
**Policy and Institutional Reforms to Improve Horticultural Markets in Pakistan
(ADP/2014/043)**

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**Improving Market Performance of Pakistan Horticulture Industries:
Some Initial Insights.**

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Abstract

Fruits and vegetables represent a commodity group with increasing market demand owing to growing awareness of their importance in a healthy diet, as well as population and income growth. Much of the fruit production occurs in the tropical and subtropical regions, although the growth in demand comes from across the world, creating numerous economic opportunities. As freshness attracts a higher value in growing produce markets, countries such as Pakistan where favourable natural conditions allow fruit and vegetable production over extended periods can take advantage in meeting this demand. However, to raise Pakistan's position as a supplier of consistent, quality products on a regular basis and perform well in competitive markets, efficient ways to link farmers to consumers are essential. Drawing on a review of available evidence, this paper argues that to take advantage of emerging markets and achieve greater benefits for all, each partner in the horticultural supply chain needs to better understand its role. In particular, efforts to modernise Pakistan's food value chain requires greater emphasis on improving entrepreneurial orientation at the growers' end. A focus on enhancing product quality and variety could help minimise perceived market risks, and achieve better returns that would offset the additional effort required. This would entail improving producer motivations and helping to address barriers to value retention at each stage. Focused training and capacity building to enhance farmers' business skills and networking abilities would be a sure way to stimulate improved farm management, while marketing policy reforms make progress.

Keywords

Horticulture, Supply Chain, Market Risks, Pakistan

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Introduction¹

Pakistan's horticultural industries are well-placed to take advantage in emerging markets. In this paper, we use analysis from published sources as well as from data collected from surveys of producers and market intermediaries in the ACIAR sponsored research project on 'Policy and Institutional Reforms to Improve Horticultural Markets in Pakistan', to make some preliminary observations on possible pathways to enhance competitiveness and profitability of horticultural enterprises.

The opportunity

The growing awareness of health and well-being attributes of fruits and vegetables, coupled with improving population and incomes, better logistics and year-round availability are driving greater demand worldwide for fresh produce. The health benefits of fruits and vegetables come from their rich content of vitamins and minerals, dietary fibre and a host of beneficial non-nutrient substances. Yet, an estimated 5.2 million deaths worldwide in 2013 were attributable to inadequate fruit and vegetable consumption (WHO, 2018). If the world were to meet the WHO recommendation of consuming more than 400 grams of fruits and vegetables per day to improve overall health and reduce the risk of certain diseases, the marketing performance of fruit and vegetables needs to improve substantially across the globe. As much of the fruit production occurs in the tropics and in the warmer seasons, to meet the year-round demand for fruit, most countries rely on imports to supplement local production, at least for part of the year. For the same reason, importing countries in one season become exporters during other times, when the local availability exceeds domestic needs. Yet, the global trade in fruit represents less than 10% of global production, leaving substantial opportunities for growth (van Rijswijk, 2018). Pakistan, with significant unexploited capacity for high value fruit and vegetable production, is well placed to take advantage in this emerging setting. However, to give Pakistan an opportunity to reap

¹ We draw on the draft papers and reports of the ACIAR sponsored research project "Policy and Institutional Reforms to Improve Horticultural Markets in Pakistan (ADP2014/043).

associated economic gains from fruit and vegetable production, a concerted effort is required to modernise the performance of its value chain.²

The US, China and Germany accounted for more than half of global fruit imports in 2016, while China was the leading country in global fruit production. The recent trends in global fruit trade also suggest that while the trading volumes are increasing only slowly, the values are growing faster, particularly in more competitive markets in the US and the EU, where fresh produce fetches premium prices. This trend indicates two aspects: that there is latent demand to be exploited, and that the critical constraints for industry development are in supply systems, rather than lack of effective demand. While this assessment seems awkward, in particular for producers struggling to compete, what that really means is that if countries such as Pakistan were to succeed in these highly competitive markets, effective strategies to improve market access as well as to create dependable production capacity are crucial. Without dependable production capacity, establishing a reputation as reliable suppliers of high-quality products that consistently meet consumer expectations would remain a distant goal.

To this end, emerging Asia—including China, India, Indonesia, Malaysia and Thailand - where disposable incomes are rising steadily, also offers an important growth platform for exports. These opportunities come at a time when there is also significant capacity to improve domestic consumption of horticultural products within Pakistan, where urbanisation is continuing and prospects for income growth are also high. These wide-ranging prospects in varied export destinations and within the domestic demand base offer added certainty for investors seeking to expand trade opportunities for horticultural products. What is required are capabilities for organising and orientating products to satisfy both the expanding domestic and higher-value export demand, by meeting market-specific product and quality requirements; these are often overlooked, particularly at the point of primary production. Farmers therefore remain a key target group for interventions to make a substantial difference in the marketability of produce—by improving the quality and desirability of goods produced for sale.

² We use the terms value chain and supply chain indiscriminately, but the focus is on bidirectional flow of goods and services and information flows and the relationships that influence them.

Pathways to opportunity

Pakistan's existing produce marketing channels that have evolved from the post-colonial forwarding agent tradition typically involve one or more intermediaries that link the producer and the buyer on a commission basis. These entities are proving suboptimal in supporting growth in market supplies and in meeting the needs of a more sophisticated, higher value market that deal with differentiated products. In developed countries, the combination of shifts in commercial demand and supply have led to the emergence of modern marketing channels employing sophisticated management methods, such as grading and standards or vertical coordination or integration of activities that profitably add value to raw commodities through transport, storage and end-point processing. These wider range of activities that provide lucrative investment opportunities in agri-food infrastructure in rural and peri-urban settings are yet to become common place in Pakistan.

These systems can help participant farmers develop confidence to explore comparative advantage and tap into the latent demand of better-off or more distant markets made accessible by emergent global agricultural value chains. Hence, they trigger investments supporting improvements in productivity and profitability, thereby further stimulating commercial demand and supply. In particular, they can facilitate innovation in postharvest systems that improve productivity across the value chain. The promotion and modernization of agricultural value chains (AVCs) could thus contribute to economic development both in peri-urban and rural localities, supporting broad-based growth (Barrett et al., 2012, Mallawaarachchi et al., 2009).

In this context, this paper takes a broader systems approach to agricultural value chain development. We outline key features of the Pakistan horticultural industry in 2018 and identify attributes which provides a strong basis for growth in the emerging context of increased connectivity, demand growth and changing social aspirations. Given the large diversity and complexity of the existing industry setting, we focus on mangoes and chillies to assess key risk factors underpinning production system performance and opportunities in adapting to take advantage in expanding markets. This follows an evaluation of risks at the primary production end of the value chain to assess critical elements that constrain optimal farmer behaviour, leading to a discussion on possible interventions to manage those risks and guide efficient adjustment across the value chain to guide the Pakistan horticultural industry on its path to growth and modernisation.

Modernising agricultural markets

The role of marketing is to enhance consumption. In fresh produce marketing, the primary challenge is to retain the quality of produce through to the point of consumption, whereas, naturally the quality is at its prime at the point of initial production—at the farm. Therefore, in seeking to maximise value for both producers and consumers, the ideal marketing capacity includes a) farms that are involved in high-quality production and b) a systematic and well-integrated supply system that preserves product quality to the point of consumption. These two parts are interdependent and cannot work in isolation or in a hierarchical fashion, with one dominating the other. Together, they can facilitate the primary marketing function of satisfying the customer and achieving a fair return to producers and other investors involved.

