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Contents

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    - Dr Elizabeth Petersen, UWA – Project leader,
    - Dr David Vanzetti, the Australian National University,
    - Dr Stephen Harrison, the University of the Sunshine Coast (USC), and
    - Mr Robert Harrison, USC

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    - Dr Muhummad Qasim, National Agricultural Research Centre (NARC),
    - Dr Abdul Ghafoor, University of Agriculture Faisalabad (UAF),
    - Dr Khuram Nawaz Sadozai, The University of Agriculture Peshawar (UAP), and
    - Mr Muhammad Ibrahim Lashari, Social Sciences Research Institute, Tandojam (Sindh).

2 Executive summary

Pulses are dried seeds of the legume family and are an important source of vegetable protein. Important pulse species grown in Pakistan include chickpeas, mung beans, lentils and mash beans. In Pakistan, pulses are grown on 5 per cent of total cultivated area of crops (1.5 million hectares) (PBS 2015), with chickpea being the major winter pulse (occupying 73 per cent of total pulses area) and mung beans being the major summer pulse (occupying 18 per cent of pulses area).

Consumption of pulses in Pakistan and globally is increasing. Despite this, pulses production in Pakistan has stagnated over the last 50 years. This stagnation of production reflects stagnation of yields and area planted over this time period. Imports of pulses have risen dramatically since 1980 to address increasing domestic consumption. In addition, the production of pulses is relatively more volatile than their substitutes in production (wheat, rice and other cereals), and post-harvest losses are perceived by growers as a significant problem.

Pulses receive significantly less Government funding and support as other crops, even when considered in proportion to area planted. A large ACIAR-funded project, "CIM/2015/041: Increasing productivity and profitability of pulses production in cereal based cropping systems in Pakistan", commenced in November 2016. Agronomic research from this project is expected to lead to productivity increases in pulses in the next 5 years. While increasing productivity is undoubtedly beneficial, it raises **research questions** that have been addressed this project:

1. What are the current government policies and how do they affect pulses production and trade?
2. What are the constraints to increasing production and consumption of pulses? Given pulses are substitutes in production with other crops, will farmers adopt new varieties given variable yields and input and output prices, uncertain rainfall and other agronomic conditions?
3. What is the impact of Government policies and what can the Government do to encourage production?

The **overarching aim** of this project was to provide evidence-based economic analysis and advice to policy-makers on policy reform to reduce constraints to pulses production and trade and increase productivity in Pakistan.

To achieve this overarching aim, **four objectives** were defined as follows:

Objective 1: Review current policies and programs that affect pulses production and trade in Pakistan.

Objective 2: Identify the constraints and barriers to pulses production, consumption and trade.

Objective 3: Analyse the impact of Government policies on pulses prices, production and trade.

Objective 4: Provide advice to Pakistani policy-makers on policy reform to increase pulses productivity and trade.

The project employed a number of **methodologies** to best achieve the project aim and objectives. They include desktop review, a farm survey, farm-level analysis, partial equilibrium analysis, project workshops (inception workshop and mid-project workshop), and end-of-project forums.

The project achieved the following **outputs**:

1. Meetings/workshops/policy forums. Project outcomes in this area include a mid-project workshop in Islamabad (with 40 policy stakeholders in attendance), presentation at the DAWN Pakistan Food and Agri Expo 2017, three end-of-project policy forums in Lahore, Islamabad and Karachi (with a total of 120 policy stakeholders in attendance), numerous individual meetings with policy stakeholders, and a field trop to pule-growing areas around Islamabad.
2. Publications. The project team produced eight academic papers (three of which have been submitted for publication in international peer-reviewed journals), one policy brief and one newspaper article.

While it is expected that the full **impact of project** will be realised in the years to come, a number of outcomes have already been achieved, as summarised below. They include capacity building, provision of policy advice, and evidence of policy reform.

1. Capacity building. The project led to significant capacity building amongst researchers in Pakistan and Australia. Pakistani project team members have developed capacity in:
    - Project management and facilitation,
    - Working with team members located in other countries,
    - The administration of survey processes and data collation and analysis,
    - Econometrics, especially with respect to the estimation of demand and supply own and cross price elasticities required for partial equilibrium models,
    - Partial equilibrium modelling and its use for policy analysis,
    - Farm-level economic modelling and its use for policy analysis,
    - Engaging with policy makers, especially through organisation of policy forums, and
    - Report writing and preparation of papers for international review.

    Australian project team members have developed capacity in all these areas, with the addition of:
    - gaining experience in project leadership, and
    - understanding the mechanisms for engaging with policy-makers and influencing policy reform in Pakistan.
2. Policy advice. The project has made a significant contribution to understanding the policies affecting pulses production in Pakistan and how they can be reformed to promote pulses production and trade in Pakistan. This will be of significant benefit to policy-makers in Pakistan in the years to come. This advice will be of benefit to Pakistan policy-makers and the ACIAR project CIM/2015/041 team.
3. Policy reform. The extent to which our policy recommendations are applied will only be fully understood through time. However, the project has already had some impact on policy reform in Pakistan. There has already been evidence of:
    - increased investment in pulses research development and extension as a result of ACIAR investment in this area,
    - use of research findings to direct investment in pulses RD&E, and
    - a change in thinking regarding the Government's role in encouraging pulses production.

Regarding the **conclusions of the project**, survey results showed that the leading causes of low pulses production in Pakistan are perceived by farmers to be:

- Lack of access to high-yielding varieties,
- Significant impacts of pests and diseases,
- Low mechanisation,
- Inefficient input use,
- A poorly developed agribusiness sector, and
- Losses of chickpea grain during harvest.

There is significant need for increased RD&E in the pulses industry to raise productivity up to regional standards. Based on empirical policy research, a number of **policy recommendations** have been developed within the project:

Recommendation 1: Remove the 35 per cent export tax on pulses

Recommendation 2: Phase out the wheat procurement policies

Recommendation 3: Phase out fertiliser, water and energy subsidies

Recommendation 4: Don’t introduce a Government procurement price for pulses.

