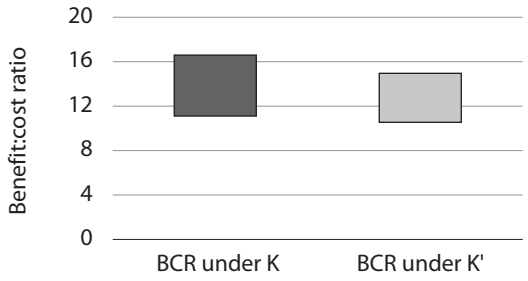


Figure 42. Range of benefit:cost ratios. BCR = benefit:cost ratio. Data source: MAIL and ACIAR survey data.

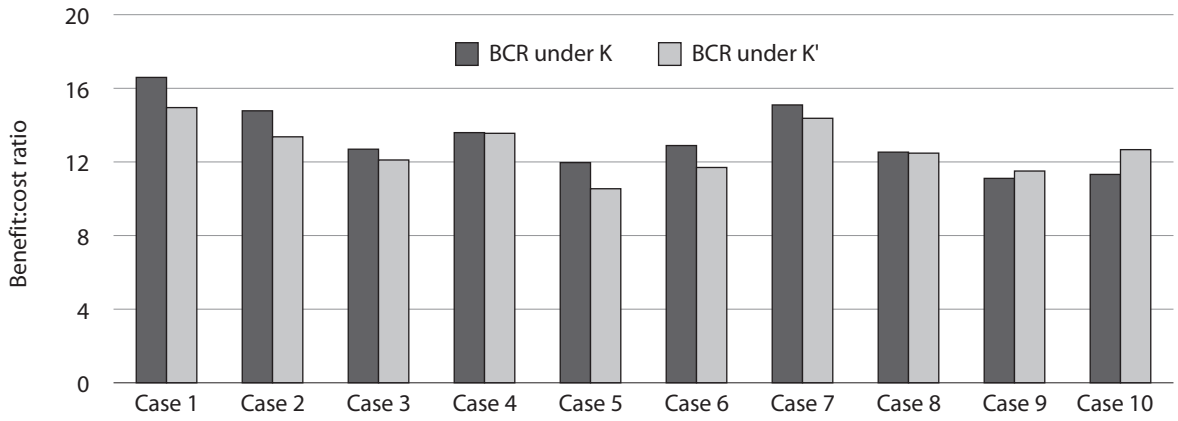


Figure 41. Benefit:cost ratios under different scenarios. BCR = benefit:cost ratio. Data source: MAIL and ACIAR-survey data

A$40.6 million. The projects are therefore expected to produce net benefits or a net present value (NPV) of A$435 million.

Attribution

Since all of the ACIAR and EU programs were considered necessary to achieve the ultimate objective of enhancing agricultural productivity for farmers and ensuring food security, it was appropriate to attribute benefits among the project contributors on a cost-share basis. Using a discount factor of 5%, ACIAR contributed A$6.6 million, or 16.3% of total costs. Consequently, present value benefits of A$77.4 million could be attributed to ACIAR (Table 29). In contrast, benefits attributed to the EU equated to A$398.3 million in present value terms.

Table 29. Estimated potential benefits from ACIAR- and EU-funded programs

	Producer surplus (A$)	Present value of benefits (A$)	Benefits attributed to ACIAR (A$)	Benefits attributed to EU (A$)	Present value of total net benefits
2002	–	–	–	–	–1,042,561
2003	28,531	44,261	7,198	37,063	–5,275,842
2004	39,302	58,066	9,443	48,623	–4,070,805
2005	111,444	156,812	25,502	131,310	–4,175,123
2006	228,462	306,161	49,790	256,371	–3,665,869
2007	517,319	660,245	107,373	552,872	–4,416,396
2008	854,389	1,038,515	168,890	869,625	–3,943,425
2009	2,551,677	2,953,886	480,380	2,473,505	–2,117,798
2010	4,562,636	5,030,306	818,061	4,212,245	1,247,850
2011	7,478,827	7,852,769	1,277,069	6,575,700	4,896,649
2012	10,870,551	10,870,551	1,767,840	9,102,711	10,870,551
2013	14,725,143	14,023,946	2,280,666	11,743,280	14,023,946
2014	17,693,366	16,048,404	2,609,897	13,438,507	16,048,404
2015	19,603,440	16,934,188	2,753,949	14,180,239	16,934,188
2016	20,731,293	17,055,686	2,773,708	14,281,979	17,055,686
2017	21,399,555	16,767,111	2,726,778	14,040,333	16,767,111
2018	21,827,355	16,287,909	2,648,847	13,639,062	16,287,909
2019	22,136,642	15,732,098	2,558,457	13,173,641	15,732,098
2020	22,389,553	15,154,131	2,464,464	12,689,667	15,154,131
2021	22,616,495	14,578,794	2,370,899	12,207,895	14,578,794
2022	22,832,073	14,016,912	2,279,522	11,737,390	14,016,912
2023	23,043,247	13,472,909	2,191,053	11,281,856	13,472,909
2024	23,253,321	12,948,319	2,105,741	10,842,578	12,948,319
2025	23,463,869	12,443,390	2,023,626	10,419,765	12,443,390
2026	23,675,642	11,957,808	1,944,657	10,013,151	11,957,808
2027	23,889,006	11,491,020	1,868,745	9,622,275	11,491,020
2028	24,104,140	11,042,384	1,795,785	9,246,599	11,042,384
2029	24,321,141	10,611,233	1,725,668	8,885,565	10,611,233
2030	24,540,061	10,196,902	1,658,287	8,538,615	10,196,902
Post-2030	24,760,935	195,974,857	31,870,718	164,104,139	195,974,857
Total	**448,249,414**	**475,709,576**	**77,363,014**	**398,346,562**	**435,045,235**

Note: Producer surplus in 2031 is A$24,760,935, and we assumed that this benefit was carried forward in perpetuity (calculated under the 'Present value of benefits (A$)' column).

Source: CIE.

Break-even analysis

The estimated benefits presented in this impact assessment are based on a degree of subjectivity, particularly regarding the rate of adoption. Clearly, the projects can deliver benefits only if new improved varieties are adopted and deliver yields similar to those obtained by farmers in the ACIAR-funded survey.

In undertaking this assessment, we estimated a maximum adoption rate of 20% based on the 2012 adoption rate of 10.41% from our survey, and then produced an estimate of the net benefits based on that rate. An alternative approach was to reconfigure the analysis and assume that the survey adoption rate was not representative of the actual adoption rate in selected provinces. In this case, what would the maximum adoption rate have to be to deliver no benefits? Taking this approach, the analysis showed that to produce a net present value of 0 (a benefit:cost ratio of 1), the maximum adoption rate would have to be 1.71% of the irrigated wheat area in the 10 ACIAR-selected provinces. An adoption rate of 1.71% translated to coverage of approximately 11,047 ha by 2031.

Sensitivity analysis

While the prospects look promising, the establishment of a fully functioning and sustainable seed sector in Afghanistan is by no means certain. The take-up of new improved varieties on a large scale relies on an efficient production and delivery system that is capable of providing good quality, productive seed varieties to farmers at reasonable prices. A functioning commercial seed system would ideally develop new varieties to cater to the real demand of farmers and disseminate those varieties quickly. Such a system is yet to take shape in many developing countries, let alone in Afghanistan, where much of the country is remote due to mountains, has underdeveloped roads and infrastructure and lacks adequate security. It is therefore not surprising that the informal seed market remains the key source of seed for most farmers, particularly in remote areas where distributors find access difficult and farmers cannot easily reach commercial seed markets (IAK and AFCI 2012).

It is also not clear whether new wheat varieties will be immune to rust, particularly the new emerging Ug99 stem rust. The law and order situation beyond 2014 adds an additional layer of uncertainty. Given these multifaceted uncertainties, it would be useful to look at results under different discount and adoption rates. NPV and benefit:cost ratio calculations are particularly sensitive to changes in underlying parameters, so it is important to understand the results in perspective. In this section, we analyse the impact of variations in the discount and adoption rates as well as the sale price of wheat on benefit and cost streams coming out of our central case (Case 6).

Tables 30 and 31 and Figure 43 highlight the influence on our analysis of changes in key assumptions. The most important assumptions are about the discount and adoption rates. A higher discount rate of 7.5% or 10% reflects greater uncertainty in the future stream of benefits and inevitably yielded a lower benefit:cost ratio than our baseline case. Similarly, a maximum adoption rate of 15% indicated that the area planted to improved varieties was likely to be lower than in the base case (20%); it also returned a lower NPV and benefit:cost ratio. In the absence of an efficient seed system and secure environment, these variations were not necessarily counterintuitive.

While the parameters used in the base-case scenario seemed reasonable in the light of current realities on the ground, it was nevertheless important to test the robustness of our conclusions to variations in these assumptions. The low and high alternative assumptions used in the above sensitivity analysis were brought together to estimate benefit and cost streams under pessimistic (high discount rate and low adoption rate) and optimistic (low discount rate and high adoption rate) outlooks. The results under these different assumptions are summarised in Tables 32 and 33.

The pessimistic and central (baseline) scenarios perhaps offered the most conservative yet realistic forecasts of future benefits, given the precarious and uncertain conditions across Afghanistan. In this way, we estimated the net present value to be between A$148.20 million and A$435.05 million, the benefit:cost ratio to be between 3.82 and 11.70, and the benefits attributed to ACIAR to be likely to be between A$34.39 million and A$77.36 million.

Table 30. Summary measures

	Present value of benefits (A$m)	Present value of costs (A$m)	Net present value (A$m)	Benefit:cost ratio	Internal rate of return (%)
Discount rate (%)					
2.5	959.59	35.84	923.75	26.78	25.25
5	475.71	40.66	435.05	11.70	25.25
7.5	318.95	46.18	272.77	6.91	25.25
10	242.77	52.47	190.30	4.63	25.25
Maximum adoption rate (%)					
15	374.31	40.66	333.64	9.20	24.54
20	475.71	40.66	435.05	11.70	25.25
25	579.15	40.66	538.49	14.24	26.91
30	680.23	40.66	639.57	16.73	28.13
Price of wheat (A$/tonne)					
318.32	428.14	40.66	387.47	10.53	23.89
353.69	475.71	40.66	435.05	11.70	25.25
389.06	523.28	40.66	482.62	12.87	26.52

Note: Changes to each parameter were made while holding all other parameters constant.

Source: CIE.

Table 31. Attribution of benefits to ACIAR

	Present value of ACIAR costs (A$m)	Share of total costs (%)	Present value of benefits attributable to ACIAR (A$m)
Discount rate (%)			
2.5	5.67	15.82	151.83
5	6.61	16.26	77.36
7.5	7.71	16.70	53.27
10	8.99	17.14	41.61
Maximum adoption rate (%)			
15	6.61	16.26	60.87
20	6.61	16.26	77.36
25	6.61	16.26	94.19
30	6.61	16.26	110.62
Price of wheat (A$/tonne)			
318.32	6.61	16.26	69.63
353.69	6.61	16.26	77.36
389.06	6.61	16.26	85.10

Note: Changes to each parameter were made while holding all other parameters constant.

Source: CIE.

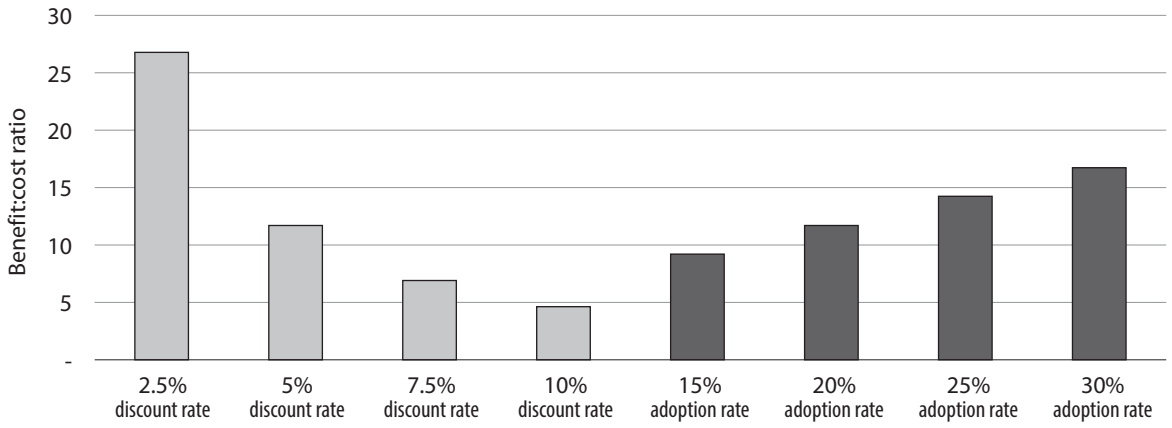


Figure 43. Sensitivity of benefit:cost ratio to changes in the discount and adoption rates. Note: The adoption rate was the maximum adoption rate. The discount rate was held constant at 5% when altering the maximum adoption rate, and the adoption rate was held constant at 20% when altering the discount rate. Data source: CIE.

Table 32. Alternative assumptions for sensitivity analysis

	Pessimistic	Central (baseline)	Optimistic
Discount rate	10	5	2.5
Maximum adoption rate	15	20	30

Source: CIE.

Table 33. Summary measures under alternative assumptions

	Pessimistic	Central (baseline)	Optimistic
Present value of benefits (A$m)	200.67	475.71	1,404.96
Present value of costs (A$m)	52.47	40.66	35.84
Net present value (A$m)	148.20	435.05	1,369.12
Benefit:cost ratio	3.82	11.70	39.20
Internal rate of return (%)	24.54	25.25	28.13

Note: The sale price of wheat was held constant at $353.69/tonne.

Source: CIE.

Table 34. Attribution of benefits to ACIAR under alternative assumptions

	Pessimistic	Central (baseline)	Optimistic
Present value of ACIAR costs (A$m)	8.99	6.61	5.67
Share of total costs (%)	17.14	16.26	15.82
Present value of benefits attributable to ACIAR (A$m)	34.39	77.36	222.30

Note: The sale price of wheat was held constant at $353.69/tonne.

Source: CIE.

Statistical confidence analysis

The results presented so far effectively refer to the mid-point outcomes from the survey. Given the statistical uncertainty associated with any survey, it was useful to use variation within the sample to provide an indication of confidence in a range of outcomes (such as the present value of net benefits) calculated on the basis of the survey.

To do this, we used a bootstrapping (or resampling) technique based on the full survey sample results. This technique involves resampling from the original survey outcomes numerous times, each time recalculating the values of interest. The result was a probability distribution of outcomes that could then be used to test various hypotheses.

For this analysis, we resampled from the relevant distributions for each of the 10 cases used to compare the with- and without-research outcomes.

For the analysis here, we were particularly interested in:

- the probability that *K'* (the vertical shift in the supply curve) is greater than zero (this is akin to testing the 'significance' of the values for *K'* estimated under the various cases)
- the probability that the present value of net benefits (NPV) to 2020 is greater than zero
- the probability that NPV to 2030 is greater than zero

These three tests provided some confidence that the ACIAR and related project funding had, in fact, generated positive benefits. We chose NPV to 2020 and to 2030 simply to eliminate the uncertainty involved in projecting benefits any farther into the future.

Table 35 summarises the results of the bootstrapping analysis. It shows the range of probabilities for the lowest and highest values from each of the 10 scenarios.

Based on the resampling results, there was a 65%–79% probability that *K'* was greater than zero. That is, there was about a 70% chance that the released varieties had increased yield (net of incremental costs) for the farmers surveyed.

In terms of present values, there was a 59%–69% chance that the ACIAR funding would at least break even by 2020 (within the next eight years). There was a 65%–77% chance that the funding would at least break even by 2030.

Rainfed wheat

The cost–benefit analysis was built on data for irrigated wheat in selected provinces. Given the opportunistic nature of rainfed wheat plantings, the ACIAR survey results were unlikely to provide an accurate representation of the performance of improved varieties over time. It was therefore not appropriate to use survey results to calculate benefit:cost ratios for rainfed wheat. As Figure 44 indicates, only 22 surveyed farmers planted ACIAR project varieties in rainfed areas. Most farmers, however, planted local varieties in those areas.

Table 35. Confidence in calculations based on survey results

Variable	Range of probabilities that value of selected variable is greater than zero
	%
K' (vertical shift in the supply curve)	65 to 79
Present value of net benefits to 2020	59 to 69
Present value of net benefits to 2030	65 to 77

Source: CIE estimates.

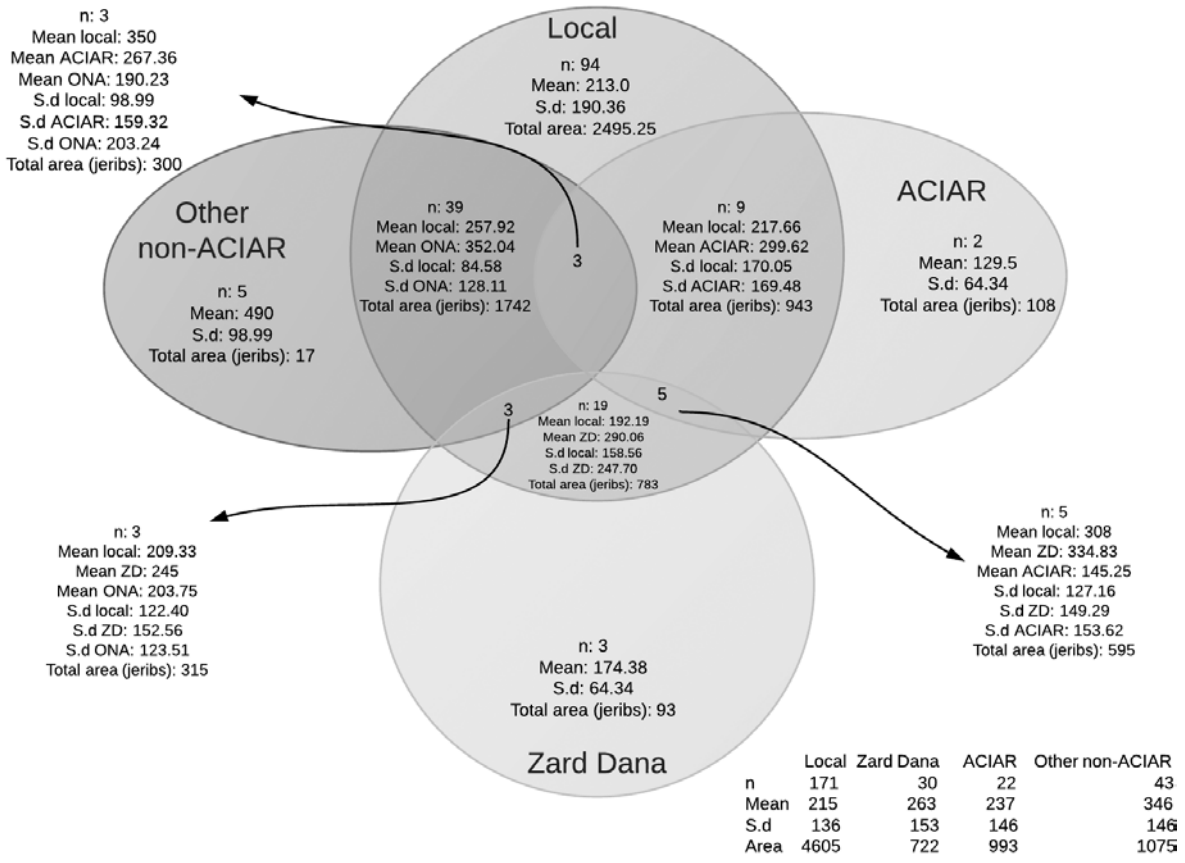


Figure 44. Plantings of rainfed wheat seed varieties

7 Conclusions

While widespread benefits are yet to be realised, we estimate that the ACIAR projects will eventually deliver considerable benefits to Afghan farmers growing wheat using improved seed varieties in irrigated areas.

ACIAR wheat and maize project activities in Afghanistan delivered three key outputs:

- the identification, distribution and multiplication of superior wheat and maize varieties
- capacity built
- the promotion of superior agricultural techniques.

We can reasonably assume that the identification, distribution and multiplication of superior varieties contributed directly to adoption and the realisation of benefits. Capacity built and the promotion of superior agricultural techniques are likely to have supported this process.

Importantly, only the benefits of adopting 'superior' or improved wheat varieties in irrigated areas were modelled in a cost–benefit framework. Although ACIAR project varieties were planted (by 22 farmers) in rainfed areas, it was difficult to accurately analyse their performance using survey results because plantings of rainfed wheat are opportunistic. Furthermore, the relatively lower adoption rate for improved varieties in rainfed areas also suggests that most farmers tend to use local seeds that have been tried and tested—a rational decision if we assume risk averseness. It was also not reasonable to use survey results to model benefits under maize, particularly in the absence of ACIAR project varieties in our sample (only one ACIAR-funded maize variety was reported in the survey—Rampur, which is also known as Zudras).

Improved varieties of wheat have the potential to deliver benefits, whether in higher yields or disease resistance, to farmers in Afghanistan. While we could only model the benefits deliverable to Afghan farmers in 10 provinces with reasonable confidence, there is long-term potential for similar or higher adoption in other provinces of Afghanistan. This will require increased production and wider distribution of improved varieties, as well as a speedy delivery system that provides good quality, productive seed to farmers on time.

Some lessons from the impact assessment

Figure 45 summarises the pathway to benefits from the three ACIAR projects. The adoption of the new improved varieties has had significant economic and social impacts. This was observable when we looked at yields obtained by farmers in the ACIAR survey who adopted improved varieties of wheat. Building the capacity of farmers in crop management and promoting superior agricultural techniques have similarly contributed to positive outcomes and impacts. However, the Afghanistan seed sector remains underdeveloped, and many farmers still depend on relief agencies and the informal market for seed. The development and sustainability of this sector, along with the security situation in Afghanistan, are important risk factors that will determine the realisation and continuation of project benefits.

Final impacts from the wheat and maize projects also appear promising. The most obvious economic impacts include increased local food production, greater crop productivity and implicit income gains, particularly for farmers adopting improved, higher yielding varieties. The economic benefits under the projects should also help foster greater levels of self-reliance in farming

communities. Environmental benefits from the introduction of new varieties of wheat with better and more durable disease resistance include reduced risk of crop disease and greater farm sustainability.

Finally, social impacts are important when considering the overall impact of a project on the lives of communities and may often help to justify future work, extensions and projects. Food security, poverty alleviation, employment generation and increased income are generic social benefits to producers as well as consumers. In addition, the increased value of legitimate cereal crops is expected to reduce economic incentives to engage in opium production. Many provinces of Afghanistan, particularly in the north and north-east, have already achieved opium poppy free status.

Some observations from the impact assessment may be relevant for future extension projects. In particular, the adoption of improved varieties remains a key area of uncertainty. While MAIL data provide an indication of the overall production and area planted to wheat and maize, there is no reliable information on the actual adoption and performance of improved wheat varieties across Afghanistan over time.

However, based on survey responses and NGO final reports submitted to ACIAR, a considerable number of farmers do not have accurate information about improved seed varieties; nor do they know how to plant them. Many farmers are also ignorant about the names of improved varieties. This suggests a need to complement the production and dissemination of improved seed varieties with better training and awareness-raising campaigns. As the NGO reports recommended, training should include:

- seed variety and quality identification
- cultivation techniques
- appropriate levels of irrigation and fertilisation
- land preparation techniques
- weed, pest and disease control methods.

In addition to our limited knowledge about the actual adoption of improved varieties, the security situation in Afghanistan makes any assessment of the future particularly difficult. Lack of security often means that farmers have to postpone certain farming activities and delay visiting their farms for long periods. It also restricts farmers from being able to travel freely to purchase good quality seed, so they have to rely on nearby local markets. Adverse security conditions may even affect livelihoods if farmers cannot sell their production because roads are unsafe and because of threats from warlords and armed groups.

While research programs can do little to overcome some of these deep-rooted challenges, it is important to be mindful of them to appreciate the complex nature of undertaking and assessing development projects in a country like Afghanistan.

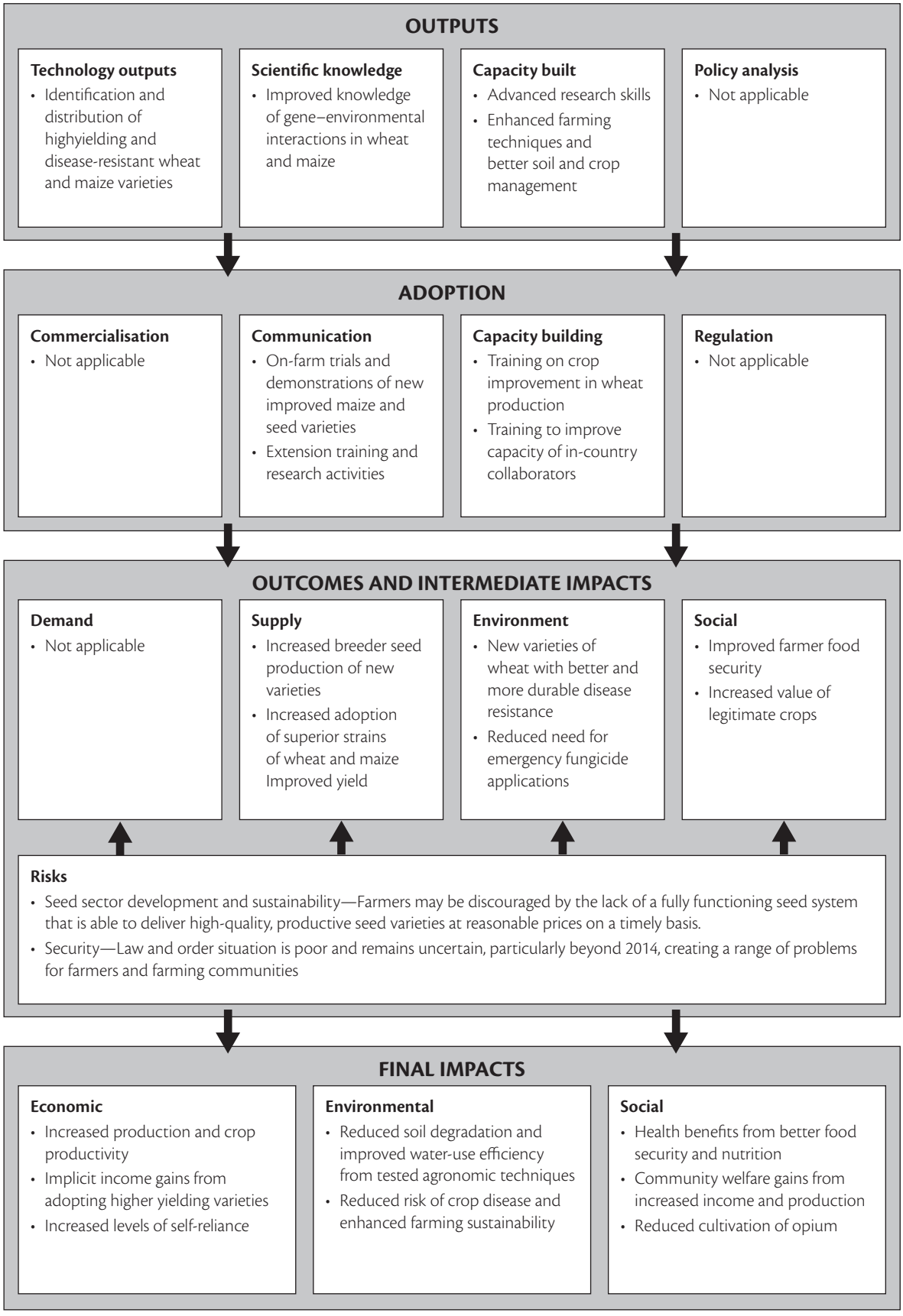


Figure 45. Pathway to benefits. Source: CIE.

Appendix 1: The survey process and organisation

Following a competitive tender to survey 466 wheat producers in Afghanistan, ACIAR contracted four NGOs as partner organisations to conduct the field work:

- the Agency for Technical Cooperation and Development (ACTED) for the provinces of Kunduz, Baghlan and Takhar
- Coordination of Humanitarian Assistance (CHA) for the province of Balkh
- Mission d'Aide au Développement des Economies Rurales (MADERA) for the provinces of Laghman and Nangarhar
- Solidarité Afghanistan Belgique (SAB) for the province of Kabul.

Key survey administrative activities

The survey involved a number of detailed administrative activities, set out in a separate report to ACIAR. Key features included:

- drafting and agreeing upon terms of reference for the partner organisations (3 September 2012)
- developing the survey instrument
- liaising with CIMMYT to conduct training sessions (on grain varieties) for the partner organisations (4 September 2012)
- coordinating partner organisation training (completed by the end of September 2012)
- translating the survey instrument into Dari and Pashtu (finalised by mid-September 2012)
- setting up the survey database management system
- monitoring partner organisations' field work.

Sample design and survey data collection

Study area

The survey covered wheat and maize producers in seven provinces of Afghanistan. The seven provinces were selected according to five criteria.

Poverty headcount

To reduce the possibility of producing biased results, the sample population was drawn from provinces with different levels of poverty. It was possible to classify the provinces in five groups according to their poverty headcounts, or the percentage of the population living under the official poverty line (Figure A1.1).

Production of wheat

Large parts of Afghanistan are arid and not suitable for agricultural production. Only provinces with significant production of wheat per square kilometre over the total provincial area were surveyed (Figure A1.2).

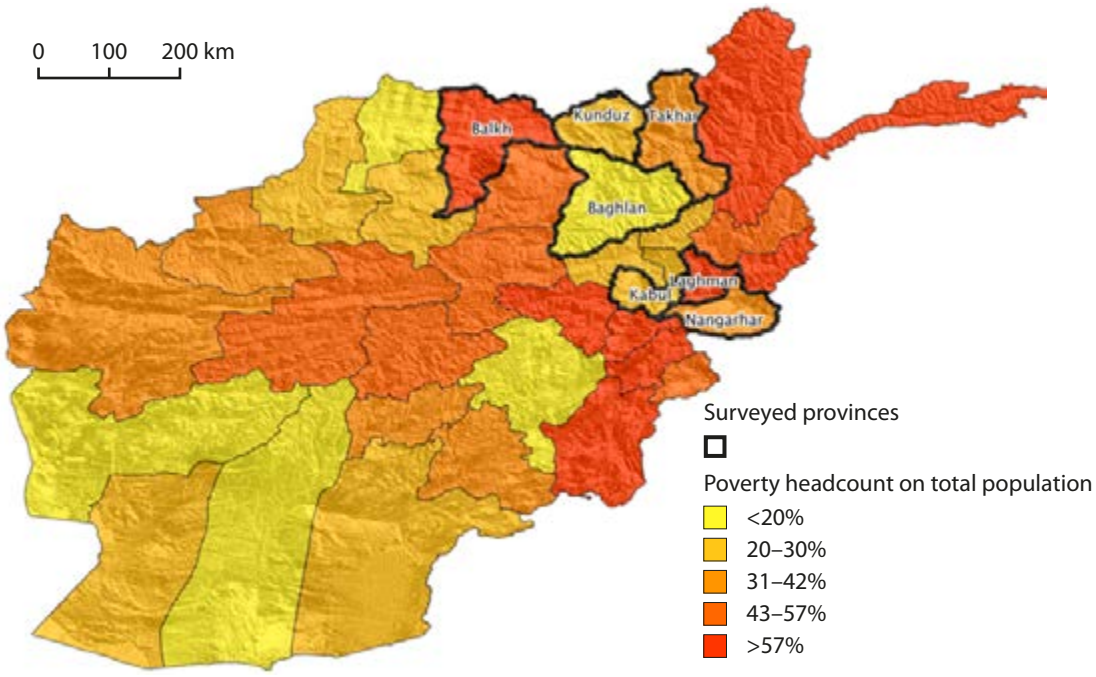


Figure A1.1. Poverty headcount. Source: MAIL, *Agriculture prospect report,* 31 May 2011.

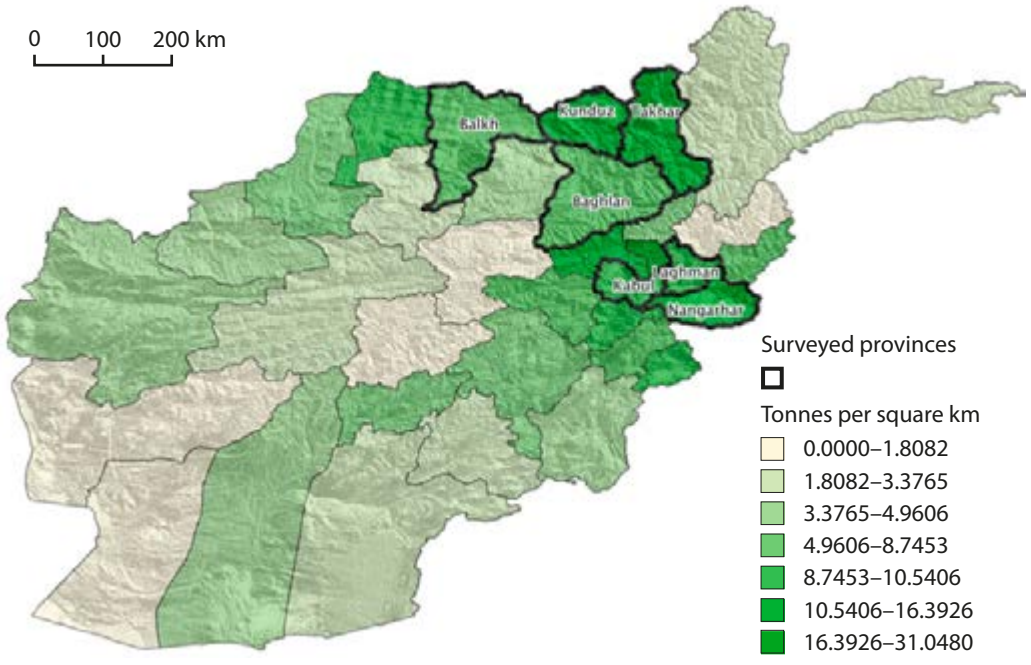


Figure A1.2. Wheat production over total provincial area. Source: MAIL.

Yield

Focusing only on provinces with high yields (tonnes of production per hectare of cultivated land) would have distorted results. Therefore, provinces with different levels of soil fertility and agricultural productivity were surveyed (Figure A1.3).

Rainfed fields and irrigated fields

The total areas in Afghanistan dedicated to rainfed fields and irrigated fields are similar (1.00 million hectares and 1.15 million hectares, respectively), but that proportion is not reflected in all provinces—some have proportionally more area dedicated to one or the other type of cultivation. Therefore, provinces were selected to represent different ratios of irrigated land to total cultivated land (Figure A1.4).

Area of release

Finally, while the three ACIAR projects did not target any particular province, only provinces where the release of improved varieties had been confirmed were selected (Figure A1.5).

Selection of partner organisations

The partner organisations were selected based on their experience in conducting monitoring and evaluation, their expertise in agricultural development, the qualifications of their staff, the quality of their proposal (completeness and ability to anticipate operational challenges), their experience in operating in the selected provinces, the level of access to the selected provinces, the capacity in place in the selected provinces, and budgetary requests.

In other words, the organisations were required to have built trustful relationships with the communities over the years (in order to guarantee the greatest possible collaboration during the administration of the questionnaires) and to be able to quickly implement all the activities involved in survey administration.

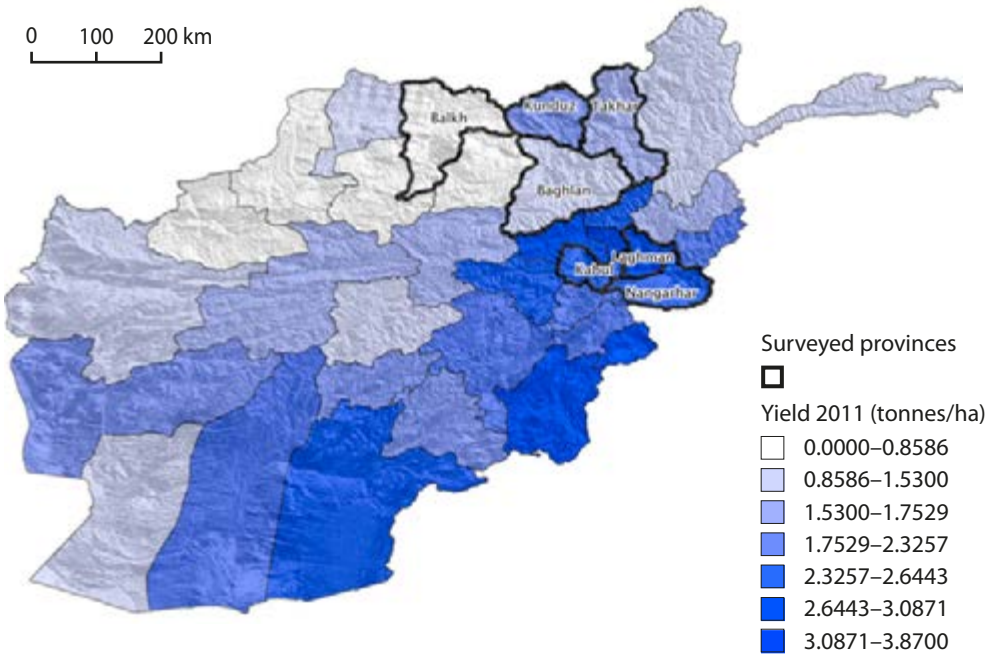


Figure A1.3. Wheat yield. Source MAIL.

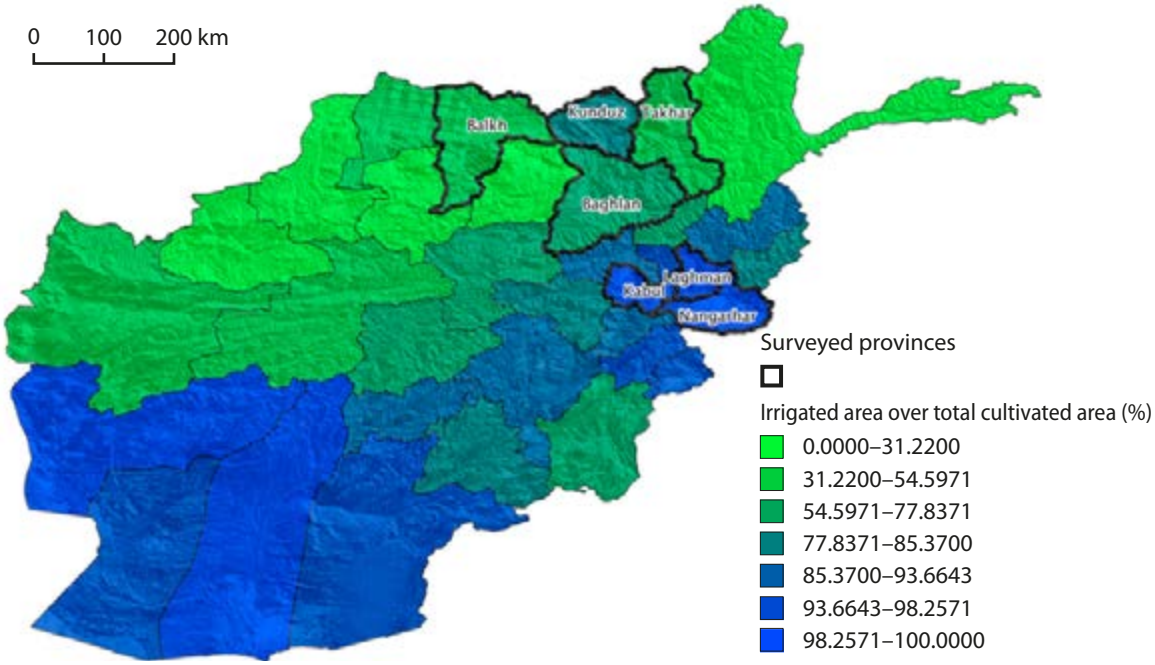


Figure A1.4. Irrigated land as a proportion of total cultivated land. Source MAIL.

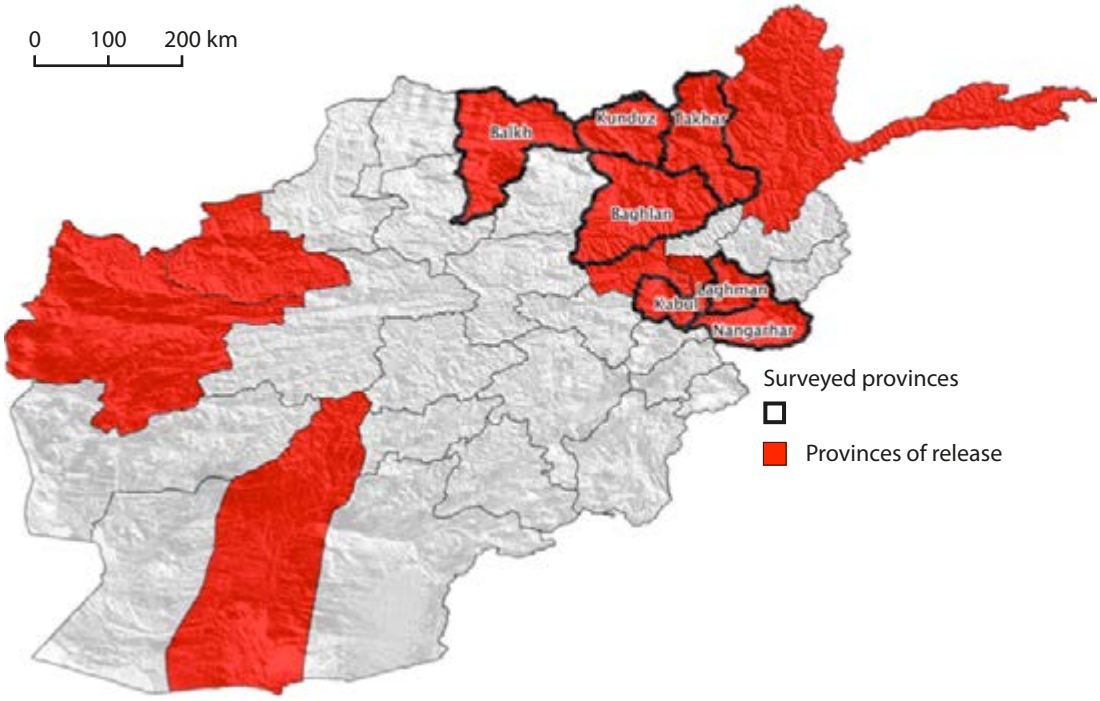


Figure A1.5. Areas of variety release. Sources: ACIAR review report CIM/2007/065, project final report SMCN/2004/002, final report SMCN/2002/028.