The traditional focus in agricultural marketing has been on the economic processes and institutions that coordinate the flow of products from producers to consumers, and money in the opposite direction (Griffith and Watson, 2016). The focus then shifted to value adding and hence value chain analysis in the 1980s, as returns to farmers started to decline and governments were keen to focus on trade promotion, to capture benefits from increased market share. Historically, government intervention was often prompted by episodic low prices and incomes associated with climatic and marketing risks, magnified by a dependence on domestic markets and limited access to global markets, which were also volatile and often highly distorted. Invariably, the focus of economic policies was to address non-trade concerns (NTC) which include market failure and the misallocation of resources, and those that relate to distributional issues. To deal effectively with both types of NTC, domestic policies that correct for missing institutions or address institutional failure were considered the necessary basis for growth (Blandford et al 2005).

Moreover, for agricultural commodities, apart from fair returns to producers, governments have always been keen to pursue accessible domestic prices for consumers. In seeking these conflicting objectives, various governments have adopted a suite of measures relating to price and income support, all of which fall broadly within the realm of agricultural policy. The purview of interventions has recently been expanded to include health and well-being and the policy domain now covers the broader scope of the food system. While such policies have desirable motivations and guided invariably by both political and social welfare interests, policy or business interventions involving a segment of the food system often have consequences beyond the original issue the intervention was meant to address.

Hence, the challenges of improving the food system in the 21st century will require systemic approaches that take full account of social, economic, ecological, and evolutionary factors (Institute of Medicine and National Research Council, 2015). Economic analyses often play a pivotal role in understanding critical issues and determining critical trade-offs and cost-effective interventions. From an economic perspective, government intervention in agricultural markets focuses on improving economic efficiency in the production value chain and thereby raising income to industry participants while offering a greater choice for consumers. The resulting improvements in the producer and consumer surplus gives rise to enhanced social well-being.

With the widening access to growing global markets, coupled with unprecedented technological innovation in global communication and logistics networks, costs of trade are set to decline. Declining costs of trade will create new opportunities while threatening the traditional business models that are inflexible and unwieldy. The widening scope for trade could particularly benefit higher value product lines, such as horticulture, where the demand is also growing. Capturing these potential gains in the new economy, however, may require inventive approaches to address NTC, where the focus is on value creation in differentiated markets, a far cry from the traditional emphasis on low-value, bulk commodity trade in agriculture (Mallawaarachchi et al., 2009).

The global food supply system

In expanding global food supply systems, three types of networks—producers, processors, and distributors—provide the logistical basis to organise activities across the value chain from farms to consumers. These, essentially market led, developments have triggered transformational change in supply dynamics involving significant investment in the modernization of agricultural value chains. While wholesale and supermarkets takes a dominant role, the later emergence of ‘niche market’ platforms, such as farmers’ markets, online vendors and the buoyant organic produce sector (Australian Organics Ltd, 2018), have helped to create a more sophisticated marketplace.

Clearly the emphasis has shifted from the traditional bulk commodity focus to supplying differentiated products from the point of primary production, which has served to add variety and meet the needs of a growing range of consumers (Figure 1). The result has been a

significant increase in the scope for value addition, investment, employment and consumer choice. These emerging trading platforms also entertain effective feed-back mechanisms, by way of price signals and non-price attributes such as credence, that are leading to ongoing refinements of ways to drive enhanced productivity as well as to addressing of social and environmental concerns of transformative change, providing pathways to ensure broader food systems sustainability.

In the foregoing sections, we examine key features of the Pakistan horticultural industry with a view to highlight opportunities for firm level optimisation of production activities in an era of globalisation and economic reorganisation. The aim is to provide insights on the relative gains from addressing farm-level deficiencies, while the process of policy reform takes its course in other areas of the supply system³.

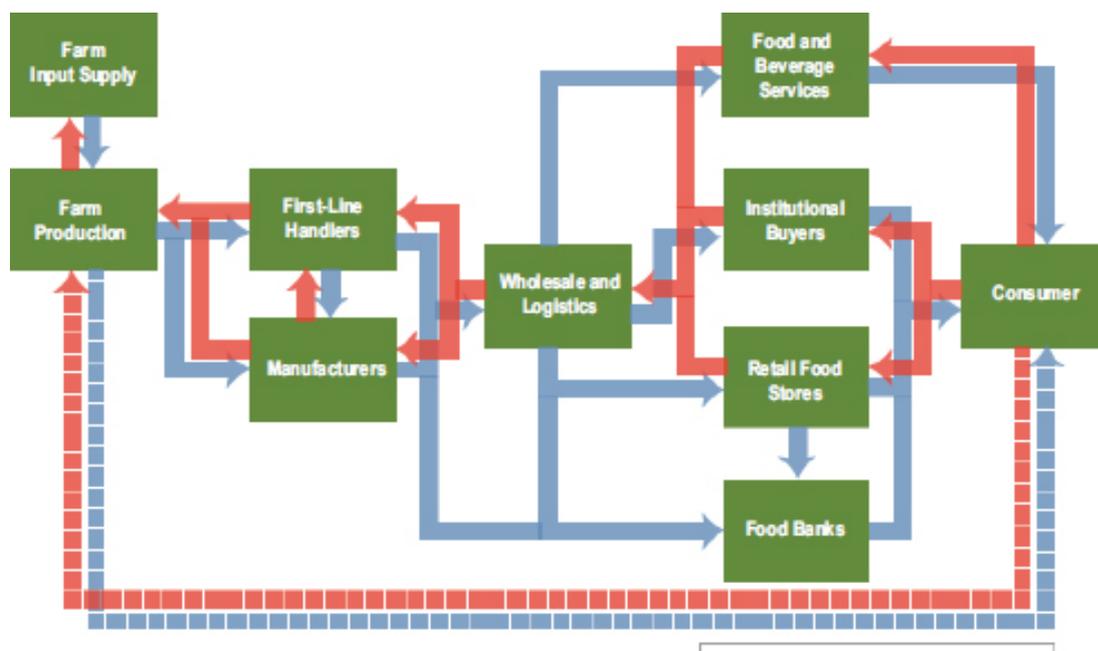


Figure 1: Conceptual model of a food supply chain incorporating the bidirectional flow of service and information (source: Institute of Medicine and National Research Council (2015))

³ Activities undertaken outside the farm and their implications are considered further in Ejaz (2018).

Pakistan horticultural industry

Pakistan's versatility in climate, rich genetic diversity and a strong domestic market for fruits and vegetables enable it to grow a rich complement of fruits ranging from cool temperate (apples, pears, plums and cherries), warm temperate (apricots, figs, grapes, pomegranates and melons) and tropical and sub-tropical species like bananas, mangoes, dates, guava and citrus fruits. Being a year-round supplier of fruit in the international market is not out of scope for Pakistan. This also applies to many vegetables and condiments, where potatoes, onion, chillies, garlic, tomatoes and turmeric are notable examples. While the temperate fruit varieties are produced in Baluchistan and NWFP, the tropical and subtropical fruits are grown mostly in the Punjab and Sindh provinces. The Pakistan horticultural industry is characterised by a large number of small-scale producers operating an area of about 8.04 million hectares, but each contributing a very small output. Speciality farms are few and many farmers cultivate fruits and vegetables in a multi-enterprise farming system for both subsistence and sale. Fruits and vegetables are a major source of nutrition in the diet. It is also important from an equity point of view, because of the significant involvement of women in production and processing (World Bank, 2014).