Recommendation 5: Increase spending on pulses research, development and extension.

Recommendation 6: Focus on social protection programs targeted to those in need.

Recommendation 7: Aim to achieve food security through import and export diversification of pulses

There is nothing specific about pulses which make it a preferable crop to grow instead of other crops such as rice or wheat. We recommend the Government establish a level playing field so that producers can grow what they can produce with greatest profitability. Even with these recommended policy changes, it may be that Pakistan producers continue to grow these crops with greater profitability than pulses. In that case, Pakistan’s best strategy may be to focus on diversifying export locations for these other crops, and food security of pulses by diversifying sources of pulses imports.

3 Introduction

Pulses are dried seeds of the legume family and are an important source of vegetable protein. Important pulse species grown in Pakistan include chickpeas, mung beans, lentils and mash beans. In Pakistan, pulses are grown on 5 per cent of total cultivated area of crops (1.5 million hectares) (PBS 2015), with chickpea being the major winter pulse (occupying 73 per cent of total pulses area) and mung beans being the major summer pulse (occupying 18 per cent of pulses area). Pulses are traded internationally, and are substitutes in production with wheat, rice and other cereals (which are cultivated on 42 per cent, 14 per cent and 7 per cent of total cultivated area, respectively). Like these cereals, pulses are a storable commodity with long shelf life and can be transported long distances.

Consumption of pulses in Pakistan and globally is increasing. Despite this, pulses production in Pakistan has stagnated over the last 50 years. This stagnation of production reflects stagnation of yields and area planted over this time period. Imports of pulses have risen dramatically since 1980 to address increasing domestic consumption. In addition, the production of pulses is relatively more volatile than their substitutes in production (wheat, rice and other cereals), and post-harvest losses are perceived by growers as a significant problem.

Pulses receive significantly less Government funding and support as other crops, even when considered in proportion to area planted. A large ACIAR-funded project, "CIM/2015/041: Increasing productivity and profitability of pulses production in cereal based cropping systems in Pakistan", commenced in November 2016. Agronomic research from this project is expected to lead to productivity increases in pulses in the next 5 years. While increasing productivity is undoubtedly beneficial, it raises important questions that have been addressed this project:

1. What are the current government policies and how do they affect pulses production and trade?
2. What are the constraints to increasing production and consumption of pulses? Given pulses are substitutes in production with other crops, will farmers adopt new varieties given variable yields and input and output prices, uncertain rainfall and other agronomic conditions?
3. What is the impact of Government policies and what can the Government do to encourage production?

At commencement of this project, economic analysis of policies affecting pulses was fragmented and not comprehensive.[1] The publicly-available information about the pulses industry was limited.[2] The aim of this project is to fill this research gap by providing evidence-based economic analysis and advice to policymakers on policy reform to reduce constraints to pulses production and trade, and increase pulses productivity in Pakistan.

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[1] The WTO has reviewed Pakistan trade policies in its Trade Policy Review Mechanism (WTO 2015). Some economic analysis has been undertaken by the National Agricultural Research Centre in Islamabad. Its researchers have published papers on demand elasticities (Rani et al. 2014), growth, instability and price flexibility (Rani et al. 2012), and forecasting (Rani and Raza 2012), but these papers do not examine the efficiency and distributional effects of policies.

[2] The national statistics office publishes data on production, imports and exports. Tariff data is submitted to the WTO, but submissions on domestic support are behind schedule. The latest is 2008.

4 Aims and objectives

The overarching aim of this project was to provide evidence-based economic analysis and advice to policy-makers on policy reform to reduce constraints to pulses production and trade and increase productivity in Pakistan.

To achieve this overarching aim, four objectives were defined as follows:

Objective 1: Review current policies and programs that affect pulses production and trade in Pakistan.

Objective 2: Identify the constraints and barriers to pulses production, consumption and trade.

Objective 3: Analyse the impact of Government policies on pulses prices, production and trade.

Objective 4: Provide advice to Pakistani policy-makers on policy reform to increase pulses productivity and trade.

5 Methodology

The project employed a number of methodologies to best achieve the project aim and objectives, as highlighted below. They include desktop review, a farm survey, farm-level analysis, partial equilibrium analysis, project workshops (inception workshop and mid-project workshop), and end-of-project forums.

5.1 Desktop review

The desktop review was conducted to:

- identify key policies/programs affecting pulses in Pakistan with initial assessment of these policies/programs against policy principles,
- understand previous work already completed on the impacts of these policies/programs on the pulses sector in Pakistan, and
- identify the constraints and barriers to pulses production, consumption and trade in Pakistan

5.2 Farm survey

A farm survey of a small project-scale sample of farmers was conducted across different regions in Pakistan using different pulses production techniques (farm size, irrigation, cropping patterns). The objective of the survey was to gather data on the profitability of pulses compared with alternative crops, and to elicit farmer perceptions regarding the constraints to pulses production.

5.3 Farm-level analysis

Using data from the farm survey, farm-level analysis was conducted to understand the relative profitability of cropping systems to analyse the impact of a potential productivity improvement on farm profits in different regions, and understand the impacts of constraints to adoption of pulses. A mixed-integer mathematical programming model was developed using Excel.

5.4 Partial equilibrium analysis

A partial equilibrium model was developed with capacity to analyse changes in productivity, trade taxes and subsidies, world prices, storage costs, post-harvest losses, and government procurement. This involved estimating the relevant own and cross-price demand and supply elasticities, and simulating the policy shocks. The model is a modified version of GSIM, a modelling framework developed by Francois and Hall (2007). It is a static, deterministic, multiple commodity (chickpeas, lentils, mung/mash beans, cotton, sugar, wheat and rice), bilateral trade model with ten regions (including Pakistan and its major trading partners, plus a Rest of World region).