Sampling

Given the precarious security situation in most of the country, the sample population was necessarily limited to those living in areas that the partner organisations deemed safe to reach. During the whole survey process, the partner organisations had full responsibility and full discretion in assessing the security conditions in their areas.

The sampling was based on the list of 31,347 Afghan settlements published by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA 2012). This list was first filtered for settlements included in areas of wheat production according to maps published by the Afghanistan Information Management Service (AIMS 2004) and based on information produced by the FAO and the United States Geological Survey.

This list was then passed to the relevant organisations to indicate:

- settlements considered accessible for the purpose of administering the survey, in terms of both staff and resident population security
- settlements considered unsafe to reach
- settlements that were unknown to them.

Among the settlements that were deemed accessible were 349 villages in Balkh, 191 in Takhar, 216 in Kunduz, 290 in Baghlan, 231 in Laghman, 142 in Nangarhar, and 338 in Kabul.

From the list of 1,757 accessible settlements, 10 were randomly selected for each province. To avoid selection bias towards more populated areas—where the number of settlements was higher—10 random points where selected within the boundaries of cultivated areas in each province using QGIS geographic information software. The settlement selected was the one closest to the random point.

Each partner organisation was then responsible for surveying a minimum of five and a maximum of 10 farmers in each selected settlement. In one case, in the province of Kabul, the partner organisation asked for one selected settlement to be replaced with another because of worsening security in the area.

Figures A1.6 to A1.10 map selected communities and surveyed households in the seven provinces. Notably, geographic coordinates were not taken in the field in the provinces of Laghman, Nangarhar, Takhar and in western Baghlan due to security concerns. In limited cases, geographic coordinates clearly show transcription errors.

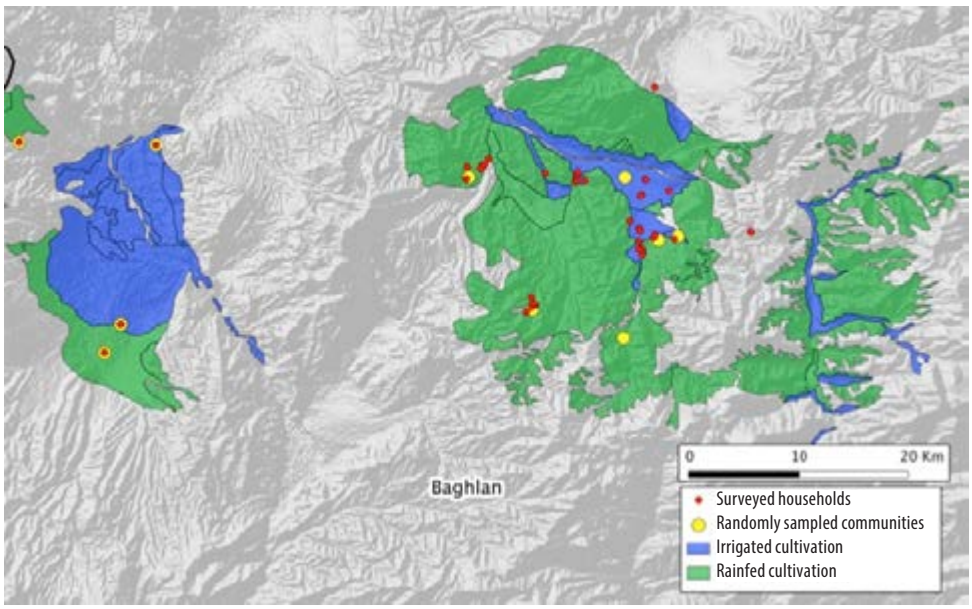


Figure A1.6. Baghlan sampling

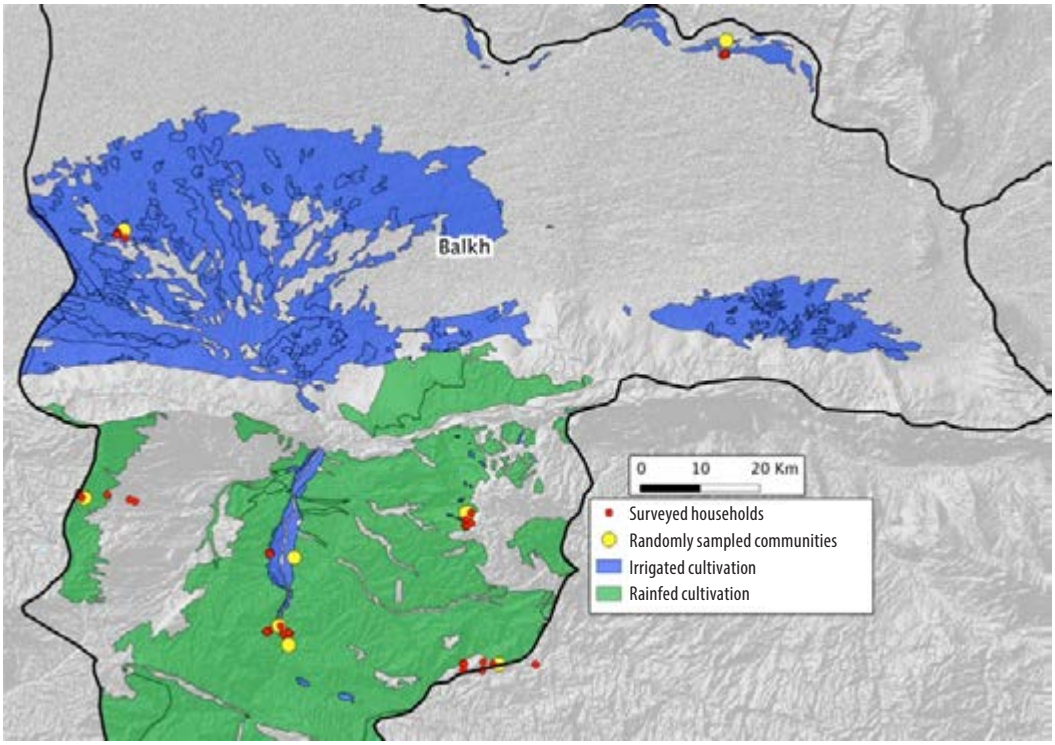


Figure A1.7. Balkh sampling

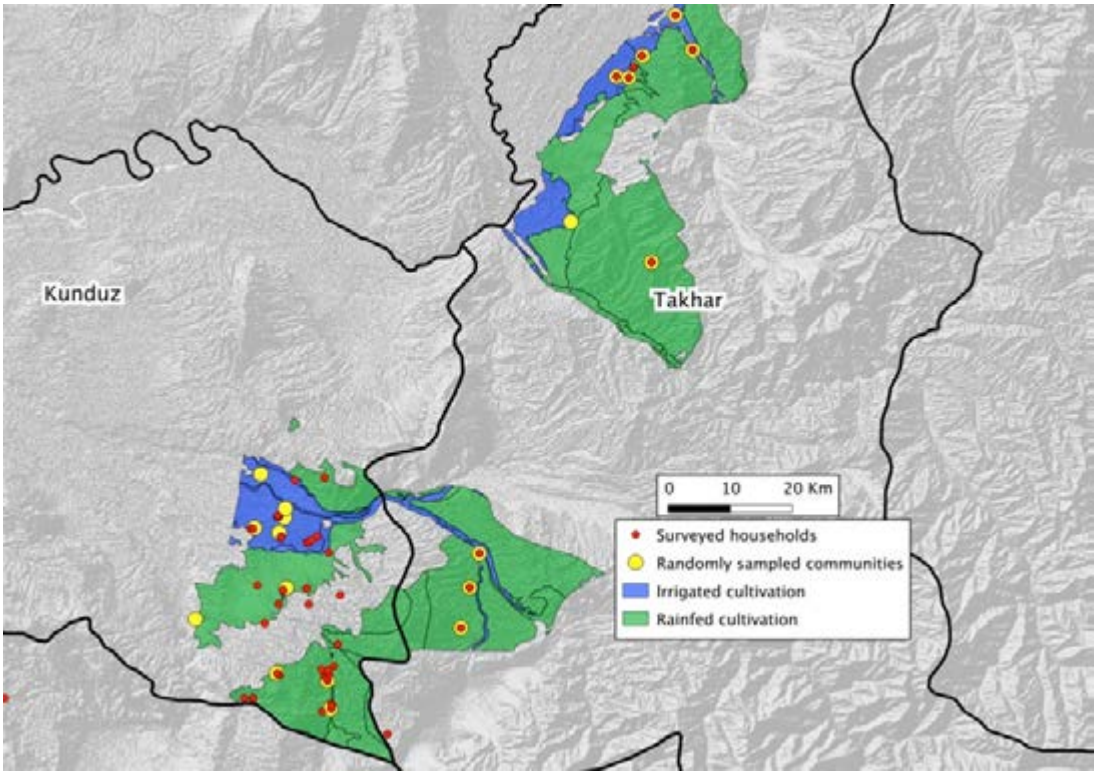


Figure A1.8. Kunduz and Takhar sampling

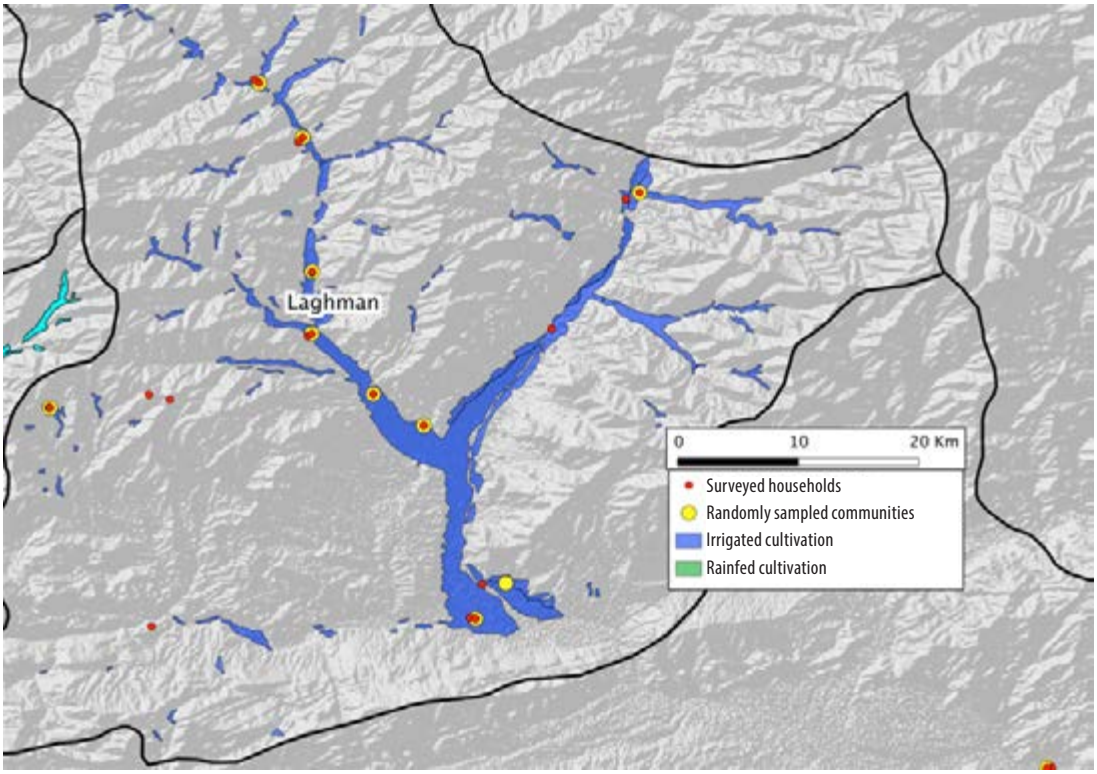


Figure A1.9. Laghman sampling

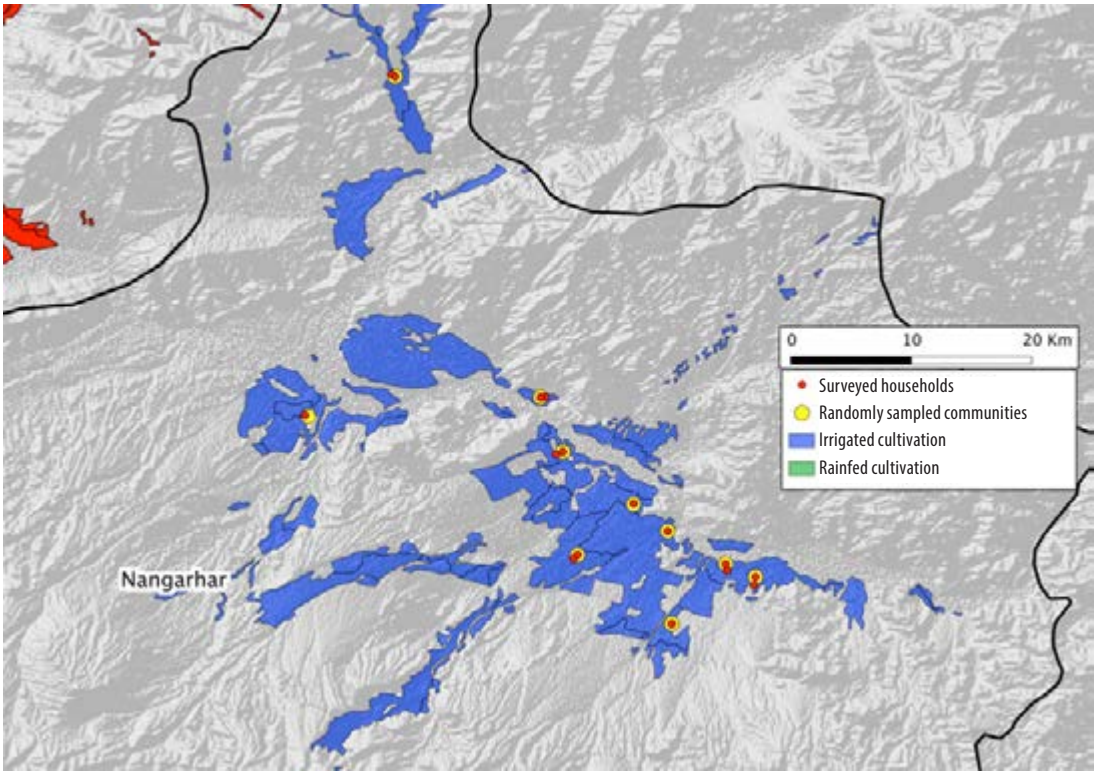


Figure A1.10. Nangarhar sampling

Questionnaire design

The questionnaire consisted of seven sections: survey location data, farmer details, aggregate farm information, knowledge of and access to improved seed, wheat production information, maize production information, opium production and general security. The draft questionnaire used significant inputs from the four partner organisations and CIMMYT in the form of comments and feedback resulting from field tests.

Data

The primary means of collecting data was the administration of the questionnaire to 466 households between the last week of September 2012 and 12 November 2012. Qualitative and quantitative information collected before, during and after the survey from different sources was also important for the survey, especially considering the impossibility of travel to Afghanistan at any stage of the exercise. Indeed, ACIAR specifically requested the partner organisations to integrate the collected data with their comments and analysis on the adoption of improved varieties, which were included in the final report each organisation submitted to ACIAR after completing the survey.

The information collected through the questionnaire proved to be both internally and externally consistent (that is, when compared with information produced by the survey or by other sources). Nevertheless, the characteristics of the surveyed population and the conditions under which the survey was administered must be taken into consideration, in particular the low literacy level of the interviewees and the persistent insecurity throughout the country, which necessarily weakened the trust between interviewers and interviewees.

Data submitted through the database system were checked at different stages and were carefully scrutinised to avoid systematic and repeated errors (mostly caused by entering the information in the wrong field). Also, as the data were submitted they were checked for internal consistency (that is, every value that was considered too distant from the mean was submitted to the corresponding organisation with a request to recheck it). All data were entered by the organisations as reported by the interviewer on the survey form, with the exception of the data indicating the names of the improved varieties, which were entered by the data editor based on the transliteration of what was reported on the form.

As discussed in the main body of this report, despite this checking, some data points were clearly outliers (due to reporting errors rather than transcription or data entry errors) and so were modified for the analysis.

Appendix 2: The survey instrument

Australian Government
Australian Centre for International Agricultural Research

QUESTIONNAIRE

IMPACT ASSESSMENT AF-2012
IMPROVED WHEAT AND MAIZE SEED VARIETIES

A: Survey location data

A5. Date

A6. GPS location: ____ N ____ E

A7. Name of interviewer

☐ No ☐ Yes A8. Photograph taken

☐ No ☐ Yes A9. Permission to use photo

ORGANISATION

A1. Survey identifier
Unique form identification number to be allocated by survey organisation
O R G ___ ___ ___

A2. Province

A3. District

A4. Village

Organisation

B: Farmer details

B10. How do you plough and prepare your land?
- ☐ Machinery only
- ☐ Mostly machinery with some animals
- ☐ Equal machinery and animals
- ☐ Mostly animals with some machinery
- ☐ Animals only

B11. What is your total farm income? ____ Afs

B12. What is your total farm cost? ____ Afs

☐ No ☐ Yes B13. Does your family have any sources of income other than your farm?

B14. If yes, what is your approximate annual income from these sources ____ Afs

B15. Could you specify these other income sources?

B1. Name

☐ Female ☐ Male B2. Gender

B3. Age

☐ No ☐ Yes B4. Are you the household head?

B5. If no, what is your relationship to the household head

B6. Years of formal education

☐ No ☐ Yes B7. Have you received training in good farming practice the past 5 years?

B8. If yes, how many months training did you receive?

B9. Number of family members?

C: Aggregate farm information

What livestock do you farm?
- ☐ C6. Sheep
- ☐ C7. Cattle/oxen
- ☐ C8. Poultry

What crops do you produce?
- ☐ C3. Vegetables
- ☐ C4. Cotton
- ☐ C5. Oilseeds
- ☐ C1. Wheat
- ☐ C2. Maize

C9. What is your total farm area for crops? ☐ Jareb

C10. How much is irrigated? ☐ Jareb

C11. How much is rain fed? ☐ Jareb

C12. How much land do you own? ☐ Jareb

C13. How much land do you lease? ☐ Jareb

C14. How much land do you farm as a share cropper? ☐ Jareb

How much land do you cultivate to wheat?

C15. Irrigated? ☐ Jareb

C16. Rain fed? ☐ Jareb

C17. Cost of (DAP) fertiliser ☐ Afs/Kg

C18. Cost of Urea ☐ Afs/Kg

C19. Sale price of wheat ☐ Afs/Kg

C20. Sale price of maize ☐ Afs/Kg

C21. Did you plough, harrow and level the land to a fine tilth for wheat cultivation? ☐ No ☐ Yes

C22. Do you use low-till or no-till farming? ☐ No ☐ Yes

How do you control weeds?

C23. Herbicide ☐ No ☐ Yes

C24. Labour ☐ No ☐ Yes

What proportion of your wheat production is:

C25. Kept for seed ☐☐ %

C26. Used as family food ☐☐ %

C27. Used to barter ☐☐ %

C28. Used to pay rent or other obligations ☐☐ %

C29. Given to others (family or neighbours) as assistance or as a gift ☐☐ %

C30. Sold in the market ☐☐ %

C31. Do you have access to sufficient irrigation during the planting and growing season? ☐ No ☐ Yes

D: Knowledge of, and access to improved wheat seeds

D1. Are you aware of any of the following wheat seed varieties: [SPECIFIC LIST PROVIDED BY ENUMERATOR] ☐ No ☐ Yes

D2. Have you ever planted any of these? ☐ No ☐ Yes

D3. Have you planted other improved wheat seed varieties? ☐ No ☐ Yes

D4. Can you name these?

D5. Did you use fertiliser with the improved seeds? ☐ No ☐ Yes

D6. Do other farmers in your village/region plant improved wheat seeds? ☐ No ☐ Yes ☐ Don't know

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D19. High price of improved seeds

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D20. Improved seed not available at planting time

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D21. Improved seeds need more costly fertiliser

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D22. Improved seeds are harder to farm

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D23. Insufficient information on how to farm these seeds

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D24. Local merchants do not sell improved seed

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D25. Improved seeds not easily available locally

How important are the following sources of seed?

☐ Very important
☐ Important
☐ Not important
D26. Own saved seed

☐ Very important
☐ Important
☐ Not important
D27. Seed from other farmers

☐ Very important
☐ Important
☐ Not important
D28. Seed purchased in local markets

☐ Very important
☐ Important
☐ Not important
D29. Free seed from the government

☐ Very important
☐ Important
☐ Not important
D30. Seed purchased from a village based association

☐ Very important
☐ Important
☐ Not important
D31. Seed on credit from a village based association

☐ Very important
☐ Important
☐ Not important
D32. Free seed from relief agencies

☐ Very important
☐ Important
☐ Not important
D33. Seed on credit from relief agencies

☐ No ☐ Yes ☐ Don't know
D7. Do you think that improved wheat seeds give higher yields?

☐ No ☐ Yes
D8. Have you increased your planting of improved seeds in recent years?

How much has your yield improved since planting improved seeds?

K g / J a r
D9. Yield before use of improved seeds

K g / J a r
D10. Yield after use of improved seeds

How important are the following factors in determining whether you plant improved seed varieties?

☐ Very important
☐ Important
☐ Not important
D11. Higher yield

☐ Very important
☐ Important
☐ Not important
D12. Uses less water (drought resistant)

☐ Very important
☐ Important
☐ Not important
D13. Good for bread

☐ Very important
☐ Important
☐ Not important
D14. Insect resistant

☐ Very important
☐ Important
☐ Not important
D15. Disease resistant

☐ No ☐ Yes
D16. Do you save enough seed for the next seasons crop?

Do any of the following factors limit your use of improved seed?

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D17. Not aware of the availability of improved seeds

☐ Limits use
☐ Somewhat limits use
☐ Does not limit use
D18. No money to buy seed

E: Detailed wheat production information

Irrigated wheat production

In the most recent season, please indicate

K g / J a r	E12. DAP (black) fertiliser application
K g / J a r	E13. Urea (white) fertiliser application
N o .	E14. Water application
K g	E15. Total production
For improved variety 2, please indicate	
	E16. Name of variety (if known)
J a r e b	E17. Total area planted
K g / J a r	E18. Seed rate
A f s / K g	E19. Cost of seed (if purchased)
K g / J a r	E20. DAP (black) fertiliser application
K g / J a r	E21. Urea (white) fertiliser application
N o .	E22. Water application
K g	E23. Total production

For any local seed varieties	
J a r e b	E1. Total area planted
K g / J a r	E2. Seed rate
A f s / K g	E3. Cost of seed (if purchased)
K g / J a r	E4. DAP (black) fertiliser application
K g / J a r	E5. Urea (white) fertiliser application
N o .	E6. Water application
K g	E7. Total production
For improved variety 1, please indicate	
	E8. Name of variety (if known)
J a r e b	E9. Total area planted
K g / J a r	E10. Seed rate
A f s / K g	E11. Cost of seed (if purchased)

Rain fed wheat production

In the most recent season, please indicate

For improved variety 1, please indicate	
	E30. Name of variety (if known)
J a r e b	E31. Total area planted
K g / J a r	E32. Seed rate
A f s / K g	E33. Cost of seed (if purchased)
K g / J a r	E34. DAP (black) fertiliser application
K g / J a r	E35. Urea (white) fertiliser application
K g	E36. Total production

For local varieties	
J a r e b	E24. Total area planted
K g / J a r	E25. Seed rate
A f s / K g	E26. Cost of seed (if purchased)
K g / J a r	E27. DAP (black) fertiliser application
K g / J a r	E28. Urea (white) fertiliser application
K g	E29. Total production

A f s / K g	E40. Cost of seed (if purchased)		*For improved variety 2, please indicate*
K g / J a r	E41. DAP (black) fertiliser application		E37. Name of variety (if known)
K g / J a r	E42. Urea (white) fertiliser application	J a r e b	E38. Total area planted
K g	E43. Total production	K g / J a r	E39. Seed rate

F: Maize production and varieities

☐ No	☐ Yes	F5. Did you use fertiliser with the improved seeds?	☐ No ☐ Yes F1. Are you aware of any of the following maize seed varieties:[LIST PROVIDED BY ENUMERATOR]
☐ No	☐ Yes	F6. Do other farmers in your village/region plant improved maize seeds?	
☐ No	☐ Yes	F7. Do you think that improved seeds give higher yields?	☐ No ☐ Yes F2. Have you ever planted any of these?
☐ No	☐ Yes	F8. Have you increased your planting of improved maize seeds in recent years?	☐ No ☐ Yes F3. Have you planted other improved maize seed varieties?
	%	F9. If yes, how much has your maize yield improved as a result?	F4. Can you name these?

In the most recent season, please indicate

	For improved varieties, please indicate		*For local varieties*
	F17. Name of variety (if known)	J a r e b	F10. Total area planted
J a r e b	F18. Total area planted	K g / J a r	F11. Seed rate
K g / J a r	F19. Seed rate	A f s / K g	F12. Cost of seed (if purchased)
A f s / K g	F20. Cost of seed (if purchased)	K g / J a r	F13. DAP (black) fertiliser application
K g / J a r	F21. DAP (black) fertiliser application	K g / J a r	F14. Urea (white) fertiliser application
K g / J a r	F22. Urea (white) fertiliser application	N o .	F15. Water application
N o .	F23. Water application	K g	F16. Total production
K g	F24. Total production		

G: Opium production and general security

G1. Have you noticed any reduction in opium production in your region? ☐ Yes ☐ No

G2. If yes, do you think this is because farmers are using improved seed varieties? ☐ Yes ☐ No

G3. By what amount do you think opium production has fallen? ☐☐ %

G4. How many days were you forced away from your fields (because of fighting or security concerns) in the 12 months before your last crop? ☐☐☐☐☐☐

Comments

Data entry

Date of entry: ☐☐☐☐☐☐

Name of responsible:

Signature of responsible:

Australian Government
Australian Centre for International Agricultural Research

QUESTIONNAIRE

IMPACT ASSESSMENT AF-2012
IMPROVED WHEAT AND MAIZE SEED VARIETIES

A: معلومات موقعیت سروی

سازمان: ORGANISATION

A1. تشخصیه سروی: شماره تشخصیه فرمه منحصر بفرد که توسط سازمان سروی کننده اختصاص داده میشود: O R G

A2. ولایت

A3. ولسوالی

A4. قریه

A5. تاریخ

A6. موقعیت جی پی اس: N / E

A7. اسم مصاحبه کننده

A8. عکس گرفته شده: بلی ☐ نخیر ☐

A9. گرفتن اجازه بخاطر استفاده کردن عکس: بلی ☐ نخیر ☐

B: مشخصات دهقان

B1. نام

B2. جنس: مرد ☐ زن ☐

B3. سن

B4. ایا شما ریس فامیل هستید؟: بلی ☐ نخیر ☐

B5. اگر جواب نخیر، چه رابطه با ریس این فامیل دارید

B6. سال های تعلیمی رسمی

B7. آیا در طول 5 سال گذشته شما آموزش های در مورد زراعت خوب دیده اید؟: بلی ☐ نخیر ☐

B8. اگر بلی، چند ماه اموزش دیده اید؟

B9. تعداد اعضای فامیل

B10. چگونه زمین را قلبه و اماده میسازید؟
- تنها از ماشین آلات ☐
- اکثراً ماشین الات و بعضی اوقات حیوانات ☐
- ماشین الات و حیوانات برابر ☐
- اکثراً حیوانات و بعضی اوقات ماشین الات ☐
- تنها از حیوانات ☐

B11. مجموع درآمد مزرعه شما چقدر است؟ Afs

B12. مجموع مصارف مزرعه شما چقدر است؟ Afs

B13. ایا فامیل شما بغیر از کشت کار کدام منبع عایداتی دیکری هم دارد؟: بلی ☐ نخیر ☐

B14. اگر بلی، درآمد تقریبی سالانه شما ازین منابع چقدر است؟ Afs

B15. می توانید این منابع عایداتی را مشخص کنید؟

C: معلومات مجموعی مزرعه

چه محصولات شما تولید میکنید ؟
- C1. گندم ☐
- C2. جواری (زرت) ☐
- C3. سبزی جات ☐
- C4. پنبه ☐
- C5. نباتات تیلی ☐

کدام مواشی را پرورش می دهید؟
- C6. گوسفند ☐
- C7. گله گاو/گاو نر ☐
- C8. مرغ خانگی ☐

C9. مجموع ساحه کشت کار شمابرای تولید محصولات زراعتی چقدر است؟ Jareb

C10. چقدر آن آبی است؟ Jareb

C11. چقدر آن للمی است؟ Jareb

C12. مالک چه مقدار زمین هستید؟ Jareb

C13. چه مقدار زمین رابه گروی داده اید؟ Jareb

C14. چه مقدار زمین را بشکل دهقانی (شراکتی) کشت میکنید؟ Jareb

چه مقدار زمین را گندم می کارید؟

C15. آبی؟ Jareb

C16. للمی؟ Jareb

C17. قیمت کود کمیاوی Afs/Kg

C18. قیمت کود کیمیاوی سفید (یوریا) Afs/Kg

C19. نرخ فروش گندم Afs/Kg

C20. نرخ فروش جواری (زرت) Afs/Kg

C21. ایا شما زمین تان را قلبه، خیشاوه و هموار برای کشت گندم کردید؟ بلی ☐ نخیر ☐

C22. ایا شما از قلبه سطحی ویا کشت بیدون قلبه استفاده میکنید؟ بلی ☐ نخیر ☐

رشد علف های هرزه را چطور کنترل میکنید؟

C23. استعمال علف کش ها بلی ☐ نخیر ☐

C24. طریقه میخانیکی (خیشاوه) بلی ☐ نخیر ☐

چند فیصد از محصول گندم شما:

C25. برای تخم نگهداری میکنید ☐☐%

C26. برای تغذیه فامیل استفاده میکنید ☐☐%

C27. برای تبادله (جنس به جنس) استفاده میکنید ☐☐%

C28. برای پرداخت کرایه و یا ضروریات دیگر استفاده میکنید ☐☐%

C29. برای دیگران (فامیل و یا همسایه) برای کمک و یا تحفه میدهید ☐☐%

C30. دربازار به فروش میرسانید ☐☐%

C31. ایا دسترسی به آب کافی در زمان کشت و نموی مزرعه تان برای آبیاری دارید؟ بلی ☐ نخیر ☐

D: دانش و دسترسی به تخم های اصلاح شده گندم

D1. ایا شما اگاهی از تخم های گندم و انواع ان دارید (لست مشخص از طرف مسؤل فراهم خواهد شد) بلی ☐ نخیر ☐

D4. لطفا انرا نام ببرید؟

D2. ایا هرگز یکی از این تخم ها را کاشته اید؟ بلی ☐ نخیر ☐

D5. ایا با تخم های اصلاح شده از کود کیمیاوی استفاده کرده اید؟ بلی ☐ نخیر ☐

D3. آیا دیگر تخم های اصلاح شده را کاشته اید؟ بلی ☐ نخیر ☐

D6. ایا دیگر دهاقین درقریه یا منطقه شما از تخم های اصلاح شده استفاده میکند؟ بلی ☐ نخیر ☐ نمیدانم ☐

D7. ایا فکر میکیند تخم های اصلاح شده تولید یا حاصل بیشتر دارد؟ بلی ☐ نخیر ☐ نمیدانم ☐

D8. آیا کاشتن تخم های اصلاح شده را در سال های اخیر بیشتر کرده اید؟ بلی ☐ نخیر ☐

تولید گندم شما در نتیجه کاشتن تخم های اصلاح شده چقدر بهبود یافته است؟

D9. حاصلات شما قبل از استفاده تخم های اصلاح شده چقدر بود | K | g | / | J | a | r |

D10. حاصلات شما بعد از استفاده تخم های اصلاح شده چقدر بود | K | g | / | J | a | r |

عوامل ذیل در تعین اینکه شما انواع مختلف تخم های اصلاح شده راکشت کنید چقدر اهمیت دارد:

D11. تولید بالا ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D12. آب کمتر مصرف میکند(مقاوم در برابر خشکی) ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D13. برای نان خوب است ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D14. مقاوم باحشرات میباشد ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D15. دربرابر امراض سرخی ساقه گندم مقاوم است ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D16. ایا برای سال اینده تان بقدر کافی تخم ذخیره میکنید؟ بلی ☐ نخیر ☐

عوامل ذیل چقدر در محدودیت دسترسی شما به گونه های مختلف تخم اصلاح شده مهم است؟

D17. عدم معلومات به ارتباط موجودیت تخم های اصلاح شده ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D18. پول برای خریدن تخم را ندارید ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D19. قیمت با لا تخم های اصلاح شده ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D20. در فصل کشت تخم های اصلاح شده دردسترس قرار نمی گیرد ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D21. تخم های اصلاح شده کود کیمیاوی قیمتی بیشتر ضرورت دارد ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D22. کشت و کار تخم های اصلاح شده سخت میباشد ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D23. عدم معلومات کافی در مورد طروق کشت وعملیات زراعتی این تخم ها ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D24. فروشنده های محلی تخم های اصلاح شده را نمی فروشند ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

D25. تخم های اصلاح شده به اسانی در منطقه دستیاب نمی باشد ☐ استفاده را محدود میسازد ☐ تا یک اندازه استفاده را محدود میسازد ☐ استفاده را محدود نمیسازد

منابع ذیل برای بدست آوردن تخم چقدر مهم است:

D26. تخم های ذخیره شده شخصی ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D27. بدست آوردن تخم از دیگر دهاقین ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D28. خریداری تخم از بازارهای محلی ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D29. عرضه تخم مجانی از طرف حکومت ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D30. خریداری تخم از انجمن های مقیم در قریه ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D31. بدست آوردن تخم بشکل قرضه از انجمن های مقیم در قریه ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D32. بدست آوردن تخم مجانی از سازمان های خیریه ☐ بسیار مهم ☐ مهم ☐ مهم نیست

D33. بدست آوردن تخم بشکل قرضه از سازمان های خیریه ☐ بسیار مهم ☐ مهم ☐ مهم نیست

E: معلومات مفصل محصول گندم

تولید گندم آبی

درتازه ترین فصل گذشته، لطفا مشخص کنید

برای هرگونه تخم محلی

E1. مجموع ساحه کشت شده [J a r e b]

E2. مقدار تخم ریز [K g / J a r]

E3. قیمت تخم *(اگر خریداری شده)* [A f s / K g]

E4. استعمال کود کیمیاوی سیاه [K g / J a r]

E5. استعمال کود کیمیاوی سفید *(اوریا)* [K g / J a r]

E6. استعمال آب [N o .]

E7. مجموع محصول [K g]

برای نوع اصلاح شده یک، لطفا انتخاب کنید:

E8. نام نوعه *(اگر معلوم باشد)* [ ]

E9. مجموع ساحه کشت شده [J a r e b]

E10. مقدار تخم ریز [K g / J a r]

E11. قیمت تخم *(اگر خریداری شده)* [A f s / K g]

E12. استعمال کود کیمیاوی سیاه [K g / J a r]

E13. استعمال کود کیمیاوی سفید *(اوریا)* [K g / J a r]

E14. استعمال آب [N o .]

E15. مجموع محصول [K g]

برای نوعی اصلاح شده دوم، لطفا انتخاب کنید:

E16. نام نوعه *(اگر معلوم باشد)* [ ]

E17. مجموع ساحه کشت شده [J a r e b]

E18. مقدار تخم ریز [K g / J a r]

E19. قیمت تخم *(اگر خریداری شده)* [A f s / K g]

E20. استعمال کود کیمیاوی سیاه [K g / J a r]

E21. استعمال کود کیمیاوی سفید *(اوریا)* [K g / J a r]

E22. استعمال آب [N o .]

E23. مجموع محصول [K g]

محصول گندم للمی

درتازه ترین فصل گذشته، لطفا مشخص کنید

برای انواع محلی

E24. مجموع ساحه کشت شده [J a r e b]

E25. مقدار تخم ریز [K g / J a r]

E26. قیمت تخم *(اگر خریداری شده)* [A f s / K g]

E27. استعمال کود کیمیاوی سیاه [K g / J a r]

E28. استعمال کود کیمیاوی سفید *(اوریا)* [K g / J a r]

E29. مجموع محصول [K g]

برای نوع اصلاح شده یک، لطفا انتخاب کنید:

E30. نام نوعه *(اگر معلوم باشد)* [ ]

E31. مجموع ساحه کشت شده [J a r e b]

E32. مقدار تخم ریز [K g / J a r]

E33. قیمت تخم *(اگر خریداری شده)* [A f s / K g]

E34. استعمال کود کیمیاوی سیاه [K g / J a r]

E35. استعمال کود کیمیاوی سفید *(اوریا)* [K g / J a r]

E36. مجموع محصول [K g]

برای نوعی اصلاح شده دوم، لطفا انتخاب کنید:

E37. نام نوعه *(اگر معلوم باشد)*

E38. مجموع ساحه کشت شده (Jareb)

E39. مقدار تخم ریز (Kg/Jar)

E40. قیمت تخم *(اگر خریداری شده)* (Afs/Kg)

E41. استعمال کود کیمیاوی سیاه (Kg/Jar)

E42. استعمال کود کیمیاوی سفید *(اوریا)* (Kg/Jar)

E43. مجموع محصول (Kg)

F: محصولات جواری و انواع ان

F1. ایا شما آگاهی از تخم های جواری و انواع آن را دارید (لست مشخص از طرف مسو ل فراهم خواهد شد) ☐ بلی ☐ نخیر

F2. ایا هرگز یکی از این تخم ها را کاشته اید؟ ☐ بلی ☐ نخیر

F3. ایا از انواع دیگر تخم های اصلاح شده جواری را کاشته اید؟ ☐ بلی ☐ نخیر

F4. ایا از انها نام برده میتوانید؟

F5. ایا با تخم های اصلاح شده از کود کیمیاوی استفاده کرده اید؟ ☐ بلی ☐ نخیر

F6. ایا دیگر دهاقین درقریه یا منطقه شما از تخم های اصلاح شده استفاده میکند؟ ☐ بلی ☐ نخیر

F7. فکر میکنید تخم های اصلاح شده تولید یا حاصل بیشتر دارد؟ ☐ بلی ☐ نخیر

F8. ایا کاشتن تخم های اصلاح شده جواری را در سال های اخیر بیشتر کرده اید؟ ☐ بلی ☐ نخیر

F9. اگر بلی، درنتیجه تولید جواری شما چقدر بهبود یافته است؟ (%)

درتازه ترین فصل گذشته، لطفا مشخص کنید

برای انواع محلی

F10. مجموع ساحه کشت شده (Jareb)

F11. مقدار تخم ریز (Kg/Jar)

F12. قیمت تخم (اگر خریداری شده) (Afs/Kg)

F13. استعمال کود کیمیاوی سیاه (Kg/Jar)

F14. استعمال کود کیمیاوی سفید (اوریا) (Kg/Jar)

F15. استعمال آب (No.)

F16. مجموع محصول (Kg)

برای انواع اصلاح شده، لطفا مشخص کنید

F17. نام نوعه (اگر معلوم باشد)

F18. مجموع ساحه کشت شده (Jareb)

F19. مقدار تخم ریز (Kg/Jar)

F20. قیمت تخم (اگر خریداری شده) (Afs/Kg)

F21. استعمال کود کیمیاوی سیاه (Kg/Jar)

F22. استعمال کود کیمیاوی سفید (اوریا) (Kg/Jar)

F23. استعمال آب (No.)