Out of an estimated annual production of 6.57 million tonnes only 674 thousand tonnes of fruits were exported in 2015-16 (Government of Pakistan, 2017). This represents well under one per cent of total production. Even if all the fruit were used in Pakistan, with a population of 208 million in 2017, it just equates to 90 grams of fruit per person per day, well below the 400 grams UN target, even if we were to add imports and account for own-consumption at grower households. Studies also indicate that the share of household expenditure on fruit and vegetables is increasing (Khan et al 2018), and rapid urbanisation with nearly 80 million already living out of rural areas points to further growth in domestic consumption.

In this context, the current lagging performance, against its vast potential, reinforces the large opportunity for Pakistan horticulture to combine country's natural resource, labour and geographic location advantages to enhance sector productivity and economic well-being of its participants. This could be a credible pathway to help achieve the new Prime Minister's pledge to eliminate child malnutrition, improve rural incomes and promote rural entrepreneurship. While various investigations have found that lack of appropriate investments, inappropriate institutional structures, and a host of socio-economic factors are at

play, a pertinent question is “Are there opportunities to boost productivity while improving the macro settings?”

Policy and institutional setting

Extensive analyses over the past several decades have highlighted numerous weaknesses in the regulatory framework that constrain productivity and profitability of the horticulture sector in Pakistan (Ahmed, 1996, Ali, 2014, Mustafa and Ahmad, 2003, Sherani, 2017, Spielman et al., 2016, USAID, 2011). A recent comprehensive review by Rana (2018) characterizes the legal framework as ‘archaic and restrictive’, and hence inadequate and inappropriate for efficient market functioning. Developed several decades ago, these frameworks have failed to evolve with the changing context, exposing farmers to a range of market risks, disincentives and high transaction costs overall. The costs arise from the heavy traditional commodity focus, where the regulations are designed to channel produce through licensed agents and officially approved market structures. With only a few buyers at the wholesale level, it is alleged that farmers face oligopsony conditions in produce markets, which have become too congested, and the mechanisms for price transmission, in particular for recognising quality differentials are ineffective. Pakistani governments acknowledge the limitations, and a process of reform underway. Given the slow progress, the completion of the reform process is likely to take considerable time.

Therefore, suffice to say that, at this point, the fresh produce markets in Pakistan remain inadequate and inefficient. On the other hand, many factors that are often excluded in regulatory analyses also affect the optimising behaviour of farm households and hence productive efficiency. For instance, the highly variable nature of the production system, and in particular the risks imposed owing to the variable nature of the resource base: agroclimatic conditions, soil quality, water resource availability, as well as landholding sizes and tenure status, have a large bearing on farm-level resource utilization and the productivity of predominantly household scale farm enterprises. While most of those constraints are linked to the overall institutional setting, from a risk management perspective, most relates to firm-specific risks that can be addressed through context-specific management.

Moreover, because households are both producing and consuming units, what is produced on farm and the marketable surplus will vary depending on home consumption needs, influenced

by the input and output market conditions, and access to off-farm income and infrastructure (Speilman 2016). Taken together with the emerging aspects of climate change and global market uncertainties relating to developments such as Brexit and the growing sentiments towards protectionism in some markets, the decision-making environment for farm households represents a highly uncertain environment. In this context it is instructive to examine the nature of risks that arise within the chain that links producers to consumers, which influences the level of its performance, in particular at the point of initial production – the farm level.

Horticulture value chain risks

The context

Within a value chain, operators face numerous exogenous risks, which are beyond the control of policy – policy settings can only influence how impacts can be mitigated or offer incentives to adapt to face the likely consequences of changes in the exogeneous environment.

As identified in Jaffe et al. (2010), in searching for ways to improve supply chain performance, it is crucial to understand the ability or propensity for the chain participants to anticipate and respond to shocks— their risk management practices. Given the focus of this paper on improving marketing performance of Pakistan horticulture sector, emphasis is on understanding the sources of risks and how they relate to power relations, decision-making, and to identify dominant parties who determine the overall character of the chain. And, whether there are any examples of lead firms becoming responsible for undertaking activities within individual links to maximise their success. The process of coordinating interactions between the links, the issues of value chain governance, and the underlying political economy dimension are not explicitly considered.⁴ They enter into the analysis insofar as factored into the contributory role of each link, essentially as moderating factors of relationships. The analysis also takes industry supply and demand conditions as given. Thus, the analysis retains a focus on firm level actions and determinants that are directed to maximise the share of gains

⁴ See Rana 2018 for an extensive consideration of political economy aspects of agricultural marketing institutions in Pakistan.

in the industry value added within the existing institutional and business operating environment, as briefly discussed above.

Methods

We use a survey-based approach including sample surveys, key informant interviews and survey of literature, to gather data for the analyses within a broader approach resembling rapid supply chain risk assessment outlined in Jaffee et al. (2010). The underlying philosophy is that from a business perspective: 1) risks can be recognised and measured, 2) responding to risks is the best way to assess their relevance, 3) risk behaviours help distinguish between leaders and followers, 4) risks offer opportunities to innovate, and 5) risks provide learning opportunities that leads to success (Australian Institute of Business, 2016).

Farms as optimising units

Taking a farm as an economic entity, its overall performance can be thought to be influenced by the internal organization of the farm operation, and the external setting that influences the opportunity costs facing farm operators, which together allow for the best use of available resources. In this view, farmers are taken to be price takers in a market where they have little or no influence in controlling the general price level for both inputs and outputs. The conventional focus, therefore, has been to minimize the costs of production through technologies that lead to economies of scale and intensification. While such a focus has worked for large firms and industries, small farm agriculture often lacks economies of scale. In looking for ways to increase internal economies of scale, or doing things well within a firm, large gains could be had in economies of scope, where the focus is on factors that make it cheaper to produce a range of products together than to produce each one of them on its own (Hindle, 2008). Such economies can come from businesses sharing centralised functions, finance or marketing within a locality, such as in a fruit producing village. Or they can come from interrelationships within the business process, such as cross-producing one product alongside another, or using the outputs of one business as the inputs of another, as in the case of processed products such as jams and marmalades. This could also extend to the production of a set of quality grades, or different fruit varieties through to diversifying into fruits, vegetables and livestock, thus bringing substantial opportunities through greater economies of scope in production and marketing. For instance, in early days of horticulture industry modernisation in Australia, an important basis of growth was through increased economies of scope at the farm level, given the multi-product nature of the horticultural business, and build

a foundation to gain economies of scale in marketing and distribution (Industry Commission, 1993). That process led to a complete transformation of the Australian fruit and vegetable industry enabling it to become the multi-billion-dollar production sector it is today.

In data gathered from three sets of sample surveys conducted on chillies, mango and tomato farms, we sought to examine attributes that exhibit optimising behaviours directed to maximise returns from their farming activities. Where relevant, farmers views on constraints influencing their behaviour were also investigated. While individual survey reports provide a detailed discussion of methods and the results derived, the analysis below is confined to the aspects of risk perceptions and management thereof. We focus only on chillies and mangoes here to illustrate some economic insights, which would hopefully be applicable across the horticulture industry. We also outline a framework to better analyse farm scale optimising behaviour under uncertainty, which will allow more robust insights.