5.5 Workshops and policy forums

A number of project workshops and policy forums were conducted throughout the project. An inception workshop was conducted at the start of the project to make sure all project team members were aligned regarding team and individual expectations for the project. A mid-project workshop was conducted as initial results became available for early engagement with policy makers. Three end-of-project policy forums were conducted across regions of Pakistan (Lahore, Islamabad and Karachi) to disseminate final project findings to policy makers.

6 Project outputs

A list of the SRA outputs and their completion dates are presented in the table below. More detail is provided on each of these project outputs in the rest of this section.

Table: Summary of project outputs and their completion date

#	Output	Completion date
1	Inception meeting in Pakistan and unpublished data collection	30 Sep 2016
2	Report identifying current national and provincial policies/programs affecting pulses production and trade	30 April 2017
3	Workshop paper documenting the literature review on pulses production in Pakistan; including species, production trends, production regions and areas, benefits of pulses relative to other crops, opportunities and constraints	30 April 2017
4	Workshop paper documenting farm-level studies in mixed cropping contexts to understand the profitability of pulses compared with alternative crops, and understanding producer perceptions of constraints to production	30 May 2018
5	Workshop paper outlining consumer analysis of constraints to increased pulses consumption in Pakistan	30 April 2017
6	Workshop paper documenting economic assessment of factor's affecting Pakistan's pulses production and domestic trade, including government policy and other constraints to production and trade	30 May 2018
7	Workshop paper documenting economic assessment of Pakistan's international trade policies to identify their impact on pulses production and trade	30 May 2018
8	Documentation providing evidence-based policy advice on policy reform to enhance the productivity and trade of pulses (within papers outlined above and policy briefs)	30 May 2018
9	Mid-project workshop	30 April 2017
10	End-of-project policy forums	30 May 2018
11	Final report	30 June 2018

1. Inception meeting in Pakistan and unpublished data collection

The inception meeting allowed the project team to meet, understand what was expected from the project overall, and how these expectations were going to be met. Each team member had the opportunity to discuss the best ways of meeting these expectations and how they could contribute to that.

2. Report identifying current national and provincial policies/programs affecting pulses production and trade

Citation: Vanzetti, D., Petersen, E.H., and Rani, S. (2017). Economic review of the pulses sector and pulses-related policies in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April.

Submitted for publication *Review of Agricultural and Applied Economics*

Abstract: In Pakistan, pulse production has stagnated over the past 70 years, caused by the absence of growth in area planted and yields. Consumption has increased steadily and imports have risen dramatically in recent years. Concerned about this increase in imports, in 2007 the Pakistani Government stopped pulse exports by imposing a 35 per cent export tax. This was done with the intent to secure domestic production for domestic consumption. Since that time, pulse exports have all but ceased and pulse prices have increased dramatically in level and variability, in contrast to other crops. The Government also supports agriculture through subsidies on fertiliser, water and energy. These subsidies distort markets and prices and favour more fertiliser-intensive crop production over pulse production, which requires relatively less fertiliser. The Government implements a procurement price for wheat, which discourages pulse production by making pulses relatively less profitable and riskier to produce compared with wheat. We suggest that the Pakistani government remove the pulses export tax, phase out all agricultural subsidies, and remove the wheat procurement price. It should not implement a pulses procurement price. Instead, we suggest the Government diversify sources of imports, encourage participation in open markets, investment into sustainable agricultural productivity growth (through infrastructure development, and research, development and extension (RD&E)), and develop social protection programs to provide safety nets during economic and food crises.

3. Workshop paper documenting the literature review on pulses production in Pakistan; including species, production trends, production regions and areas, benefits of pulses relative to other crops, opportunities and constraints

Citation: Harrison, S., Harrison, R., Qasim, M., Rani, S., Chaudhry, A.G., Sadozai, K., Vanzetti, D., Petersen, E.H. (2017) Pulse production in Pakistan: A literature review. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April.

Abstract: This working paper discusses various aspects of food cropping in Pakistan, with particular emphasis on pulse crops. A review has been conducted of the literature on pulses species, area cropped relative to other food species, cropping systems, food security, crop support measures, gender issues, trade statistics, and opportunities and constraints for expansion of pulses production. These notes have been prepared to form part of the information set for the team in ACIAR small research activity (SRA) ADP/2016/045, *Economic analysis of policies affecting pulses in Pakistan*. The SRA is

designed to support ACIAR large project CIM/2015/041, which has a focus on increasing productivity and profitability in the pulses sector in Pakistan.[3] Some Pakistan maps of major city locations, administrative units, cropping pattern and food security area classifications are appended.

4. Workshop paper documenting farm-level studies in mixed cropping contexts to understand the profitability of pulses compared with alternative crops, and understanding producer perceptions of constraints to production

Citation: Harrison, S., Harrison, R, Sadozai, K., Qasim, M., Rani, S., Chaudhry, A.G., Petersen, E.H. (2017) Farm-level Financial and Economic Review of Pulses Production in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April.

Abstract: The objective of the working paper is to provide a platform for data collection and financial and economic modelling of pulses cropping systems including crop rotations in Pakistan. Pulses cropping systems and rotations adopted or advocated in Pakistan are described. Cost components relevant to gross margins (GM) analyses of individual pulses species are identified, literature on benefits which have been attributed to pulses production are reported, and further information requirements needed for economic evaluation are highlighted.

Citation: Ghafoor, A., and Nazam, M. (2018) Report on a survey of pulse growers in the Thal region of Punjab, Pakistan.