F24. مجموع محصول (Kg)

G: تولید کوکنار و امنیت عمومی

G1. آیا کاهش در تولید کوکنار در منطقه خود مشاهده کرده اید؟ ☐ بلی ☐ نخیر

G2. اگربلی! ایا فکر میکنید که علت کاهش آن استعمال تخم های اصلاح شده توسط دهاقین میباشد؟ ☐ بلی ☐ نخیر

G3. چه فکر میکنید تولید کوکنار چند فیصد کاهش یافته است؟ ☐☐ %

G4. در 12 ماه گذشته بعد از اخرین فصل محصولات چند روزشما به مزرعه خـود (به خاطر مشکلات امنیتی و جنگ) رفته نتوانستید؟ ☐☐☐☐☐☐

Comments

Data entry

Date of entry: ☐☐☐☐☐☐

Name of responsible:

Signature of responsile:

Australian Government
Australian Centre for International Agricultural Research

QUESTIONNAIRE

IMPACT ASSESSMENT AF-2012
IMPROVED WHEAT AND MAIZE SEED VARIETIES

A: دسروی دځای په اړه معلومات

ادارہ	ORGANISATION	A5. نیته ☐☐☐☐☐☐
A1. دسروی خانګړی شمیره: دپیژندنی هغه نمبر چه د سروی کونکی اداری لخوا سروی کیدونکی شخص ته ورکول کیږی.	ORG☐☐☐	A6. د جي پي ایس موقعیت ☐☐.☐☐☐☐☐☐N ☐☐.☐☐☐☐☐☐E
A2. ولایت	☐	A7. دمرکه کونکی شخص نوم ☐
A3. ولسوالی	☐	A8. اخستل شوی تصویر هو ☐ نه ☐
A4. کلی	☐	A9. دتصویر دکارولو اجازه اخیستل هو ☐ نه ☐

B: دکروندګر په اړه معلومات

B1. نوم	☐	B10. تاسی خپله زمکه څرنګه یوی او د کشت دپاره اماده کوی؟ یواځی ماشینونه ☐ اکثراً ماشین او لڑ ځاروی ☐ ماشین او ځاروی برابره ☐ اکثراً ځاروی او لڑ ماشین ☐ یواځی ځاروی ☐
B2. جنس	نر ☐ ښځه ☐	
B3. عمر	☐☐	
B4. ایا تاسی د کور مشر یی؟	هو ☐ نه ☐	
B5. که نه، تاسی د دی کور د مشر سره څه خپلوی لری	☐	B11. ستاسی د کروندی ټوله ګټه څومره ده؟ ☐☐☐☐☐Afs
B6. څوکاله مورسمی زدکړی کړیدی؟	☐☐	B12. ستاسی دکروندی ټول مصارف څومره دی؟ ☐☐☐☐☐Afs
B7. آیا تاسو په تیروپنځو کلونوکه دښو کرنیزو فعالیتونو په اړه روزنه اخسیتی ده؟	هو ☐ نه ☐	B13. ایاستاسی کورنی دکرکیلی دګټی نه علاوه نوری ددرآمد منابع لری؟ هو ☐ نه ☐
B8. که هو، د څو میاشتو روزنه مو لیدلی ده؟	☐☐☐	B14. که چیری لریی نودهغو منابعو څخه په کال که څومره ګټه تر لاسه کوی؟ ☐☐☐☐☐Afs
B9. دکورنی دغړوشمیر	☐☐☐	B15. اباکولای شی ددغو منابعو نمونه ووایاست؟ ☐

C: دکروندی په اړه معلومات

ستاسی کوم ډول محصولات په خپله زمکه کی تولیدوی؟	ستاسی کوم ډول کورنی ځاروی ساتی؟	
C1. غنم ☐	C3. سبزی ☐	C6. ګډې، پسونه ☐
C2. جوار ☐	C4. مالوچ ☐	C7. غوا/غویی ☐
	C5. تیلی (خوروونکی) بوټی ☐	C8. چرګان ☐

C9. ستاسی دکروندی دزمکی اندازه څومره ده؟ Jareb

C10. څومره یی آبی زمکه ده؟ Jareb

C11. څومره یی للمی زمکه ده؟ Jareb

C12. ستاسی ټوله زمکه څومره ده؟ Jareb

C13. څومره زمکه ستاسو په اجاره ورکړیده؟ Jareb

C14.څومره زمکه ستاسو په دهقانی په کلی کشی کده ده؟ Jareb

څومره زمکه ستاسی غنم کری:

C15. ابی Jareb

C16. للمی Jareb

C17. دتـوری سری (دی ای پی) مصرف Afs/Kg

C18. د سپینی سری (یوریا) مصرف Afs/Kg

C19. دغنمو دخرڅولو بیه Afs/Kg

C20. دجوارو دخرڅولو بیه Afs/Kg

C21. ایا ستاسی د غنمو دکرلو څخه مخکی ځمکه په سم ډول قلبه کوی؟ هو ☐ نه ☐

C22. ایا ستاسی د سطحی او یا صفری قلبی څخه استفاده کوی؟ هو ☐ نه ☐

تاسو زیان رسونکی واښه مخنیوې څنګه کوۍ؟

C23. د اضافی وښو دلمنځه وړلو لپاره ددوا څخه استفاده کول هو ☐ نه ☐

C24. د میخانیکی طریقی (خیشاوه) څخه استفاده کول هو ☐ نه ☐

ستاسو د غنمو د پیداوار څومره حصه تاسو ساۍ:

C25. دتخم لپاره ساتی ☐%

C26. د کورنی د خوراک لپاره مصرف کوی ☐%

C27. د بدلولو (جنس په جنس) لپاره استفاده کوی ☐%

C28. دکرایی او نورو ضرورتونو لپاره استفاده کوی ☐%

C29. نـورو (د کورنی غړیو او یا پرسیو) ته د مرستی دپاره ورکوی ☐%

C30. په بازار که یی خرڅوی ☐%

C31. ایاستاسی د خپلو کروندو د خربولو لپاره کافی اوبو ته لاس رسی لری؟ هو ☐ نه ☐

D: د غنمو د اصلاح شو تخمونو په اړه معلومات

D1. ایـا ستاسی د غنمودتخمونو دلانـدی ذکـر شـوو نـوعـو پـه اړه معلومات لری (د نوعو د نومونو لیست د مرکه کونکی لـه طرفه وړاندی کیږی) هو ☐ نه ☐

D2. ایاستاسو د پورته ذکرشوو نوعو څخه کومه یو کرلی ده؟ هو ☐ نه ☐

D3. ایا ستاسو د غنمو نوری اصلاح شوی نوعی کرلی دی؟ هو ☐ نه ☐

D4. په مننی سره دهغو نمونه ذکر کړی

D5. ایا ستاسو د اصلاح شو نوعو د تخمونو سره سره (کود) استعمال کړیدی؟ هو ☐ نه ☐

D6. ایا ستاسو په کلی او باندو کی نور کروندګر اصلاح شوی تخمونه کری؟ هو ☐ نه ☐ نه ☐

D7. ستاسی له نظره ایا د غنمو اصلاح شوی تخمونه زیات حاصل ورکوی؟ هو ☐ نه ☐

D8. ایا په تیرو څوکلونو کی تاسو د اصلاح شوو تخمونو کرنه زیاته کړیده؟ هو ☐ نه ☐

ایا ستاسودغنمو په حاصل که څومره زیاتوالی راغلی پس له دی چه د اصلاح شوی غنمو تخمونه مو استفاده وکړه؟

D9. محصولات د اصلاح شوو تخمونو نه مخکی K g / J a r

D10. محصولات د اصلاح شوو تخمونو نه وروسته K g / J a r

لاندینی عوامل د اصلاح شوو تخمونو د کرلو په تصمیم نیولو که څومره اړین دی:

D11. ډیر حاصل ډیر مهم ☐ مهم ☐ غیرمهم ☐

D12. د لږ اوبو کارول (د وچکالی په مقابل که مقاومت) ډیر مهم ☐ مهم ☐ غیرمهم ☐

D13. دخوړلو (ډوډی) لپاره ښه ده ډیر مهم ☐ مهم ☐ غیرمهم ☐

D14 . دحشراتو په مقابل که مقاومت لری ډیر مهم ☐ مهم ☐ غیرمهم ☐

D15. دسرخی د ناروغی په مقابل که مقاومت لری ډیر مهم ☐ مهم ☐ غیرمهم ☐

D16. د بل کال د کرلو دپاره مو په کافی اندازه د تخم غنم ساتلی دی؟ هو ☐ نه ☐

لاندینی عوامل او محدودیتونه د اصلاح شوو تخمونو په رانیولوکه څومره اړین دی:

D17. د اصلاح شوو تخمونو د موجودیت په اړه معلومات نلرل استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D18. دتخم اخستلو لپاره دپیسو نشتون استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D19. داصلاح شوو تخمونو لوړ قیمت استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D20. د کرلو په وخت که د اصلاح شوو تخمونو نه موجودیت استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D21. اصلاح شوی تخمونه دلوړقیمت سری (کود) استعمال ته ضرورت لری استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D22. د اصلاح شوو تخمونو کرل ډیر کارته ضرورت لری استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D23. ددی تخمونو د کرلو په اړه دکافی معلوماتو نشتون استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D24. محلی پلورونکی اصلاح شوی تخمونه نه خرڅوی استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

D25. اصلاح شوی تخمونه په اسانی سره نه پیدا کیڑی استفاده محدودیت ☐ د استفاده لڅ څه محدودیت ☐ استفاده نه محدودوی ☐

د تخمونو د حصول لاندی ذرایع څومره مهمي دي؟

D26. خپل ساتل شوی تخمونه ډیر مهم ☐ مهم ☐ غیرمهم ☐

D27. دنوروکروندګرو څخه دتخم لاسته راوړل ډیر مهم ☐ مهم ☐ غیرمهم ☐

D28. دمحلی بازار څخه د تخم رانیول ډیر مهم ☐ مهم ☐ غیرمهم ☐

D29. د حکومت څخه د تخم لاسته راوړل په وړیا توګه ډیر مهم ☐ مهم ☐ غیرمهم ☐

D30. دکلی دتولنی څخه د تخم لاسته راوړل په اخستلو سره ډیر مهم ☐ مهم ☐ غیرمهم ☐

D31. دکلی دتولنی څخه د تخم لاسته راوړل د قرضی په توګه ډیر مهم ☐ مهم ☐ غیرمهم ☐

D32. دخیریه ټولنو څخه د تخم لاسته راوړل په وړیا توګه ډیر مهم ☐ مهم ☐ غیرمهم ☐

D33. دخیریه ټولنو څخه د قرضی په شکل د تخم لاسته راوړل ډیر مهم ☐ مهم ☐ غیرمهم ☐

E: دغنمو د تولید په اړه تفصیلی معلومات

دآبی (خربوشو) غنموتولید

په همدی تیرشوی فصل کی یی په گوته کړی

دمحلی تخمونو دنوعو لپاره:

E1. د ټولی کرل شوی ځمکی اندازه [ ][J][a][r][e][b]

E2. دتخم اچونی اندازه [K][g][/][J][a][r]

E3. دتخم قیمت (که اخستل شوی وی) [A][f][s][/][K][g]

E4. دتوری سری (ډی آی پی) استعمال [K][g][/][J][a][r]

E5. د سپینی سری (یوریا) استعمال [K][g][/][J][a][r]

E6. د اوبو استعمال [ ][ ][ ][N][o][.]

E7. مجموعی حاصل [ ][ ][ ][ ][K][g]

دلومړی اصلاح شوی نوعی لپاره:

E8. دتخم د نوعی نوم (که یی پیژنی) [ ]

E9. د ټولی کرل شوی ځمکی اندازه [ ][J][a][r][e][b]

E10. دتخم اچونی اندازه [K][g][/][J][a][r]

E11. دتخم قیمت (که اخستل شوی وی) [A][f][s][/][K][g]

E12. دتوری سری (ډی آی پی) استعمال [K][g][/][J][a][r]

E13. د سپینی سری (یوریا) استعمال [K][g][/][J][a][r]

E14. د اوبو استعمال [ ][ ][ ][N][o][.]

E15. مجموعی حاصل [ ][ ][ ][ ][K][g]

د دویمی اصلاح شوی نوعی لپاره:

E16. دتخم د نوعی نوم (که یی پیژنی) [ ]

E17. د ټولی کرل شوی ځمکی اندازه [ ][J][a][r][e][b]

E18. دتخم اچونی اندازه [K][g][/][J][a][r]

E19. دتخم قیمت (که اخستل شوی وی) [A][f][s][/][K][g]

E20. دتوری سری (ډی آی پی) استعمال [K][g][/][J][a][r]

E21. د سپینی سری (یوریا) استعمال [K][g][/][J][a][r]

E22. د اوبو استعمال [ ][ ][ ][N][o][.]

E23. مجموعی حاصل [ ][ ][ ][ ][K][g]

دللمی غنمو تولید

په اوسنی موسم کې، په گوته کړئ

د محلی نوعو لپاره

E24. د ټولی کرل شوی ځمکی اندازه [ ][J][a][r][e][b]

E25. دتخم اچونی اندازه [K][g][/][J][a][r]

E26 دتخم قیمت (که اخستل شوی وی) [A][f][s][/][K][g]

E27. دتوری سری (ډی آی پی) استعمال [K][g][/][J][a][r]

E28. د سپینی سری (یوریا) استعمال [K][g][/][J][a][r]

E29. مجموعی حاصل [ ][ ][ ][ ][K][g]

د لومړی اصلاح شوی نوعی لپاره:

E30. د تخم د قسم نوم (که یی پیژنی) [ ]

E31. د ټولی کرل شوی ځمکی اندازه [ ][J][a][r][e][b]

E32. دتخم اچونی اندازه [K][g][/][J][a][r]

E33. دتخم قیمت (که اخستل شوی وی) [A][f][s][/][K][g]

E34. دتوری سری (ډی آی پی) استعمال [K][g][/][J][a][r]

E35. د سپینی سری (یوریا) استعمال [K][g][/][J][a][r]

E36. مجموعی حاصل [ ][ ][ ][ ][K][g]

د دویم تقویه شوی تخم قسم ۰ لپاره، لطفًا په ګوته کړئ

E37. د تخم د قسم نوم (که یی پیژنې)

E38. د ټولی کرل شوی ځمکی اندازه — b e r a J

E39. دتخم اچونی اندازه — r a J / g K

E40. دتـوری سری (دی آی پی) استعمال — g K / s f A

E41. د سپینی سری (یوریا) استعمال — r a J / g K

E42. د سری استعمال (سپین) اوریا — r a J / g K

E43. مجموعی حاصل — g K

F: دجوارو دحاصل او نوعو په اړه معلومات

F1. ایا ستاسی د جارودتخمونو دلانـدی ذکـر شـوو نـوعـو پـه اړه معلومات لری (د نوعو د نومونو لیست د مرکه کونکی لـه طرفه وړاندی کیږی) — هو ☐ نه ☐

F2. ایاستاسو د پورته ذکرشوو نوعو څخه کومه یو کرلی ده؟ — هو ☐ نه ☐

F3. ایا ستاسو د جوارو نوراصلاح شوی تخمونه کرلی دی؟ — هو ☐ نه ☐

F4. پـه مننی سـر دهـغـو نمونه ووایاست؟

F5. ایا ستاسو د اصلاح شو نوعو د تخمونو سره سره (کود) استعمال کړیدی؟ — هو ☐ نه ☐

F6. ایا ستاسو په کلی او باندو کی نور کروندګر دجوارو اصلاح شوی تخمونه کری؟ — هو ☐ نه ☐

F7. ستاسی له نظره ایا د جوارو اصلاح شوی تخمونه زیات حاصل ورکو؟ — هو ☐ نه ☐

F8. په تیروځو کلونو کی ایا داصلاح شوو تخمونودکارولو په نتیجه کی ستاسی کروندی زیاتی شویدی؟ — هو ☐ نه ☐

F9. که چیری هو! نو ستاسودجوارو په حاصل که څومره زیاتوالی راغلی ده؟ — % ☐☐

په همدی تیرشوی فصل کی یی په ګوته کړی

د محلی نوعو لپاره

F10. د ټولی کرل شوی ځمکی اندازه — b e r a J

F11. دتخم اچونی اندازه — r a J / g K

F12. دتخم قیمت (که اخستل شوی وی) — g K / s f A

F13. دتـوری سری (دی آی پی) استعمال — r a J / g K

F14. د سپینی سری (یوریا) استعمال — r a J / g K

F15. د اوبو استعمال — . o N ☐☐☐

F16. مجموعی حاصل — g K ☐☐☐☐

د اصلاح شوو نوعو لپاره یی لطفا په ګوته کړی

F17. دتخم د نوعی نوم (که یی پیژنی)

F18. د ټولی کرل شوی ځمکی اندازه — b e r a J

F19. دتخم اچونی اندازه — r a J / g K

F20. دتخم قیمت (که اخستل شوی وی) — g K / s f A

F21. دتوری سری (دی آی پی) استعمال — r a J / g K

F22. د سپینی سری (یوریا) استعمال — r a J / g K

F23. د اوبو استعمال — . o N ☐☐☐

F24. مجموعی حاصل — g K ☐☐☐☐

G: د کوکنارو کرل او عمومی امنیت

G1. ایا ستاسو په خپله منطقه که د کوکنارو په کرلو کی څه کمی لیدلی ده؟ ☐ هو ☐ نه

G2. که هو! ایا ستاسی فکرکوی چه وجه یی د بزګرانو په واسطه داصلاح شوو تخمونو کارول دی؟ ☐ هو ☐ نه

G3. ستاسی په اند دکوکنارو په کرکیله کی څو فیصده کمی راغلی ده؟ ☐☐ %

G4. په تیرو دولس میاشتو کی، تاسی څوورځی دخپلی کروندی څخه په زوره یا د امنیتی مشکلاتو په وجه لری پاتی شوی یاست؟ ☐☐☐☐☐☐

Comments

Data entry

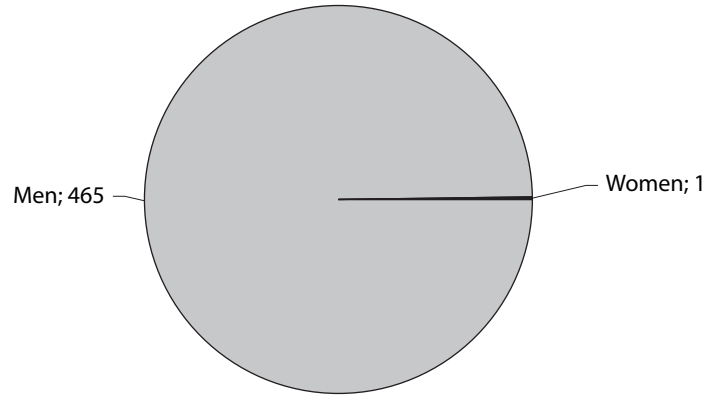
Date of entry: ☐☐☐☐☐☐

Name of responsible:

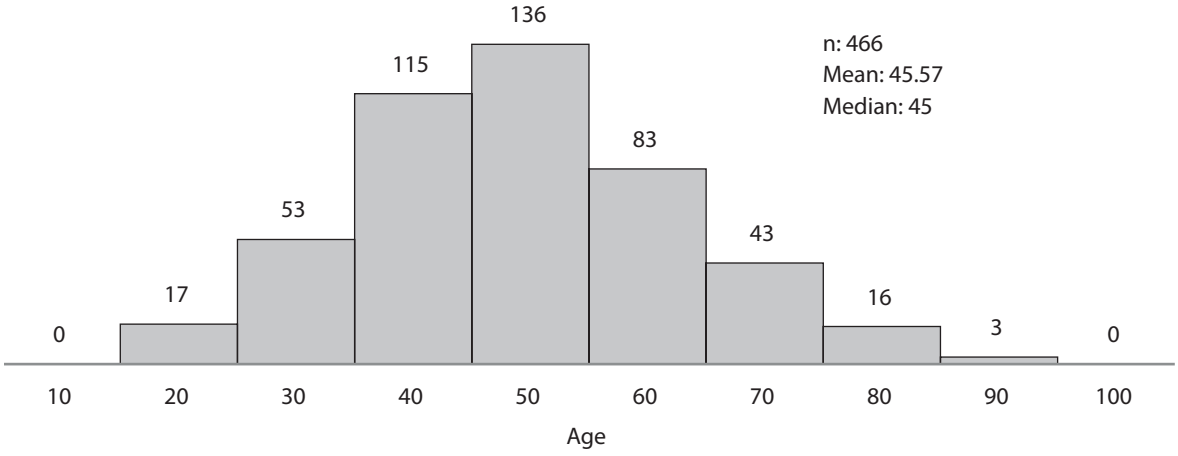
Signature of responsile:

Appendix 3: Survey responses

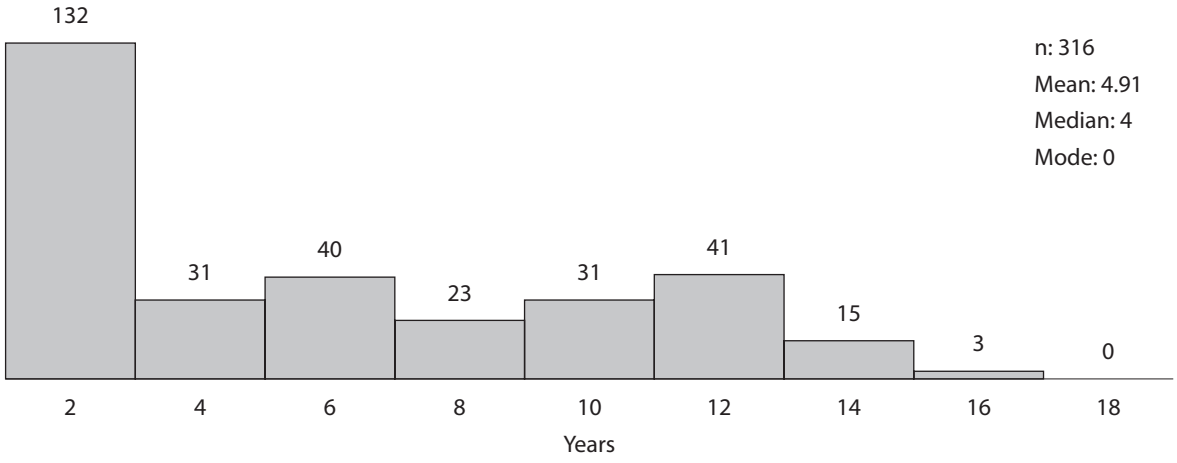
Farmer details



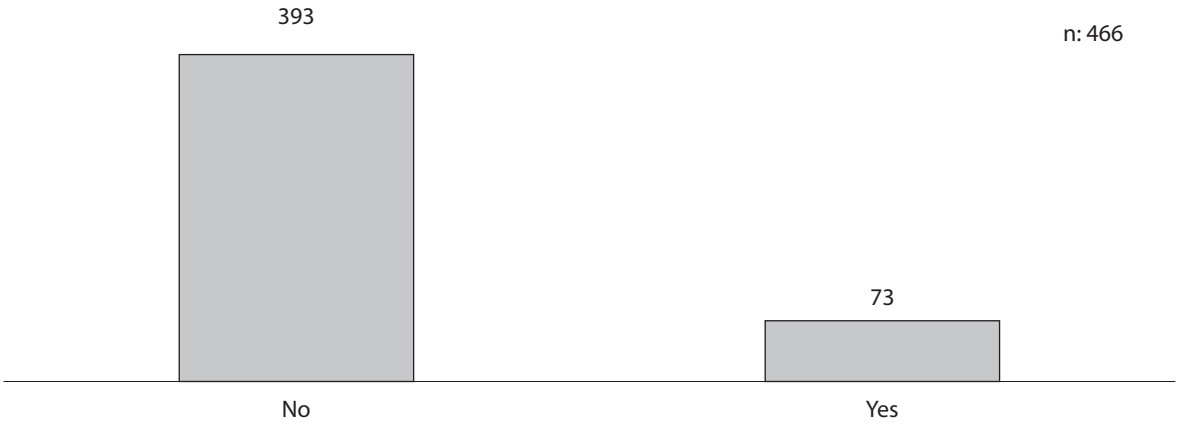
Question B2. Farmer gender. Data source: ACIAR survey.



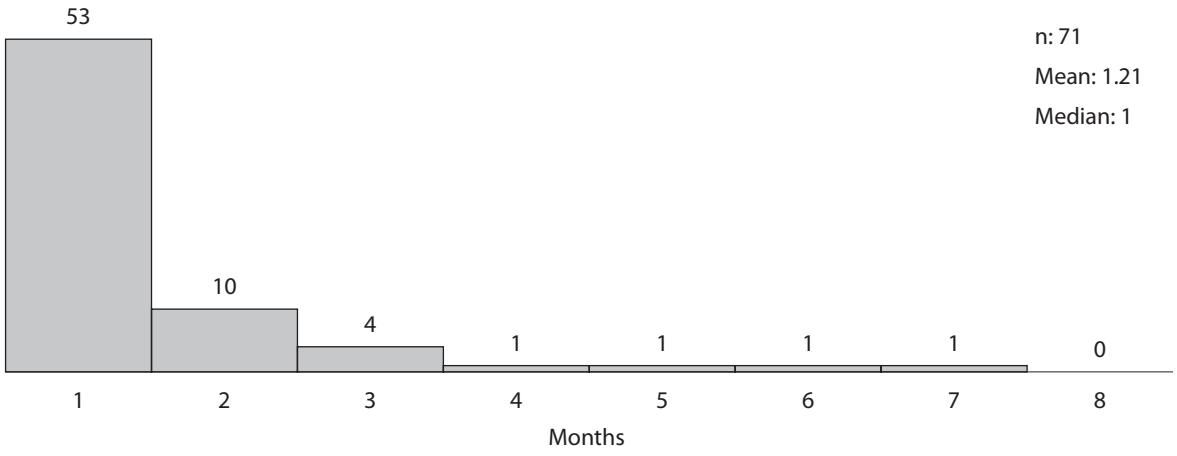
Question B3. Farmer age. Data source: ACIAR survey.



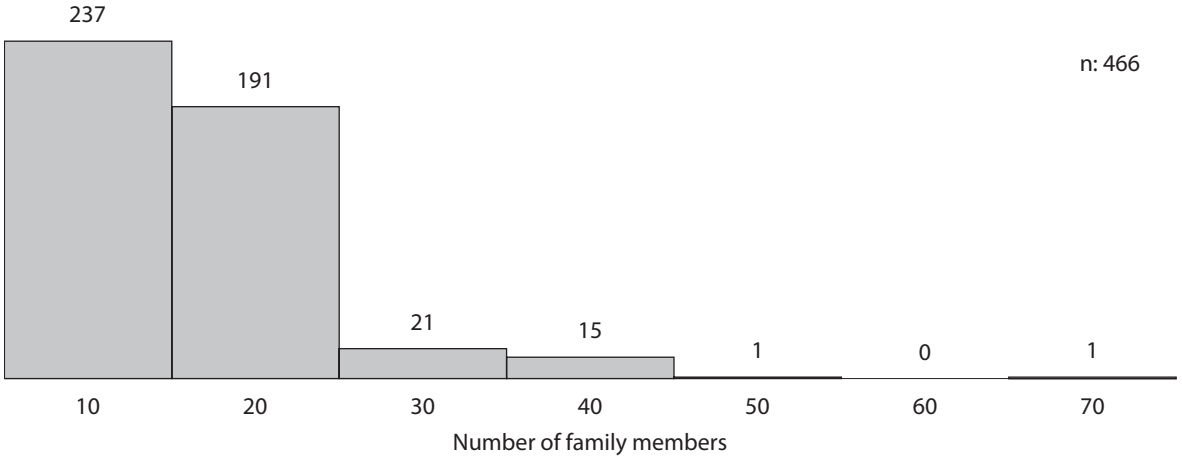
Question B6. Years of formal education. Data source: ACIAR survey.



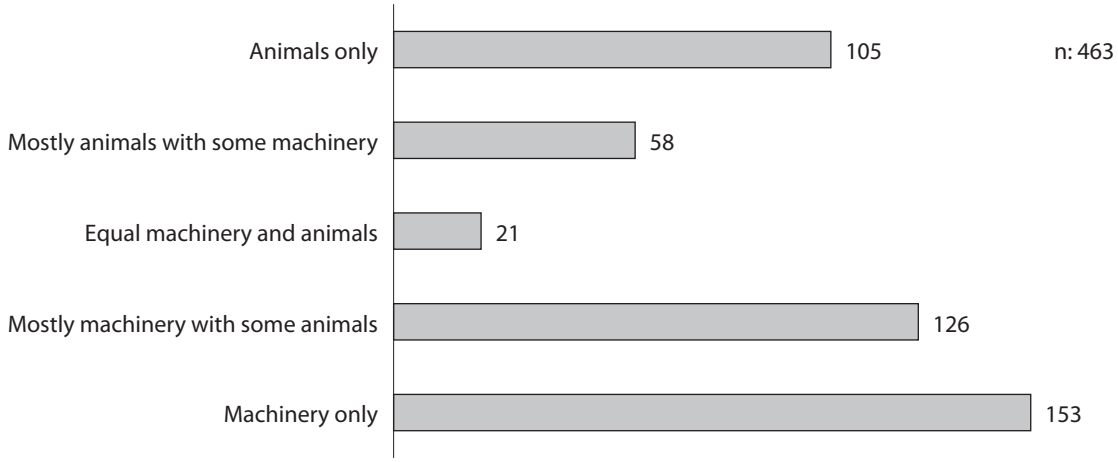
Question B7. Training in good farming practices in the past five years. Data source: ACIAR survey.



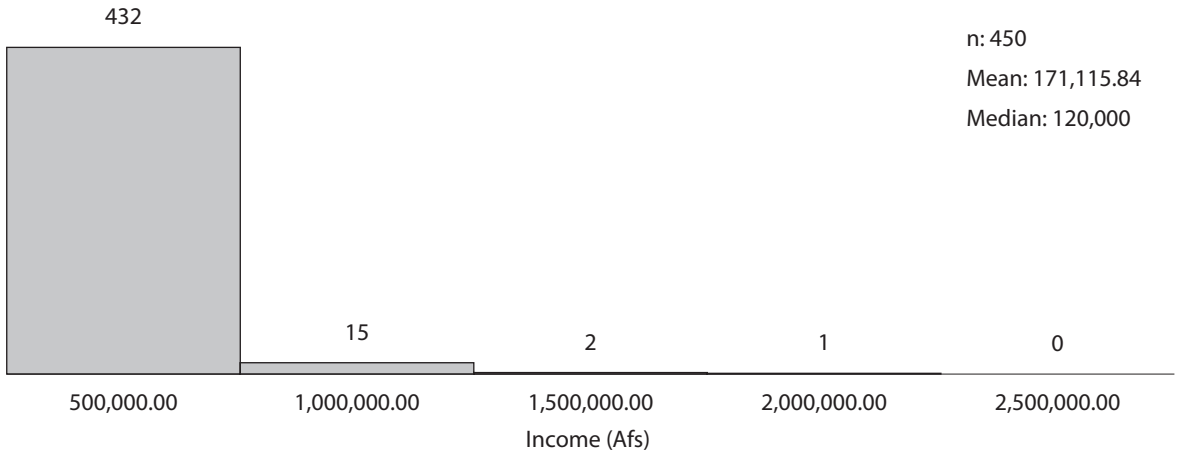
Question B8. Months of training received. Data source: ACIAR survey.



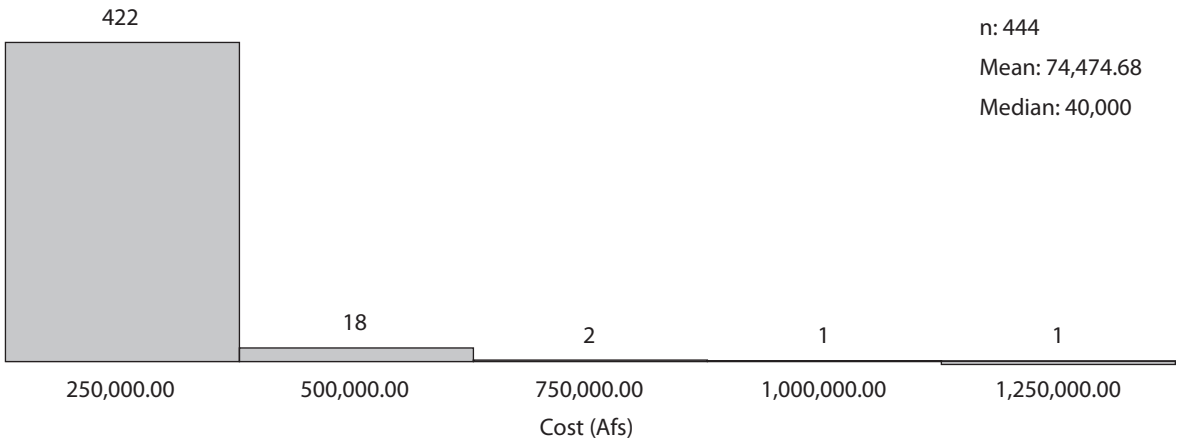
Question B9. Number of family members. Data source: ACIAR survey.



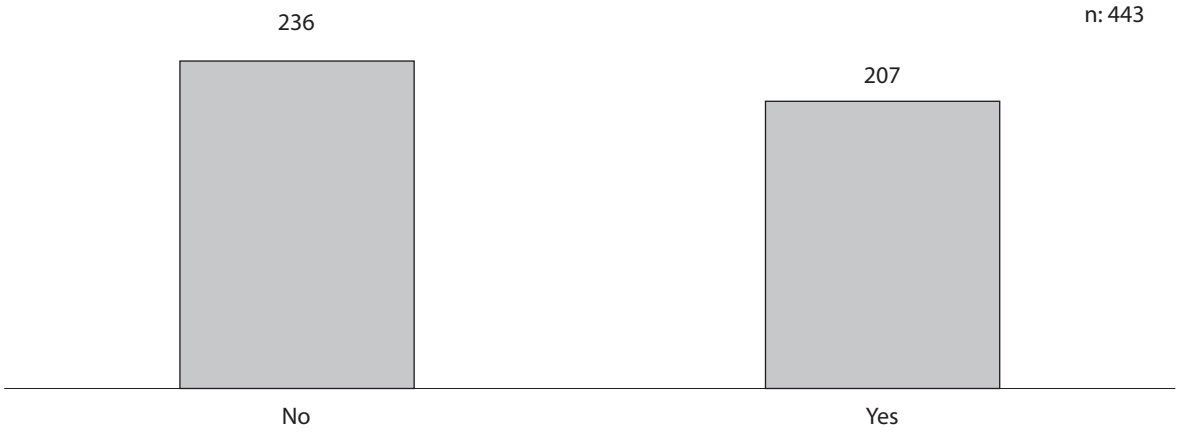
Question B10. Method of ploughing and preparing land. Data source: ACIAR survey.



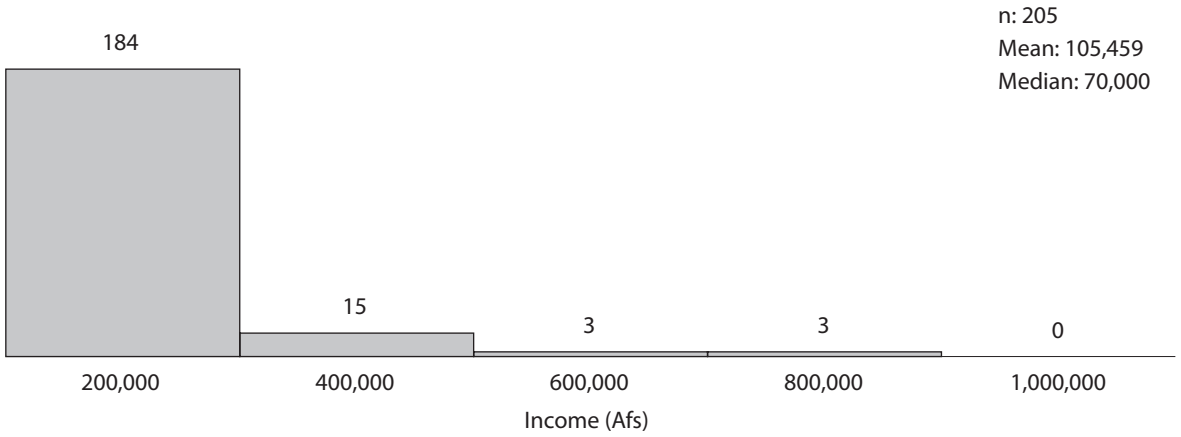
Question B11. Total farm income. Data source: ACIAR survey.



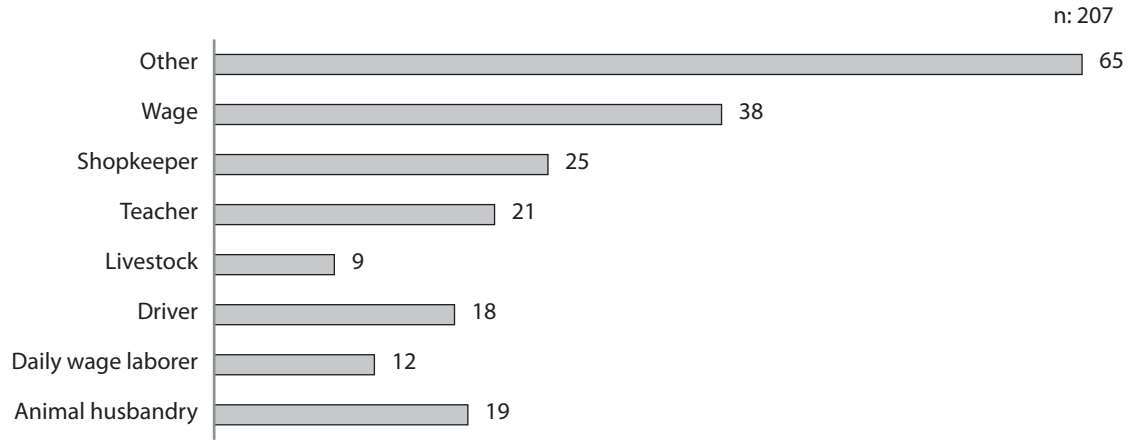
Question B12. Total farm costs. Data source: ACIAR survey.



Question B13. Other sources of income. Data source: ACIAR survey.

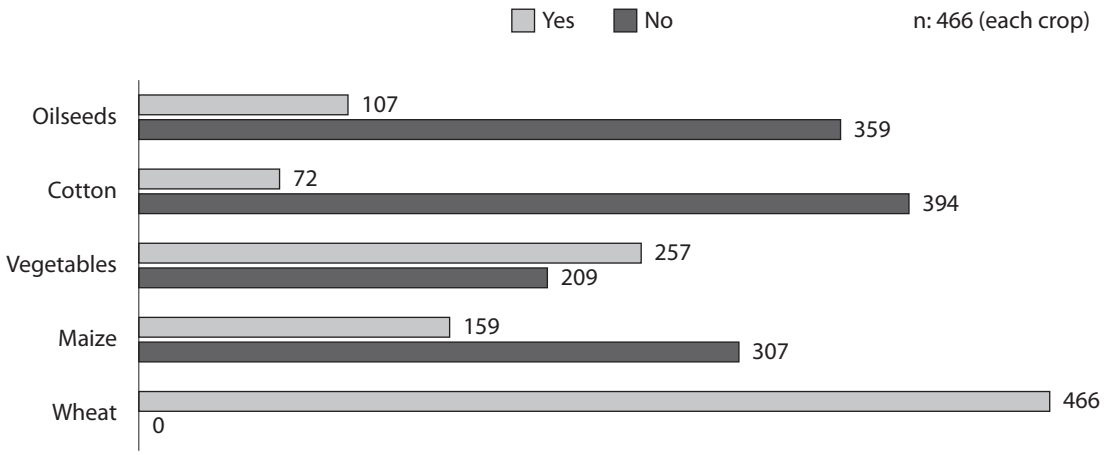


Question B14. Total farm income from non-farm sources. Data source: ACIAR survey.

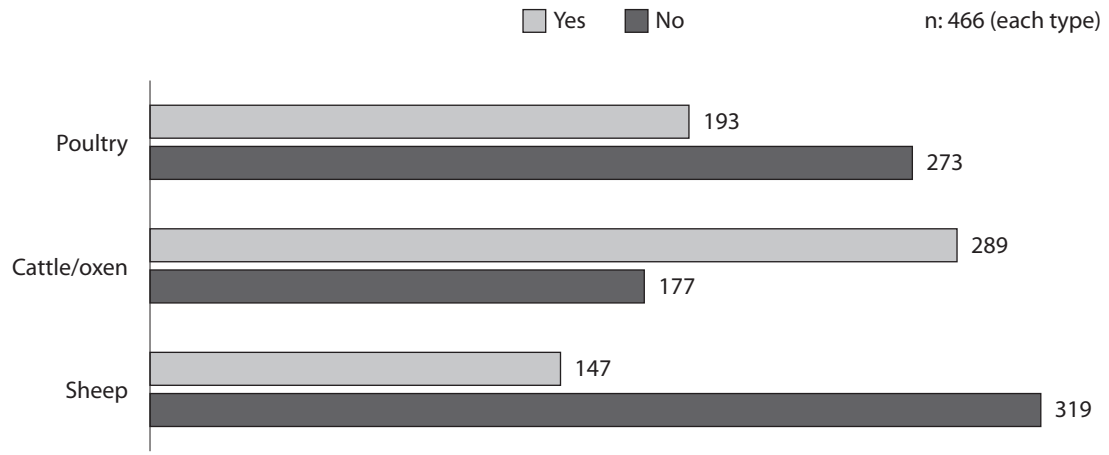


Question B15 Common sources of non-farm income. Data source: ACIAR survey.

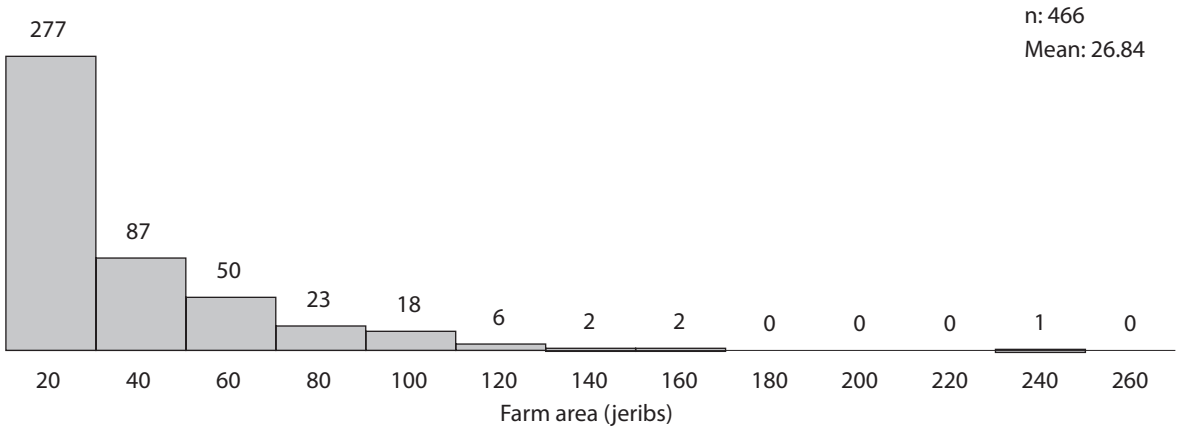
Aggregate farm information



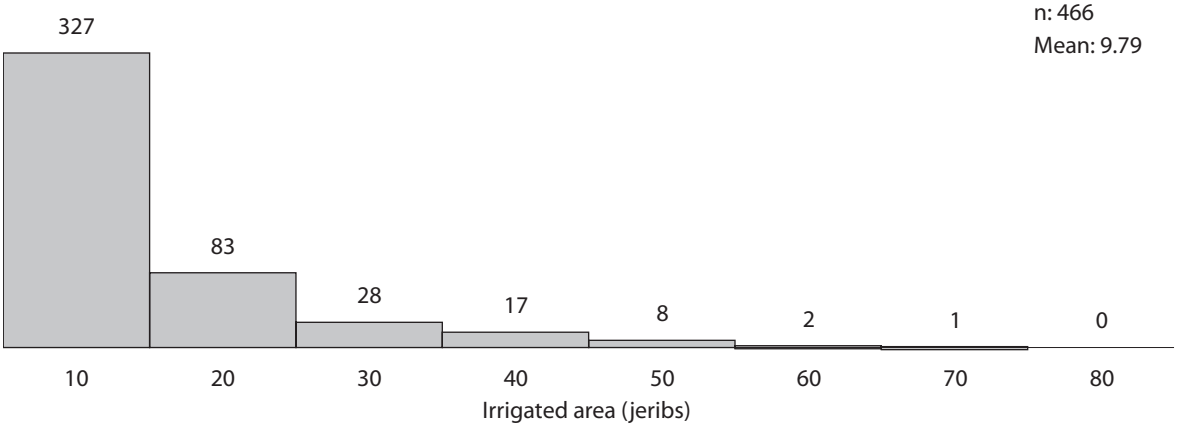
Question C(1). Crops produced. Data source: ACIAR survey.