Chillies farming in the Sindh province

Pakistan is a leading producer of red chillies taking the fourth position globally after India, China and Taiwan (FAO, 2018). In 2015-16 an estimated 65,000 ha were used for growing chillies, concentrated largely in the Kundri region of Sindh province, which produced around 128,000 tonnes of chillies. Although, only 2,816 tonnes of chillies were exported in the same year, it represented a 36% increase on the previous year, highlighting a growing export market (Government of Pakistan, 2017). Pakistan seems to have a comparative advantage in red chillies production, owing to favourable climatic conditions in its main producing regions and a specialised labour force accustomed to chillies production, involving a high proportion of women. Exports seem to follow a one to two-year lag, indicating the ability to store the product, which is an advantage compared to the perishable nature of other horticultural commodities.

The following insights were drawn from a sample survey that examined the growers' perspective and the role of different intermediaries in the supply chain, more specifically local traders, commission agents, wholesalers and retailers. The survey was carried out in two of the main chillies producing districts of Pakistan – Umerkot and Mirpurkhas (Mangan and Ruthbah, 2018b). The sample was selected following a split-sample design, to incorporate areas where a direct marketing initiative by the Pakistan Agricultural Coalition (PAC) was in

operation. This allows gaining insights about the potential benefits of alternative marketing channels, given in particular the well-known criticisms of the existing trading system characterized by the involvement of commission agents sanctioned by prevailing agricultural produce marketing legislation.

Overall, 100 farm households, and 50 market intermediaries (10 each from local traders, small commission agents, large commission agents, wholesalers and retailers) comprised the survey sample.⁵

Perceived risks

Low productivity

A key challenge for Pakistan in chillies production is to enhance its productivity and profitability. There is general awareness that quality has a strong bearing in prices received and, in particular producing chillies free of aflatoxin⁶ contamination during the drying out process remains a key target for quality assurance. The proportion exported has declined over the last decade, following a declining trend in production beginning 1991, as well as detection of aflatoxin, that contaminated chillies in export shipments (Mustafa and Ahmad, 2003). While the average yield remains above the world average, it is much lower than in regional trading partners, China, Thailand and Sri Lanka, highlighting opportunities for innovation in production agronomy and farm management.

The labour-intensive nature of chillies production

Chillies production involves high levels of labour use, and many tasks are carried out by women and children. The importance of family labour in production, and the extended nature of Pakistan households, is reflected in the large household size (10.28), whereas the country average in 2017 was 6.8 per household. This is also reflected in the observed inverse relationship between yield and farm size. Moreover, small farmers are often occupied solely in farming; on average around 90% of all chillies producers surveyed derive their income from farming. As urbanisation increase and educational and economic opportunities grow,

⁵ See Mangan and Ruthbah (2018b) for a detailed reporting of the survey method and results.

⁶ When chillies are harvested when wet and moisture content remains high, growth of mould releases a poison, called aflatoxin, a known carcinogen.

such labour-intensive production systems need to develop labour-saving innovations to maintain competitiveness.

Post-harvest practices

This jumps out as an area for immediate focus for improvement, with over half of the respondents claiming that they do not adopt quality assurance methods such as sorting, and with only 30% of small farmers sorting their chillies to different grades before sending them to market. Though larger farmers reported a higher rate (65%) of sorting, without high-levels of adherence to quality control, to manage known food risks, such as aflatoxins (Grace et al., 2015), it not only diminishes returns for those who do not grade, but also increases the risk of contamination at the points of aggregation from local traders to small commission agents through to wholesalers, and thus increases costs to intermediaries and reduces the potential for market growth. Once the reputation is tarnished, it could take years of effort to regain market credibility, particularly when quality assurance and tracing systems are not in place.

Farm gate price

The price received varies greatly across different markets and between varieties. The average price for a 40 kg bag of *Longi* chillies in 2017 amongst the survey sample was PKR8,937 in the export market, PKR7,655 in the online trading market, PKR7,000 in the *mundi*, the local trading floor, if selling through big commission agents and PKR 5,850 if selling through a small commission agent. The lowest price is received is from the local traders, who incidentally serve most of the small farmers, half of whom reported to not undertake any sorting of their produce before marketing. This thus remains the greatest source of risk of contamination. This clearly suggests that the traders are aware of the quality of produce they handle and the risks involved, and hence price them accordingly.

Apart from the lower price smaller farmers generally receive, the proportion of farmers who receive their payments in full at the time of selling is also much lower for smaller farmers. Moreover, almost half of them also rely on commission agents for production credit, in the form of cash or in kind such as fertilizer. This binds them into a perpetual trap, holding them in a low-income, and perceived low risk production system, which in fact carries very high levels of compounding risks, favouring unsustainability and entrenched poverty.

Risk responses

Production technology

Chillies farmers are taking up new technology such as hybrid varieties, allowing potential for higher yields and better-quality produce. Also, government support and interventions from development agencies such as USAID and AUSAID are encouraging the use of cleaner production methods, in particular for drying chillies, thus reducing the potential for aflatoxin contamination and enabling improvement of product quality. These include the use of geotextile sheets and plastic bins for product drying and storage respectively, thus replacing the previous practice of open field drying and storing on bare floors.

Medium to larger farmers employ permanent hired labour, thus allowing opportunities for training, improve handling practices, target better marketing channels and enhance labour productivity. This is reflected in nearly 50% and 30% higher prices received for local *Longi* chillies respectively by larger and medium size farmers, within the sample.

Proper training on improved production and processing needs to be extended to more vulnerable smaller farmers who form the majority. They remain the highest risk group with a greater margin for improvement.

Leadership and human capital development

The evidence of rural leadership that can drive innovation and entrepreneurial activities is limited. The online trading initiative introduced by the PAC has a long way to go to make a big impact. However, interactions recorded in the social media, such as Facebook, indicates that many market participants use the social media to gauge prices, contact suppliers and interact in the price discovery process. It is instructive to examine the characteristics of those who participate in modern networking activities and find ways to bring more farmers to benefit from the Internet of-things.

Creation of formal marketing groups, such as in a context similar to producer co-operatives in other countries can be an effective way to develop rural leadership and incentivise solutions based on collective bargaining.

Innovation

Apart from a partial take-up of hybrid varieties, use of synthetic sheets and bins for produce drying and storage, there is little in terms of production innovations. The take-up of the online trading system remains low, and smaller farmers in particular remain reluctant to

change practices. The incremental changes being introduced are having a limited impact. There are opportunities to rethink the ways to address risks, both the systemic – those beyond farmer control, and firm-level – those within farmer control, to implement measures that can modernise chillies production setup.

Heavy dependence on farming amongst growers in this sample, also points to the need to enhance non-agricultural opportunities in these regions. They may in fact come from agriculture-based activities, such as processing and value adding. Promoting innovations embodying diversification may also require capacity building activities and platforms to promote business skills, communication and other networks where shared learning could occur.

Separating production and processing

Efforts in postharvest handling are focused on value creation, including the protection, maintenance, or enhancement of attributes, for which buyers are willing to pay a premium. Fresh produce, being living organisms, are susceptible to deterioration that occurs over time at a variable rate. Handling practices are designed to reduce this risk of quality downgrading.

At this stage, the production of chillies and their initial processing as dried chillies takes place on farm. An idea that may help improve product quality, reduce risks of aflatoxins contamination, increase farm-level efficiency in quality chillies production, and enhance employment prospects for women in particular would be to separate production and post-harvest processing components in dry red chillies production. It may be possible to operate Group Processing Centres in main chillies producing areas, formed within a legal setup similar to a co-operative or a corporate entity, that will ensure appropriate profit sharing, risk mitigation and entrepreneurial capabilities.

Chilies is an ideal produce line that fits this form of specialisation due to its long shelf life of the processed product, versatility in the potential product line offering, as well as relatively low perishability of the raw product that in itself offer various opportunities for value adding in the raw form.