Executive Summary: In developing countries like Pakistan, agriculture is the most important sector of the economy and the single largest sector for economic growth and development. Punjab is the province with the largest agricultural production in Pakistan, with 69% of the cropped area of the country. In Pakistan, chickpea and mungbean are the most widely grown pulse crops. Pakistan spends a major portion of funds on the import of pulses to fill the gap between its demand and supply in the domestic market. Pulses are cultivated all over the world but in Pakistan it is being cultivated on 5% of total cultivated area of crops and chickpea white/black, mungbean, mash, masoor and few others are grown. These pulse crops are grown mostly as a cash crop in the summer or autumn seasons in the Nurpur Thal region of Punjab province. Pulses are consumed in several forms including cooked, roasted, sprouted or milled grains.

Mungbean is one of the important pulse crops of Pakistan. It is mainly grown in southern parts of Punjab and Sindh. Punjab alone provides 88% of Pakistan's mungbean area with 85% of the country's mungbean production.

In Pakistan, pulses consumption is 6 to 7 kg/capita annually which shows the interest of Pakistani people in pulses. In order to fulfill the requirements of pulses consumers, there is increasing demand and supply gap as consumption exceeds supply Pakistan is mainly depended on Canada, Australia, Burma, India, and African countries to fulfill the domestic requirement of pulses every year.

A survey was conducted in 3 major districts across the Punjab province in Nurpur Thal region to understand the challenges faced by mungbean and chickpea growers. A total of

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[3] Australia is a major grower and exporter of pulses, and increasingly a consumer as well. Some popular dishes made from pulses, include hummus (a spread made from mashed cooked chickpeas, blended with other ingredients and served with bread) and dhal (dal, daal, or dahl), a thick, soupy stew of pulses, high in protein, which can be served as a side dish with curry or as a base for other dishes (Grover, 2013).

130 randomly-selected farmers were interviewed across the Nurpur Thal region. Most of the farmers did not produce their own pulses seed, and a majority sowed the crop by broadcasting.

Research findings demonstrate the overall financial analysis of three selected pulse crops; chickpea white, chickpea black and mungbean. Survey results indicate that average annual farm output quantity of chickpea white was 261 kgs/per acre with a farm-gate price of Rs. 113/kg and a gross revenue of Rs. 29,345/acre. By deducting the total cost Rs. 23,053/acre, the resulted gross profit was Rs. 6,292/acre. Adopting similar calculations the gross profit of chickpea black was Rs. 5,545/acre. Finally, the gross profit of mungbean was calculated to be Rs. 25,152/acre. From the results it can be noticed that the profitability of the mungbean crop has been relatively high as compared to chickpea crops. The reason for this is due to higher yields and therefore farm output, in turn due to the utilization of agri inputs in the form of fertilizer, pesticides and irrigation water. Chickpea farmers were reliant on rainfall instead of irrigated water and agri-inputs.

The main concerns of pulses growers were the susceptibility of pulse crops to diseases and insect pests, yield variability and availability of certified seed. Pakistan's pulses sector faces a number of challenges, including lower farm-gate prices for their outputs resulting in farmers switching to other crops. If the Government of Pakistan (GoP) develop a roadmap to resolve these issues, then Pakistan will be able to produce greater quantities of pulses, contributing to improved agricultural growth.

Citation: Qasim, M., Rani, S., and Shah, H. (2018) Survey results report for the Pothwar and (rice-wheat) irrigated areas of Punjab, and Sindh.

Executive Summary: Pulses crops have been largely neglected by research, development and extension services in Pakistan over the last three decades compared with major crops such as wheat, cotton, rice and sugarcane. Evidence of this neglect is relatively small pulses breeding programs, poor distribution of certified pulses seed, lack of pulses production technologies and mechanization, and the pushing of pulses production towards marginal areas with no irrigation facilities. Pulses crops are relatively drought resistant crops and can survive in the drought conditions but current varieties are largely unimproved and are prone to climate related diseases and insect/pest attacks. These factors have resulted in the decline in area, yield and therefore production of pulses crops. With increasing domestic consumption, this reduction in production has led to a gap in demand and supply. Pakistan has a significant dependence on imports to meet domestic consumption needs.

This report presents data from a farm-level survey of 130 pulse producers conducted in 2017 to identify the constraints and opportunities in pulses area and production. The survey was conducted as part of a larger project, funded by the Australian Center for International Agriculture Research (ACIAR), to conduct economic analysis of policies affecting pulses in Pakistan. The survey was conducted in the Pothwar and rice-wheat regions of the Punjab province and the major pulses producing areas of the Sindh province. The regions and districts were selected after consultation with district extension departments and based on district-wise pulses crop area share in agricultural statistics of Pakistan. A stratified random sampling technique was used to selected households to be surveyed. A structured questionnaire was used to collect cross-sectional data of a large number of variables.

The key findings of the surveys are summarized as following:

- The average age of respondents was 50 years, and the average education level of respondents was 8 years. Farmers had 13 years of experience in growing pulses in Pothwar and Sindh, and 22 years of experience in the rice-wheat region.
- Two third of respondents were owner operators, while one third were owner-cum tenants.

- The average operational land holding was 17 acres.
- Tube well was the main irrigation source as mentioned by 58 percent farmers while canal irrigation was another significant source of irrigation as mentioned by 33 percent of respondents.
- The average household size of sampled farmers was 10. Apart from household labor, an average of two male and one female workers were employed on each farm.
- Mechanization is low. The majority of farmers sow pulses crop using the broadcasting method and manually harvest their crops.
- Private seed dealers were the major source of seed for pulses, rather than using their own seed or buying from government research institutes or corporations.
- Significant post-harvest losses were reported due to the harvesting of chickpea and lentils.
- Pulse prices are relatively stable across regions. The price received for lentil is highest (Rs.184/kg), followed by chickpea white (Rs.96/kg), mung bean (Rs.95/kg), chickpea black (Rs.84/kg), and mash bean (Rs.79/kg).
- Overall pulses are low inputs crops and still profitable but farmers are concerned about the level and riskiness of pulses yields.
- Neighbors and family members were the highest reported information source of pulses growers.
- Respondents' perceive that the major constraints to pulses production and marketing are susceptibility to diseases and insect pests and the lack of affordable certified seed which reduce the level and increase the variability of yields
- This highlights the need to increase investment in research, development and extension activities for pulses to allow improved varieties with reduced susceptibility to disease and insect pests to be available at affordable prices to pulses producers.