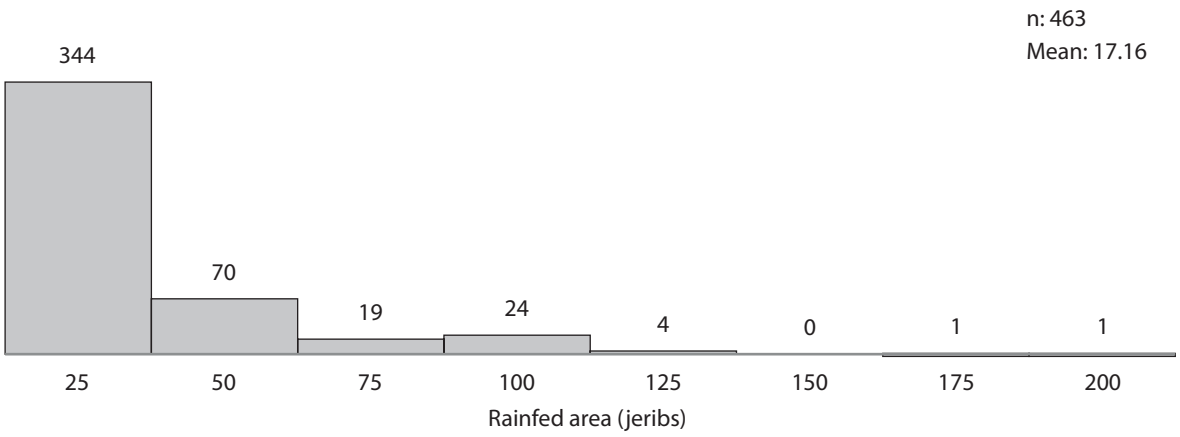
Question C(2). Livestock raised. Data source: ACIAR survey.



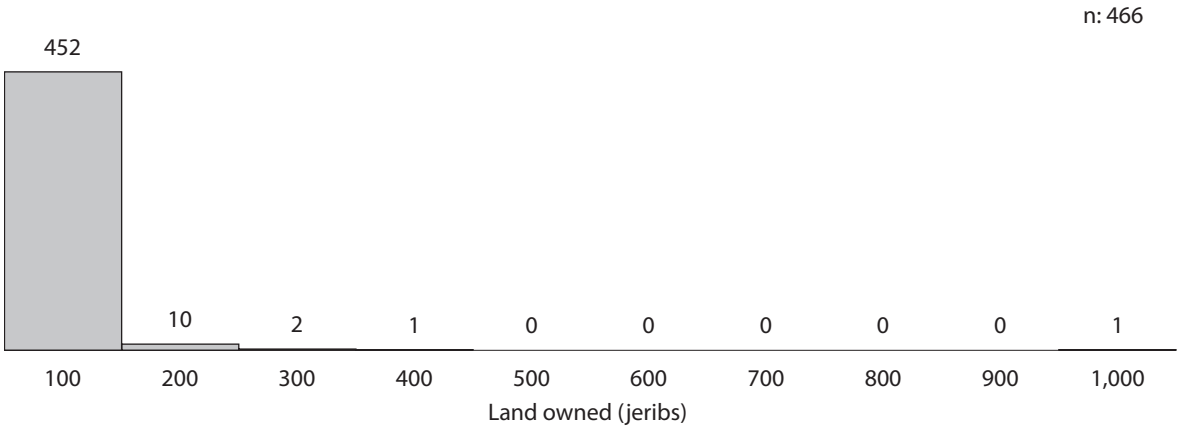
Question C9. Total farm area for crops. Data source: ACIAR survey.



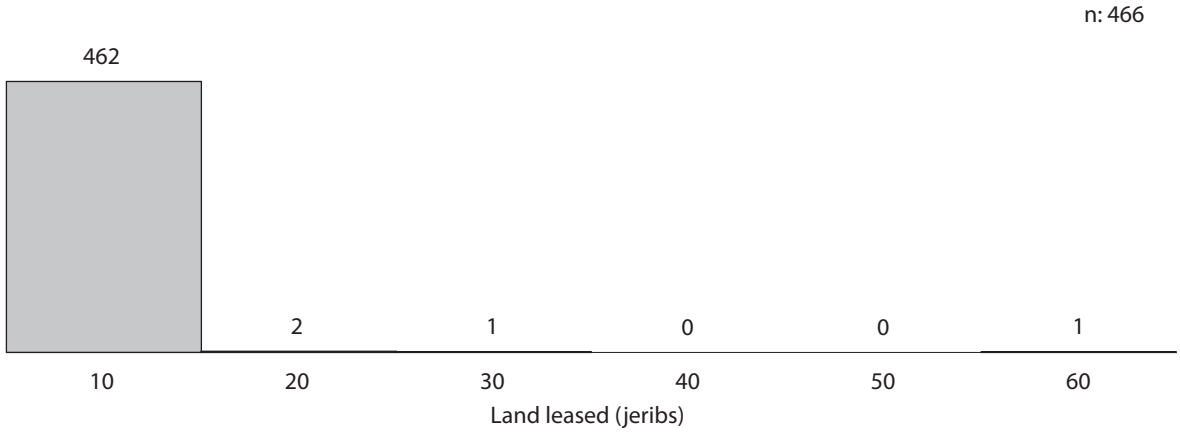
Question C10. Area irrigated. Data source: ACIAR survey.



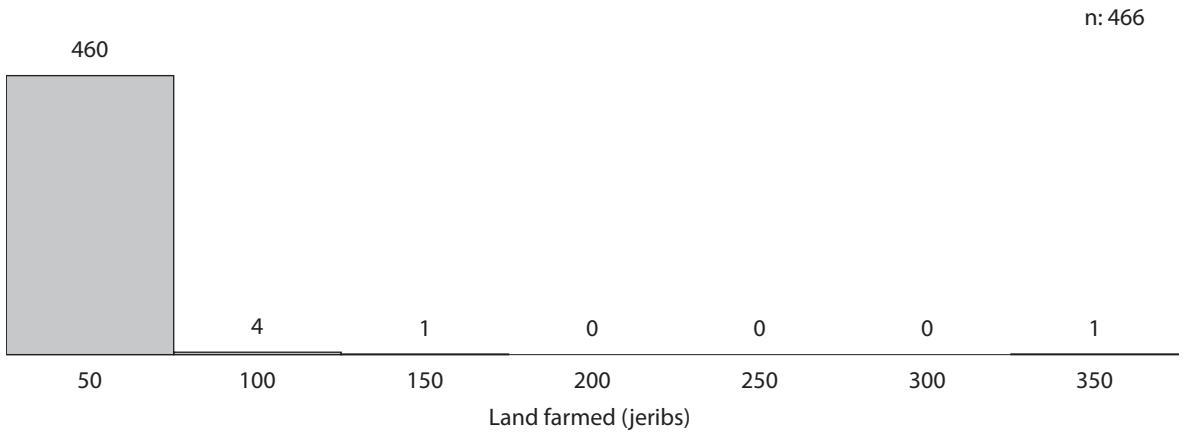
Question C11. Area rainfed. Data source: ACIAR survey.



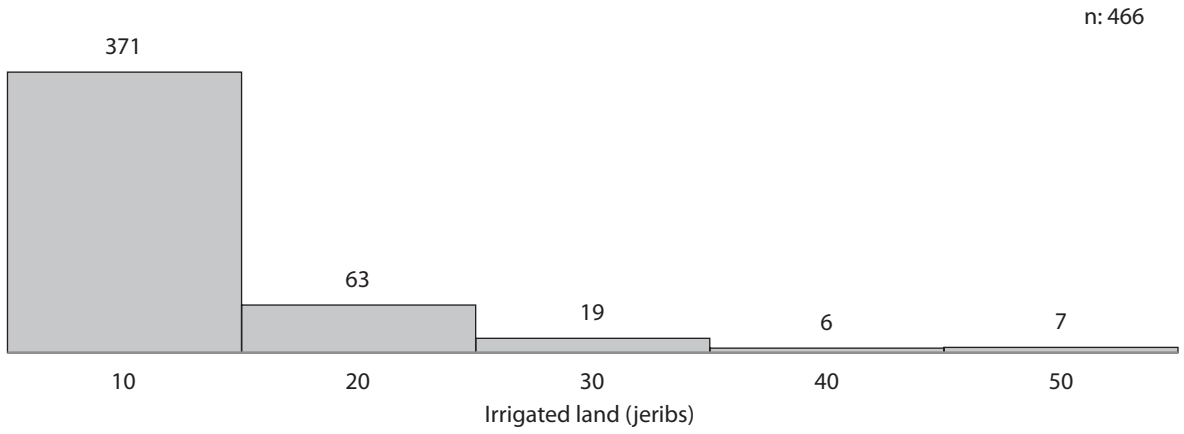
Question C12. Area of land owned. Data source: ACIAR survey.



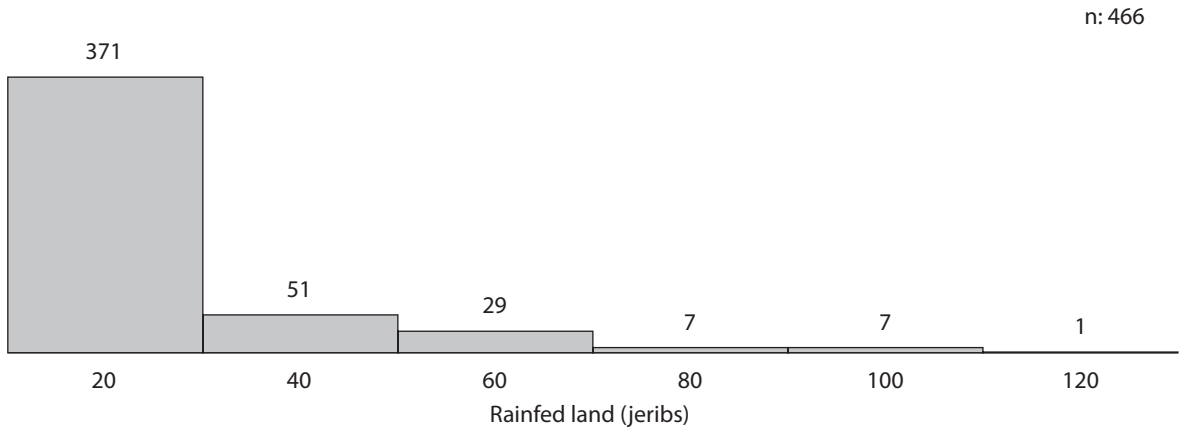
Question C13. Area of land leased. Data source: ACIAR survey.



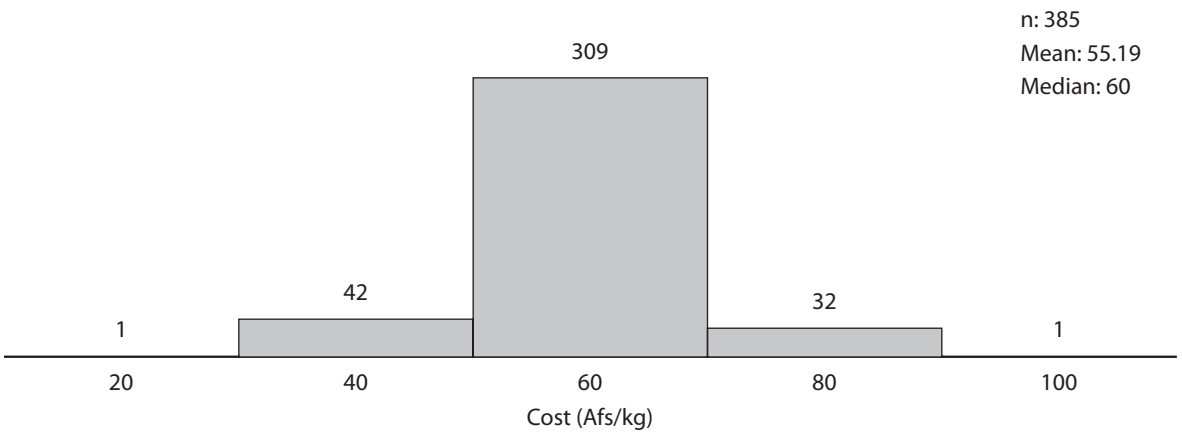
Question C14. Area of land farmed as sharecropper. Data source: ACIAR survey.



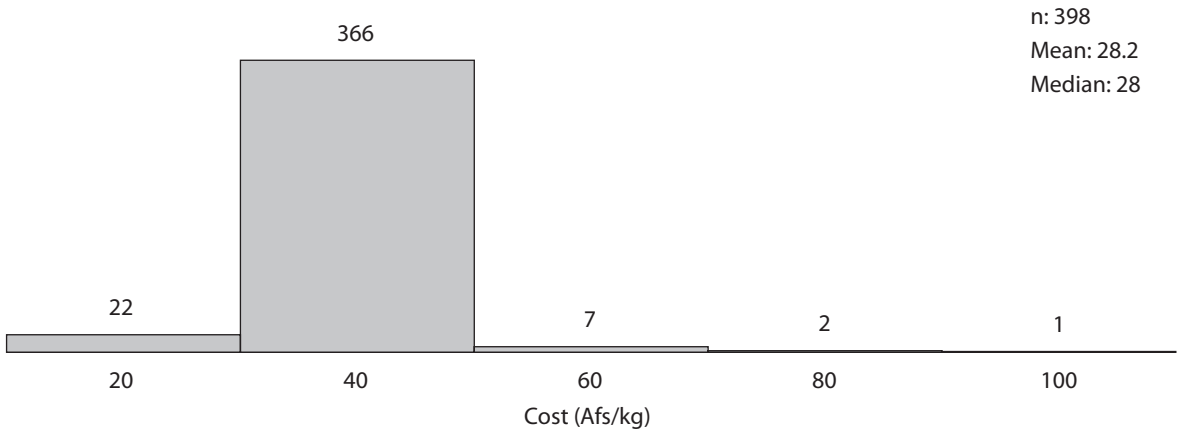
Question C15. Area of irrigated land planted to wheat. Data source: ACIAR survey.



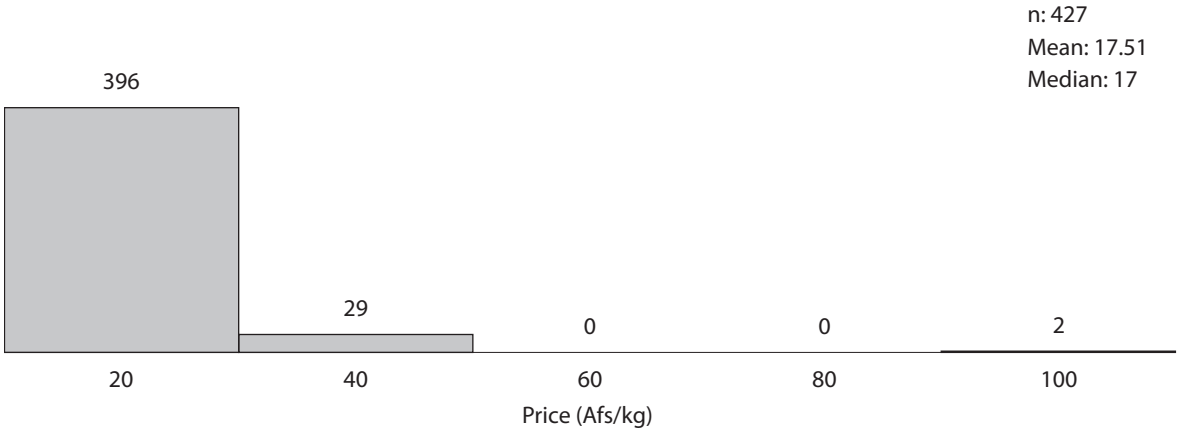
Question C16. Area of rainfed land planted to wheat. Data source: ACIAR survey.



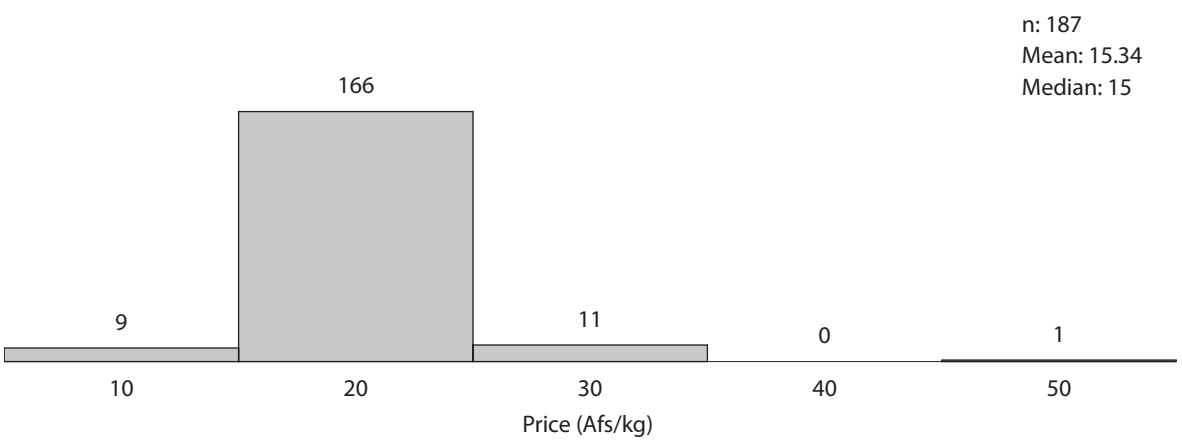
Question C17. Cost of DAP fertiliser. Data source: ACIAR survey.



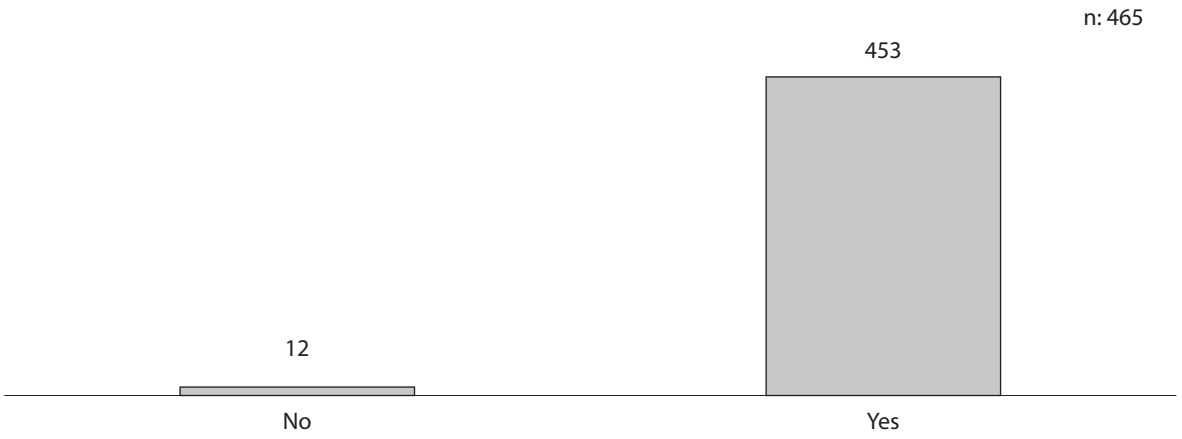
Question C18. Cost of urea. Data source: ACIAR survey.



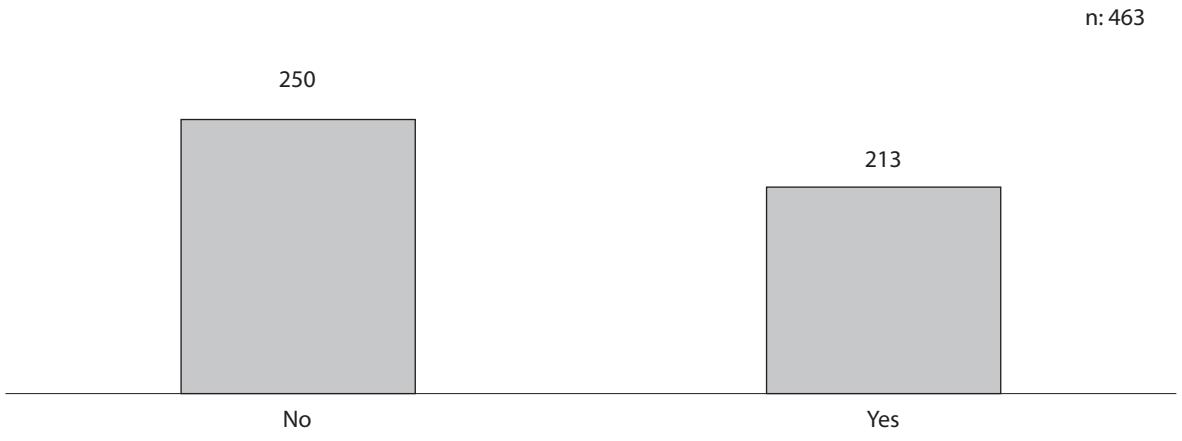
Question C19. Sale price of wheat. Data source: ACIAR survey.



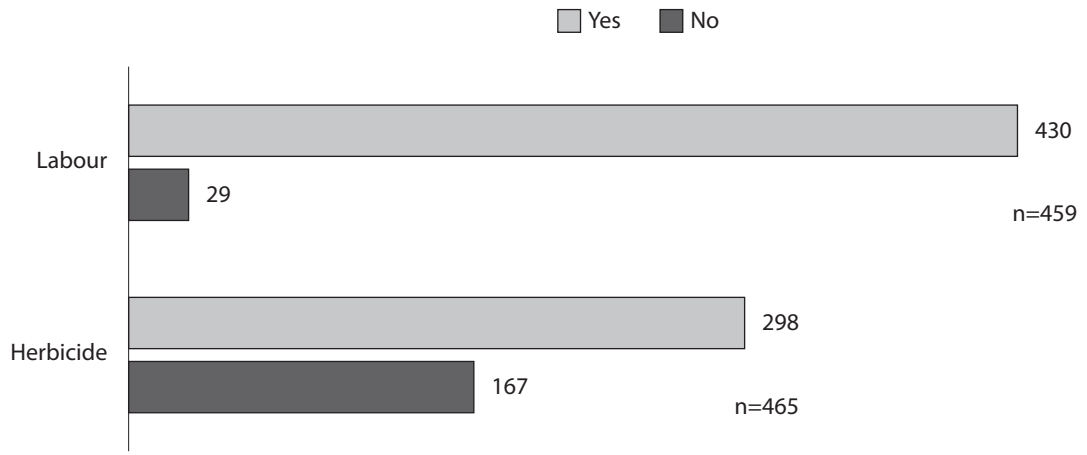
Question C20. Sale price of maize. Data source: ACIAR survey.



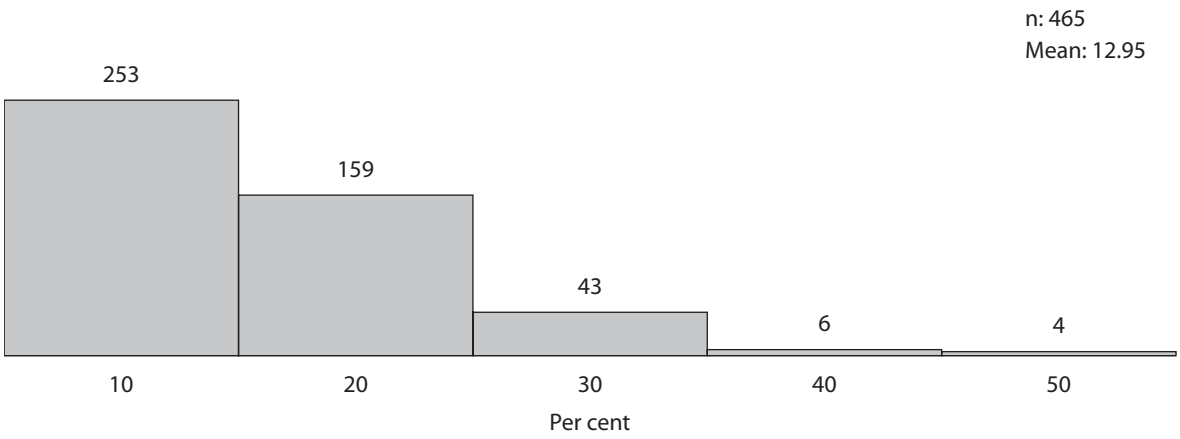
Question C21. Ploughing, harrowing and levelling of land to a fine tilth for wheat cultivation. Data source: ACIAR survey.



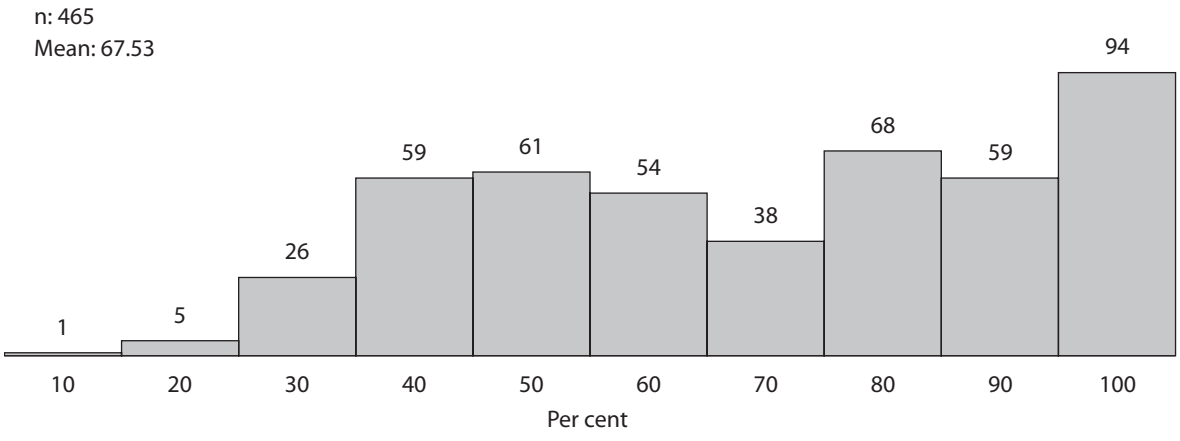
Question C22. Use of low-till or no-till farming. Data source: ACIAR survey.



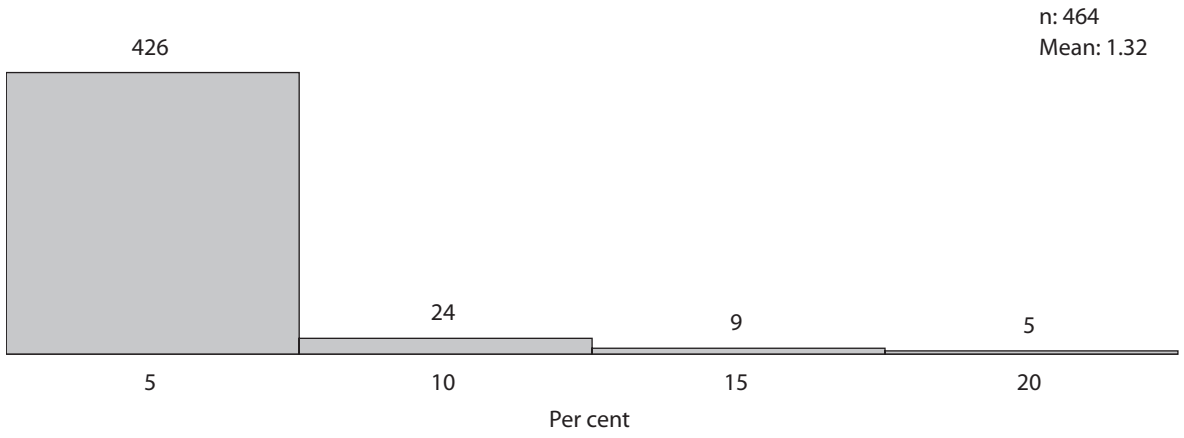
Questions C23/24. Methods of weed control. Data source: ACIAR survey.



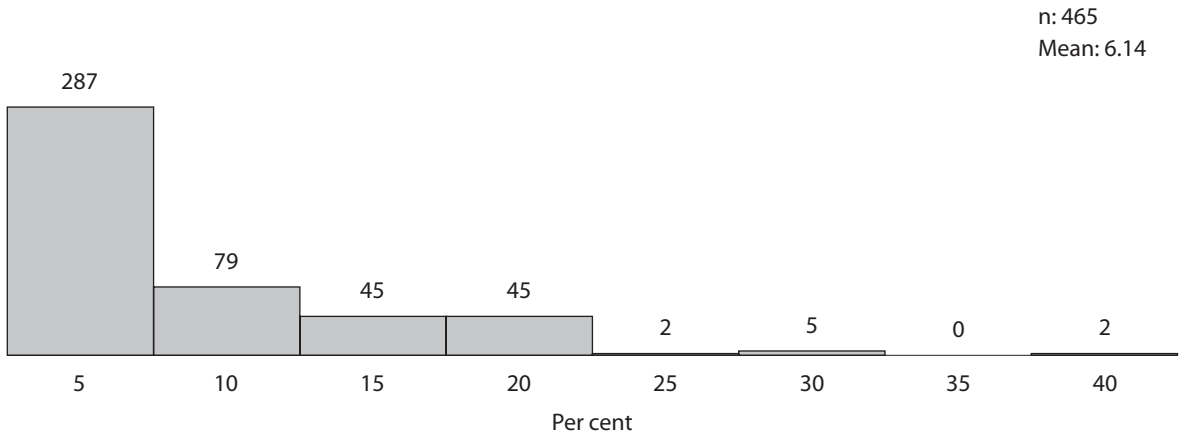
Question C25. Proportion of wheat production kept for seed. Data source: ACIAR survey.



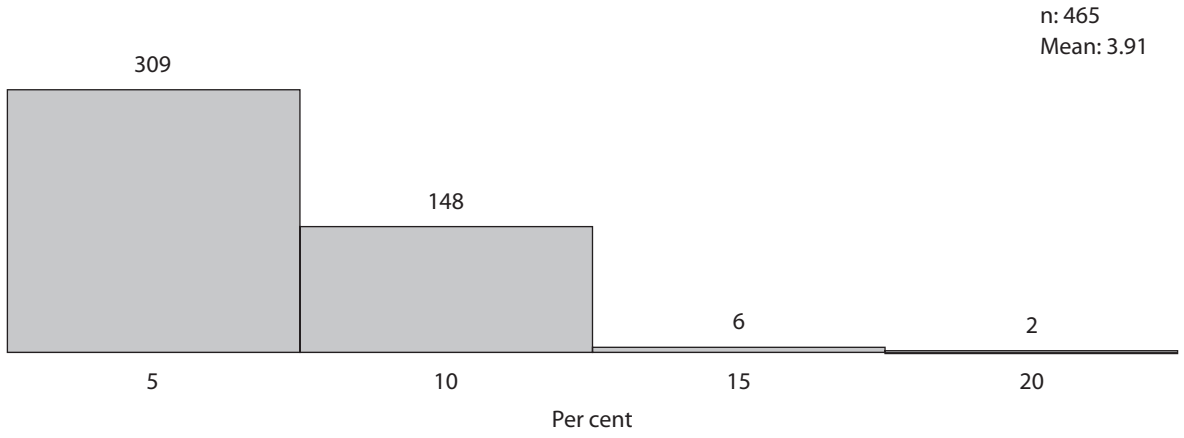
Question C26. Proportion of wheat production kept as family food. Data source: ACIAR survey.



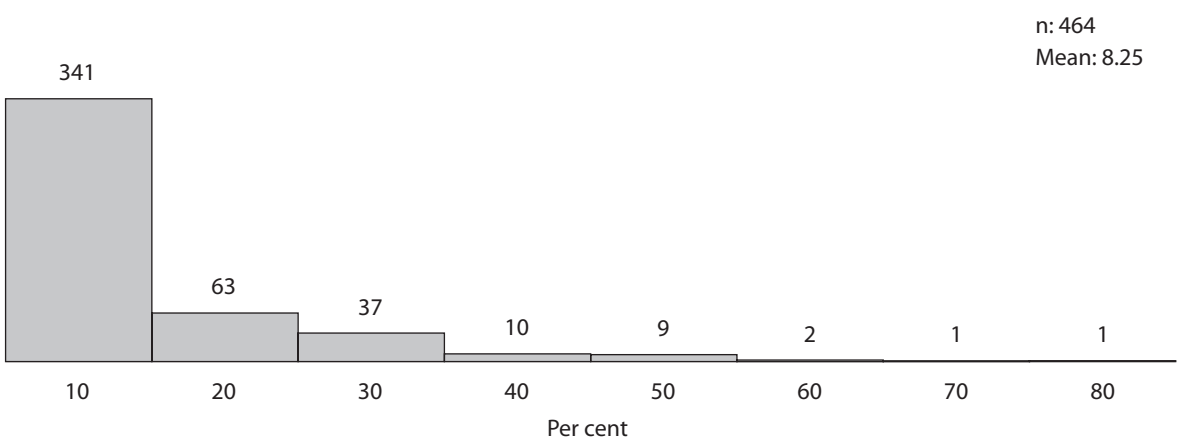
Question C27. Proportion of wheat production used to barter. Data source: ACIAR survey.



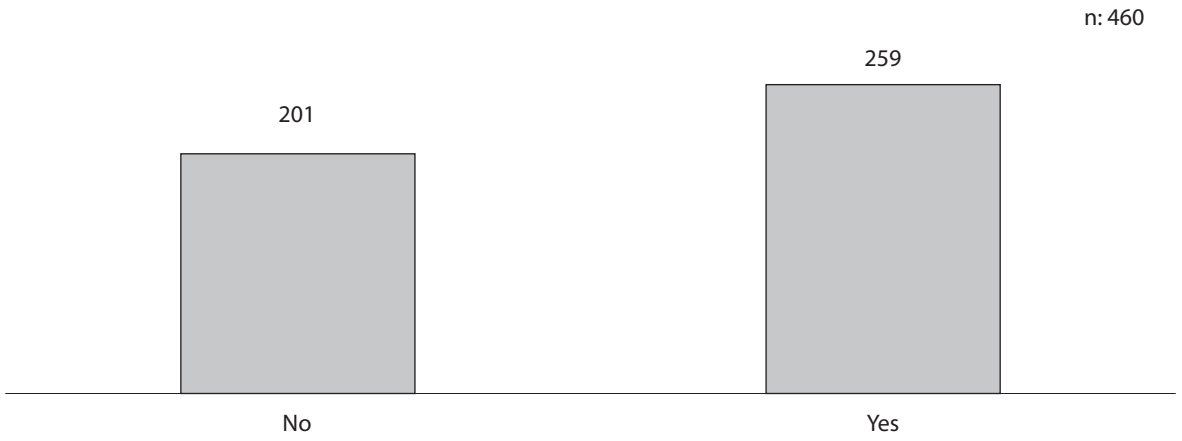
Question C28. Proportion of wheat production used to pay rent and other obligations. Data source: ACIAR survey.



Question C29. Proportion of wheat production given to others (family or neighbours) as assistance or as a gift. Data source: ACIAR survey.

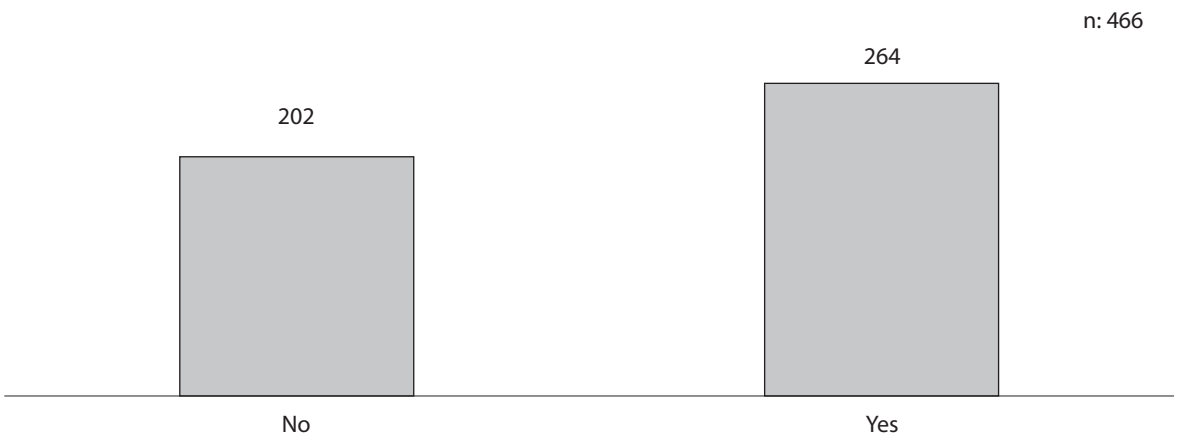


Question C30. Proportion of wheat production sold in market. Data source: ACIAR survey.

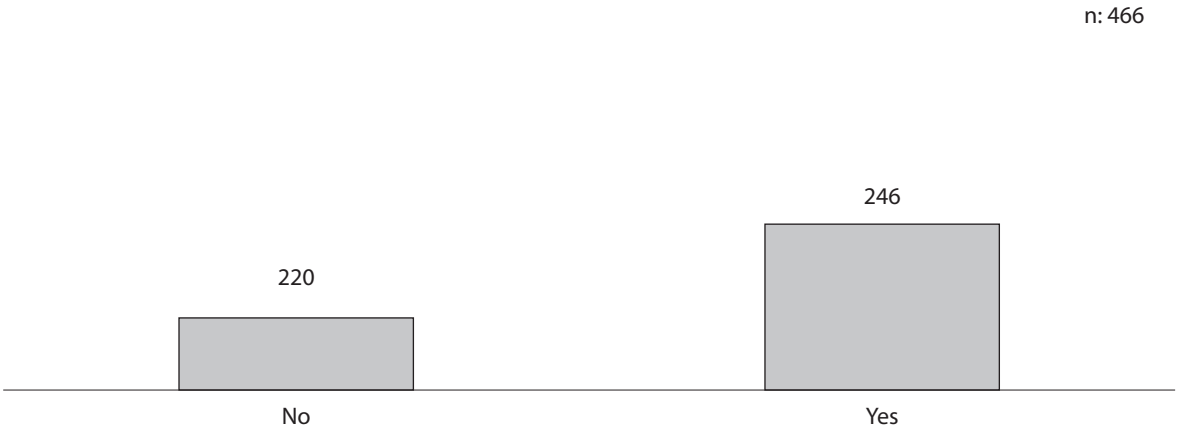


Question C31. Sufficient access to irrigation. Data source: ACIAR survey.

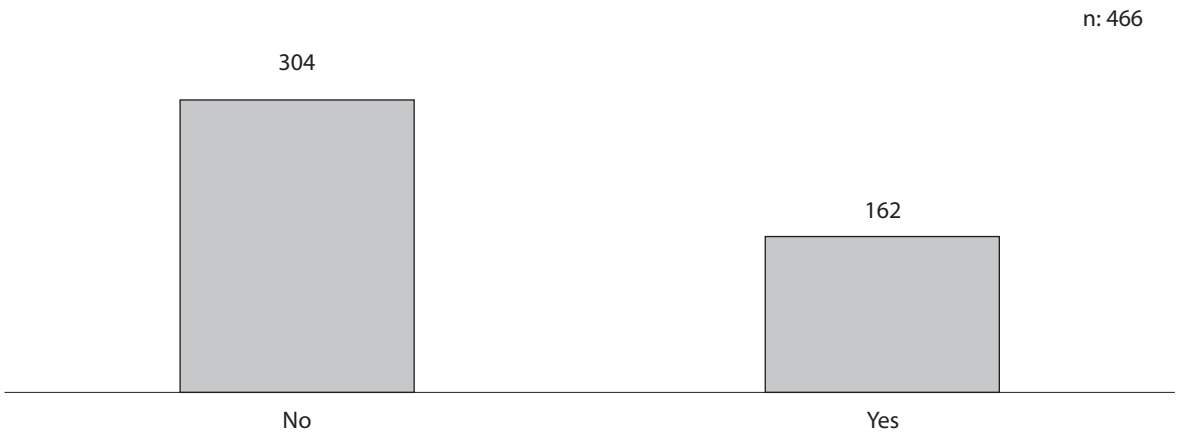
Knowledge of, and access to improved wheat seed



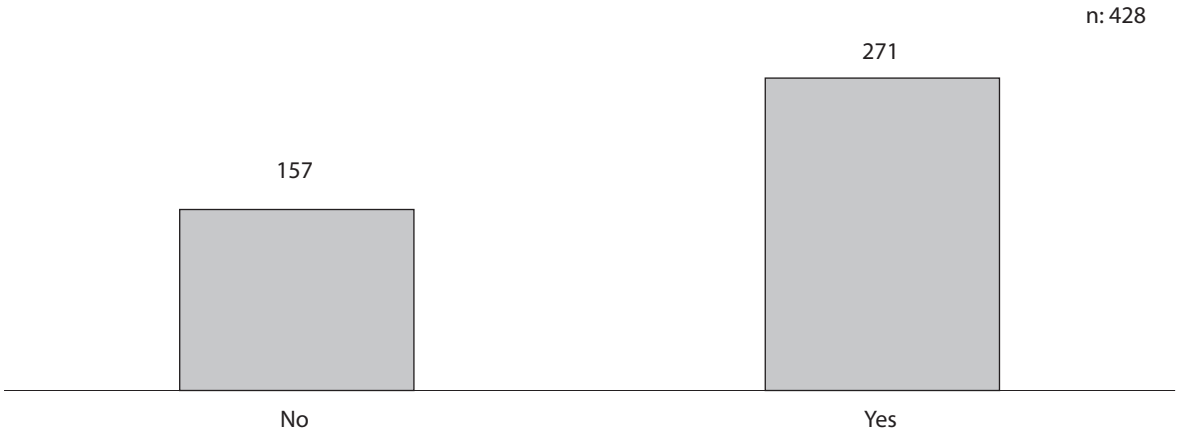
Question D1. Aware of ACIAR wheat seed varieties. Data source: ACIAR survey.