With a carefully designed vertically integrated mechanism, the growers can be directed through better pricing to specialise in the production of raw red chillies to meet processing specifications, while the processing centre focuses on drying the product to meet market specifications. As the supply of raw chillies is seasonal, opportunities to diversify product

lines and focus on value added product lines can be incorporated within the broader set-up. An entity like that can also address the farm liquidity issues and ways to dismantle the current credit linked poverty trap. More importantly such facilities can also enhance opportunities for other intermediaries in the current value chain to invest in better economic opportunities, including extending to cover other commodity lines with similar attributes.

There are many examples around the world to draw on in designing a system that works well in the Pakistan context, to lead the chillies sector modernisation to develop world class product lines following this approach. Examples include, tea production, Group Rubber Processing Centres in Sri Lanka, wine making to almond processing in Australia.

Learning

There are many learning opportunities given the prominent nature of chillies production in this region. Currently, there is little evidence, apart from, informal learning of formal means to share experiences and improve farming and trading practices. Feed-back mechanisms between players in the supply chain are almost non-existent, and there are no mechanisms to explain price differentials to farmers, who traditionally believe that market intermediaries exploit them, rather than work in a co-operative fashion.

Analysis based on survey data clearly indicates that the chillies farming community is receptive to new ideas, and that nearly 95% of the farmers reported lack of training on marketing as a strong impediment to progress. This, coupled with the very low rate of sorting practiced by farmers, clearly points to immediate gains that could be had from creating new learning opportunities.

Neighbouring India is a large exporter of chillies, where the export volume in 2014-15 has been twice the total Pakistan production. Given also the relatively lower price received for Pakistan chillies in export markets, improving quality of its production and choosing appropriate varieties that fetch higher prices may become part of the strategy to increase sector productivity and competitiveness. Learning and innovation will be a key to enhance chillies sector productivity in Pakistan.

Mango farming in Punjab

Mango is one of the major fruits produced in Pakistan. It is mainly grown in the Punjab and Sindh provinces. The Pakistan mango season lasts for four months, commencing in late May

in the Sindh province and ending in late August in Punjab. The major mango varieties grown in Pakistan are Sindhri and Chounsa whereas the other varieties like Dosehri, Malda, Swarnarika, Langra, Siroli, Alphonso, Gulab Khas, Fajri, Golden, Anwar Ratol, Began Phali are also grown in some areas. Sindhri is mainly grown in Sindh while Chounsa is primarily produced in Punjab. Chounsa and Sindhri are considered by the industry as better varieties for their superior taste and hence greater demand both in the domestic and international markets (PHDEB, 2005).

Mango is also important in terms of area cultivated, falling behind citrus, at an estimated 175,000 ha in 2015. The area under mango increased from 55 thousand hectares in 1970-71 to 171.7 thousand hectares in 2009-10, recording an annual increase of over 5 percent during the 40-year period. Over the past five years, the area under mango has only increased up to 174.6 thousand hectares, showing an annual increase of less than 1 percent.

Production of mango in Pakistan has increased from 519 thousand tonnes to 1845.5 thousand tonnes over the period 1970-2010, and reaching 1716.8 thousand tonnes in 2014-15 (Table 2). The Punjab province records the highest production and area under mango in the country sharing 76.5 percent of production and 61 percent of the area followed by Sindh which contributes 23.3 percent in production and 36 percent in area while Khyber Pakhtunkhwa (KPK) and Baluchistan have nominal shares (Government of Pakistan, 2015).

Studies, such as Collins et al., (2006), suggest that the production, postharvest and marketing systems of mango in Pakistan are poorly developed and returns are distributed quite unevenly, favouring middlemen. The fruit quality is generally considered good but 30 to 40 percent of fruit is reported wasted in the harvest-to-market system, mainly due to poor handling. Modern infrastructure such as cool storage, grading and postharvest treatment facilities and appropriate transport is almost non-existent. Periodic gluts occur in domestic markets and with no capacity to store fruit, heavy discounting of retail prices is common. The export market faces similar challenges. Pakistan mangoes have a reputation as being cheap and of poor quality, and exporters tend to dump fruit in markets such as the UAE. In general, there is little evidence of a value-oriented approach to supply chain management and there are concerns that current low returns to growers could make the industry unviable (Collins et al., 2006). The US-Pakistan Partnership for Agricultural Market Development project has recognised these limitations and USAID has provided 13 state-of-the-art, custom-made,

automated mango graders, which were reported to have been used to grade export quality mangoes during the 2017 season (USAID, 2017).

Despite these developments, there is little evidence of market differentials for premium quality in local and intermediate markets, as most of the mangoes are sold bulk at auctions. This system does not offer price differentials based on quality and offer no incentive for investing in quality improvements.

The following insights were drawn from a sample survey that examined the growers' perspective and the role of different intermediaries in the supply chain, more specifically harvest contractors, commission agents, wholesalers and retailers. The survey was carried out during July-August 2017, in three main mango producing regions of Punjab – Multan, Muzaffar Garh and Rahim Yar Khan (Ghafoor et al., 2018), and in the Hyderabad and Tando Allahyar regions in Sindh (Mangan and Ruthbah, 2018a). The sample was selected following a stratified random sampling approach. However, the survey design was also adapted to include respondents from areas where mango quality improvement measures have been previously introduced under the Australia–Pakistan Agriculture Sector Linkages Program (ASLP).

As for the chillies component discussed earlier, the objectives of the study in relation to mangoes were to:

1. identify grower's capabilities
2. investigate mango production system characteristics
3. determine market related factors that may drive productivity and profitability, and
4. draw insights on measures to improve mango marketing system in Pakistan.

This grower survey was also replicated in the Sindh province, and followed up in 2018 with interviews with a selected small sample of market intermediaries to gather their views on the operation of the market. We will revert to that after considering the insights drawn from farmer interviews⁷.

⁷ Please refer to Ghafoor et al., (2018) and Mangan and Ruthbah (2018) for detail reporting of the results of the mango grower surveys.

Perceived risks

While it is regarded that the Portuguese, who landed in Calcutta in 1498, were the first to establish a mango trade, mango is native to South Asia and has been an important part of its cuisine. The highly seasonal nature of production, quality heterogeneity owing to varieties, growing region and farm practices, as well as transport distances and the perishability resulting during transport and post-harvest handling are well-known sources of risks in meeting consumer preferences for quality mango in Pakistan and markets around the world.

Horticultural producers often claim marketing to be the single biggest risk factor determining their returns, followed by climate and the high cost of inputs. However, in assessing these claims, in terms of modernising supply chains to meet the demand in today's sophisticated markets, an examination of the way production is organised at the farm scale can yield valuable insights as to the competitiveness of the farm businesses, risk factors affecting their business model, and their ability to produce an appropriate quality product to meet market expectations, and thereby influence prices received and returns made.

Mango operational characteristics

While mango is often grown as a sole crop, most farmers grow more than one variety of mangoes. In the Punjab sample, nearly 93% of growers sampled had livestock, such as buffaloes, cows, goats and sheep, that mainly provided for domestic needs. One in ten also had non-farm employment and around 2% were involved in non-farm business activities. While the majority of growers were well literate (with 15% having a university degree), around 17% were unable to read and write.

The majority of growers (80%) fell within the small (< 5 acres) and medium (5-15 acres) farm categories, with only 20% holding a farm area greater than 16 acres. The area irrigated was inversely proportional to size, indicating limited availability of water for larger holdings. While some areas were under sharecropping and leasing arrangements, the majority (83%) of the orchards was owner-operated. Similarly, it was noted in the Sindh sample that the family size was inversely proportional to farm size.