Citation: Sadozai, K.N. (2018) Opportunities and Constraints to Pulses Production in Kyber Pakhtunkhwa (KPK), Pakistan.

Abstract: The study was carried out to estimate technical efficiency of chickpea growers in three districts of KPK; namely Karak, Lukki Marwat and D.I khan Khyber Pakhtunkhwa. The data were collected from chickpea growers through face to face interview. The primary data were collected from 120 chickpeas growers of three districts by applying multistage stratified random sampling technique. Stochastic Frontier Production Functions were estimated and the results of the Stochastic Frontier Models analyzed. The mean technical efficiency was calculated as 80 suggesting that chickpea growers can improve the efficiency of their production by 20 percent. Results suggest that improved efficiency can come from new technologies and efficient use of basic inputs. Moreover, farm Service Stations can boost their services by providing farmers basic inputs at affordable prices.

Citation: Harrison, S., Harrison, R, Chaudhry, A.G., Sadozai, K., Qasim, M., Rani, S., Petersen, E.H., Vanzetti, D. (2018) Financial Modelling to Determine Optimal Crop Combinations in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May.

Abstract: A portfolio analysis financial model has been developed to identify revenue-maximizing crop combinations including pulses, grain crops and other species for farming systems in Pakistan. Financial models for individual crop species were developed based on reported gross margins analyses and recently collected survey data on pulses in the various provinces. It was found that high variability exists in crop performance between and within provinces, and depending on farming practices, such that there is no typical farming system to model. Cost and revenue data were compiled for seven crop species,

and revenue-maximizing crop combinations for the two cropping seasons (rabi and karif) over time were identified using continuous and mixed-integer non-linear programming. The analysis indicated that pulses are a financially viable component of cropping systems, particularly for dryland farming. Further, producers are quite unresponsive to pulses yield and wheat price changes; a reduction in wheat support prices is unlikely to lead to a significant increase in pulse production except in irrigated areas. In that the financial model is a prototype, considerable scope exists for further development and refinement, and a number of potential extensions are identified.

5. Workshop paper outlining consumer analysis of constraints to increased pulses consumption in Pakistan

Citation: Harrison, S., Harrison, R, Chaudhry, A.G., Sadozai, K., Qasim, M., Rani, S., Petersen, E.H. (2017) Pulses consumption in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April.

Abstract: This working paper examines various aspects of pulses as food products in Pakistan; including nutrient composition, health benefits arising from consumption of pulses and from grain crops, and views of pulses as a 'superior good' versus 'poor man's food'. Wheat and other grain crops are the foundation for food security in Pakistan, but pulses can play a critical role by providing 'complementary proteins' in that they provide essential amino acids in human diets.

6. Workshop paper documenting economic assessment of factor's affecting Pakistan's pulses production and domestic trade, including government policy and other constraints to production and trade

Citation: Rani, S., Vanzetti, D., Petersen, E and Qasim, M. (2018). Estimation of supply and demand elasticities for major crops produced in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April.

Abstract: The paper fills the gap regarding the factors affecting the supply and demand of major crops produced in Pakistan. The supply elasticities are estimated using a Nerlovian partial adjustment process, while demand elasticities are estimated by applying the Deaton and Muellbuauer Almost Ideal Demand Systems (AIDS). The secondary data used for the estimation was collected from various Household Integrated Economic Surveys and Agricultural Statistics of Pakistan. The supply own price elasticities are between 0.1 and 0.5 for all crops. The pulses tend to have higher elasticities than the traditional crops such as wheat and rice. This reflects the scope farmers have to take these crops in or out of production depending on expected price. The pulses, except mungbean, are generally grown in low intensive areas. Own price demand elasticities are elastic and negative, with the exception of poultry and fruit which appear to be luxury items. Pulses are income inelastic, indicating that consumption will not keep up with growth in per capita incomes. Furthermore, with inelastic demand for pulses, the introduction of yield enhancing varieties which lead to an increase in national production may mean that most of the benefits will flow to consumers through lower prices.

Citation: Vanzetti, D., Petersen, E.H., and Rani, S. *(*2018). Economic analysis of pulses-related domestic policies in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May.

Submitted for publication in the *Journal of Agricultural Economics*

Abstract: Pulses are a minor crop in Pakistan and in recent years their production has remained relatively stagnant, with no increase in area planted or yields. Imports have increased dramatically. The Government would like to reverse these trends, but current domestic polices discourage an expansion of pulses production. These policies include subsidies on wheat (a competing crop) and fertiliser subsidies which discriminate against pulses which have relatively low fertiliser requirements. We develop a partial equilibrium model of the pulses sector, estimate the relevant own and cross-price elasticities, and show the impact of (i) removing the subsidy on wheat and (ii) an exogenous ten per cent productivity increase in pulses production. Removal of the wheat subsidy imposes costs on consumers and producers, but the saving in government revenue would outweigh these losses. Somewhat counter-intuitively, a productivity shift benefits consumers rather than producers because of the inelastic demand for pulses. We recommend phasing out the wheat procurement price scheme and fertiliser subsidies, and dropping the Government's current consideration of a pulse price subsidy. With removal of the export tax, we expect that farmers would be encouraged to grow more pulses, and the money saved could be spent on social protection programs targeted more appropriately.

7. Workshop paper documenting economic assessment of Pakistan's international trade policies to identify their impact on pulses production and trade

Citation: Vanzetti, D., Petersen, E.H., and Rani, S. (2018). Economic analysis of pulses-related trade policies in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May.