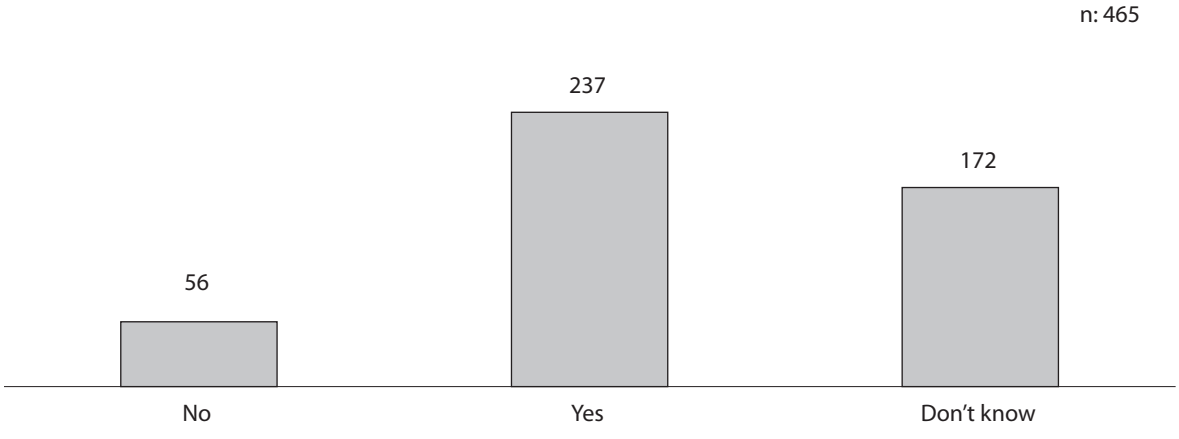
Question D2. Ever planted ACIAR varieties. Data source: ACIAR survey.



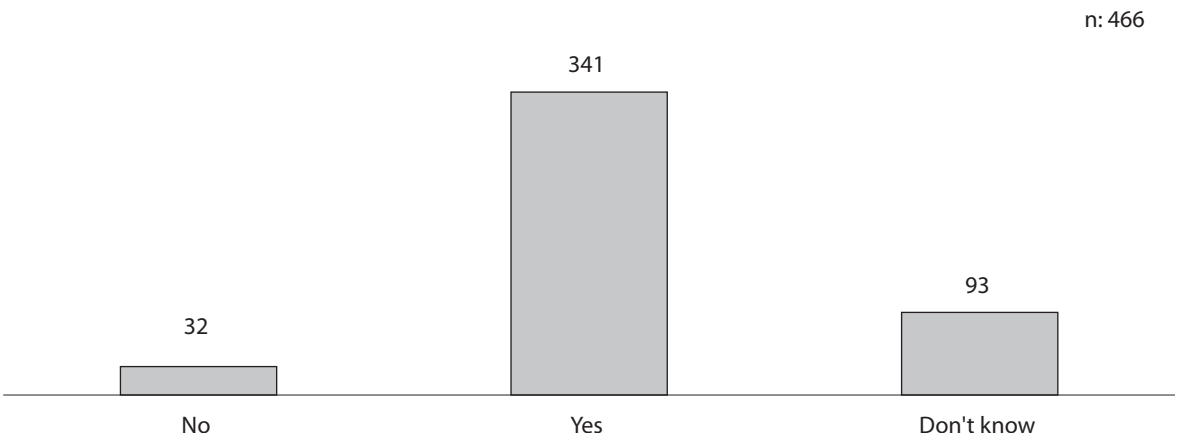
Question D3. Ever planted other improved wheat seed varieties. Data source: ACIAR survey.



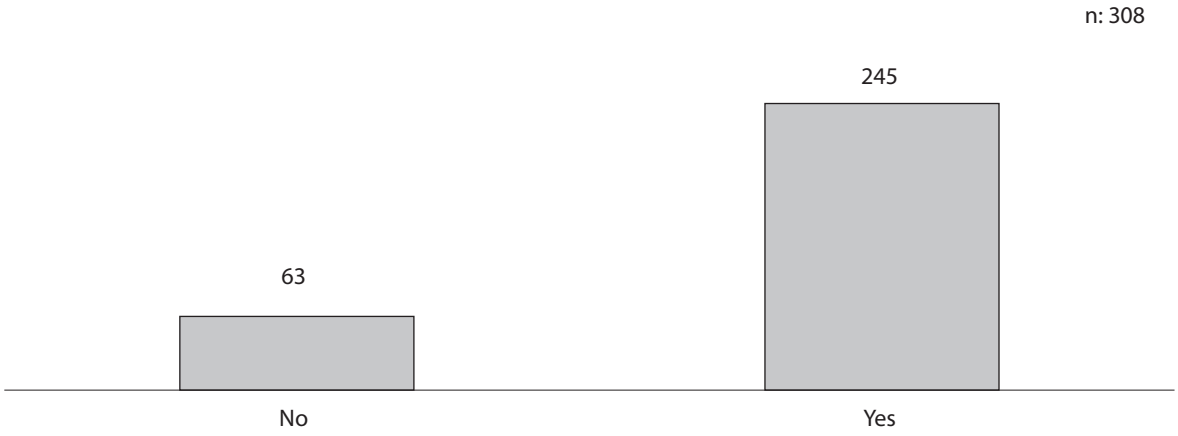
Question D5. Fertiliser used with improved seed



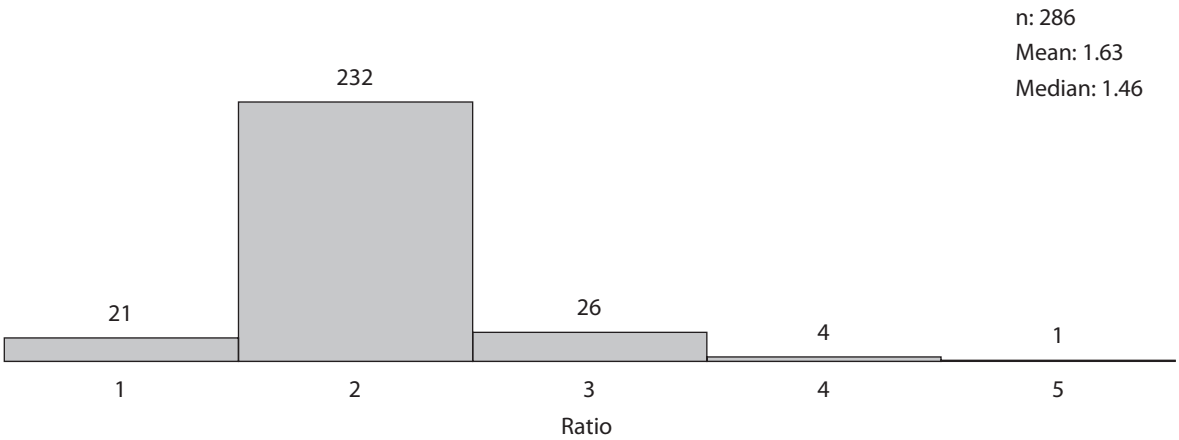
Question D6. Believe other farmers in village/region plant improved wheat seed. Data source: ACIAR survey.



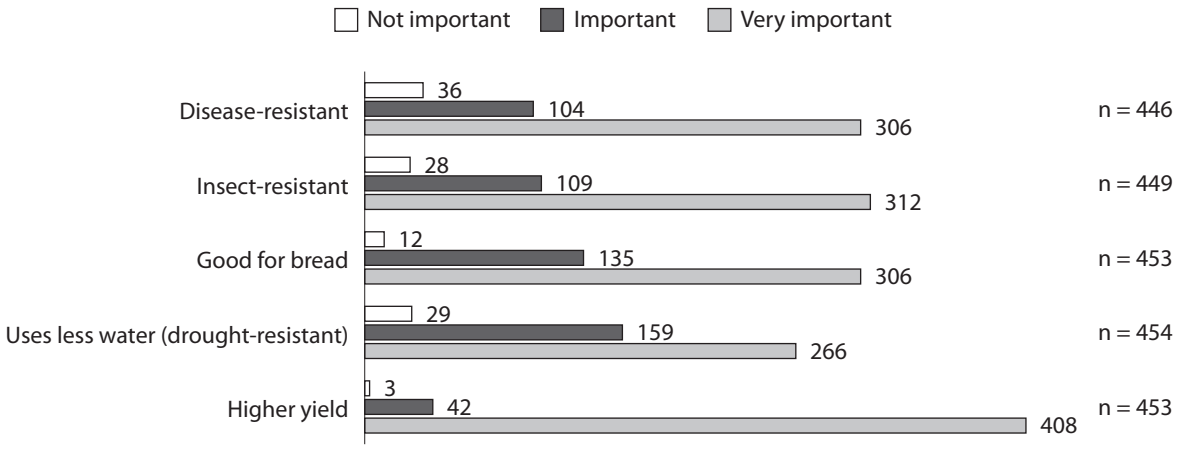
Question D7. Believe improved wheat seed gives higher yields. Data source: ACIAR survey.



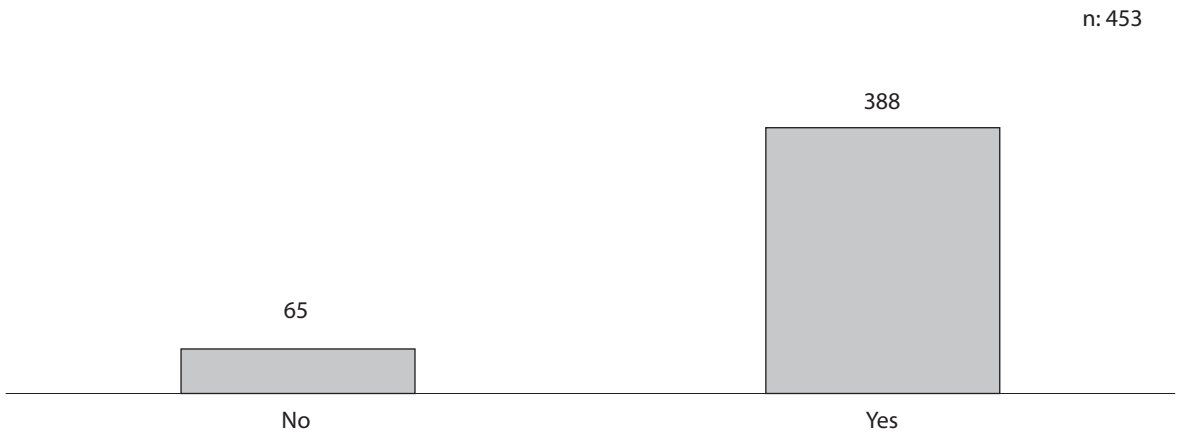
Question D8. Have increased plantings of improved seed in recent years. Data source: ACIAR survey.



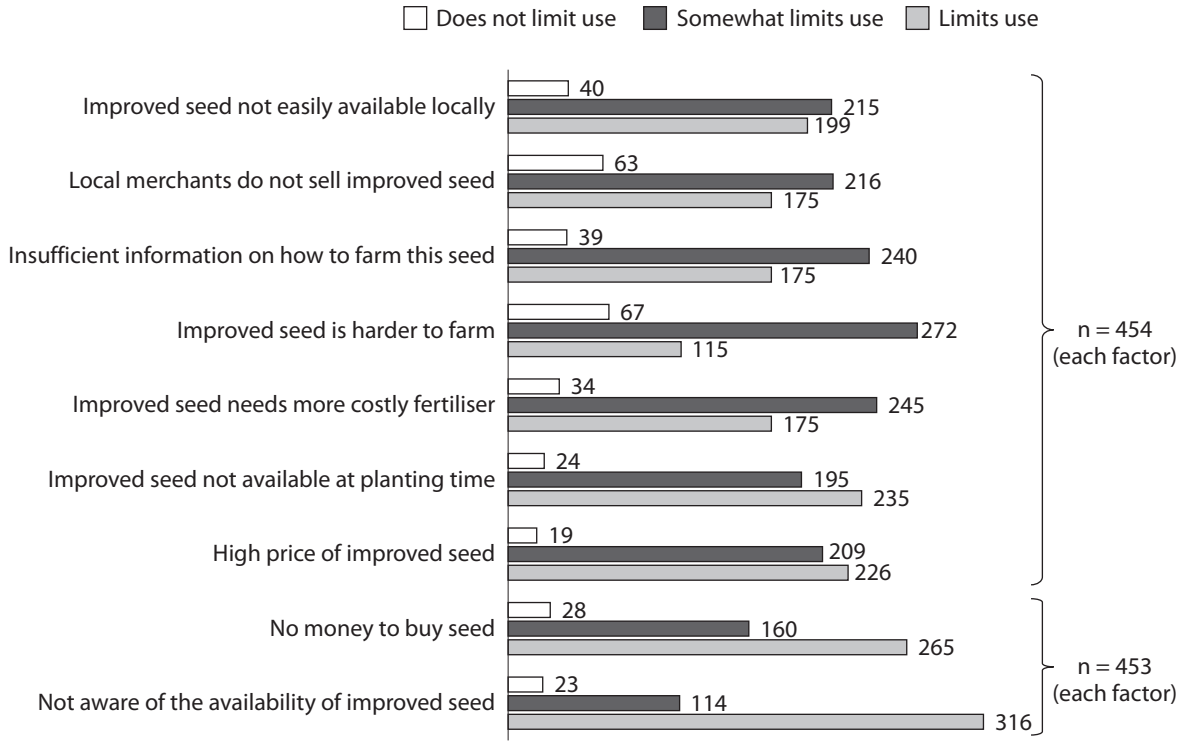
Questions D9/10. Ratio of yield after use of improved seed to yield before use of improved seed. Data source: ACIAR survey.



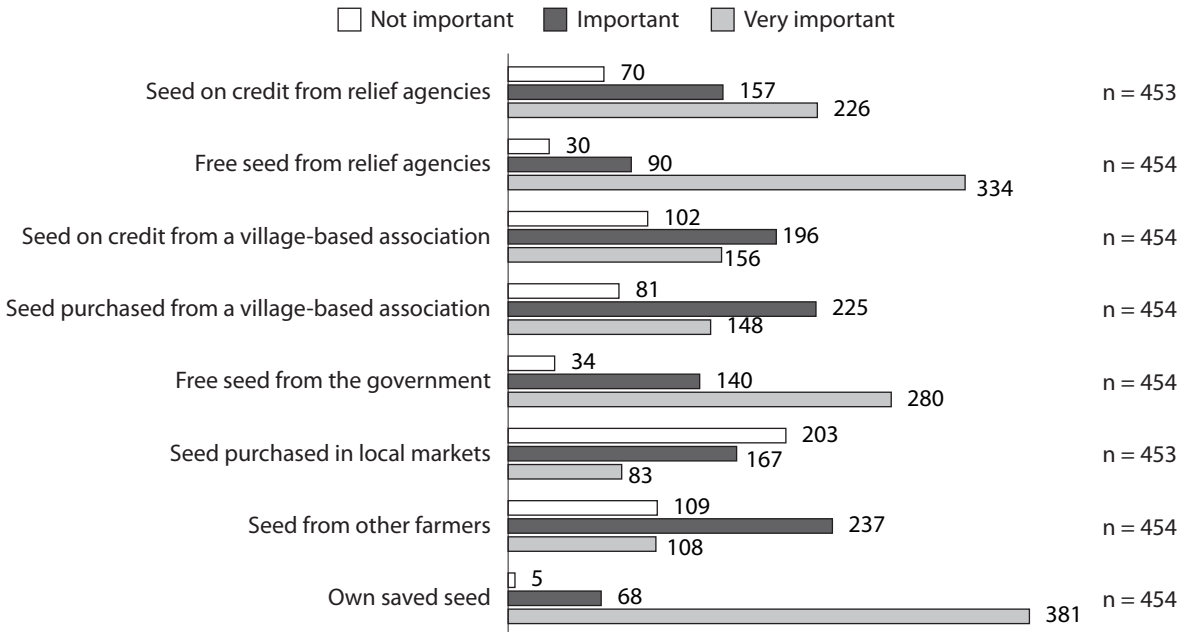
Questions D11–15. Factors determining whether improved seed varieties are planted. Data source: ACIAR survey.



Question D16. Save enough seed for the next season's crop. Data source: ACIAR survey.

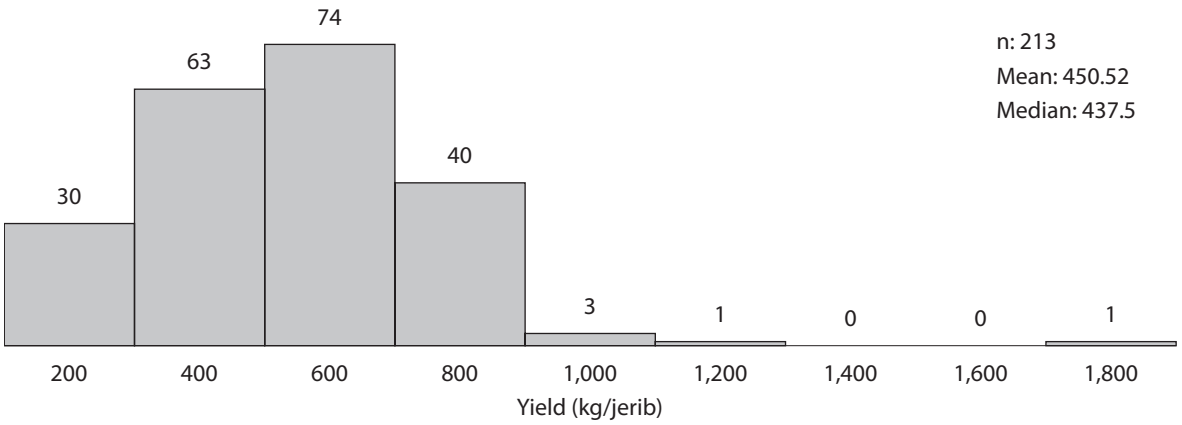


Questions D17–25. Factors limiting use of improved seed. Data source: ACIAR survey.

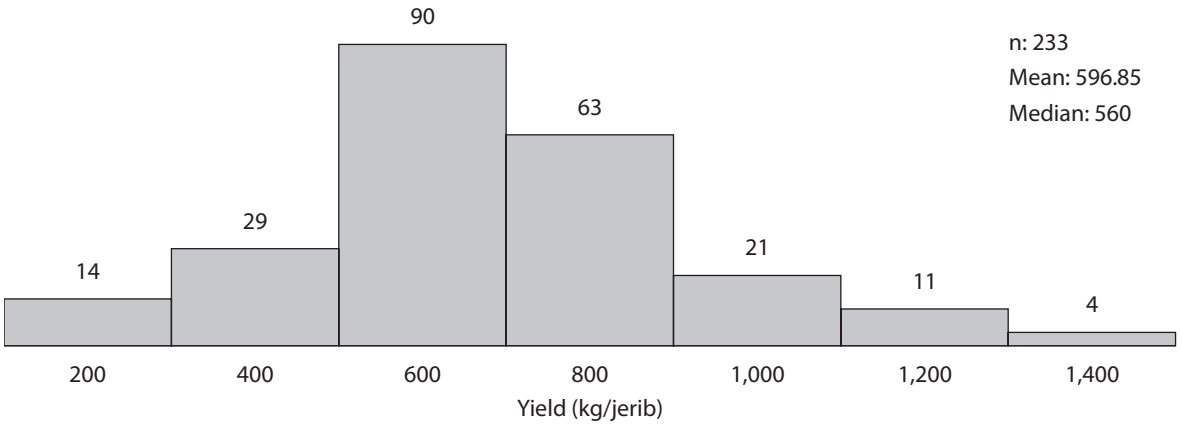


Questions D26–33. Importance of sources of seed. Data source: ACIAR survey.

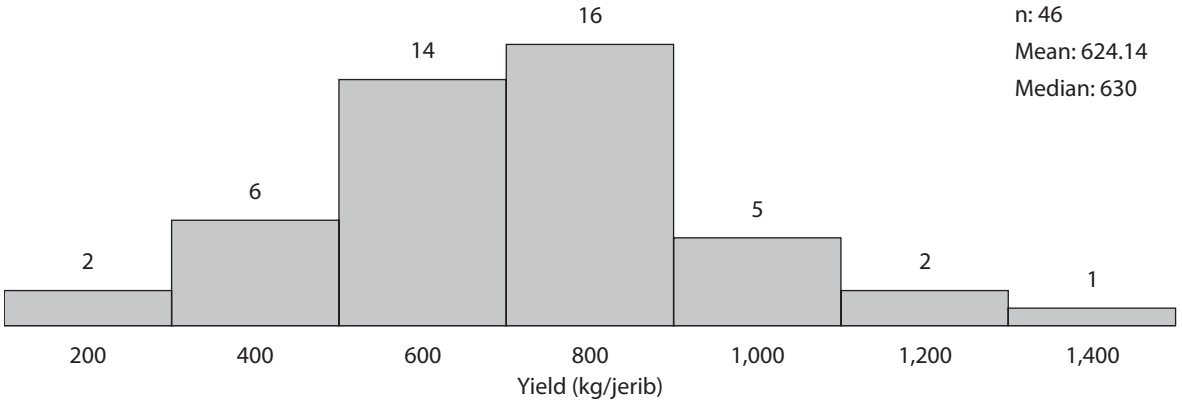
Detailed wheat production information



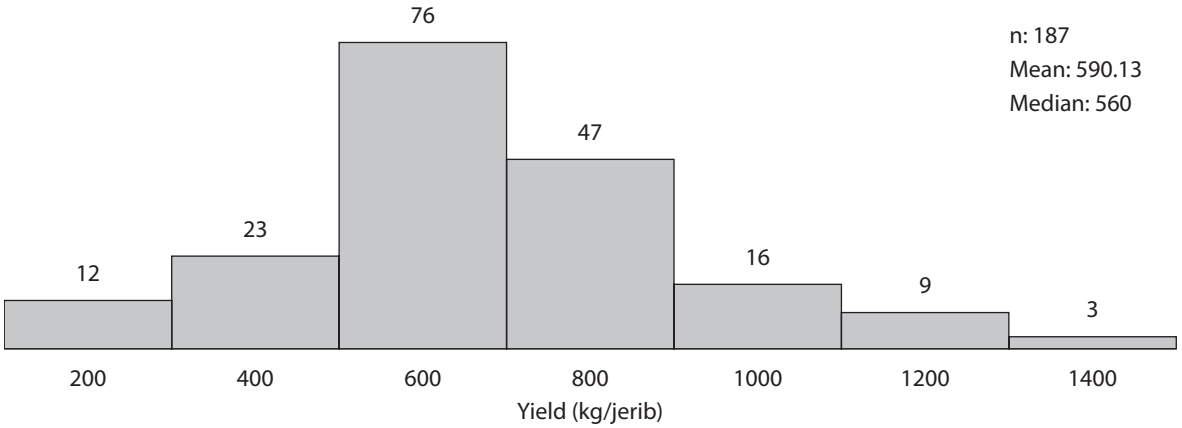
Questions E1–23. Yield, local varieties—irrigated. Note: Figure excludes outlier yield (3,500 kg/jerib). Data source: ACIAR survey.



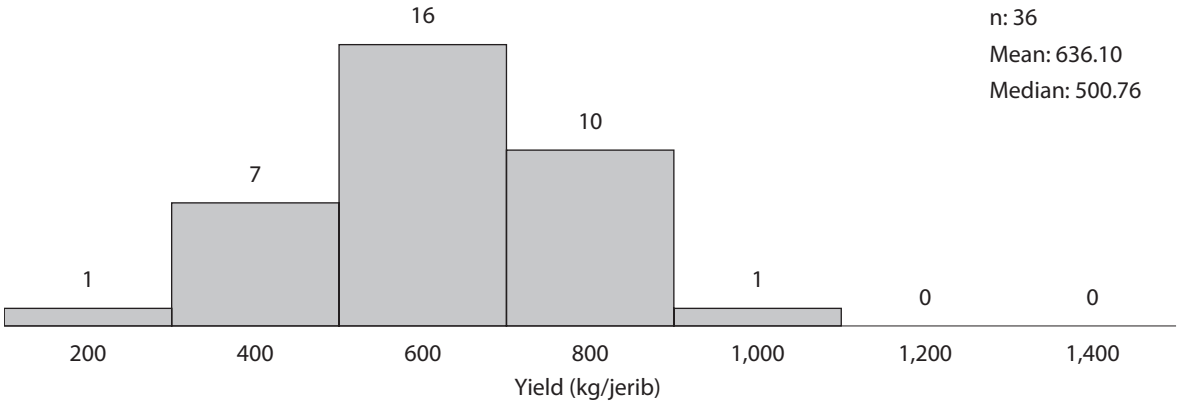
Questions E1–23. Yield, all improved varieties—irrigated (1). Note: Figure excludes outlier yield (2,400 kg/jerib). Data source: ACIAR survey.



Questions E1–23. Yield, ACIAR varieties—irrigated (1). Data source: ACIAR survey.

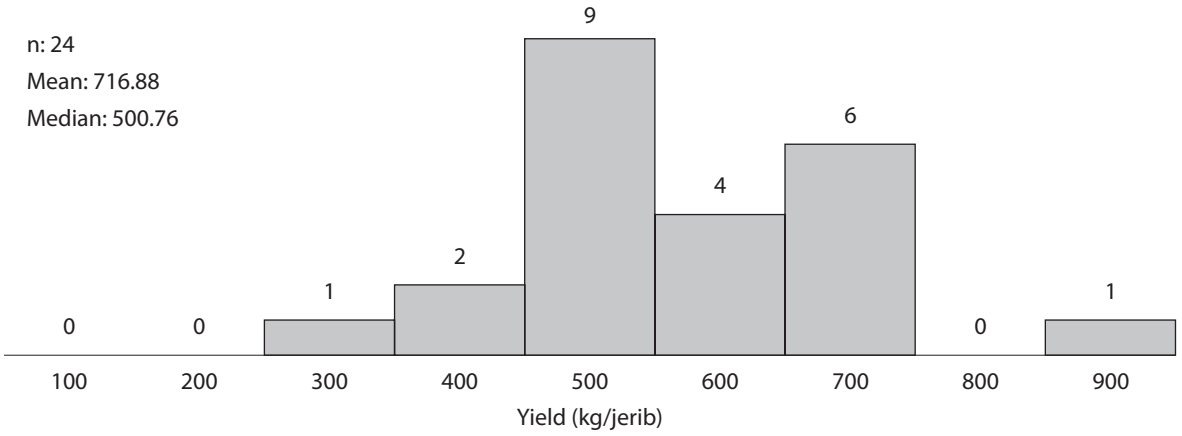


Questions E1–23. Yield, non-ACIAR varieties—irrigated (1). Note: Figure excludes outlier yield (2,400 kg/jerib). Data source: ACIAR survey.

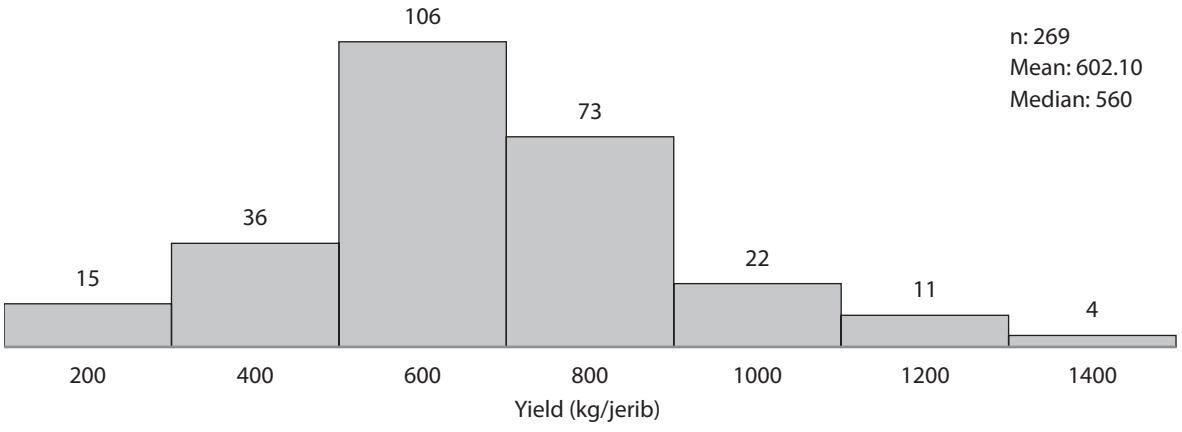


Questions E1–23. Yield, all improved varieties—irrigated (2). Note: Figure excludes outlier yield (4,900 kg/jerib). Data source: ACIAR survey.

Questions E1–23. Yield, ACIAR varieties—irrigated (2). Data source: ACIAR survey.

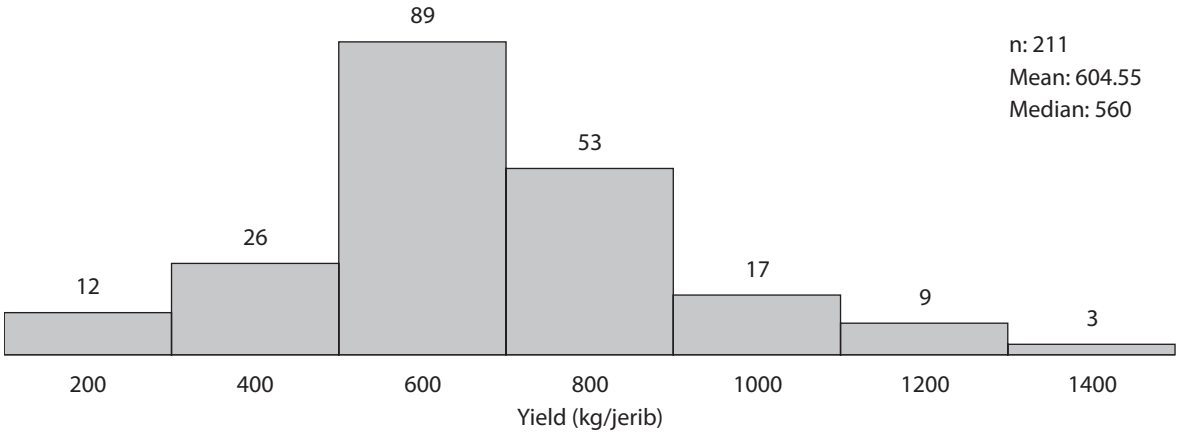


Questions E1–23. Yield, non-ACIAR varieties—irrigated (2). Note: Figure excludes outlier yield (4,900 kg/jerib). Data source: ACIAR survey.

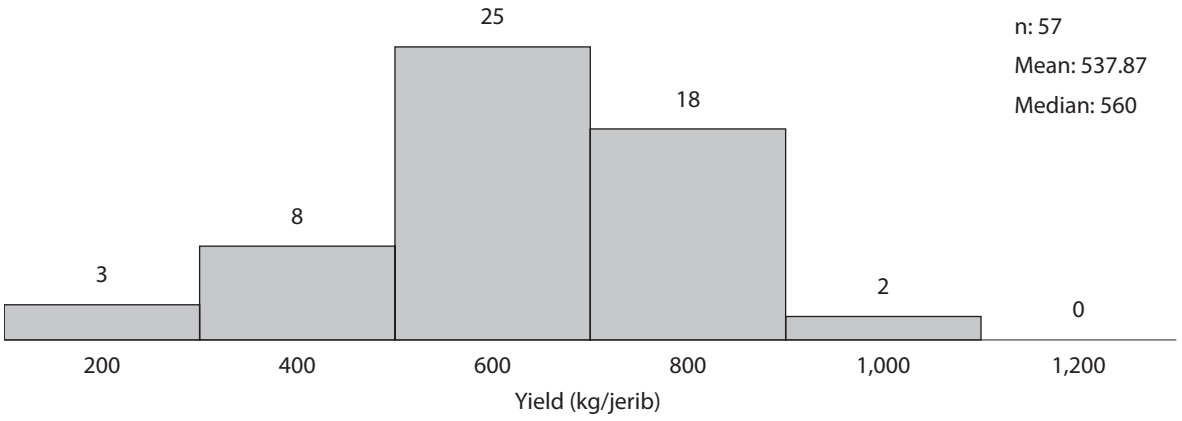


Questions E1–23. Yield, all improved varieties—irrigated. Note: Figure excludes outlier yields (2,400 and 4,900 kg/jerib). Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.

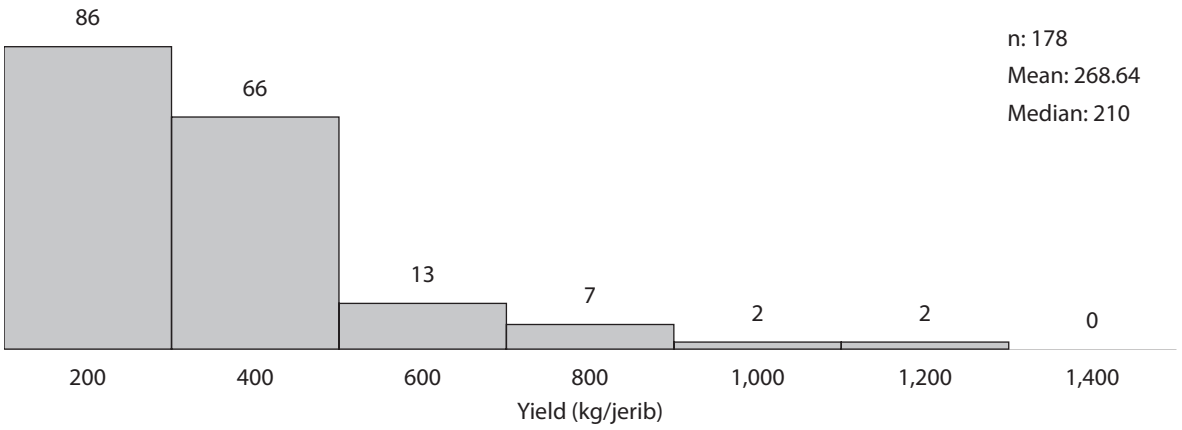
Questions E1–23. Yield, all ACIAR varieties—irrigated. Note: Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.



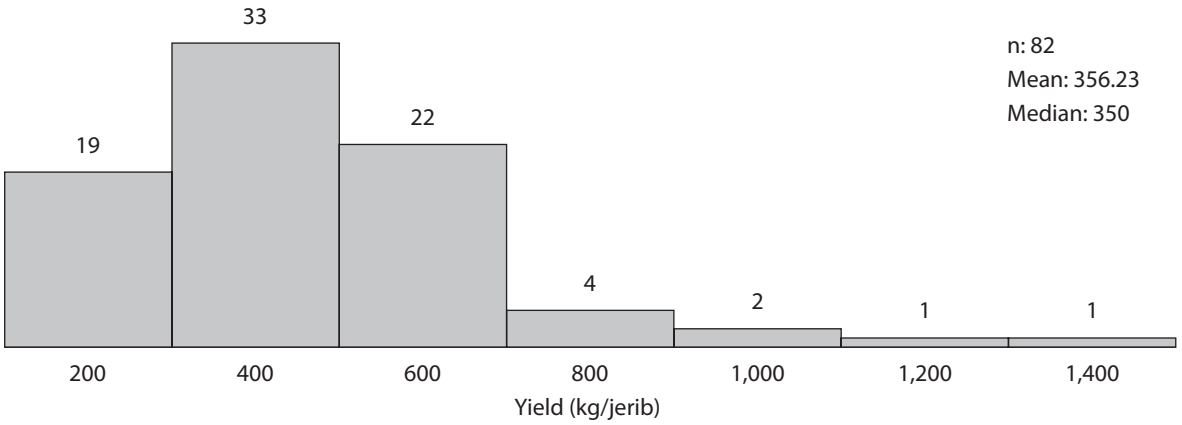
Questions E1–23. Yield, all non-ACIAR varieties—irrigated. (a) Excludes Zard Dana. Note: Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.



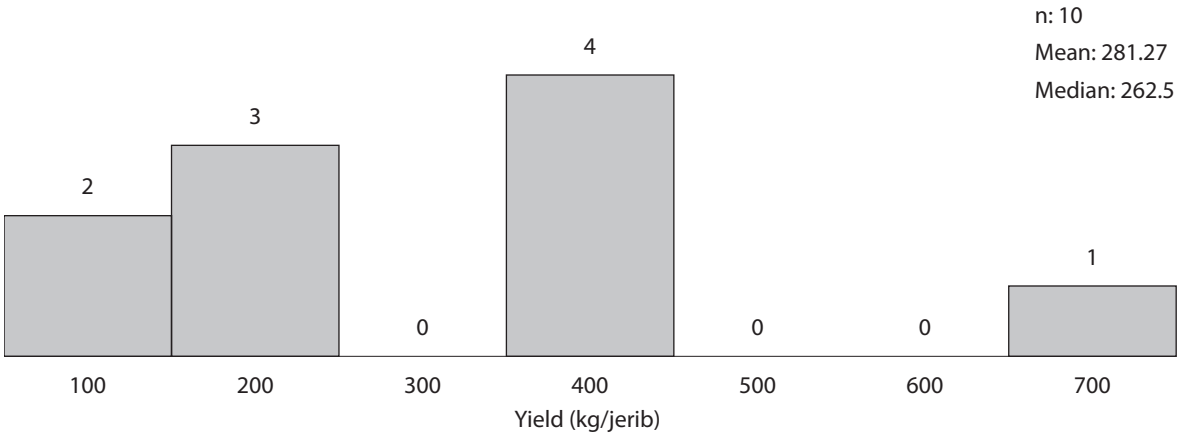
Questions E1–23. Yield, Zard Dana—irrigated. Note: Includes Zard Dana listed under improved variety 1 and improved variety 2. Data source: ACIAR survey.



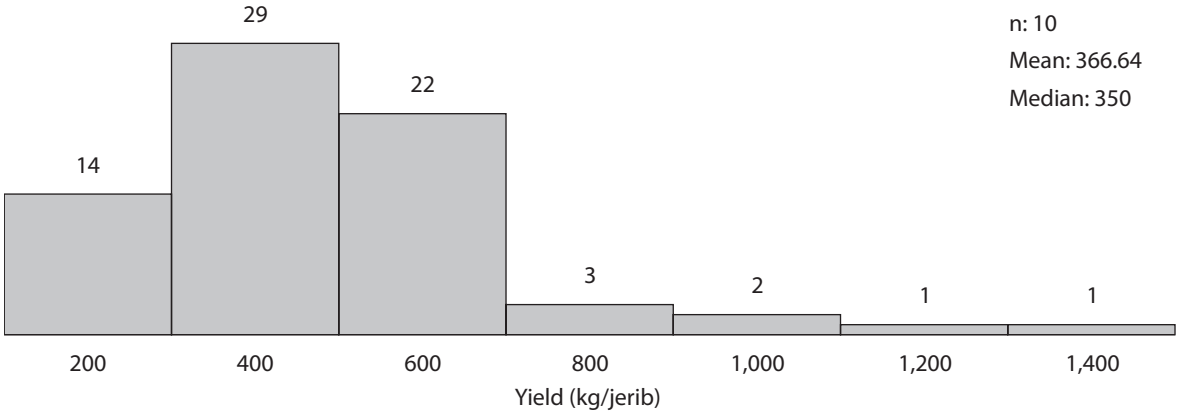
Questions E24–39. Yield, local varieties—rainfed. Note: Figure excludes outlier yield (3,700 kg/jerib). Data source: ACIAR survey.



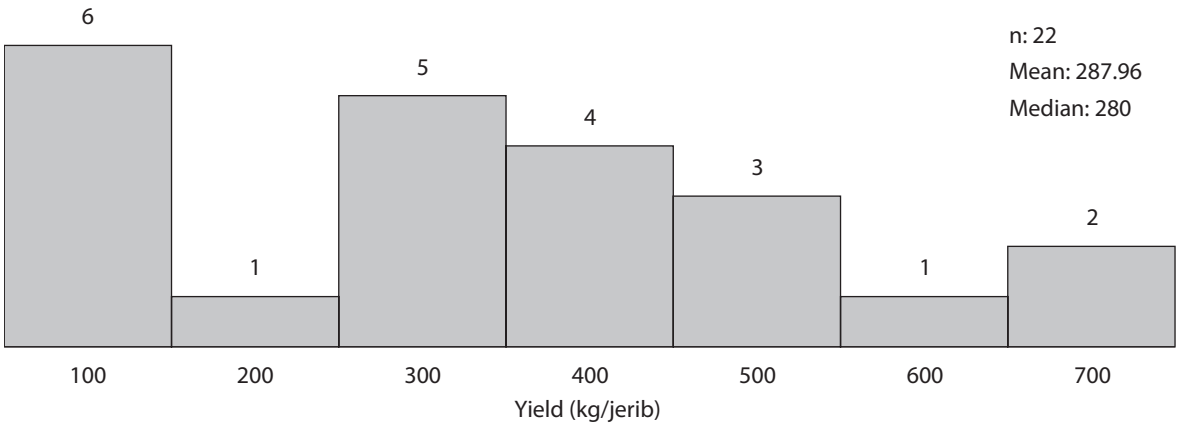
Questions E24–39. Yield, all improved varieties—rainfed (1). Data source: ACIAR survey.