A range of mango varieties are grown on these farms and the yield levels varied widely, reflecting variety, varying planting density and management conditions, as well as soil fertility. Farmers rated climate variability as the leading production risk (48%), affecting fruit

set, fruit maturity and immature fruit fall. Poor market price for produce and high input costs, rated highly by around 70% of the growers, were the primary sources of market risk.

Product disposal/marketing

The preferred method of product disposal (80%) is through pre-harvest contractors, with contracts often made two years in advance. Post-harvest contractors were used by 20%, with the balance using local assembly markets (8%), direct sales to wholesalers (5%), and around 2% each directed to exports and processing into juices and other products.

Preharvest contracting arrangements in Multan, where the yield levels are relatively high (around 14 t/ha), were predominantly for one year, with the majority contracting at the fruit formation stage, while others enter into contracts at the flowering stage. In Rahim Yar Khan, where the average yield is much lower, contracting was always done for multiple years. Only about 20% of growers in the sample entered into contracts at fruit maturity.

Almost all contracts with small farmers are verbal, and no formal exchange of documents. Medium to large growers enter into written contracts, where most of the orchard management (excluding plant protection) is by the owner, while the contractor implements plant protection measures and does the harvesting.

Payments are made in instalments; with medium to large growers, the initial payment is around 1/3 of the total value, with subsequent payments at the first and last harvests. Often payments in kind are involved, as in providing fertiliser.

Transport and handling

Handling practices during and after harvest vary; except for export targeted mangoes, traditional methods of bulk handling is the norm. Method of maturity detection is mainly visual. Only a few growers who are directly or indirectly involved in export perform formal maturity assessments.

Sorting is done usually on-farm, by contractors' labourers. Mangoes are usually held on farm for around 24 hours before dispatch to next destination typically in 40 kg wooden crates which are often overfilled. Transport often takes many hours. No cool storage or temperature-regulated transport vehicles are used. Farmers acknowledged that proper grading and better packaging of mangoes can result in improved market performance and greater profit.

Product quality is the result of the interaction among many factors including the variety, management, consumer perceptions, distribution, and postharvest handling systems. Quality

cannot be improved after harvesting; therefore, it is important to grow appropriate varieties, manage the crops optimally, harvest fruits and vegetables at the proper stage, size, and at optimal quality (Berruto and Busato, 2009). Hence the assurance of quality begins at the farm. Yet there is little evidence that the production, handling and transport aspects are quality orientated.

For perennial crops, such as mangoes, the bundle of attributes inherent in the available supply is already predetermined by past events, by farmers' decisions made months in the past as well as the subsequent growing conditions experienced. Often desired quality attributes of agricultural commodities are incorporated in farm products through technological change over time including new varieties, cultural practices (e.g., organic) or value adding services such as post-harvest treatment and packaging (e.g., pack houses). In our sample, less than 2% indicated the use of a 'pack house', although the level of sophistication was unknown.

Of note for policy analysis is the fact that for a given output such as mangoes, producers have no control over the prices they receive — the market determines the prices of the different grades and the raw product they supply is often undifferentiated. But, in the short and longer run, farmers can influence the prices received to the degree that they can influence the quality of their output (Mallawaarachchi et al., 2009).

Risk responses

The risks associated with the existing handling, transport and storage are well-known and well-documented (Khushk and Smith, 1996, USAID, 2011, Badar, 2015). Comparison of studies over several decades show little or no improvement, except for the recent USAID led initiatives mentioned earlier. The progress made is not dissimilar in other horticultural industries (Sharif et al., 2005).

Learning

While the two farm surveys provided useful insights on the risk-averse nature of mango growers, from an economic perspective, it was instructive to examine to what extent the constraints faced by growers in the marketing channel are influencing producers' behavioural responses. To get a deeper understanding upstream-downstream linkages and understanding the link between farm management activities and supply chain procedures influence the heterogeneity in product quality (Zúñiga-Arias et al., 2009), an investigation of the entire

chain was undertaken based on a small sample of market participants. The detailed description of this investigation is given in Ejaz (2018), and we draw following insights on how interfirm interactions and powerplay may influence performance and what might help catalyse a move towards greater entrepreneurial attitudes.

What may be the crucial elements guiding risk behaviours?

It is well-known that the effectiveness of any supply chain depends on mutual relationships between the participants that lead to efficient coordination, information sharing, cooperation, partnership building and maintaining long-term associations (Mentzer et al., 2001). The degree to which a firm or organisation exhibits a commitment to efficient behaviour rests with the importance they place on that activity in relation to other activities in their overall business strategy.

Examination of the small sample of respondents indicated that amongst mango growers that the community identified as 'lead players', only a minority (20%) considered mango growing as the primary source of income. Various farm and non-farm income opportunities complement their mango incomes. Similarly, their networking and relationship building effort was also limited. Given the level and nature of mango returns, this behaviour makes perfect sense.

If this is the case, one would expect low levels of investment in improvements. Examination of national data indicated that the area under mangoes and the yields are all levelling out. Confirming this trend, within this sample, more than half (11 of the 21) the orchards were 30 or more years old. Associated with a high proportion of orchards under very low planting densities, poor pruning and management practices, yields of such orchards would decline quickly. For instance, growers acknowledged that "high density planting give 10 times more yield than conventional densities in the first 10 years". It was interesting though, that the reported gross yield (20 tonnes/ha) is closer to that specified for "well managed farms" in Bally (2006). This may confirm the favourable natural growing conditions for mangoes in Pakistan and the potential for exploiting this advantage. However, it must be noted that due to poor management, a significant proportion of this biological yield is not converted to marketable output – a key contributor to low productivity.

For instance, none of the farmers used modern information technology, and only three reported recent innovations; two moving towards high density plantation and one using trimming/pruning of trees to reduce wastage during harvesting. All of them reported being satisfied by the outcome of these innovations.

Our analysis also highlighted the fact that the low productivity and the very low profitability of these smallholder-led enterprises are often unaddressed as they are not brought to attention. They are hidden partly due to erroneous methods of estimating enterprise returns, often termed ‘profits’, which excludes important components of cost of non-traded inputs, such as household labour and the value of the land (most of the properties were inherited). More systematic analysis is necessary to gather such critical information to guide policy.

Marketing Channel

Pre-harvest contracting is the norm, with the two-year contracts being the most popular (<50%), followed by one-year contracts (33%) and the rest exceeding two years duration. Contracting is driven by past experience, price offered and the reputation. The majority considered offers from at least two to three contractors before deciding. While the “current season’s crop condition”, followed by “highest price after negotiating with more than one contractor” and “prevailing prices in the area” were noted as influencing the decision process, the long-term nature of the contract can create decision conflicts.

Leadership and innovation

In recent times, Pakistan has acknowledged that the quality of what is produced as a key barrier to increase competitiveness, (Zúñiga-Arias et al., 2009, Sharif et al., 2005, Mustafa and Ahmad, 2003, Badar, 2015, International Trade Centre, 2013). However, a focus on product quality is yet to be elevated as an industry-wide strategy to enhance production system performance and risk-taking abilities of horticultural producers. We explored to what extent quality awareness was a factor in decision-making in a small group of progressive farmers.