Submitted for publication in *Food Policy*

Abstract: Pulses production in Pakistan has stagnated over the last 70 years, with little increase in yields or area over this period. With growing domestic demand, imports have increased dramatically in recent years along with exports. Concerned about these issues, in 2007 the Pakistan Government introduced an export tax on pulses which effectively stopped all pulse exports. We present a partial equilibrium model of Pakistan's pulses sector to analyse the economic welfare impacts of the export tax, as well as an import tariff as a policy alternative. Our results suggest that removal of the export tax or applying an import tariff on pulses would lead to increased production and domestic prices and decreased consumption. Overall, this leads to a transfer of benefits from consumers to producers. Removal of the export tax would cause a small reduction in government revenue, whereas applying an import tariff would results in a similar increase. Both policies are simple and transparent, but unless applied across the board, they cause distributional impacts between consumers, producers and taxpayers. We recommend the removal of the export tax without introduction of an import tariff. We suggest the government focus on diversification of sources of pulse imports and exports, rather than aiming to reduce them, to meet consumption demand while maximising food security.

8. Documentation providing evidence-based policy advice on policy reform to enhance the productivity and trade of pulses

This evidence-based policy advice is contained within papers above and has been summarised in a policy brief and newspaper article as cited below.

Citation: Petersen, E.H., Ghafoor, A., Qasim, M., Sadozai, K., Rani, S., Vanzetti, D., and Harrison, S. (2018). Pulses Policy in Pakistan: Policy options for increasing pulses production in Pakistan. Policy Brief for project *ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan"*, May 2018.

Policy recommendations: A Government procurement price for pulses, similar to wheat, would increase production but the policy would be expensive, inefficient and inequitable. A better approach is to remove the pulses export tax and phase out the wheat procurement price scheme and fertiliser subsidies. Money saved could be spent on pulses RD&E, and social protection programs targeted to those in need. Together, these policy reforms are expected to lift pulses production in Pakistan.

A newspaper article was published in *The Nation* on Monday 21st May 2018 titled "Policy reforms required to enhance pulses production: UAP VC" (see Attachment 13).

9. Mid-project workshop

There were over 40 people in attendance at the mid-project workshop; including policy-makers, government staff and researchers, academic researchers, industry members, farmers and project team members. Six workshop papers were presented with initial policy recommendations. Significant discussion of these findings allowed the project team to engage early with project stakeholders, disseminate findings and improve research outputs.

A number of other meetings/presentations were made in conjunction with this workshop, including:

- a meeting with the Chairman of PARC (Dr Yusaf Zafar),
- two project team meetings,
- an Advisory Group meeting,
- project dinner with Pakistan's Productivity Commission,
- a field trip to pulse-growing areas around Islamabad,
- participation and presentation at the DAWN Pakistan Food and Agri Expo 2017,
- ACIAR project dinner with the Australian High Commission,
- a meeting with the Punjab Provincial Secretary of Agriculture, and
- a meeting with the Pakistan Agriculture Coalition.

10. End-of-project policy forums

Three end-of-project policy forums were conducted to disseminate final project findings and engage with policy stakeholders. A total of 120 participants attended these meetings in Lahore (45 participants), Islamabad (42 participants), and Karachi (33 participants).

A number of other meetings were made in conjunction with these forums, including:

- a meeting with the Deputy Secretary Agriculture and other relevant Punjab Department of Agriculture officials to brief them about findings),
- a dinner with Hans G.P. Jansen, Senior Agriculture Economist, World Bank,
- a Meeting with Chairman PARC, Dr Yusaf Zafar, and
- a meeting at the State Bank of Pakistan (Muhammad Usman Abbasi).

7 Project outcomes

While it is expected that the full impact of project will be realised in the years to come, a number of outcomes have already been achieved, as summarised below. They include capacity building, provision of policy advice, and evidence of policy reform.

7.1 Capacity building

The project has lead to significant capacity building amongst researchers in Pakistan and Australia. Pakistani project team members have developed capacity in:

- Project management and facilitation,
- Working with team members located in other countries,
- The administration of survey processes and data collation and analysis,
- Econometrics, especially with respect to the estimation of demand and supply own and cross price elasticities required for partial equilibrium models,
- Partial equilibrium modelling and its use for policy analysis,
- Farm-level economic modelling and its use for policy analysis,
- Engaging with policy makers, especially through organisation of policy forums, and
- Report writing and preparation of papers for international review.

Australian project team members have developed capacity in all these areas, with the addition of:

- gaining experience in project leadership, and
- understanding the mechanisms for engaging with policy-makers and influencing policy reform in Pakistan.

7.2 Policy advice

The project has made a significant contribution to understanding the policies affecting pulses production in Pakistan and how they can be reformed to promote pulses production and trade in Pakistan. This will be of significant benefit to policy-makers in Pakistan in the years to come. This advice will be of benefit to:

1. **The ACIAR project CIM/2015/041.** Initially, the ADP project commenced to provide information to the CIM project to highlight any policies that will affect the uptake and impacts of CIM project outcomes. The ADP project has highlighted a number of policies that will constrain the adoption of CIM outcomes. It has shown that, without policy reform, CIM project outcomes will certainly have economic benefits to the Pakistan economy, but that Pakistani pulse consumers will be the recipients of these benefits, probably at the expense of Pakistani pulse producers. Unless the pulses export tax is removed, Pakistani producers are likely to be worse off with pulses productivity improvements as any increase in production (pulse supply) will need to be absorbed by the domestic market leading to reduced farm-gate prices and profitability.
2. **Pakistan policy-makers.** Some policy-makers noted that they didn't agree with all our recommendations (there was disparate views voiced about the importance of the wheat procurement price scheme, the likelihood that it would be phased-out, and therefore the importance of matching it with a pulses procurement price scheme) but that our policy recommendations would be considered by the

Government as a whole and reform would be decided informed by our work through due processes (those people attending our forums with views opposed to our recommendations would not block our work from being considered by other policy-makers). We noted that the role of our project was to provide information to Pakistan policy-makers, and that policy reform would be their sovereign right. In this spirit, project team members were able to engage in full, frank, amicable and fruitful engagement with policy makers.