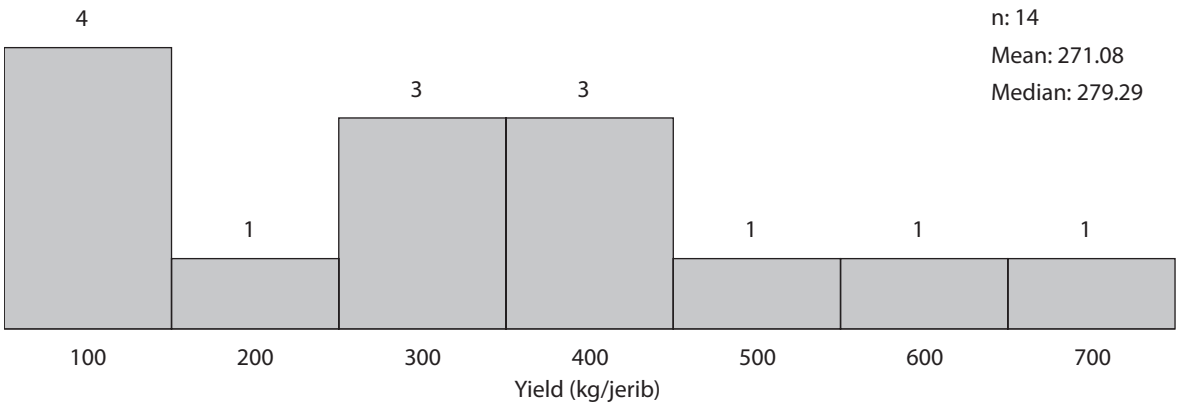
Questions E24–39. Yield, ACIAR varieties—rainfed (1). Data source: ACIAR survey.



Questions E24–39. Yield, non-ACIAR varieties—rainfed (1). Data source: ACIAR survey.

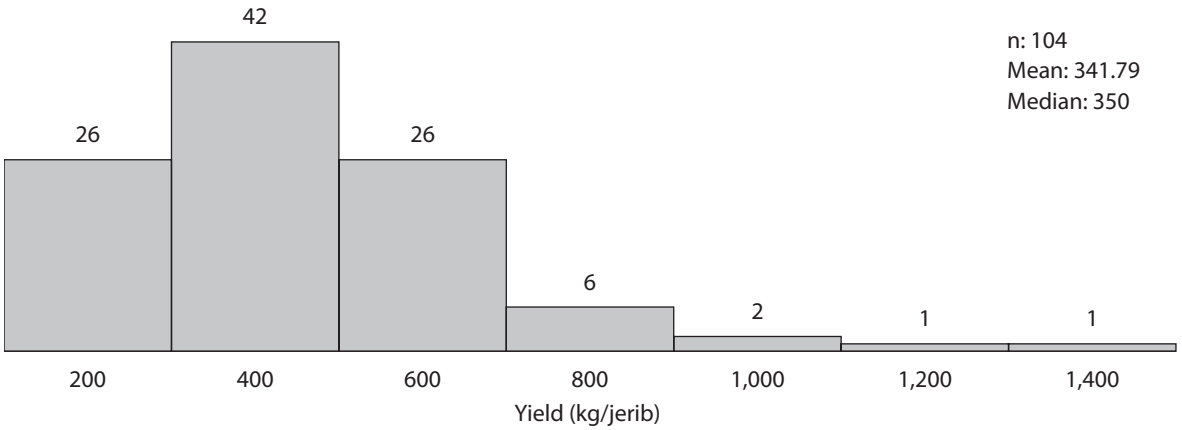


Questions E24–39. Yield, all improved varieties—rainfed (2). Data source: ACIAR survey.

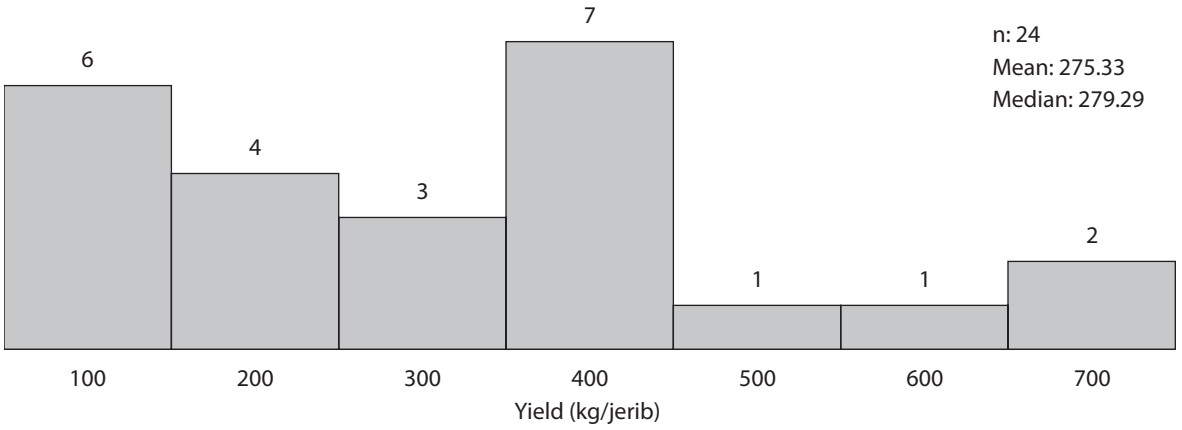


Questions E24–39. Yield, ACIAR varieties—rainfed (2). Data source: ACIAR survey.

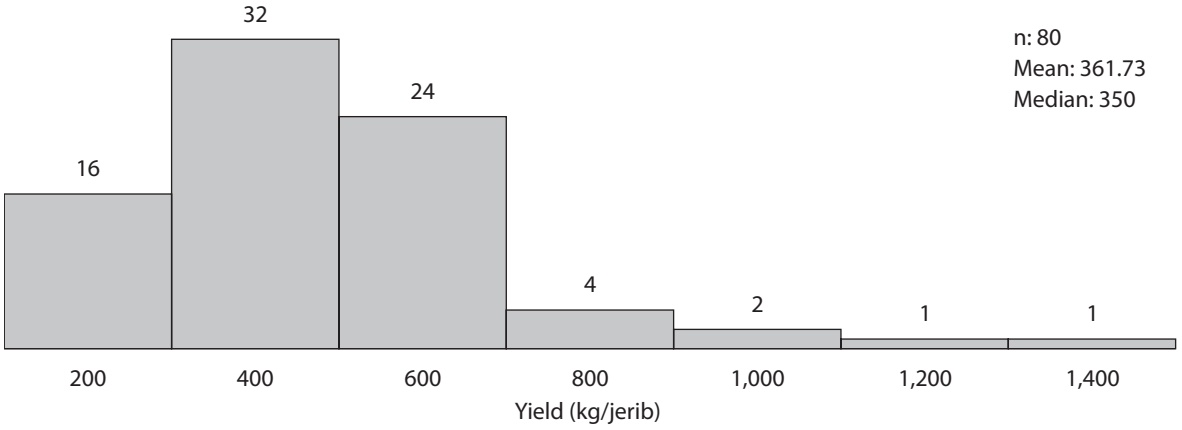
Questions E24–39. Yield, non-ACIAR varieties—rainfed (2). Data source: ACIAR survey.



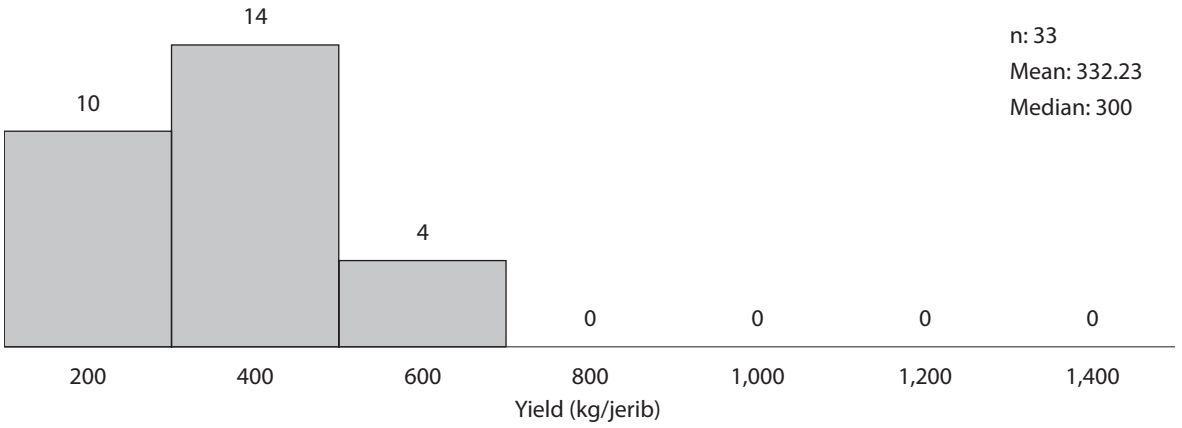
Questions E24–39. Yield, all improved varieties—rainfed. Note: Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.



Questions E24–39. Yield, all ACIAR varieties—rainfed. Note: Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.

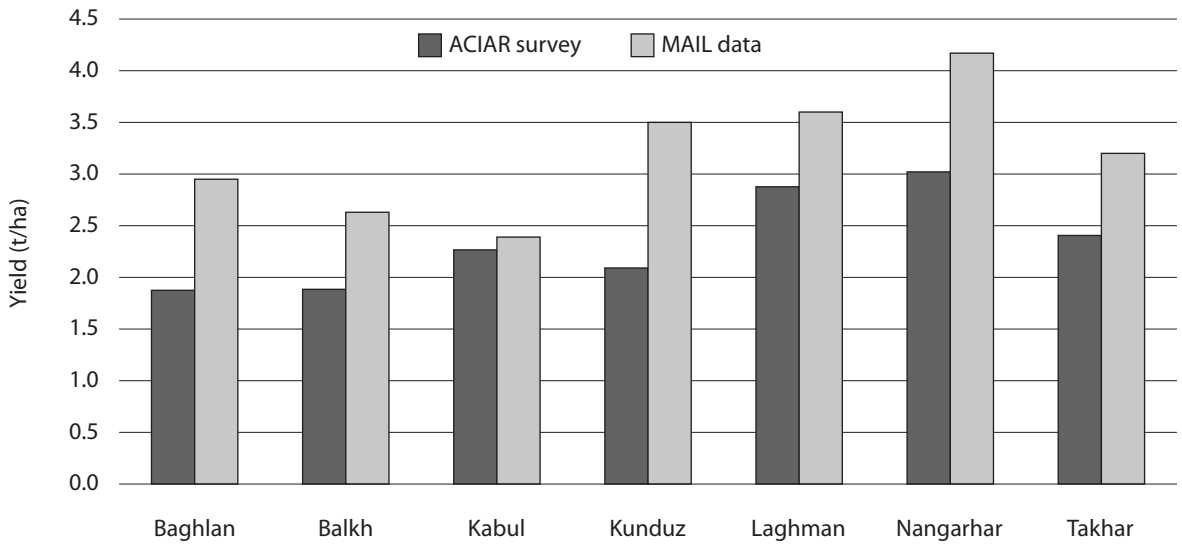


Questions E24–39. Yield, all non-ACIAR varieties—rainfed. Note: Shows observed yields when improved variety 1 and improved variety 2 yields were combined. Data source: ACIAR survey.

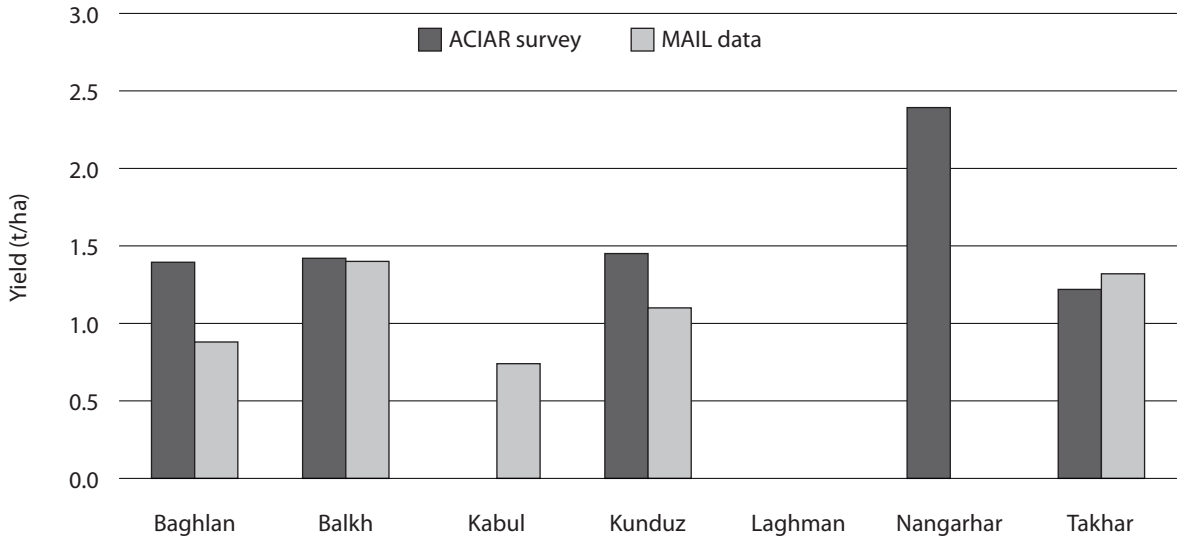


Questions E24–39. Yield, Zard Dana—rainfed. Note: Includes Zard Dana listed under improved variety 1 and improved variety 2. Data source: ACIAR survey.

Yields, by province

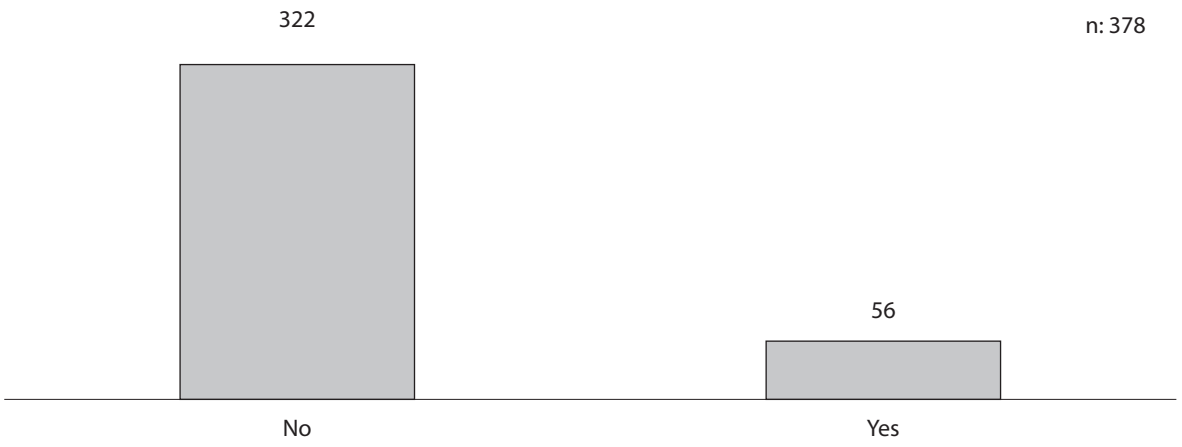


Questions D9–10. Comparison of wheat yields (irrigated) across provinces in 2012. Note: MAIL data relates to provisional estimates from May 2012. Data source: ACIAR survey and MAIL data.

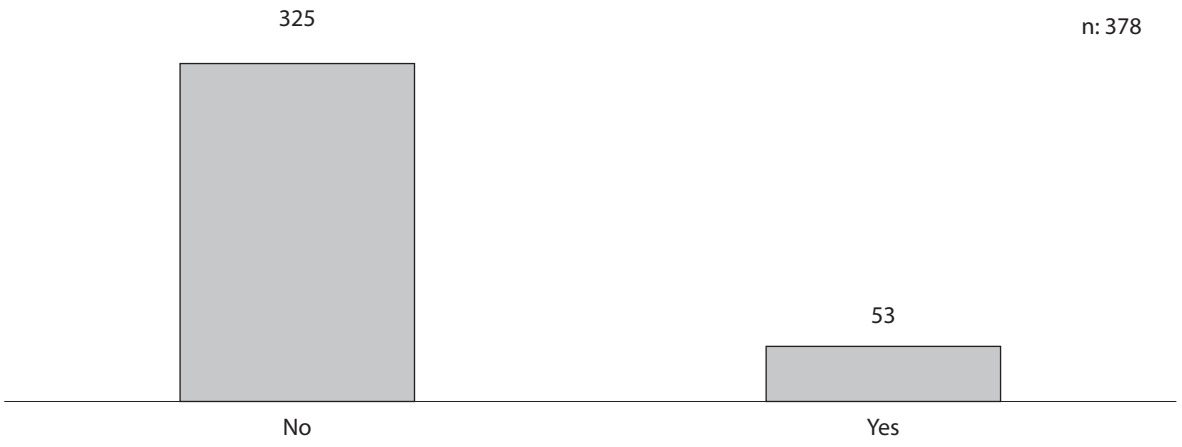


Questions D9–10. Comparison of wheat yields (rainfed) across provinces in 2012. Note: MAIL data relates to provisional estimates from May 2012. Data source: ACIAR survey and MAIL data.

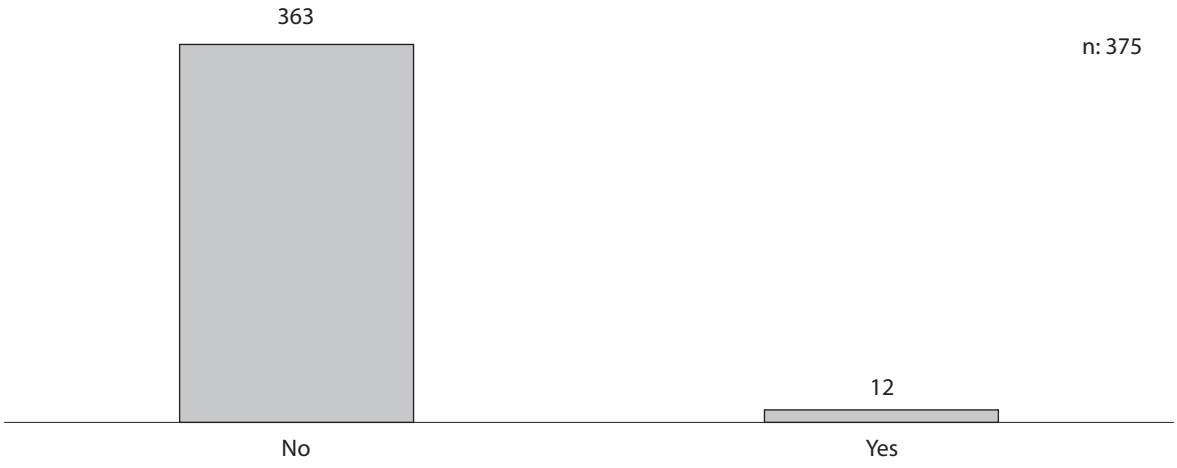
Knowledge of and access to improved maize seed



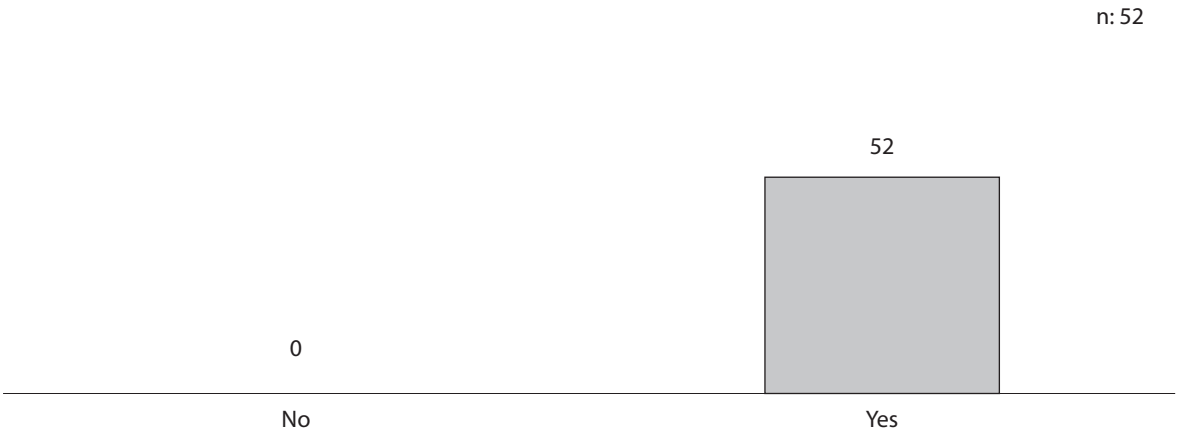
Question F1. Aware of ACIAR project maize seed varieties. Data source: ACIAR survey.



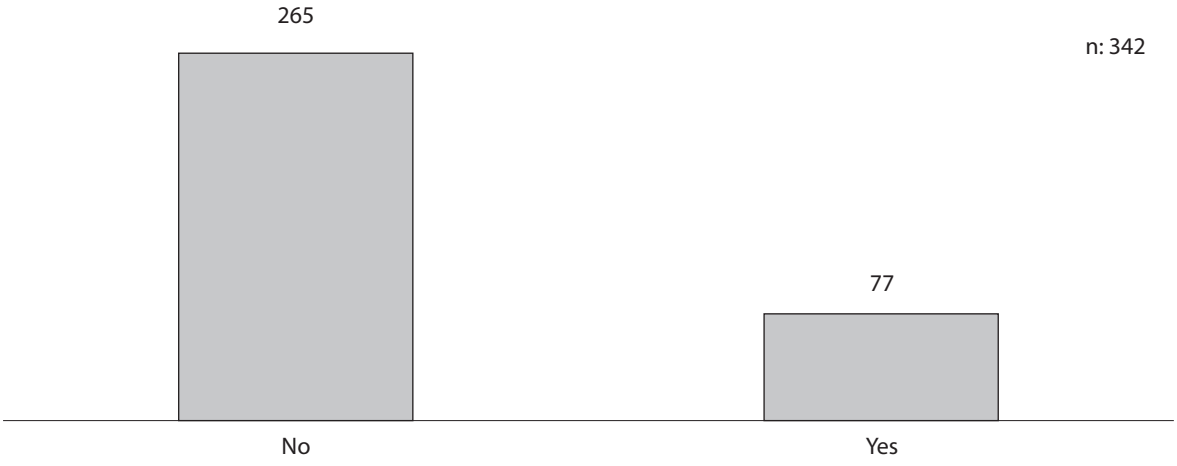
Question F2. Ever planted any of the ACIAR project varieties. Data source: ACIAR survey.



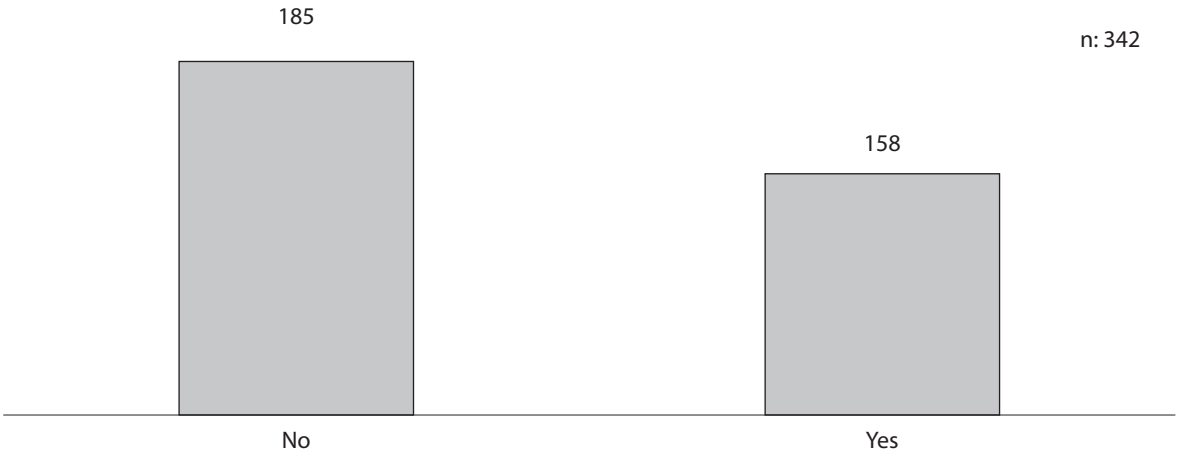
Question F3. Ever planted other improved maize varieties. Data source: ACIAR survey.



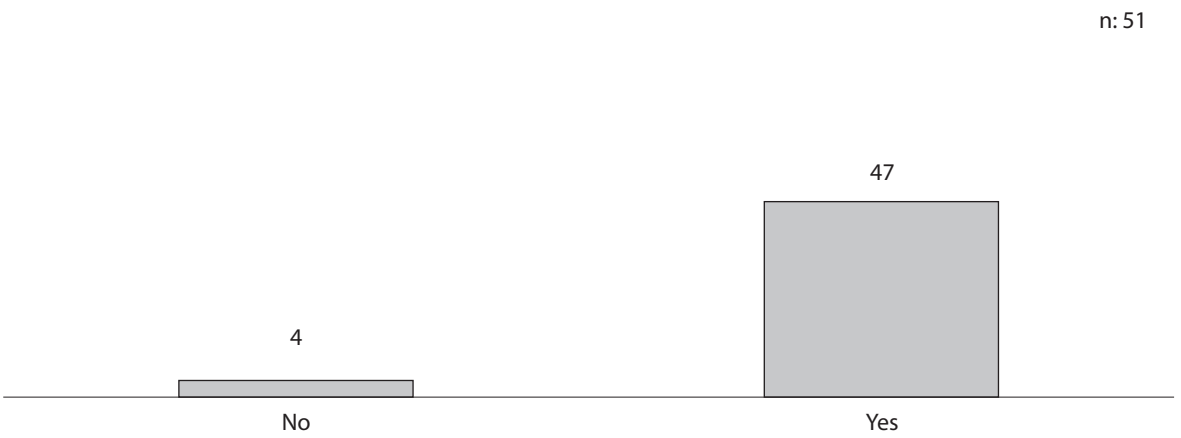
Question F5. Use of fertiliser with improved seed. Data source: ACIAR survey.



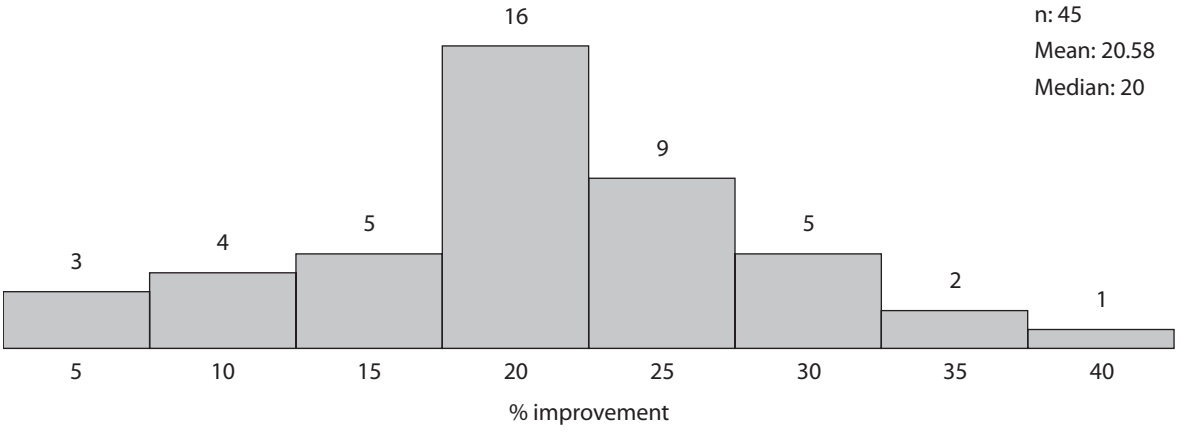
Question F6. Believe other farmers in village plant improved maize varieties. Data source: ACIAR survey.



Question F7. Believe improved maize seed gives higher yields. Data source: ACIAR survey.

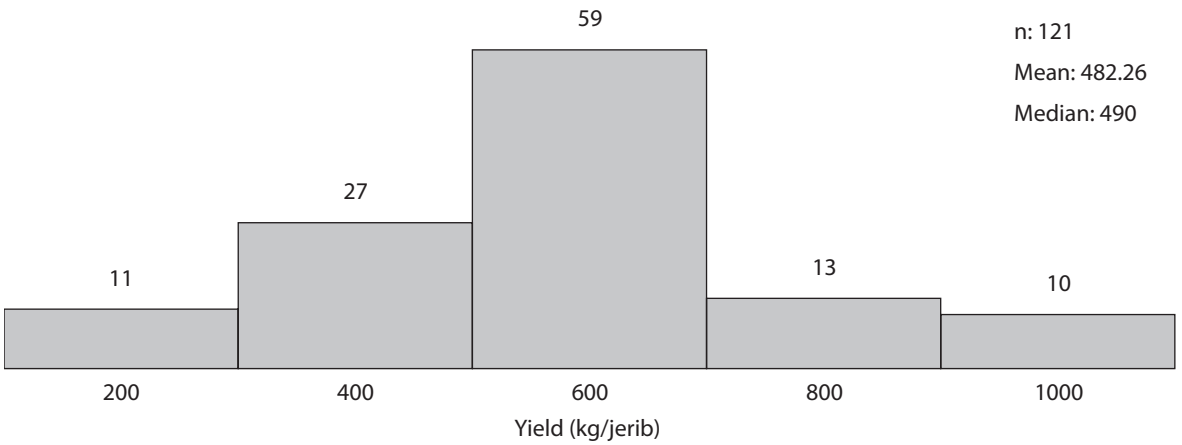


Question F8. Have increased plantings of improved maize seed in recent years. Data source: ACIAR survey.

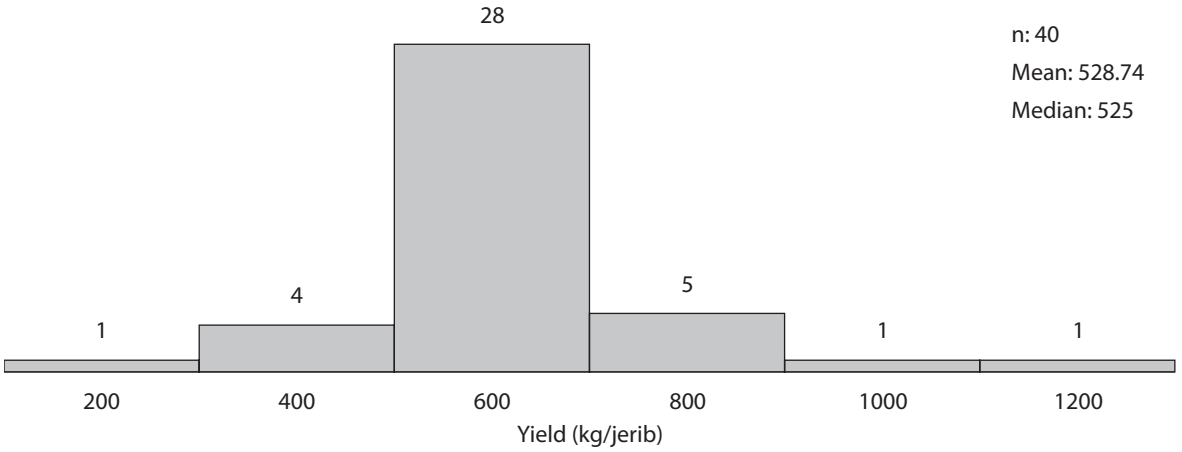


Question F9. Improvement in maize yield as a result of planting improved maize seed. Data source: ACIAR survey.

Detailed maize production details



Questions F10–17. Yield, local varieties. Note: Figure excludes outlier yield (2,400 kg/jerib). Data source: ACIAR survey.



Questions F10–17. Yield, improved varieties. Data source: ACIAR survey.

Appendix 4: Qualitative information from the survey NGOs

As part of the survey, ACIAR asked partner organisations to integrate the collected data with their comments and analysis on the adoption of improved varieties. The comments were included in the final reports each organisation submitted to ACIAR after completing the survey. They outline key challenges and observations as well as selected beneficiary responses. Because NGOs assisted with on-the-ground (field) work, their inputs and comments are highly valuable and are summarised in Tables A4.2, A4.3 and A4.4.

Table A4.1. Survey coverage and implementing organisations

Partner organisation	North	North-east	Central	East
CHA	Balkh			
ACTED		Baghlan		
ACTED		Kunduz		
ACTED		Takhar		
SAB			Kabul	
MADERA				Nangarhar
MADERA				Laghman

ACTED = Agency for Technical Cooperation and Development; CHA = Coordination of Humanitarian Assistance; MADERA = Mission d'Aide au Développement des Economies Rurales; SAB = Solidarité Afghanistan Belgique.
Source: CIE.

Table A4.2. Challenges and observations

Key challenges / observations	North	North-east	Central	East
Security impacts on farmers	Security affected farming and agribusiness, especially in insecure and vulnerable districts. Lack of security restricted farmers from going to their farms and even resulted in loss of life in some families. In certain districts, farmers visited their farms in groups due to security concerns and returned home before sunset.	Farmers in a few districts postponed certain farming activities, which affected the yields of their crops. A number of security issues, including ethnic clashes, the Taliban, warlords/ armed commanders and groups running the opium trade, have created problems for farmers.	Overall security situation in Kabul considered satisfactory, although farmers remain uncertain about the future.	Lack of security affects farmers and their ability to travel to the local market. It may damage their livelihoods if they cannot send their product because of unsafe roads.
Security impact on surveyors	The field team completed its interviews while guarded by armed local men in the Chimtal district.	In some cases, surveyors were unable to visit farmers on their farmland because of security concerns and had to conduct interviews in the village centre.	One security problem was identified in Chahar Asyab district, where an insurgent movement was active. As a result, a different village was selected.	Poor security prevented surveyors from taking pictures and bringing GPS devices to the field.
Illiteracy	Most of the respondents were not literate and some were unable to understand the questions asked.			Communication with some staff members was at times difficult due to their low level of education or limited English. This was an administrative issue in the survey process.
Respondent expectations			Some farmers were unwilling to respond to the questionnaire or expected to receive something in return. In some cases, that expectation modified the statement of the respondent. To minimise this challenge, teams were instructed to explain the survey's objective clearly before the start of the survey.	Some answers may have been biased, particularly if farmers thought their answers would influence a future project. However, surveyors ensured that objectives were clearly defined and asked questions in an appropriate manner to ensure truthfulness in responses.

Source: NGO final reports.

Table A4.3. Key reasons preventing adoption of improved varieties

Reason	North	North-east	Central	East
Lack of appropriate knowledge	A considerable number of farmers did not have accurate information about improved seeds and how to plant them.	Poor knowledge about improved seed varieties was identified as the primary factor limiting adoption. Local seed that has been tried and tested remains the default requirement of farmers, despite its acknowledged poor quality. Many farmers were not even aware of the names of improved varieties on offer.	Farmers who received improved seed had low knowledge of its application and were often not able to increase their productivity. Technical training is recommended for farmers, including in appropriate agricultural practices (seed selection, land preparation, irrigation, fertilisation, integrated pest management, harvesting and storage).	Many interviewees were reluctant to use improved seed as they did not know the advantages of planting it. There was also confusion about the names of improved varieties (the same variety was often known by different names).
Lack of trust between buyer and seller (or distributor) and consequent lack of reliable sources of improved seed		Demand for improved varieties may have been limited by poor trust between buyers and sellers. Farmers stated that improved seed was often simply labelled as 'improved' despite being of the same poor quality as local seed. The significantly higher price in local markets for improved seed also meant farmers had to take on much greater risk.	The limited number of traders working in improved seed multiplication is another factor limiting the use of improved seed. Farmers who know the potential of improved seed and are motivated to cultivate it are not able to obtain clear information on qualities of the different varieties or to obtain pure and quality seed.	
Lack of follow-up and distribution issues			More than three varieties were distributed in one village, in which farmers received different amounts of each variety. Farmers said that they become confused about the presence of different varieties of wheat seed with different quantity of production.	Farmers reported that after 2 or 3 years the distributed improved seed was now mixed with local varieties and the results were not as good as expected. This is linked to poor training and lack of information. Other farmers indicated that they didn't receive the improved seed because the village heads kept it to sell in the local market or for their own cultivation.

Continued…

Table A4.3. (continued) Key reasons preventing adoption of improved varieties

Reason	North	North-east	Central	East
Off-season seed distribution		Some farmers reported poor harvests or crop failures after using improved seed varieties in the wrong season or using a poor methodology.	A variety that is appropriate for autumn was distributed in spring or winter. Sometimes seed was distributed to farmers very late and they could not cultivate on time. They saved the seed and cultivated it in the next season, which was not appropriate. This caused a significantly decreased yield and affected the overall popularity of improved seed among all village farmers.	Some seed was not adapted to the weather in the targeted areas: winter or cold weather seed may have been distributed in spring or summer. This may also be linked to a lack of appropriate information.
Lack of relevant training		There were concerns over the type of soil needed, the planting methods, watering requirements and harvesting limited the adoption of improved varieties.	During the growing season, most farmers do not have access to irrigation water but receive and cultivate improved varieties, which results in low yields due to the shortage of water. Because of their limited training and knowledge, farmers judge that the problem is with the seed and return to their local varieties.	

Source: NGO final reports.

Table A4.4. Recommendations for encouraging farmers to adopt improved varieties

	CHA	ACTED	SAB	MADERA
Raise awareness	Conduct awareness-raising campaigns aimed at increasing knowledge about the benefits and productivity of improved seed, particularly when proper methods are followed.	Increase awareness of all aspects of improved seed, including the benefits, how to identify the seed, and how to ensure good quality when purchasing the seed. This should also include how to plant and care for the crop and the levels of irrigation needed. A potential way to increase awareness would be to identify the heads of agricultural cooperatives and hold a workshop on the seed varieties.	The activities should not be limited to seed distribution. Most farmers' knowledge is very limited and they always concentrate on traditional techniques. Appropriate information must be communicated to rectify ignorance.	Information leaflets should be distributed with the seed to support the oral information given by the teams organising the distributions. Another way to increase awareness is to implement a demonstration plot before the distribution to show that improved seed has a better yield than local varieties. Alternatively, organising exchange visits between farmers who are encouraged by improved seed and those who are reluctant.
Conduct appropriate and relevant training	Workshops and training would be useful in teaching the farmers methods of using improved seed, the timing and quantities of seed and fertiliser on a given piece of land in rainfed and irrigated systems, and how to look after the crop.		The seed receivers should be trained in all technical aspects, such as varietal characteristics, the selection of seed, land preparation, cultivation techniques, irrigation, fertilisation, integrated pest management, weed control and harvesting (including sorting, grading and storage).	Farmers appear to want more training in wheat cultivation, maize cultivation, seed selection, seed storage, pest/disease control, weeding, removal of haulms, and irrigation techniques.

Continued…

Table A4.4. (continued) Recommendations for encouraging farmers to adopt improved varieties

	CHA	ACTED	SAB	MADERA
Improve availability and accessibility of seed	Make improved seed available to farmers as and when they need it, particularly during the planting season. Most farmers complained of not having access to enough improved seed.	Some farmers stated that improved seed was not readily available in the market. An increased awareness of how to identify the seed, or areas where it is possible to purchase approved seed, would minimise distrust and increase the sowing of the crop. Identify sellers at the district level who would become approved sellers, provide guarantees with the seed, and inform agricultural cooperatives and district/provincial government agricultural organisations of their locations.	Sources of improved seed are scarce and farmers are not able to easily obtain seed on time. Farmers who received and planted improved seed are not properly trained in seed harvesting techniques. Many end up mixing the improved variety with another variety, which decreases production. After two or three years, the seed becomes ineffective. The establishment of cooperatives or local associations would help to produce seed and also would ensure that farmers receive inputs on time.	
Ensure on-time delivery and suitable distribution		A number of farmers who had received improved seed from the government or NGOs stated that they had received the seed at a unsuitable time of the year. When it was time to sow, the seed had been spoilt, sold or mixed in with standard subquality seed. Distribute seed about a month before sowing to ensure that poor quality seed is not purchased and that farmers use the distributed seed.	Planned seed distribution should meticulously respect farming times. The suppliers should provide seed to farmers at least a month before sowing. As the agroclimate in Kabul province is diverse, all activities need to be planned in advance. Farmers should be trained properly to enable them to classify the varieties according to their season specifications and thus avoid the wrong variety in the wrong season.	Seed should be distributed directly to farmers. Distributing to a focal point (local authority or village head) in charge of dispatching the seed bags adds greater risks of corruption, and targeted beneficiaries might not receive bags on time, or at all.

Continued…

Table A4.4. (continued) Recommendations for encouraging farmers to adopt improved varieties

	CHA	ACTED	SAB	MADERA
Enhance follow-up and monitoring	Follow-up was limited once seed had been distributed. Farmers in one district complained that they had planted improved seed and the harvest was not good, but there was no follow-up on why and how to find better ways to improve yields. Follow-up must therefore be an integral part of the distribution program.		For sustainable agriculture projects, long-term follow-up is required. Because of their short duration, most of the implemented projects have not given positive results. A long-term follow-up system is essential to increase the ownership of projects and the adoption of improved varieties in the long term.	Better monitoring would allow problems to be identified promptly, allowing readjustment of the distribution process, the information given and/or the training, as required.