Interestingly, all the respondents reported that they are able to charge a quality premium for their produce. This seems consistent with the findings of Badar et al., (2016) which indicates that the participants in their study “desired to consume good quality mangoes and for that they expressed their willingness to pay a premium”. The premium ranged from PKR 5-10 per kg for the low-income group, PKR 10-20 per kg for the medium income group, to PKR 20 per kg by the higher income participants “if mangoes of their desired quality were available”. While this suggests that there is potential for quality premiums in the domestic market, such premiums are yet to become a driver of quality improvement at the farm level. For instance, Medhi et al., (2012) reports that “the aspirations of the growers that they would receive

adequate rewards for their efforts to improve quality were not evident in the majority of cases” (p. 134).

The grower-contractor relationship seems to be the crucial link that could be utilised strategically to introduce the concept of quality premium and develop appropriate mechanisms. Currently, most growers want their contractors to adopt better harvesting practices. Conversely, according to contractors, growers need to be more careful towards orchard upkeep and pre-harvest practices. High contract price is the other major concern. Further, almost half of the contractors feel that nothing needs to be improved regarding the commission agents’ behaviour; the only major concern being the high commission rates. Thus, in general, contractors seem to be satisfied with the ongoing marketing channels.

In this respect, augmenting the capacity of rural entrepreneurs to better utilise information — to bring ideas and resources together to overcome constraints and gain competitive advantage— is regarded as a key condition necessary to go beyond the initial comparative advantage (Diop and Jaffee, 2004, Fleming and Hardaker, 1993). As highlighted in a series of World Development Reports, (World Bank, 2007b, World Bank, 2007a, World Bank, 2014, World Bank, 2016), in responding to demand in a system that at best represents incomplete markets, a further challenge is to better represent the complex risk management and adaptation aspects to circumvent competitive barriers in the first place, and then organise to shift those barriers over time through collective action mechanisms. Recent advances in innovation economics, a theory that emphasises entrepreneurship (Potts and Kastle, 2017), and advances in decision-making under uncertainty (Quiggin and Chambers, 2006, Chambers and Quiggin, 2000, Rasmussen, 2011) seem to offer new ways to better represent firm behaviour in risk management and niche competition in modern agricultural markets.

In the emerging Pakistan horticultural industry context, such a consideration could lead us to identify some new directions to complement the existing reform program, providing a shift in emphasis from a market failure to collective action models of the innovation problem, and from government-led to industry-level solutions for industrial organisation in agriculture (Potts and Kastle, 2017). A key consideration in this shift in focus is long-term sustainability of enterprises in an evolving market setting. In the context of markets becoming more informed and concerned with long-term sustainability, innovations in agriculture can be defined as the changes brought by a business entity into enterprise activities with the aim of increasing the market competitiveness of its products (Almukhambetova et al., 2017).

A key notion in this conceptual evolution is that in seeking to adapt to uncertain and uncontrollable production environment, the entrepreneur takes greater control of his welfare, focusing on both self-protection and mitigation of risks (OECD, 2009, OECD, 2010, Mallawaarachchi and Harris, 2014). In this process, objective adaptation of innovations and experiential learning becomes critical. Moreover, in the pursuit of market competitiveness as a goal, innovation is considered as involving three aspects: an *outcome*, achieved through a *process*, involving an adaptive *mindset* (Kahn, 2018).

Studies conducted as part of the main project to which this study relates highlight transferable learnings from reviews of Australian and Chinese horticultural industry performance experience. They offer a useful basis to evaluate some production system characteristics of the Pakistan horticultural industry. For this purpose, we rely on both published sources as well as authors' own investigations that focused on economic organization of activities across Pakistan horticultural value chain. As this discussion is directed to analyse entrepreneurial orientation, or risk-management aspects of the horticultural business, we introduce a conceptual model of production under uncertainty, as an analytical framework to situate the discussion.

The state-contingent model of production under uncertainty

The weakest part of much of the modelling exercises is the lack of an empirical basis for the modelling of choices that determine endogenous risk, the part of the risks that are within the firm. The problem of agricultural production is generally examined using a stochastic production function in the form

$$z = f(x, \varepsilon), \quad (1)$$

where z is a scalar output, x is a vector of inputs, and ε represents a random shock, which may be conceived as an input from nature, such as rainfall or soil moisture. In this model, as is generally the case, effort on production leads to random outcomes as dictated by forces of nature.

Yet, modern agricultural production is almost always about controlling for natural variability through appropriate selection of input combinations, to produce a preferred bundle of outputs. While nature plays a crucial role, the effort is context-specific, with knowledge playing a key role in the conscious choice of inputs and their application, thus overcoming the tendency for wide fluctuations in output. Randomness, then is brought about by the unawareness of

appropriate input combinations, or technology, or the inability or reluctance to experiment with nature— which we call the entrepreneurial ability. In economic systems, as Coase stated in 1937, individuals “exercise foresight and choose between alternatives”, in a process of planning and organization, involving judgements about “substitution at the margin” (Coase, 1937). That substitution, essentially involves the consideration of trade-offs, where one outcome is forgone in preference to another, which gives rise to the realization of opportunity costs and the nature of binding constraints. The stochastic production function fails to offer realistic insights to this process of managerial influence, which is critical for success, in the presence of constraints.

The state-contingent model for production analysis, which originated from the earlier work of Arrow and Debreu, and advanced in Chambers and Quiggin (2000), provides greater flexibility to better represent the role of the entrepreneur who coordinates production under uncertainty, an idea originally introduced by Knight (Knight, 1921). While, in a competitive system, relative prices and costs are determined through the coordination of the price system outside the firm, within a firm it is the role of the entrepreneur, who, takes the place of the price mechanism in the direction of resources (Coase, 1937).

Then, the role of the entrepreneurial judgement becomes a matter of greater importance when the price system is inadequate and inefficient, and there are costs associated with the price discovery, as is the case in incomplete markets. Then, there are gains to be made in examining entrepreneurial judgement within the purview of decision-making under uncertainty. In this view entrepreneurs purpose is “owning, controlling, and combining heterogeneous assets, which differ in their attributes, and deploying these assets within a firm to produce goods and services in anticipation of economic profit” (Foss and Klein, 2015). This notion can be conceptually represented in the general state-contingent model (Chambers and Quiggin, 2000, Quiggin and Chambers, 2006), as a multi-input, multi-output production function, where inputs are heterogeneous and categorically identified into finite states of nature, such as classes of soil or growing season conditions, such as wet, normal and dry. Similarly, outputs can be identifiable into specific classes or grades, and ways to produce such outputs with specific methods, or technologies that link states of nature with possible output categories.

In the general, in the state contingent model, as specified in Quiggin and Chambers (2006), there are M distinct outputs, N distinct inputs, and S possible states of nature. Inputs $x \in \mathfrak{R}_+^N$

are committed *ex ante* and fixed *ex post*. State-contingent outputs $z \in \mathfrak{R}_+^{S \times M}$ are chosen *ex ante* but produced *ex post*. Here, if the *ex ante* output choice was matrix z , and if state s was realised, then the observed output $z_s \in \mathfrak{R}_+^M$ corresponds to the M outputs produced in state s .

Inputs that are variable *ex post*, such as irrigation, may be regarded as negative state-contingent outputs, in which case we generalise to allow $z_s \in \mathfrak{R}^M$. We denote by $1_s \in \mathfrak{R}^S$ the unit vector with all entries equal to 1.

The formal structure may be considered as a two-period game with nature, with periods denoted 0 and 1. In period 0, the producer commits inputs $x \in \mathfrak{R}_+^N$. When nature reveals the state s , the individual produces the output z_s .