There has been significant demand for project papers to be provided by attendees of the policy forums to senior government officials and Ministers who were unable to attend the forum. This provides some evidence of interest to apply our policy recommendations in Pakistan.

7.3 Policy reform

The extent to which our policy recommendations are applied will only be fully understood through time. However, the project has already had some impact on policy reform in Pakistan:

1. **Evidence of increased investment in pulses research development and extension.** As a direct result of pulses research conducted in Pakistan with ACIAR-funding, the Pakistani Government has decided to spend an additional US$10 million on pulses RD&E in Pakistan[4],
2. **Evidence of use of research findings to direct investment in pulses RD&E.** The additional Government investment on pulses was due to be allocated in May/June 2018 after policy-makers engaged with the ADP project team and heard their research findings and recommendations at the end-of-project policy forums. However, the forums were postponed when Australian team members were unable to obtain visas to enter Pakistan. In response, Dr Muhammad Azeem Khan, Member of Food Security and Climate Change, Planning Commission, Pakistan wrote the following email:

   "It is indeed disappointing to know that [the] visit of pulses professionals from Australia [has] not matured yet. This visit is very crucial as the experts were supposed to share finding of pulses project with research managers and policy makers. Currently, [the] Planning Commission is processing a mega PC-1 worth Rp2.7 billion on pulses to achieve self-sufficiency during [the] next ten years. Information generated from this project could have been effectively communicated and used in the mentioned PC-1. I hope that the issue could be sorted out amicably for holding this planned event in near future for developing [the] pulses sector of Pakistan."

3. **Evidence of a change in thinking regarding the Government's role in encouraging pulses production.** At the conclusion of the end-of-project policy forums, a number of key policy-makers noted that they found the project's outputs to be rigorous and informative in helping them direct research spending. They noted that they were aligned with the team's recommendations, including the importance of focussing on food security rather than self-sufficiency.

[4] *For more information, reader may contact Dr Aamer Irshad, Chief of Food and Agriculture, Planning Commission, Government of Pakistan, aamer_irshad@yahoo.com.*

8 Conclusions and recommendations

8.1 Conclusions

Pulses are dried seeds of the legume family and are an important source of vegetable protein in Pakistan. The main pulses produced in Pakistan include chickpeas, mung beans, lentils and mash beans. While domestic and international demand for pulses is expected to continue to grow, pulses production in Pakistan (in terms of yields and area) has stagnated in recent years. Imports have risen dramatically since 1980, production is volatile, and post-harvest losses are perceived by growers as a significant problem.

At commencement of this project, economic analysis of policies affecting pulses was fragmented and not comprehensive. The publicly-available information about the pulses industry was limited. The aim of this project is to fill this research gap by providing evidence-based economic analysis and advice to policymakers on policy reform to reduce constraints to pulses production and trade, and increase pulses productivity in Pakistan.

The project's research approach included a number of different activities, including:

- A number of desktop reviews,
- A farm survey of 310 pulse producers across pulses production regions of Pakistan,
- Farm-level financial modelling of a 'typical' pulse-producing farm in Punjab,
- Partial equilibrium modelling of the pulses sector in Pakistan, and
- Engagement with policy-makers and researchers through workshops and policy forums to disseminate recommendations for policy reform.

Survey results showed that the leading causes of low pulses production in Pakistan are perceived by farmers to be:

- Lack of access to high-yielding varieties,
- Significant impacts of pests and diseases,
- Low mechanisation,
- Inefficient input use,
- A poorly developed agribusiness sector, and
- Losses of chickpea grain during harvest.

There is significant need for increased RD&E in the pulses industry to raise productivity up to regional standards.

A number of government policies are affecting pulses production in Pakistan:

- **A 35 per cent export tax on pulses.** The export tax is intended to lower the level and variability of pulse prices domestically, yet prices have increased in level and variability significantly since its introduction in 2007. As a result of the tax, exports of pulses from Pakistan have all but ceased. Removal of the export tax is expected to lead to an increase in producer prices and profitability leading to increased production.
- **A wheat procurement price.** The government implements a procurement price for wheat which discourages pulses production by making pulses relatively less profitable and riskier to produce compared with wheat. Removal of the wheat subsidy imposes costs on consumers and producers, but the saving in government

revenue (approximately Rp93billion/year) outweighs these losses.

- **Subsidies on fertilisers.** The government also supports agriculture through subsidies on fertiliser, water and energy (approximately Rp57billion in 2012). The fertiliser subsidy in particular favours a number of other crops that use higher fertiliser inputs compared with pulses.
- **Funding for RD&E**. Pakistan's agricultural R&D intensity (public agricultural research and development spending as a share of agricultural GDP = 0.25) is low compared with other middle-income countries (0.43) (Flaherty *et al.* 2013). Moreover, most of this research is focussed on the high-production crops (wheat and rice) rather than pulses. We expect that if RD&E were to increase for pulses, associated productivity increases would lead to increased production and consumption, but while the export tax is in place, also a reduction in domestic prices. Producers are likely to switch into pulses if they have access to irrigation. Careful attention should be paid to ensure that productivity enhancing technological improvements are widely adopted.
- **A proposed pulses procurement price.** Some provincial policy stakeholders in Pakistan are proposing a procurement policy for pulses, similar to wheat. Research suggests this would increase pulses prices, production, consumption and decrease imports. If funded by Government, it would benefit consumers as well as producers, but it would be inequitable and costly to maintain.