Source: NGO final reports.

Beneficiary stories

CHA: Success story in Balkh

Hazratullah, a resident of Qizel Kend village in Sholgara district, has plenty of agricultural land and plants improved wheat as much as possible. However, since he does not have enough improved seed, in most of the cases he also plants traditional/domestic wheat.

Hazratullah said, 'Every year, I plant improved wheat, to the extent I get the improved seed, on several jeribs of my land, and the yields are also very good at the end. However, NGOs do not support us with enough of the improved seed.'

When asked why he does not keep enough improved seed from the harvest for the next planting season, Hazratullah replied, 'There is a problem. When we plant improved wheat in a piece of our land, we get a very good result. But when we use our yields and stocked wheat the following year, the yield is not the same as the previous year. The productivity goes lower and lower every year.'

CHA: Failure story in Balkh

Zabihullah, a resident of Bay Ghazy village in Keshendeh district, has information about improved wheat but has not planted it on his land, which is in two lots totalling 15 jeribs. Every year, he works only on one piece and keeps the other half without any crop, to be prepared for cultivation in the following year. Because he does not use fertilisers, the land would lose its productivity if he cultivated it every year.

Zabihullah said, 'For some years, in the past, I used to plant improved wheat on my farm, but I observed a decrease in its productivity year after year. Initially, we were thinking the decrease was due to lack of rainfall, as our lands are all rainfed. However, we have not been able to have a good harvest even in the years when there was enough rain, and the yields were lesser and lesser every year. Sometimes, the harvest was nothing more than a handful of grass and thorns. As a result, we decided not to plant improved seed anymore.

'Now no-one plants improved wheat in my village', he said, 'because we did not get good yields and, in some cases, we were not even able to get back what we had planted.'

ACTED: Success story in Baghlan

Abdullah, a farmer from Wardak Payan village in Puli khumri district, said, 'I used the variety of seed called Ghori-96 during the last season and I have cultivated the seed promptly and monitored my land regularly. As a result, I have collected a much better harvest compared to other farmers who used the local seed. If I receive the seed from a reliable source in good time and receive some better training in how to cultivate the crop, I think my land will be much more productive and yield even more.'

ACTED: Failure story in Baghlan

Ghulam, a farmer from Noman village in Puli khumri district, said, 'Last season I did not get the improved seed. I bought seed for my land from the local market and, like usual, I cultivated my land and monitored my crops. I also irrigated the land in a timely manner. Unfortunately, I did not get a good yield or quality of crop. I do not know if the result was my fault because of the way I cultivated the land, or if it was because of the poor quality of the seed I used.

'A good solution for me would be to receive good quality seed varieties from a good source, and be confident about how to use my land better to get higher crop yields in the future.'

SAB: Success story in Kabul Province

Mohammad Afghan is a farmer from Mulla Khel village in Bagrami district. He cultivates improved wheat on his land. He said, 'Before farmers in our village used local seed which had low yield, but after the introduction of improved wheat varieties we obtained high yields. Therefore, most of farmers in the villages are currently cultivating improved wheat seed for more benefit.'

The farmers are cooperating with each other. He said, 'Each year when I have harvested, interested farmers from other villages have requested the improved seed (Gul-96). Therefore, to support them, I distribute Gul-96 improved seed to other farmers by loan, selling and barter. I am very happy to support other village farmers and I will continue to do so. Even if farmers from other villages or districts are interested in receiving improved seed I will support them.'

SAB: Failure story in Kabul Province

Qala ye Baqi village is in Paghman district. A total of seven respondents were surveyed in this village. Most of them told to survey team that they had never received improved wheat seed from any organisation. The issue was discussed with the village elder, who confirmed what the farmers said.

All farmers in the village claimed that they used their own local seed. The survey team contacted the district agriculture department. The agriculture officer said that farmers in Qala ye Baqi received improved wheat seed three times (Solh-02 in 2006, Mazar-99 in 2007 and Lalmi-3 in 2011). He said that the village elder was present during the distribution. The improved seed was not adopted by farmers because of a lack of water in the village. They currently cultivate their own saved local varieties.

MADERA: Success story in Nangarhar

Dr Issa, our provincial coordinator for Nangarhar, told us the story of Ihsanullah, a farmer from the village of Shabdeyani in Bati Kot district. Ihsanullah received improved seed of a variety called PBg and cultivated it on 7 jeribs of his land. He was very satisfied with the wheat's quality and yield (about 1,050 kg/jerib). He would greatly appreciate receiving additional seed of improved varieties, as the increase in his production generated more benefits. He also appreciates the fact that he learned a lot using the seed and from NGOs and humanitarian aid actors.

But this has to be counterbalanced with some remarks:

- Ihsanullah is an experienced farmer and he has enough land to take the risk of changing both the varieties cultivated and his agricultural practices.
- He was already interested in the idea of improved seed.
- He is in regular contact with MAIL at the district level and with NGOs. He uses good practices and is an 'initiator' for some projects.
- He lives close to the city (about 15 km from Jalalabad).

Unfortunately, most farmers are not like Ihsanullah. They do not have enough information and are often

reluctant to risk adopting a variety of seed other than the one they are used to planting. One idea could be to organise exchange visits between farmers in order to allow them to see the benefits of being a successful farmer.

MADERA: Failure story in Laghman

Abdulfatah is a farmer living in the village of Hindur in Mehterlam district of Laghman Province. He said that he had not adopted the improved variety that he has received, because after a few years all varieties of seed are mixed and do not produce good results any more. He relies on his local variety because he has planted it many times and he knows how to store, handle and cultivate it.

He explained that maybe if he received training on improved seeds and their cultivation methods, and even about new agricultural technologies, he could consider adopting an improved variety. He wants to use the best variety for his land and get a greater yield, but does not know about the resistant and quality varieties. People in the region are generally reluctant to change and have a low level of trust. They need to see successful examples of what works before they engage in new practices or activities.

Nevertheless, he mentioned that his crops suffer from diseases and he cannot increase his production using his local variety. His average yield is 294 kg/jerib, and he wishes it could be more.

Appendix 5: Detailed history of yield in Afghanistan

Recent changes in national yield averages for wheat and maize

Data on national yields in irrigated and rainfed wheat over the 2003–2011 period are plotted in Figure A5.1 (data on wheat yields earlier than 2003 are not available from the FAO reports).

There was no systematic improvement in yields over the 2003–2011 period. Increases in yields for both crops, which were achieved by 2009 after poor performance in previous years, were not sustained in subsequent years.

Bad weather characterised 2006, 2008 and 2011 (for example, there was a drought in 2006) and can account for the falls in yields in those years. Because rainfed wheat farming is more dependent than irrigated farming on rainfall, this can also account for the more significant volatility in rainfed yields.

Within the 2003–2011 period, there were particular years when Afghanistan's wheat yields reached significantly high levels, but those yields were not sustained. In 2003, yields for irrigated wheat were at a high of 2.85 t/ha. In 2009 they were even higher at 2.95 t/ha. The peaks for rainfed wheat were in 2003 (1.09 t/ha), 2005 (1.23 t/ha), 2007 (1.15 t/ha) and 2009 (1.18 t/ha). Rainfall in 2005 and 2007 was also favourable for wheat cultivation. It is not surprising to see that yields for rainfed wheat track rainfall particularly well.

Figure A5.2 compares yields of maize, which was also targeted by the ACIAR programs under evaluation, with yields of rice and barley. The yield trends for all three crops are generally in lockstep, and the poor weather

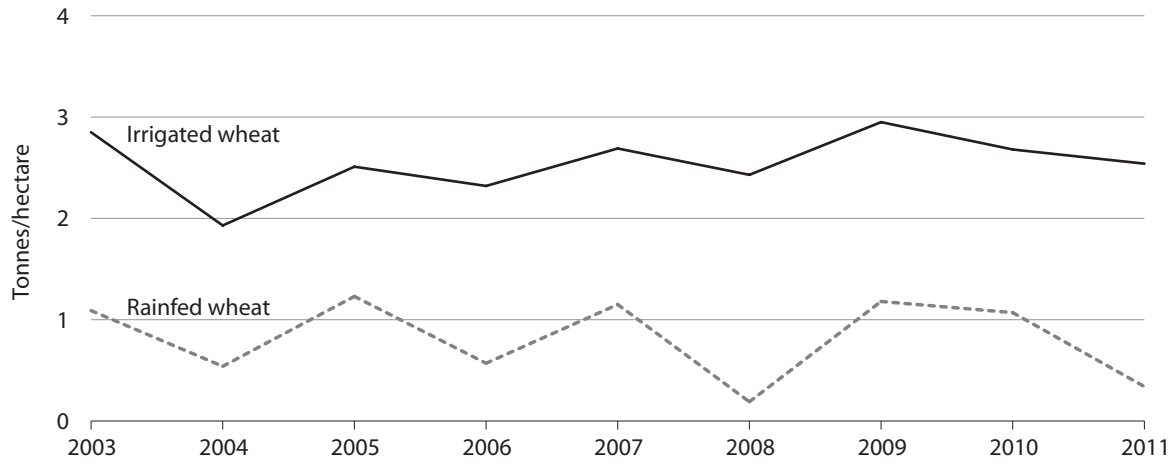


Figure A5.1. Wheat yields, 2003 to 2011. Data source: FAO.

conditions of 2008 and 2011 are evident in the data. The maize yield declined slightly over the period, and there did not appear to be any significant difference between the changes in yields for rice and barley and those for maize. After 2008, there was a brief recovery in yields for all three crops, but a flattening in rice and barley yields after 2009. A fall in maize yields did not occur until 2010.

Figure A5.3 shows the development of national wheat yields in Afghanistan over a longer period (from 1993 to 2010, omitting 2011) and compares them to wheat yields over the same period in India.

The 1993–2010 period was chosen because it allows us to divide the data into two periods of equal length: the period from 1993 to 2001, which was before the implementation of the ACIAR programs, and 2002 to 2010, which covers most of the period of operation of the programs.

India's yields were characterised by a slow but relatively steady increase over the period, with few peaks and troughs in comparison to Afghanistan. Trends in Afghanistan's yields over the 1993–2001 period look different from the trend over the 2002–2010 period, which was characterised by greater volatility but also by more marked improvements in yields. This is illustrated in Table A5.1, which compares the compounded annual growth rate (CAGR) of wheat yields of the two countries over those two periods.

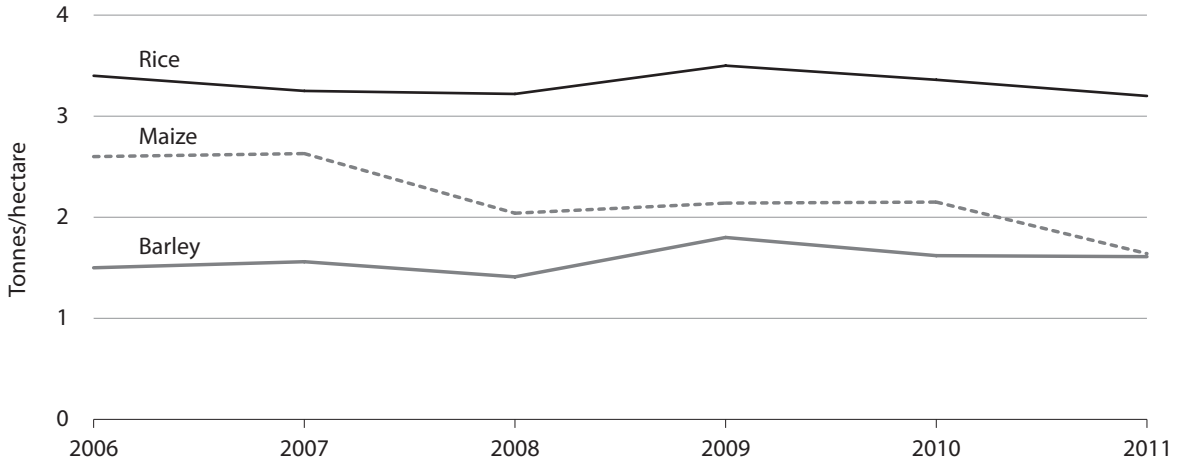


Figure A5.2. Yields of rice, maize and barley, 2006 to 2011. Data source: FAO.

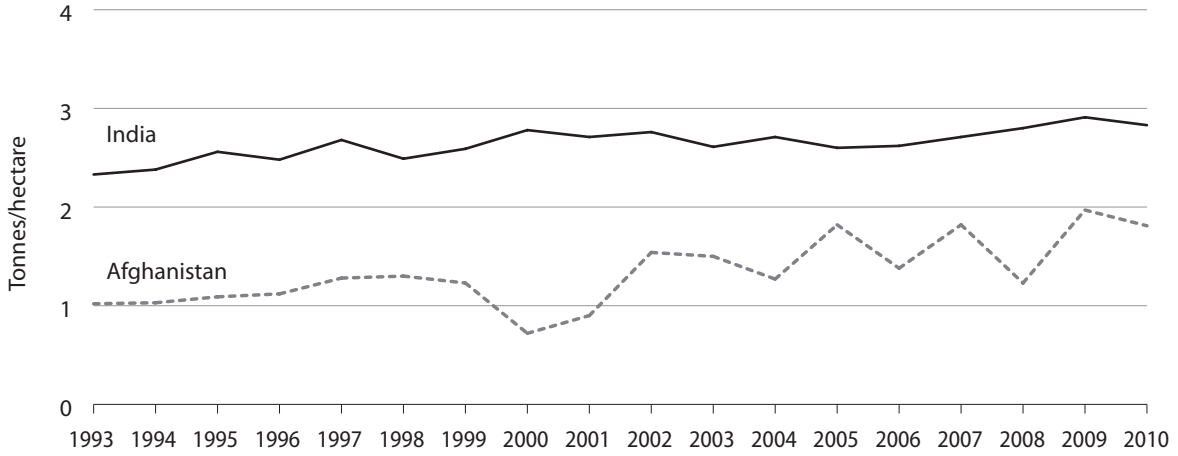


Figure A5.3. Wheat yields in India and Afghanistan, 1993 to 2010. Data source: FAO.

Table A5.1 Wheat yield trends in Afghanistan and India, 1993 to 2010

	Afghanistan	India
CAGR of wheat yield, 1993–2001 (%)	–1.95	1.85
CAGR of wheat yield, 2002–2010 (%)	2.36	0.89

Source: FAO.

While growth was positive for both periods in India, it was negative for the first in Afghanistan. More importantly, notwithstanding Afghanistan's poorer performance in the first period, its CAGR in the second period was higher than India's. Thus, there was a period of significant improvement in wheat yields in Afghanistan over the 2002–2010 period.

We also estimated the mean of wheat yields over the 1993–2001 and 2002–2010 periods in Afghanistan and India (Table A5.2).

Table A5.2. Mean wheat yields in in Afghanistan and India, 1993 to 2010

	Afghanistan	India
Mean of wheat yield, 1993–2001 (t/ha)	1.61	1.72
Mean of wheat yield, 2002–2010 (t/ha)	2.02	2.02

Source: FAO.

Before 2002, Afghanistan's average maize yield over the longer term was lagging India's but it caught up over the 2002–2010 period, when the average was more than 25% higher than in the previous period.

Figure A5.4 and Table A5.3 show maize yield trends, comparing Afghanistan's performance with India's.

India's performance was remarkably consistent over the period, compared to the more volatile changes in yield in Afghanistan. There does appear to be a break between the two periods, insofar as the first period was characterised by a long period of declining yields followed by a sudden increase in 2001. By contrast, the second period was characterised by a fall in yields from 2002 to 2003, but followed by significant increases until 2007. However, the falls in yield from 2008 onwards negated a large proportion of the gains that were made from 2003.

Nonetheless, Afghanistan's maize yield growth rate in the second period was a substantial improvement over the negative result for the first period and also exceeded India's average yield growth.

Table A5.3. Maize yield trends in Afghanistan and India, 1993 to 2010

	Afghanistan	India
CAGR of maize yield, 1993–2001 (%)	–0.81	3.17
CAGR of maize yield, 2002–2010 (%)	4.73	2.05

Source: FAO.

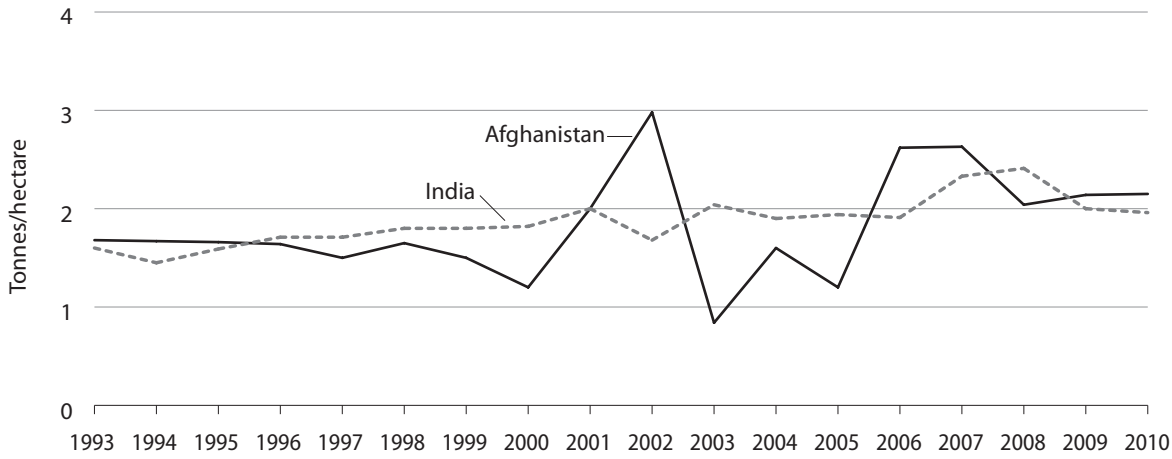


Figure A5.4. Maize yields in India and Afghanistan, 1993 to 2010. Data source: FAO.

We also estimated the mean of wheat yields over the 1993–2001 and 2002–2010 periods in Afghanistan and India (Table A5.4).

Table A5.4. Mean maize yields in Afghanistan and India, 1993 to 2010

	Afghanistan	India
Mean of maize yield, 1993–2001 (t/ha)	1.08	2.55
Mean of maize yield, 2002–2010 (t/ha)	1.59	2.73

Source: FAO.

Yields in targeted provinces

The provinces targeted by the ACIAR programs as demonstration sites for new strains of wheat, new farming methods, or both, included Balkh, Kabul, Parwan, Baghlan, Kunduz, Badakshan, Nangarhar, Laghman and Herat:

- Parwan was one of four areas where demonstration plots of Solh-02 and Gul-96 were grown from 2005. The others were Baghlan, Badakshan and Kunduz.
- Kunduz, Balkh and Herat were the sites of breeder seed production of Solh-02 and Parva-2 in 2005.
- Kunduz and Herat were also sites where a range of other promising strains, such as Lalmi-1, Daima-96 and PBW-154, were sown in small plots.
- Kabul, Nangarhar, Laghman and Parwan were sites for on-farm demonstrations of the base seed of the new wheat variety Chonte #1.
- Laghman was singled out as a district where farmers who had previously produced opium might be induced to plant legal crops, such as wheat, because of these demonstration projects.

Although other provinces, such as Mazar and Darul Aman, were also targeted, data on wheat yields in those provinces are not available from the FAO.

The figures below compare trends in total wheat yield (the average of irrigated and rainfed wheat yields) in the selected provinces with their regional averages (excluding the contribution from the selected provinces). The selected provinces experience similar weather conditions, such as rainfall, to other provinces in the same region.

Balkh's yield trends are consistent with those for the region (Figure A5.5). While yields are higher in Balkh, the difference between Balkh and the rest of the north did not change over the period.

The pattern of results for selected north-eastern provinces is similar (Figure A5.6). While there were absolute differences in yield, there was no apparent pattern in the changes in those differences over time.

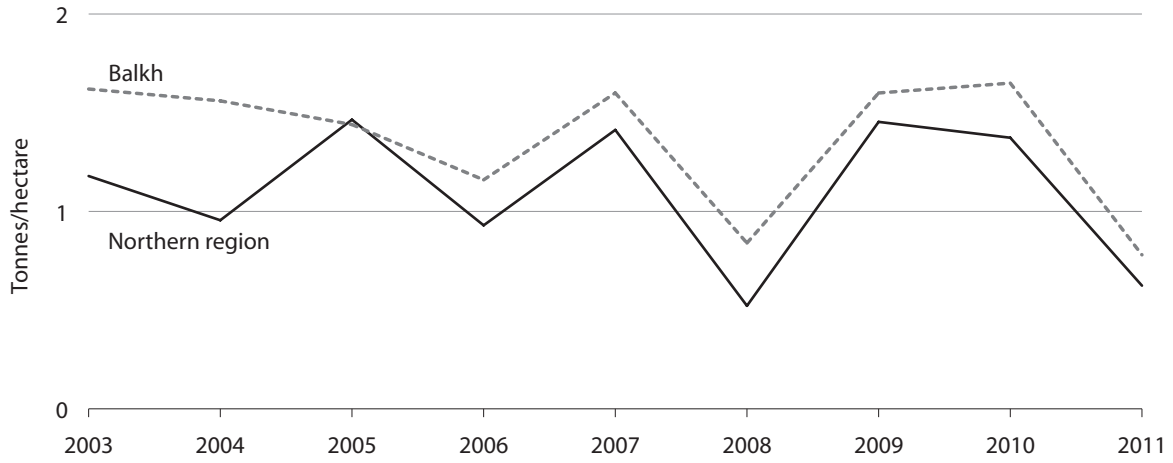


Figure A5.5. Wheat yields: Balkh vs northern regional average, 2003 to 2011. Data source: FAO.

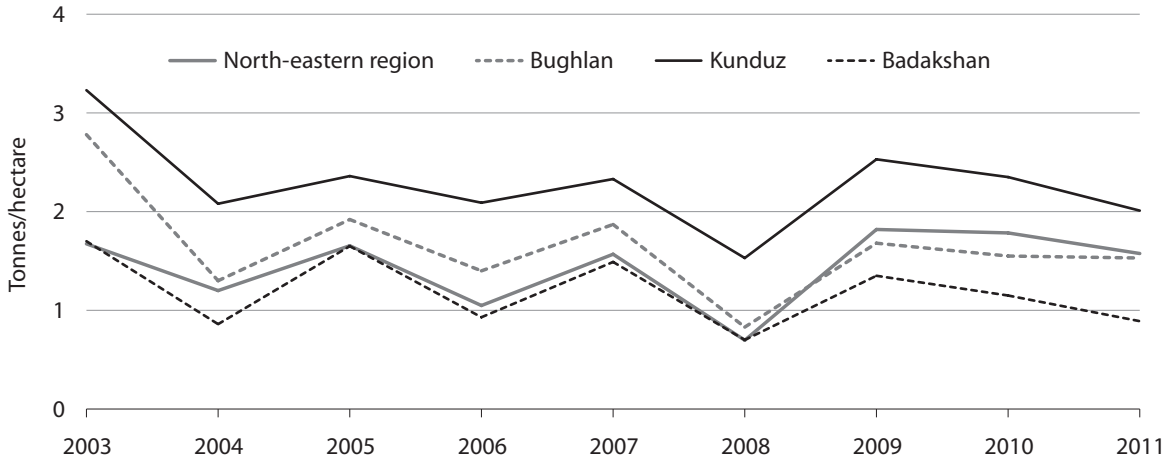


Figure A5.6. Wheat yields: Bughlan, Kunduz and Badakshan vs north-eastern region, 2003 to 2011. Data source: FAO.

Figure A5.7 compares yields in Kabul and Parwan to the average for the central region. With the exception of the 2010–2011 period, Parwan did not perform significantly better than the region. From 2006, Kabul's performance closely tracked the regional average until around 2008, when it exceeded the average.

Herat's performance over the entire period was slightly above the regional average, although it showed the same pattern of changes over time, again with no evident pattern of divergence (Figure A5.8).

While Nangarhar's performance closely tracked the average for the eastern region, Laghman's yield performance was significantly above the average for the period (Figure A5.9). Importantly, the divergence has increased over time.

Figure A5.10 shows the average wheat yields for the targeted provinces and compares them to the yearly averages for wheat yields in the rest of Afghanistan. As in the previous comparisons, there is no evidence of relative increases (over time) in yields for the selected provinces compared with the remainder of Afghanistan.

Figure A5.11 compares the average CAGR of wheat yields for selected provinces with the national growth in wheat yields.

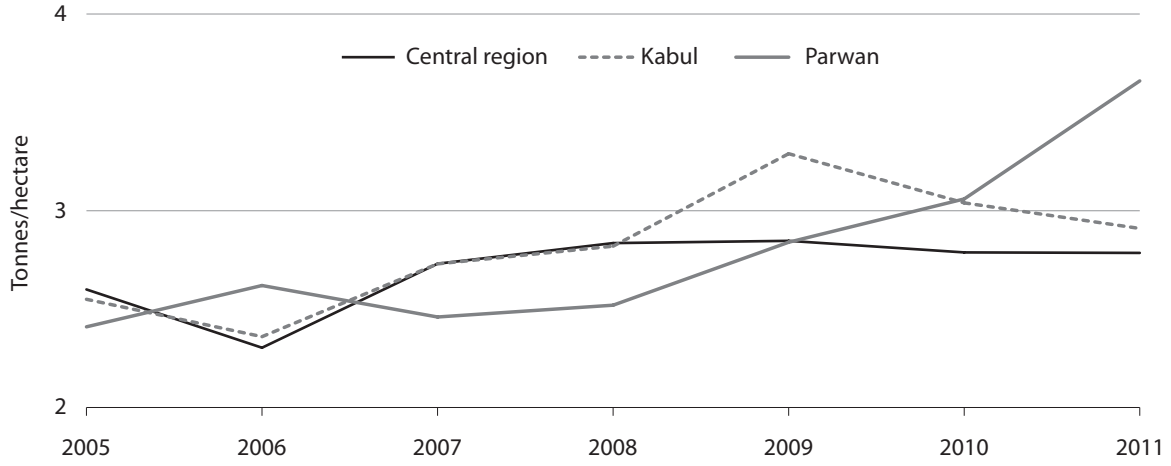


Figure A5.7. Wheat yields: Kabul and Parwan vs central region, 2005 to 2011. Data source: FAO.

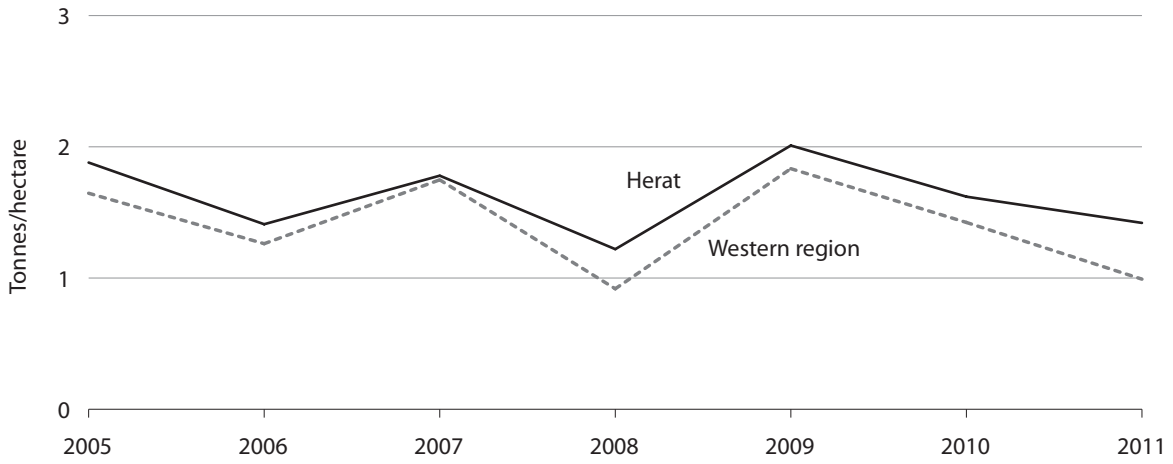


Figure A5.8. Wheat yields: Herat vs western region, 2005 to 2011. Data source: FAO.

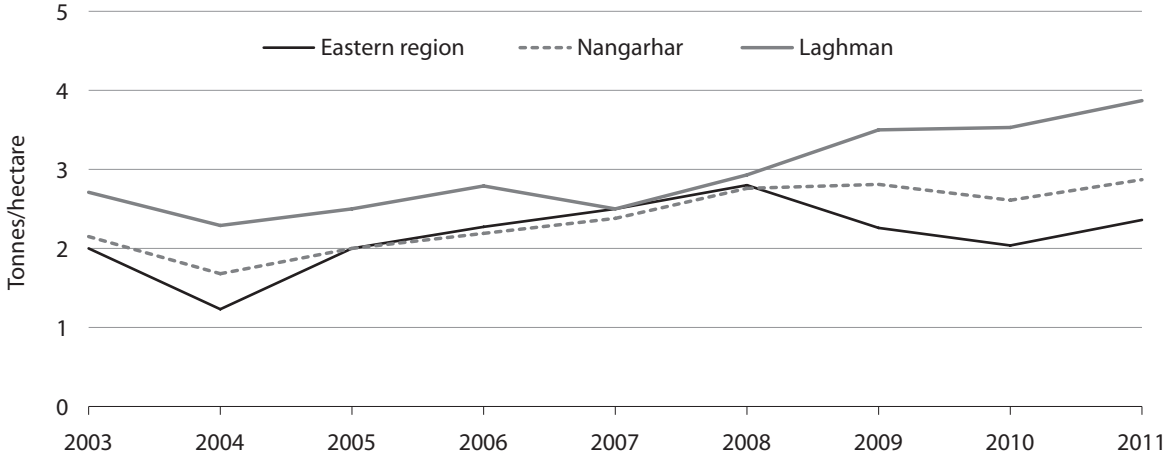


Figure A5.9. Wheat yields: Nangahar and Laghman vs eastern region, 2003 to 2011. Data source: FAO.

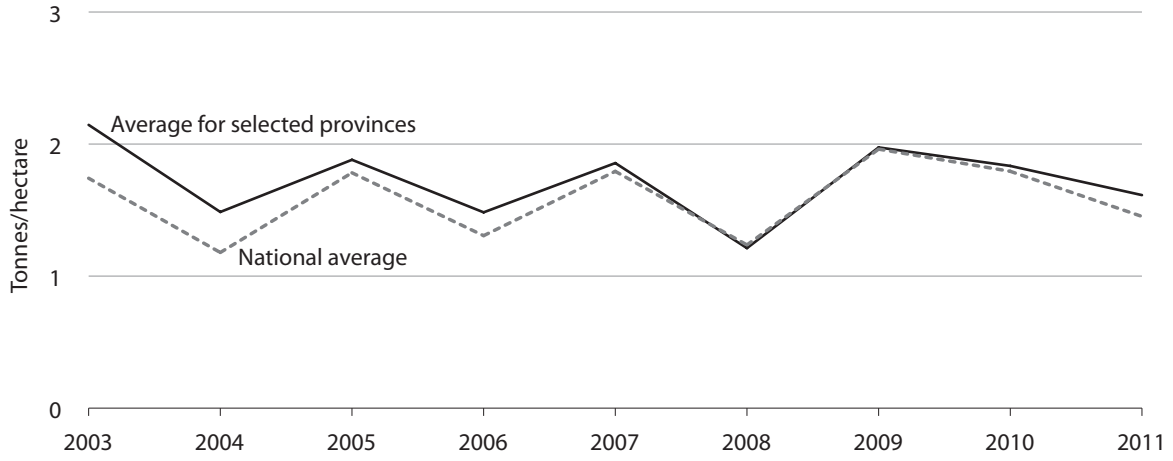


Figure A5.10. Average wheat yield for selected provinces vs national average, 2003 to 2011. Data source: FAO.

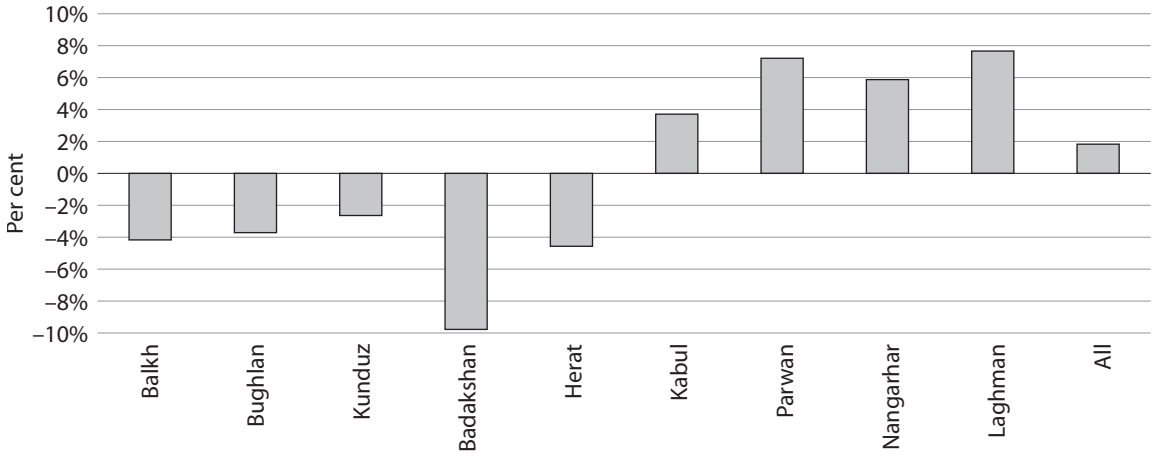


Figure A5.11. Compounded annual growth rate of wheat yields in targeted provinces vs national average, 2005 to 2011. Data source: FAO.

Slightly fewer than half the targeted provinces experienced annual yield growth above the national average. Five experienced declines (Herat and Badakhshan being the worst performing provinces). However, it is difficult to disentangle performance relative to the national average for those provinces because of the common weather conditions they may have faced, given their locations.

Of all the provinces studied, only Badakshan recorded performance both below the national average and consistently below its own regional average. Taking into account the common weather conditions Badakshan faced with other provinces in its region, this suggests that it is the only province where the ACIAR programs did not have any performance-raising impacts.

Kabul, Parwan, Nangahar and Laghman experienced yield growth significantly above the national average. This partly reflects the fact that the eastern and central regions performed well above the national average due to more favourable weather conditions. However, all these provinces performed close to or well above the average for their regions.

The strong performance in Laghman provides some indirect support for the claim that these initiatives may be likely to reduce incentives for the illegal cultivation of opium in the province.

Cultivation area

Figure A5.12 shows the cultivation area for irrigated and rainfed wheat over the 2006–2011 period. The size of the area planted to rainfed wheat is more volatile because rainfed cultivation is highly dependent on favourable weather. Ignoring 2011, there was a small increase in cultivation area for both irrigated and rainfed wheat through to 2010. The most noticeable increase for both types of cultivation was in 2009. The area planted to rainfed wheat also increased from 2006 to 2007.

Figure A5.13 plots wheat and maize cultivation in Afghanistan over the 1993–2010 period. The 1993–2001 period was characterised by a decline in cultivation area for both crops, especially for maize, but in the 2002–2010 period there was significant growth in both.

There was a nearly 4% per year increase in the cultivation area for wheat over the 2002–2010 period (Table A5.5). The annual growth rate for the period was higher than the annual increase in India in the same period.

However, the area planted to maize declined due to significant volatility, even if more slowly than in the 1993–2001 period.

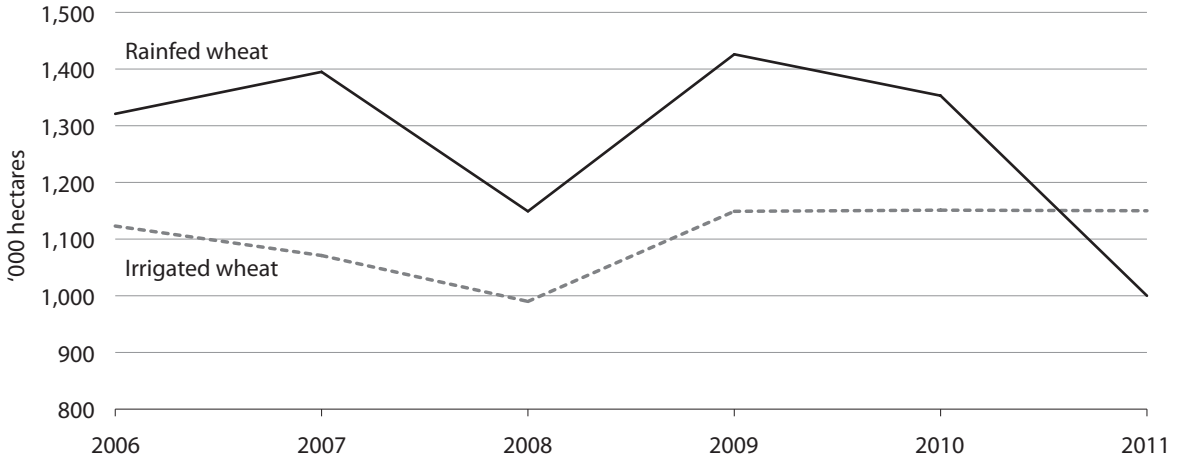


Figure A5.12. Cultivation areas of irrigated and rainfed wheat, 2006 to 2011. Data source: FAO.

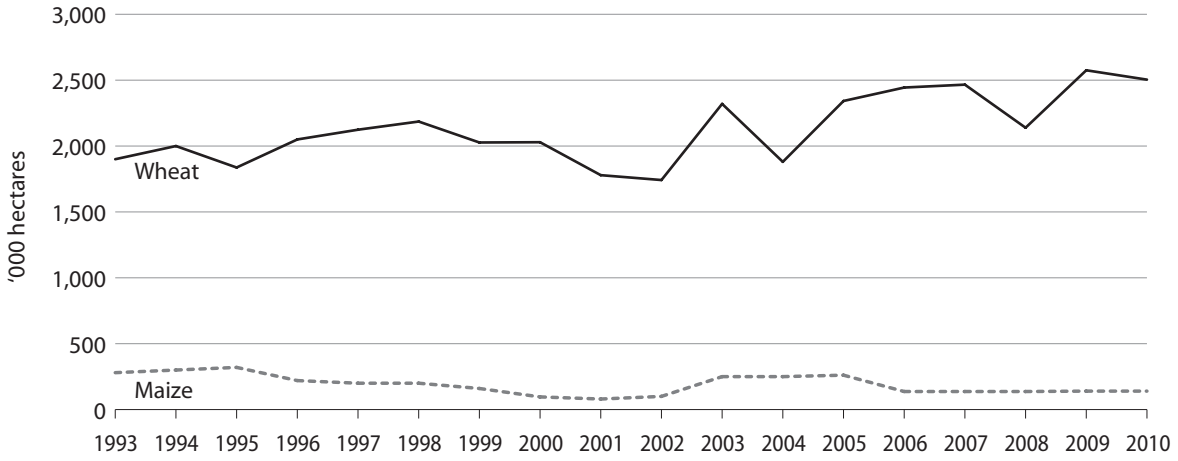


Figure A5.13. Wheat and maize cultivation in Afghanistan, 1993 to 2010. Data source: FAO.

Table A5.5. Wheat and maize cultivation area trends in Afghanistan and India, 1993 to 2010

	Afghanistan	India
CAGR of wheat cultivation area, 1993–2001 (%)	–0.07	1.09
CAGR of wheat cultivation area, 2002–2010 (%)	3.52	1.3
CAGR of maize cultivation area, 1993–2001 (%)	–15.23	1.2
CAGR of maize cultivation area, 2002–2010 (%)	–3.67	1.6

Source: FAO.

Rainfall patterns, other physical factors and agricultural productivity

Rainfall patterns have a significant impact on yields. While too little rainfall in a given year can lead to reduced yields, too much rainfall, insofar as it leads to flooding and therefore crop damage, can also lead to smaller yields.

The rainfall data we have put together begins from 2007, as detailed rainfall data at the regional and provincial levels are only available from that time. The figures are for rainfall from the latter part of the previous year to the early part of the named year, as that period covers the crop growing cycle (which is from either October to March or November to April).

Figure A5.14 shows the rainfall for the northern provinces from 2007 to 2011.

For comparison, average annual wheat yields for the northern region as a whole are shown in Figure A5.15. The peaks in rainfall in 2007, 2009 and 2010 for most of the northern provinces coincided with peaks in wheat yields over the same period. The main troughs in rainfall in 2008 coincided with falls in yields in that year. A fall in yields was also recorded in 2011. Although rainfall in 2011 does not appear to have been substantially lower than in 2010, there were declines in rainfall in three out of the four provinces, including a clearly significant reduction in Juzjan.

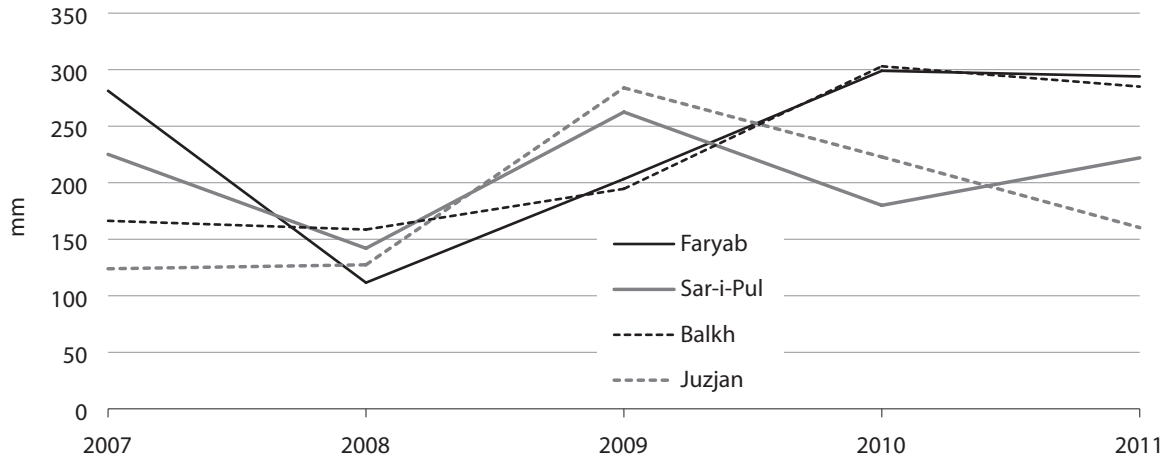


Figure A5.14. Annual rainfall over the crop growing cycle, northern provinces, 2007 to 2011. Data source: FAO.