The technology of production determines the feasible strategies (x, z) . In the current analysis, horticultural farmers' choice of management, such as irrigation and the level of fertiliser use in low and high quality land, across seasonal conditions, can be treated as state-allocable production technologies that contribute to state-contingent outputs (different yield and grades of produce) in low and high seasons respectively.

The cost function and production certainty premiums

The state-contingent technology described above may be characterised by a cost function $c(z, w, \pi)$, where $z \in \mathfrak{R}^S$ is the state-contingent output of interest (in this case, horticultural output), w is a vector of (possibly state-contingent) input prices and π is a probability vector. The cost function is defined as

$$c(z, w, \pi) = \min E_\pi [wx : (x, z) \text{ is feasible}] \quad (2)$$

For a given stochastic output z , and probabilities π , let $\bar{z} \in \mathfrak{R}^S$ denote the non-stochastic output vector with all elements equal to $E_\pi[z]$, and define the absolute production certainty premium as

$$\rho^a(z, w, \pi) = c(\bar{z}, w, \pi) - c(z, w, \pi) \quad (3)$$

and the relative production certainty premium

$$\rho^r(z, w, \pi) = \frac{c(\bar{z}, w, \pi)}{c(z, w, \pi)}. \quad (4)$$

For any μ , let

$$z^*(\mu) = \arg \min \{c(z, w, \pi) : E_\pi[z] = \mu\}. \quad (5)$$

Observe that $\rho^a(z^*, w, \pi) \geq 0$, $\rho^r(z^*, w, \pi) \geq 1$. Equality arises in the case where $z^*(\mu)$ is non-stochastic. That is, in the terminology of Chambers and Quiggin (2000), the technology is not inherently risky.

State-contingent inputs and risk premiums

As noted above, some inputs may be state-contingent. Risk-averse producers may increase the use of such inputs in unfavourable states of nature in order to reduce the variability of state-contingent output. For horticultural enterprises, including the chillies and mango farms studied here, the most important response to adverse seasonal conditions or managing variable quality grades that are amenable to management influence is the use of context-specific management to overcome natural stochastic variation.

Following the approach described above, state-contingent inputs may be treated as negative outputs, or additional costs, and returns under different input combinations can be modelled.

Such analysis, as illustrated in (Adamson et al., 2007, Mallawaarachchi et al., 2017), can be used to model farmer's farm management decisions and evaluate their risk-taking abilities and ways to influence their behaviour. Moreover, the model can also be extended to analyse the flow of goods along the supply chain, and assess the shadow price or opportunity costs of the constraints imposed by the existing regulations affecting behaviour of marketing agents.

Way forward

The time and the level of data available to date have not allowed us to implement the model using the framework described above. When implemented, the model will help analyse how the characteristics of the general business environment may influence the development of the dynamic organisational capability of a proactive farmer and how a firm's proactive farm management strategy can draw on its competitive advantage. For instance, it could examine the influence of the general business environment using the three characteristics of environmental uncertainty, complexity, and operator's own objectives, commonly used in the literature (e.g., Amit & Schoemaker, 1993; Boyd, 1990; Dess & Beard, 1984). We acknowledge that other characteristics of the general business environment may also moderate the link between farm management strategy and organizational competitive advantage and that it may be important to study general business environment risks in the form of interactions among variables (Aragón-Correa and Sharma, 2003).

Undertaking this work remains an objective of the work program and ways to meet resource needs will need to be addressed. Pending such detailed assessment, given below are some insights drawn from a careful consideration of literature and the Pakistan context as analysed earlier in this paper.

The role of government

When there are numerous suppliers (growers), no individual supplier can influence market outcomes. Then the role of public policy is about assisting collective determination of efficient outcomes, within the constraints of the system. Understanding the constraints offers the perspective on which proposals for improving the efficiency of the existing system can be considered (Tulloch and Buchanan, 1962). In a quality-focused venture, to remain competitive and profitable, all participants in the supply chain need to generate value at each point, whereby the final consumers are presented with a superior product. In this sense, this paper conjectures that in enhancing marketing performance of horticultural produce, efficient organization of primary production becomes an important necessary condition, while it is not sufficient to enhance overall productivity, unless the functions of the rest of the value chain can also be improved.

Also, recognising that public decision-making often involve large uncertainties, owing to both collective action and strategic behaviours favouring private interest, the role of governments is largely on the supply side — to reduce costs of production from farm to plate, allow greater benefits from augmented comparative advantage drawing on spatial heterogeneity in natural endowment and fitting investment in technologies. In doing so, it needs to ensure that information in relation to technologies and all opportunity costs, including those that relate to access to public goods and the environmental services are included in allocation decisions. In adapting to such challenges, more recent developments around the globe, including in Australia and China, as well as in many emerging markets points to a move away from sectoral policies in favour of a broad set of market enablers — institutions, infrastructure and information networks, that have proven effective in catalysing market led growth.

Making use of forward contracts

It was noted that the majority of mango farmers are using forward contracts as a medium to dispose their produce. There is, then an opportunity to take advantage of the ‘contract farming’ tradition, and stipulate quality standards into the contract, and improve enforcement, capacity building as required. Standards would allow meeting different market segments and thus targeting different price expectations.

On the other hand, those contracting over extended periods can be poor performers or low risk takers, and are thus using the mechanism to mitigate price volatility (Soullier and Moustier, 2018). As highlighted in Soullier and Moustier (2018), drawing on Minot and Sawyer (2016), it is also likely to appear when uncertainty and asset specificity are high, such as in the trade of products that are perishable, difficult to store and transport and probably of heterogeneous quality. This applies closely to mangoes and many horticultural products and the Pakistan experience confirms this.

Conclusions

In this paper, we outlined key features of the Pakistan horticultural industry in 2018 and identified a set of attributes which makes the industry one that has a strong basis for growth in the emerging context of increased connectivity, demand growth and changing social aspirations. In particular, shifting consumption patterns in destination markets that have a focus on health and wellness offers Pakistan horticultural producers substantial opportunities for wealth creation. In reaching the full potential of Pakistan’s horticultural production capabilities, the challenge is to develop a sustainable basis for growth and modernisation, giving farmers the flexibility to respond to market demand.

In doing so, the traditional focus in agricultural marketing on the economic processes and institutions that coordinate the flow of products from producers to consumers, and money in the opposite direction may not be sufficient. The need is to direct the supply system strategies away from the traditional commodity mentality towards value creation in differentiated markets, where product quality and variety stands out as the strategic choice. As both those attributes are determined at the point of initial production, a greater focus may be given to facilitating innovation and developing entrepreneurial skills amongst primary producers.

Although the current institutional regime increases transaction costs and encourage growers to take a low-risk-low-return approach to farming, the marketing institutional setting cannot

be considered the sole barrier that constrain optimising behaviour of horticultural producers. Clearly, ways to stimulate practice change for greater profit needs to be found. Our analysis of risk factors pointed to some possibilities, such as group processing of chillies, that can help to arrest current pathways leading to lower quality and lower returns, particularly amongst small chillies growers. Similarly, mango growers could be encouraged to seek quality premiums, by taking advantage of their affinity for forward contracts, and designing ways to share the risks between farmers and forwarding agents.

The economic modelling framework outlined allows a useful way to examine the nature of risk-sharing under alternative arrangements, and draw robust insights on mechanism design, that could catalyse a greater degree of entrepreneurial activity. Given the generally low-level of technological innovation, provision of learning and training opportunities on farm business management could be a further element in targeted farm level interventions.

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