8.2 Recommendations

Pulse production has stagnated over recent years as producers have switched to wheat, rice and sugar. These crops provide greater and more certain returns, partly due to government policies that encourage their production over pulse production. These policies include the pulses export tax, the wheat procurement price scheme, and subsidies on fertiliser, water and energy. We recommend removing these policies and the money saved invested in sustainable agricultural productivity growth (through infrastructure development and RD&E (particularly pulses)), and targeted social protection programs. We articulate seven specific recommendations below. Together, these policy reforms are expected to lift pulses production in Pakistan.

There is nothing specific about pulses which make it a preferable crop to grow instead of other crops such as rice or wheat. We recommend the Government establish a level playing field so that producers can grow what they can produce with greatest profitability. Even with these recommended policy changes, it may be that Pakistan producers continue to grow these crops with greater profitability than pulses. In that case, Pakistan's best strategy may be to focus on diversifying export locations for these other crops, and food security of pulses by diversifying sources of pulses imports.

Recommendation 1: Remove the 35 per cent export tax on pulses

Due to increasing demand for pulses in Pakistan and the stagnation of pulses production, the export tax was initially introduced to secure domestic production of pulses for domestic consumption. However, it is stifling pulses production and profitability in Pakistan. The tax is preventing pulses exports, so any increase in domestic pulses production has to be consumed domestically leading to reduced farm-gate prices and therefore producer profitability.

Recommendation 2: Phase out the wheat procurement policies

The Government implements a procurement price for wheat, which discourages pulse production by making wheat production more profitable and less risky to produce compared with pulses.

Recommendation 3: Phase out fertiliser, water and energy subsidies

The Government supports agriculture through subsidies on fertiliser, water and energy. These subsidies distort markets and prices and favour more fertiliser-intensive, water-intensive and energy-intensive crop production over pulse production (which requires relatively less fertiliser, water and energy than most other crops).

Recommendation 4: Don't introduce a Government procurement price for pulses.

A procurement price for pulses may increase pulses production but the policy would be expensive, inefficient and inequitable. It is preferable to remove the wheat procurement price rather than to respond by introducing a pulse procurement price for pulses. Its introduction in the presence of the wheat procurement price would be adding poor policy to poor policy.

Recommendation 5: Increase spending on pulses research, development and extension.

This could be funded through money saved from Recommendations 1 to 3, and is likely to have significant welfare gains in Pakistan, especially for consumers. Producers will also benefit if it is coupled with removal of the export tax (Recommendation 1).

Recommendation 6: Focus on social protection programs targeted to those in need.

It is more equitable and efficient to develop social protection programs to provide safety nets during economic and food crises through targeted social protection programs rather than through subsidies.

Recommendation 7: Aim to achieve food security through import and export diversification of pulses

Rather than aiming for self-sufficiency in pulses (which can actually lead to poor food security if there is a drop in domestic pulse production, as might occur during a drought or due to conflict), we recommend aiming for food security through diversifying sources of pulses imports and exports.

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9.2 List of publications produced by project

Ghafoor, A., and Nazam, M. (2018) Report on a survey of pulse growers in the Thal region of Punjab, Pakistan (Attachment 5).

Harrison, S., Harrison, R, Chaudhry, A.G., Sadozai, K., Qasim, M., Rani, S., Petersen, E.H., Vanzetti, D. (2018) Financial Modelling to Determine Optimal Crop Combinations in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May (Attachment 8).

Harrison, S., Harrison, R, Chaudhry, A.G., Sadozai, K., Qasim, M., Rani, S., Petersen, E.H. (2017) Pulses consumption in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April (Attachment 4).

Harrison, S., Harrison, R., Qasim, M., Rani, S., Chaudhry, A.G., Sadozai, K., Vanzetti, D., Petersen, E.H. (2017) Pulse production in Pakistan: A literature review. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April (Attachment 2).

Harrison, S., Harrison, R, Sadozai, K., Qasim, M., Rani, S., Chaudhry, A.G., Petersen, E.H. (2017) Farm-level Financial and Economic Review of Pulses Production in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April (Attachment 3).

Petersen, E.H., Ghafoor, A., Qasim, M., Sadozai, K., Rani, S., Vanzetti, D., and Harrison, S. (2018). Pulses Policy in Pakistan: Policy options for increasing pulses production in Pakistan. Policy Brief for project *ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan"*, May 2018 (Attachment 12).

Qasim, M., Rani, S., and Shah, H. (2018) Survey results report for the Pothwar and (rice-wheat) irrigated areas of Punjab, and Sindh (Attachment 6).

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Sadozai, K.N. (2018) Opportunities and Constraints to Pulses Production in Kyber Pakhtunkhwa (KPK), Pakistan (Attachment 7).

Vanzetti, D., Petersen, E.H., and Rani, S. *(*2018). Economic analysis of pulses-related domestic policies in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May. *Submitted for publication in Journal of Agricultural Economics* (Attachment 10).

Vanzetti, D., Petersen, E.H., and Rani, S. (2018). Economic analysis of pulses-related trade policies in Pakistan. *Paper presented at the End-of-Project Policy Forums of ACIAR Project ADP/2016/140 "How can policy reform improve the pulses sector in Pakistan?"*, Lahore, Islamabad and Karachi, 8-11 May. *Submitted for publication in Food Policy* (Attachment 11).

Vanzetti, D., Petersen, E.H., and Rani, S. (2017). Economic review of the pulses sector and pulses-related policies in Pakistan. *Paper presented at the Mid-Project Workshop of ACIAR Project ADP/2016/140 "How can policy reform remove constraints and increase productivity in Pakistan?"*, Islamabad, 3 April*. Submitted for publication in Review of Agricultural and Applied Economics* (Attachment 1).

A newspaper article was published in *The Nation* on Monday 21st May 2018 titled "Policy reforms required to enhance pulses production: UAP VC" (see Attachment 13).