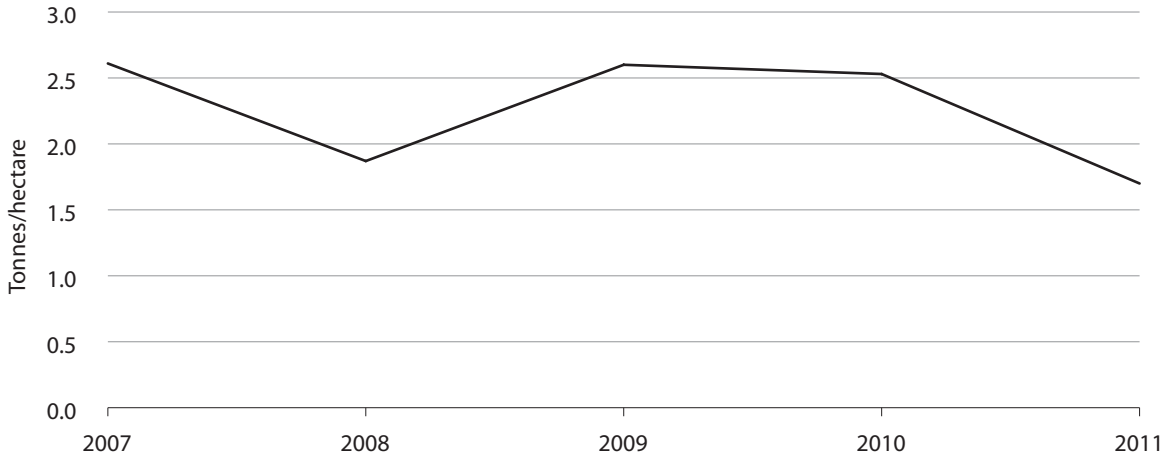


Figure A5.15. Average annual wheat yields in the northern region, 2007 to 2011. Data source: FAO.

Similar relationships for the north-eastern region are shown in Figures A5.16 and A5.17. For example, the poor rainfall in the north-eastern provinces was matched by steeply declining yields in the region in 2008, while an increase in rainfall in 2009 in three out of the four provinces was matched by yields greater than in 2007.

Rainfall patterns differed slightly in the eastern region. For example, while the eastern provinces also had 2009 as a peak rainfall year, a decrease in rainfall was observed in 2010 before a modest increase in 2011. Nonetheless, the wheat yields in the region as a whole broadly matched the peaks and troughs of rainfall in both the north-east and the east.

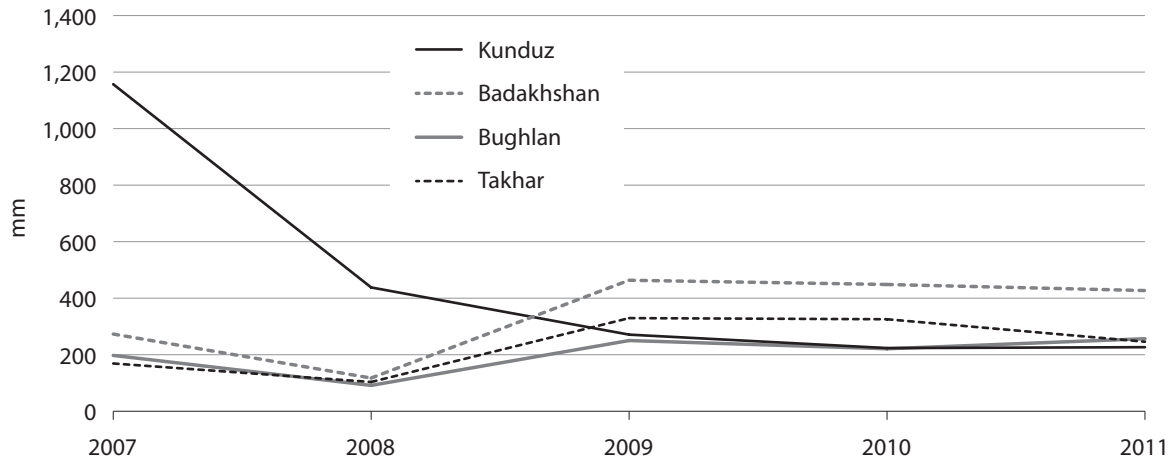


Figure A5.16. Annual rainfall over the crop growing cycle, north-eastern provinces, 2007 to 2011. Data source: FAO.

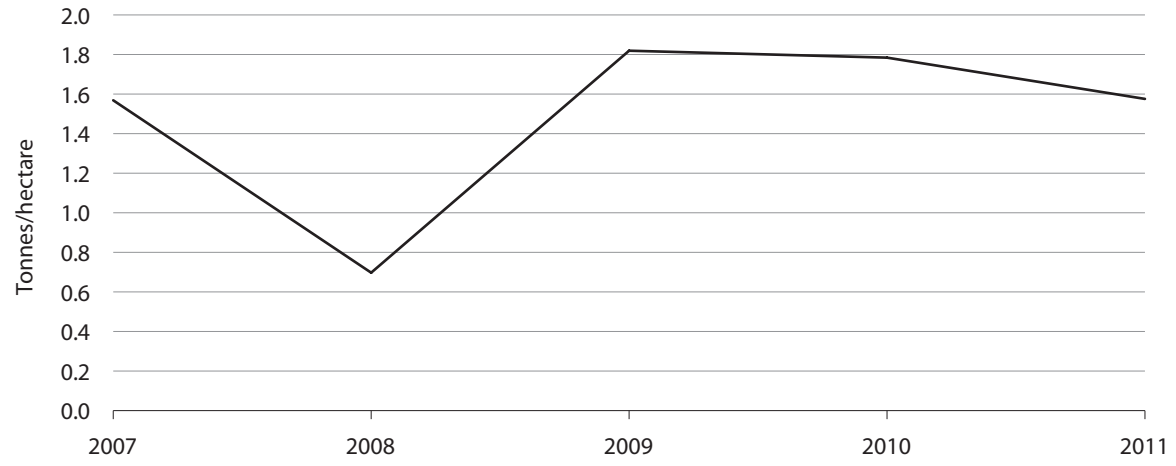


Figure A5.17. Average annual wheat yields in the north-eastern region, 2007 to 2011. Data source: FAO.

The relationship appears to be less clear-cut for the eastern provinces (Figure A5.18). While rainfall declined in 2008, yields increased (Figure A5.19). However, in other years, yields were generally consistent with rainfall. Because we are dealing with overall wheat yields, some of the lack of correspondence may reflect differing proportions of rainfed and irrigated wheat in the different regions. Irrigated wheat yields can be expected to be less responsive to rainfall patterns than rainfed wheat yields. By far most of the wheat grown in the east is irrigated, whereas most of the wheat grown in the north is rainfed.

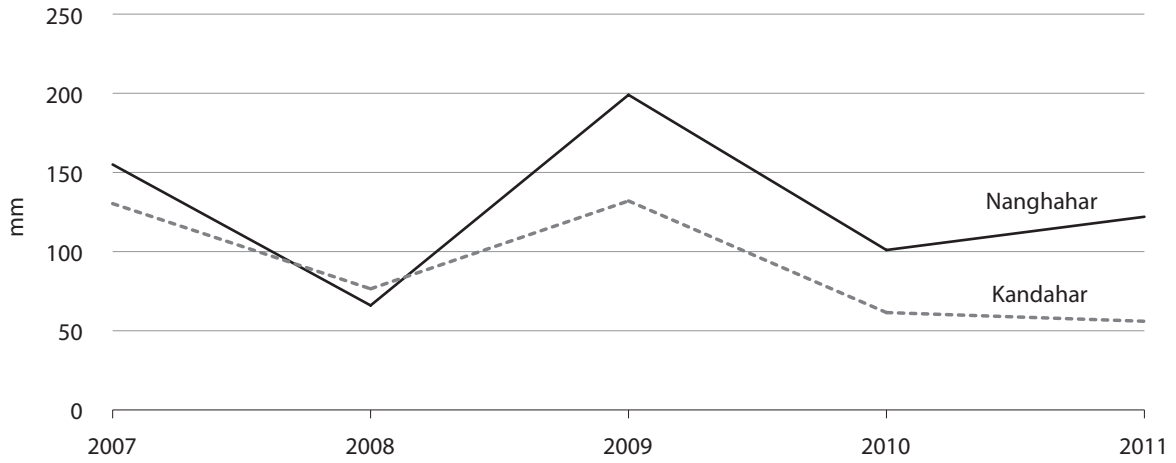


Figure A5.18. Annual rainfall over the crop growing cycle, eastern provinces, 2007 to 2011. Data source: FAO.

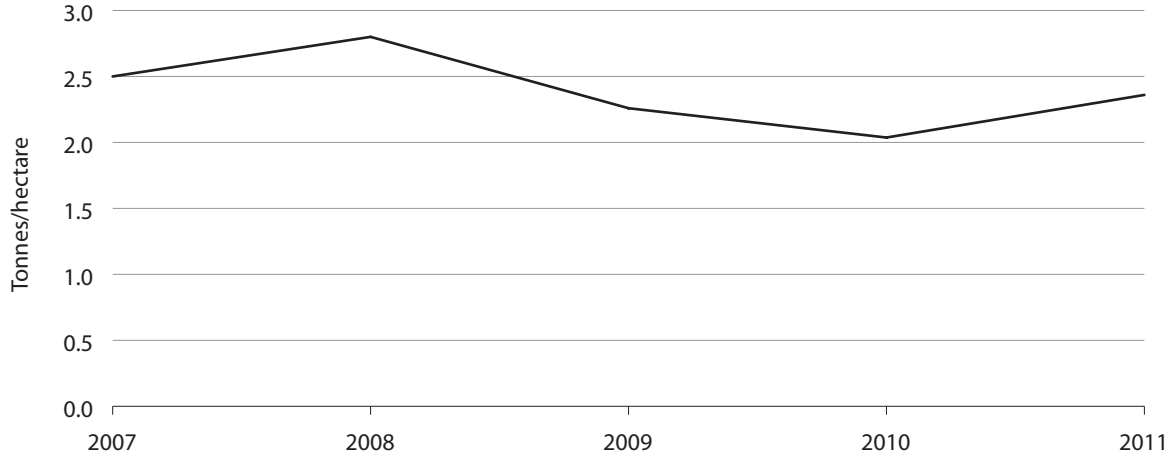


Figure A5.19. Average annual wheat yields in the eastern region, 2007 to 2011. Data source: FAO.

Figures A5.20 and A5.21 show that annual wheat yields in the western provinces also tracked annual rainfall reasonably well, with the exception of 2010 and 2011, when improved rainfall did not translate into higher yields. The increased rainfall in 2011 went against the general national trend of poor rainfall in that year.

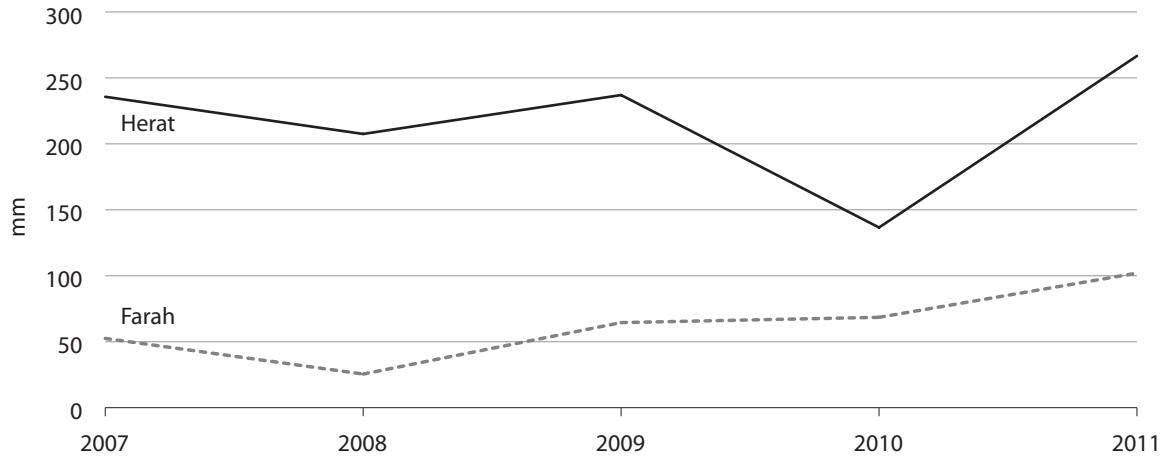


Figure A5.20. Annual rainfall over the crop growing cycle, western provinces, 2007 to 2011. Data source: FAO.

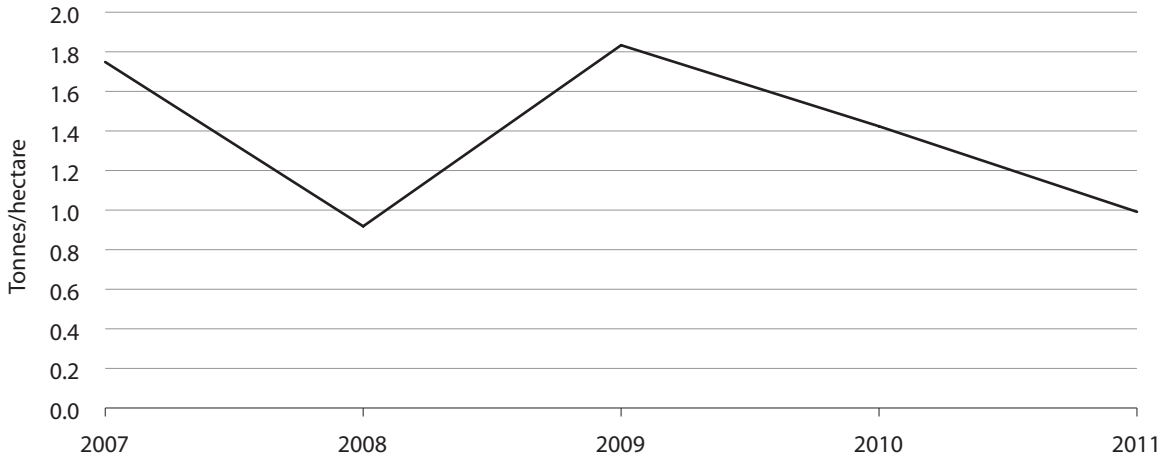


Figure A5.21. Average annual wheat yields in the western region, 2007 to 2011. Data source: FAO.

Figures A5.22 and A5.23 show the relationship between rainfall and wheat yields in central Afghanistan. The anomalies were in 2007 and 2008, when rainfall changed in the opposite direction to yields. However, the wheat planted in the central region is overwhelmingly irrigated wheat.

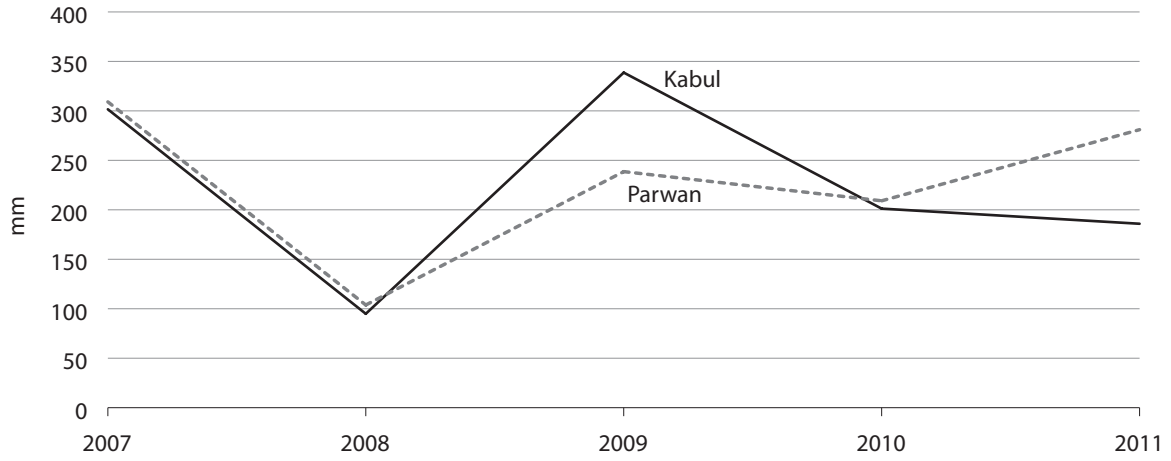


Figure A5.22. Average monthly rainfall, central provinces, 2007 to 2011. Data source: FAO.

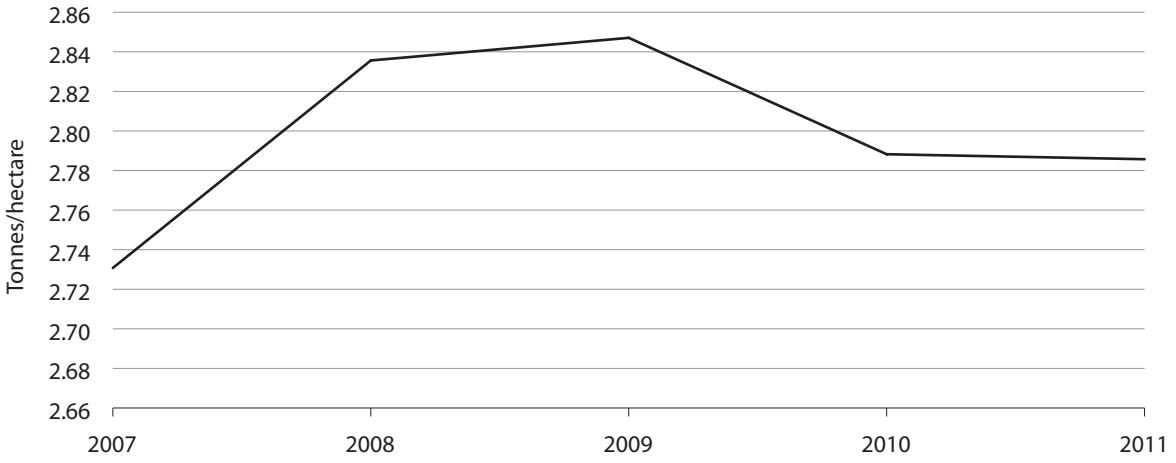


Figure A5.23. Average annual wheat yields in the central region. Data source: FAO.

Below we summarise national rainfall trends year by year from 2005 to the present, along with other relevant physical conditions noted in past annual *Agriculture prospect reports* by the Ministry of Agriculture, Irrigation and Livestock. Refer also to Figure A5.1 in this appendix, which documents yields for irrigated and rainfed wheat.

Weather synopses

2005

Rainfall from late 2004 to early 2005 was above average in all parts of the country, and there was also higher than average rainfall in mid-2005. Rainfall was higher than the long-term average, especially in the east and south. Generally, 2005 was seen as favourable for winter and spring crop growing. This was reflected in 2005 being one of the peak years for rainfed wheat yields. Rainfed wheat yields in the east and south were high and close to irrigated wheat yields (at 2.09 t/ha and 2.58 t/ha, respectively, which were also high relative to the national average of 1.82 t/ha), whereas in other regions irrigated wheat yields tended to be significantly higher.

2006

Rainfall from late 2005 to early 2006 was lower than the long-term average, and the dry spell continued through to May 2006. Mainly because of the low rainfall, there was a considerable reduction in yields, with the north and north-east regions hardest hit by the failure of crops, particularly rainfed wheat. This was consistent with the significant dip in rainfed wheat yields shown in Figure A5.1. It was also consistent with the low rainfed wheat yields recorded for the north and north-east regions, which were 0.99 t/ha and 1.33 t/ha, respectively, compared to the national average of 1.38 t/ha.

2007

Rainfall from late 2006 to early 2007 was generally favourable for winter and spring crop growing, and that situation persisted through to April and May 2007. However, demonstrating the precariousness of physical conditions for agriculture in Afghanistan, this otherwise good rainfall pattern was also accompanied by flood damage. The net crop area damaged by floods was estimated at 7,500 ha. The generally positive weather was nevertheless reflected in an improvement in wheat yields in 2007.

2008

Rainfall in October and November 2007 in most parts of the country was well below normal. Although the situation improved slightly by early 2008, 2008 was generally a period of low rainfall, which was consistent with the dip in yields in that year. The best rainfall was in the eastern region, where rainfed wheat yields reached 2.79 t/ha, which was significantly above the national average for rainfed wheat of 1.23 t/ha.

2009

Rainfall from late 2008 to mid-2009 was above normal and favourable to crop growth. However, there can be too much of a good thing: an estimated 35,000 tonnes of cereal production was lost to flooding. Another significant contributor to lost production was cereal rust. A decline in yields in the next season is shown in Figure A5.1.

Surveys by MAIL cited 'increased use of improved seeds' and 'effective and timely control of pests and diseases' as contributing to a good harvest. These were developments that were promoted by the ACIAR programs assessed in this report.

2010

For the first time in recent years, Afghanistan had good harvests in 2010 for the second consecutive year. By May 2010, the weather was regarded as 'very favourable' for standing crops. However, there was once again flood damage to agricultural production and infrastructure in the northern, western and central regions. Generally, the favourable conditions were reflected in the yields for rainfed wheat, which held steady over 2009 and 2010, although irrigated wheat yields fell slightly in 2010.

MAIL noted increased use of improved seed and the effective and timely control of pests and diseases as factors contributing to good cereal production prospects.

2011

While all areas experienced good rainfall in late 2010, MAIL noted in January 2011 that rainfall at that time was 'not at all sufficient for optimal growth and development of crops and pasture'. It remained unsatisfactory in April 2011 in the north, north-east and west. The year was therefore marked by a failure of rainfed crops. This was consistent with the significant dip in yields of rainfed wheat in 2011 shown in Figure A5.1. In 2011, yields of rainfed wheat fell from 1.07 t/ha to 0.34 t/ha. According to the report for that year, irrigated wheat was also affected by reduced water flow in rivers, hence the equally substantial falls in irrigated wheat yields.

References

ACIAR (Australian Centre for International Agricultural Research) 2003. Stress tolerant wheat and maize for Afghanistan: Seeds of strength, annual report, Canberra, SMCN/2002/028 <http://aciar.gov.au/project/smcn/2002/028>.

ACIAR 2005. Wheat and maize productivity improvement in Afghanistan, annual report, CIM/2004/002 <http://aciar.gov.au/project/cim/2004/002>.

ACIAR 2006. Wheat and maize productivity improvement in Afghanistan, annual report, CIM/2004/002 <http://aciar.gov.au/project/cim/2004/002>.

ACIAR 2007. Wheat and maize productivity improvement in Afghanistan, review report, CIM/2004/002 <http://aciar.gov.au/project/cim/2004/002>.

ACIAR 2008. Wheat and maize productivity improvement in Afghanistan, final report, CIM/2004/002 <http://aciar.gov.au/project/cim/2004/002>.

ACIAR 2010. Sustainable wheat and maize production, mid-project review, CIM/2007/065 <http://aciar.gov.au/project/cim/2007/065>.

ACIAR 2011a. Sustainable wheat and maize production in Afghanistan, review report, CIM/2007/065 <http://aciar.gov.au/project/cim/2007/065>.

ACIAR 2011b. Summary and status of ACIAR projects on cereal crop improvement in Afghanistan, SMCN/2002/028, CIM/2004/002 and CIM/2007/065.

ACIAR, undated. Stress tolerant wheat and maize for Afghanistan: Seeds of strength, final report, SMCN/2002/028 <http://aciar.gov.au/project/smcn/2002/028>.

AIMS (Afghanistan Information Management Service) 2004. National landcover.

Alston J.M., Norton G.W. and Pardey P.G. 1998. Science under scarcity: principles and practice for agricultural research evaluation and priority setting. CABI Publishing: Cambridge, Massachusetts.

Coke A. 2004. Wheat seed and agriculture programming in Afghanistan: its potential to impact on livelihoods. Afghanistan Research and Evaluation Unit: Kabul.

FAO (Food and Agricultural Organization of the United Nations) 2008. Wheat Rust Disease Global Programme. FAO: Rome, Italy.

FAO 2011. Afghanistan and FAO achievement and success stories. FAO: Rome, Italy.

FAO 2013a. FAO Corporate Document Repository 2013, Summary FAO/EC on-going projects (financially open), European Office and DG Development. <www.fao.org/docrep/006/AD356E/ad356e03.htm>, accessed 5 March 2013.

FAO 2013b. AGP—detail. <www.fao.org/agriculture/crops/agp-project-work/detail/fr/c/48973/>, accessed 5 March 2013.

FAO 2013c. Afghanistan variety and seed industry development, <coin.fao.org/cms/world/afghanistan/en/Projects/AfghanistanVarietySeedIndustryDevelopment.html>, accessed 6 March 2013.

IAK and AFCI (IAK Agrar Consulting GmbH and AFC Consultants International GmbH) 2012. Technical review of the seed sector in Afghanistan: draft final report.

Khanzada S.K., Raza A., Ahmad S., Korejo I. and Imran Z. 2012. Release of Chonte#1 in Afghanistan: future threat to sustainable wheat production in the region. Pakistan Journal of Phytopathology 41(1), 82–84.

Kugbei S. 2011. Efficiency of wheat seed production and crop diversification in Afghanistan. Journal of Crop Improvement 25(3), 191–201.

Kugbei S. and Shahab S. 2007, Analysis of the seed market in Afghanistan, FAO, Rome, Italy.

Madden N. and Bell M. 2012a. Fertilizer: diammonium phosphate. Fact sheet. UC Davis College of Agricultural and Environmental Sciences.

Madden N. and Bell M. 2012b. Fertiliser use in Afghanistan. Fact sheet. UC Davis College of Agricultural and Environmental Sciences.

Madden N., Santibanez M.P. and Bell M. 2012. Urea, the 'white' fertiliser. Fact sheet. UC Davis College of Agricultural and Environmental Sciences.

MAIL (Ministry of Agriculture, Irrigation and Livestock) 2012. Agriculture prospect report(s), December 2005–2012, Kabul.

Nianne A.A., Bishaw Z., Kugbei S., Aria A.Z., Wahed A., Sherzad F., Ahmad G. and Zadda Z.A. 2011. National catalogue of wheat varieties in Afghanistan. FAO, Rome, Italy and ICARDA, Aleppo, Syria.

Obaidi M.Q., Osmanzai M., Singh R.P., Pena J., Braun H.J. and Sharma R. 2011. Development of four Ug99 resistant wheat varieties for Afghanistan. eWIS 112:4–10.

OCHA (United Nations Office for the Coordination of Humanitarian Affairs) 2012. Afghanistan P-Code by settlement, <http://ochaonline.un.org/OchaLinkClick.aspx?link=ocha&docId=1125106>, accessed 8 December 2012.

Persaud S. 2012. Long-term growth prospects for wheat production in Afghanistan. United States Department of Agriculture: Washington DC.

Sharifi H. and Bell M. 2012. Maize overview. Information sheet. UC Davis College of Agricultural and Environmental Sciences.

Singh R.P., Hodson D.P., Huerta-Espino J., Jin E., Bhavani S., Njau P., Herrera-Foeseel S., Singh P.K., Singh S. and Govindan V. 2011. The emergence of Ug99 races of the stem rust fungus is a threat to world wheat production. Annual Review of Phytopathology 49, 465–81.

USDA FAS (United States Department of Agriculture Foreign Agricultural Service) 2011. 2011 Afghan agricultural economy update, Kabul.

IMPACT ASSESSMENT SERIES

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Centre for International Economics 1998.	Control of Newcastle disease in village chickens	AS1/1983/034, AS1/1987/017 and AS1/1993/222
2	George P.S. 1998.	Increased efficiency of straw utilisation by cattle and buffalo	AS1/1982/003, AS2/1986/001 and AS2/1988/017
3	Centre for International Economics 1998.	Establishment of a protected area in Vanuatu	ANRE/1990/020
4	Watson A.S. 1998.	Raw wool production and marketing in China	ADP/1988/011
5	Collins D.J. and Collins B.A. 1998.	Fruit fly in Malaysia and Thailand 1985–1993	CS2/1983/043 and CS2/1989/019
6	Ryan J.G. 1998.	Pigeonpea improvement	CS1/1982/001 and CS1/1985/067
7	Centre for International Economics 1998.	Reducing fish losses due to epizootic ulcerative syndrome—an ex ante evaluation	FIS/1991/030
8	McKenney D.W. 1998.	Australian tree species selection in China	FST/1984/057 and FST/1988/048
9	ACIL Consulting 1998.	Sulfur test KCL–40 and growth of the Australian canola industry	PN/1983/028 and PN/1988/004
10	AACM International 1998.	Conservation tillage and controlled traffic	LWR2/1992/009
11	Chudleigh P. 1998.	Postharvest R&D concerning tropical fruits	PHT/1983/056 and PHT/1988/044
12	Waterhouse D., Dillon B. and Vincent D. 1999.	Biological control of the banana skipper in Papua New Guinea	CS2/1988/002-C
13	Chudleigh P. 1999.	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
14	McLeod R., Isvilanonda S. and Wattanutchariya S. 1999.	Improved drying of high moisture grains	PHT/1983/008, PHT/1986/008 and PHT/1990/008
15	Chudleigh P. 1999.	Use and management of grain protectants in China and Australia	PHT/1990/035
16	McLeod R. 2001.	Control of footrot in small ruminants of Nepal	AS2/1991/017 and AS2/1996/021
17	Tisdell C. and Wilson C. 2001.	Breeding and feeding pigs in Australia and Vietnam	AS2/1994/023
18	Vincent D. and Quirke D. 2002.	Controlling *Phalaris minor* in the Indian rice–wheat belt	CS1/1996/013
19	Pearce D. 2002.	Measuring the poverty impact of ACIAR projects—a broad framework	
20	Warner R. and Bauer M. 2002.	*Mama Lus Frut* scheme: an assessment of poverty reduction	ASEM/1999/084
21	McLeod R. 2003.	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038
22	Bauer M., Pearce D. and Vincent D. 2003.	Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea	CS2/1988/002-C
23	McLeod R. 2003.	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055, AS2/1990/011 and AS2/1993/001

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
24	Palis F.G., Sumalde Z.M. and Hossain M. 2004.	Assessment of the rodent control projects in Vietnam funded by ACIAR and AusAID: adoption and impact	AS1/1998/036
25	Brennan J.P. and Quade K.J. 2004.	Genetics of and breeding for rust resistance in wheat in India and Pakistan	CS1/1983/037 and CS1/1988/014
26	Mullen J.D. 2004.	Impact assessment of ACIAR-funded projects on grain-market reform in China	ADP/1997/021 and ANRE1/1992/028
27	van Bueren M. 2004.	Acacia hybrids in Vietnam	FST/1986/030
28	Harris D. 2004.	Water and nitrogen management in wheat–maize production on the North China Plain	LWR1/1996/164
29	Lindner R. 2004.	Impact assessment of research on the biology and management of coconut crabs on Vanuatu	FIS/1983/081
30	van Bueren M. 2004.	Eucalypt tree improvement in China	FST/1984/057, FST/1987/036, FST/1988/048, FST/1990/044, FST/1994/025, FST/1996/125 and FST/1997/077
31	Pearce D. 2005.	Review of ACIAR's research on agricultural policy	
32	Tingsong Jiang and Pearce D. 2005.	Shelf-life extension of leafy vegetables—evaluating the impacts	PHT/1994/016
33	Vere D. 2005.	Research into conservation tillage for dryland cropping in Australia and China	LWR2/1992/009 and LWR2/1996/143
34	Pearce D. 2005.	Identifying the sex pheromone of the sugarcane borer moth	CS2/1991/680
35	Raitzer D.A. and Lindner R. 2005.	Review of the returns to ACIAR's bilateral R&D investments	
36	Lindner R. 2005.	Impacts of mud crab hatchery technology in Vietnam	FIS/1992/017 and FIS/1999/076
37	McLeod R. 2005.	Management of fruit flies in the Pacific	CS2/1989/020, CS2/1994/003, CS2/1994/115 and CS2/1996/225
38	ACIAR 2006.	Future directions for ACIAR's animal health research	
39	Pearce D., Monck M., Chadwick K. and Corbishley J. 2006.	Benefits to Australia from ACIAR-funded research	AS2/1990/028, AS2/1994/017, AS2/1994/018, AS2/1999/060, CS1/1990/012, CS1/1994/968, FST/1993/016 and PHT/1990/051
40	Corbishley J. and Pearce D. 2006.	Zero tillage for weed control in India: the contribution to poverty alleviation	CS1/1996/013
41	ACIAR 2006.	ACIAR and public funding of R&D. Submission to Productivity Commission study on public support for science and innovation	
42	Pearce D. and Monck M. 2006.	Benefits to Australia of selected CABI products	
43	Harris D.N. 2006.	Water management in public irrigation schemes in Vietnam	LWR1/1998/034 and LWR2/1994/004
44	Gordon J. and Chadwick K. 2007.	Impact assessment of capacity building and training: assessment framework and two case studies	CS1/1982/001, CS1/1985/067, LWR2/1994/004 and LWR2/1998/034

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
45	Turnbull J.W. 2007.	Development of sustainable forestry plantations in China: a review	
46	Monck M. and Pearce D. 2007.	Mite pests of honey bees in the Asia–Pacific region	AS2/1990/028, AS2/1994/017, AS2/1994/018 and AS2/1999/060
47	Fisher H. and Gordon J. 2007.	Improved Australian tree species for Vietnam	FST/1993/118 and FST/1998/096
48	Longmore C., Gordon J. and Bantilan M.C. 2007.	Assessment of capacity building: overcoming production constraints to sorghum in rainfed environments in India and Australia	CS1/1994/968
49	Fisher H. and Gordon J. 2007.	Minimising impacts of fungal disease of eucalypts in South-East Asia	FST/1994/041
50	Monck M. and Pearce D. 2007.	Improved trade in mangoes from the Philippines, Thailand and Australia	CS1/1990/012 and PHT/1990/051
51	Corbishley J. and Pearce D. 2007.	Growing trees on salt-affected land	FST/1993/016
52	Fisher H. and Gordon J. 2008.	Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts	AS2/1994/023
53	Monck M. and Pearce D. 2008.	The impact of increasing efficiency and productivity of ruminants in India by the use of protected-nutrient technology	AH/1997/115
54	Monck M. and Pearce D. 2008.	Impact of improved management of white grubs in peanut-cropping systems	CS2/1994/050
55	Martin G. 2008.	ACIAR fisheries projects in Indonesia: review and impact assessment	FIS/1997/022, FIS/1997/125, FIS/2000/061, FIS/2001/079, FIS/2002/074, FIS/2002/076, FIS/2005/169 and FIS/2006/144
56	Lindner B. and McLeod P. 2008.	A review and impact assessment of ACIAR's fruit-fly research partnerships—1984 to 2007	CP/1997/079, CP/2001/027, CP/2002/086, CP/2007/002, CP/2007/187, CS2/1983/043, CS2/1989/019, CS2/1989/020, CS2/1994/003, CS2/1994/115, CS2/1996/225, CS2/1997/101, CS2/1998/005, CS2/2003/036, PHT/1990/051, PHT/1993/87 and PHT/1994/133
57	Montes N.D., Zapata Jr N.R., Alo A.M.P. and Mullen J.D. 2008.	Management of internal parasites in goats in the Philippines	AS1/1997/133
58	Davis J., Gordon J., Pearce D. and Templeton D. 2008.	Guidelines for assessing the impacts of ACIAR's research activities	
59	Chupungco A., Dumayas E. and Mullen J. 2008.	Two-stage grain drying in the Philippines	PHT/1983/008, PHT/1986/008 and PHT/1990/008
60	Centre for International Economics 2009.	ACIAR Database for Impact Assessments (ADIA): an outline of the database structure and a guide to its operation	
61	Fisher H. and Pearce D. 2009.	Salinity reduction in tannery effluents in India and Australia	AS1/2001/005

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
62	Francisco S.R., Mangabat M.C., Mataia A.B., Acda M.A., Kagaoan C.V., Laguna J.P., Ramos M., Garabiag K.A., Paguia F.L. and Mullen J.D. 2009.	Integrated management of insect pests of stored grain in the Philippines	PHT/1983/009, PHT/1983/011, PHT/1986/009 and PHT/1990/009
63	Harding M., Tingsong Jiang and Pearce D. 2009.	Analysis of ACIAR's returns on investment: appropriateness, efficiency and effectiveness	
64	Mullen J.D. 2010.	Reform of domestic grain markets in China: a reassessment of the contribution of ACIAR-funded economic policy research	ADP/1997/021 and ANRE1/1992/028
65	Martin G. 2010.	ACIAR investment in research on forages in Indonesia	AS2/2000/103, AS2/2000/124, AS2/2001/125, LPS/2004/005, SMAR/2006/061 and SMAR/2006/096
66	Harris D.N. 2010.	Extending low-cost fish farming in Thailand: an ACIAR–World Vision collaborative program	PLIA/2000/165
67	Fisher H. 2010.	The biology, socioeconomics and management of the barramundi fishery in Papua New Guinea's Western Province	FIS/1998/024
68	McClintock A. and Griffith G. 2010.	Benefit–cost meta-analysis of investment in the International Agricultural Research Centres	
69	Pearce D. 2010.	Lessons learned from past ACIAR impact assessments, adoption studies and experience	
70	Harris D.N. 2011.	Extending low-chill fruit in northern Thailand: an ACIAR–World Vision collaborative project	PLIA/2000/165
71	Lindner R. 2011.	The economic impact in Indonesia and Australia from ACIAR's investment in plantation forestry research, 1987–2009	FST/1986/013, FST/1990/043, FST/1993/118, FST/1995/110, FST/1995/124, FST/1996/182, FST/1997/035, FST/1998/096, FST/2000/122, FST/2000/123, FST/2003/048 and FST/2004/058
72	Lindner R. 2011.	Frameworks for assessing policy research and ACIAR's investment in policy-oriented projects in Indonesia	ADP/1994/049, ADP/2000/100, ADP/2000/126, AGB/2000/072, AGB/2004/028, ANRE1/1990/038, ANRE1/1993/023, ANRE1/1993/705, EFS/1983/062 and EFS/1988/022
73	Fisher H. 2011.	Forestry in Papua New Guinea: a review of ACIAR's program	FST/1994/033, FST/1995/123, FST/1998/118, FST/2002/010, FST/2004/050, FST/2004/055, FST/2004/061, FST/2006/048, FST/2006/088, FST/2006/120, FST/2007/078 and FST/2009/012
74	Brennan J.P. and Malabayabas A. 2011.	International Rice Research Institute's contribution to rice varietal yield improvement in South-East Asia	
75	Harris D.N. 2011.	Extending rice crop yield improvements in Lao PDR: an ACIAR–World Vision collaborative project	CIM/1999/048, CS1/1995/100 and PLIA/2000/165
76	Grewal B., Grunfeld H. and Sheehan P. 2011.	The contribution of agricultural growth to poverty reduction	

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
77	Saunders C., Davis L. and Pearce D. 2012.	Rice–wheat cropping systems in India and Australia and development of the 'Happy Seeder'	LWR/2000/089, LWR/2006/132 and CSE/2006/124
78	Carpenter D. and McGillivray M. 2012	A methodology for assessing the poverty-reducing impacts of Australia's international agricultural research	
79	Dugdale A., Sadleir C., Tennant-Wood R. and Turner M. 2012	Developing and testing a tool for measuring capacity building	
80	Fisher H., Sar L. and Winzenried C. 2012	Oil palm pathways: an analysis of ACIAR's oil palm projects in Papua New Guinea	ASEM/1999/084, ASEM/2002/014, ASEM/2006/127, CP/1996/091, PC/2006/063, PC/2004/064, CP/2007/098
81	Pearce D. and White L. 2012	Including natural resource management and environmental impacts within impact assessment studies: methodological issues	
82	Fisher H. and Hohnen L. 2012	ACIAR's activities in Africa: a review	AS1/1983/003, AS1/1995/040, AS1/1995/111, AS1/1996/096, AS1/1998/010, AS2/1990/047, AS2/1991/018, AS2/1993/724, AS2/1996/014, AS2/1999/063, AS2/1996/090, AS2/1996/203, AS2/1996/149, AS2/1997/098, CP/1994/126, CS2/1990/007, EFS/1983/026, FST/1983/020, FST/1983/031, FST/1983/057, FST/1988/008, FST/1988/009, FST/1991/026, FST/1995/107, FST/1996/124, FST/1996/206, FST/2003/002, IAP/1996/181, LPS/1999/036, LPS/2002/081, LPS/2004/022, LPS/2008/013, LWR/2011/015, LWR1/1994/046, LWR2/1987/035, LWR2/1996/049, LWR2/1996/163, LWRS/1996/215, LWR2/1997/038, SMCN/1999/003, SMCN/1999/004, SMCN/2001/028, SMCN/2000/173
83	Palis F.G., Sumalde Z.M., Torres C.S., Contreras A.P. and Datar F.A. 2013	Impact pathway analysis of ACIAR's investment in rodent control in Vietnam, Lao PDR and Cambodia	ADP/2000/007, ADP/2003/060, ADP/2004/016, AS1/1994/020, AS1/1996/079, AS1/1998/036, CARD 2000/024, PLIA/2000/165
84	Mayne J. and Stern E. 2013	Impact evaluation of natural resource management research programs: a broader view	
85	Jilani A., Pearce D. and Bailo F. 2013	ACIAR wheat and maize projects in Afghanistan	SMCN/2002/028, CIM/2004/002 and CIM/2007/065

Australian Aid

ACIAR

Research that works for developing countries and Australia

aciar.gov.au