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Bangkok, Thailand

Extended Summaries

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This book includes the extended summaries of the scientific presentations made during the 12th Asian Maize Conference and Expert Consultation on "Maize for Food, Feed, Nutrition and Environmental Security" held at Bangkok, Thailand (October 30 – November 1, 2014). The Conference was co-organized by the Asia-Pacific Association of Agricultural Research Institutions (APAARI), International Maize and Wheat Improvement Center (CIMMYT), Food and Agriculture Organization of the United Nations (FAO RAP), and Department of Agriculture (DOA), Thailand. The 12thAsian Maize Conference (AMC) brought together over 300 delegates from 30 countries worldwide, including researchers, policy makers, service providers, innovative farmers and representatives of various NARS institutions, private sector, international agricultural research centres, advanced research institutions, non-governmental organizations, foundations and funding agencies, involved in maize breeding, biotechnology, production management, seed systems, and value chains. The conference features over 225 presentations, including keynote lectures, invited oral presentations, and poster presentations, besides scientific deliberations and discussions on maize research and development in Asia. The Book of Extended Summaries includes 73 reviews/research papers on a diverse range of topics, including maize drivers in Asia; maize research-for-development opportunities and challenges; strategies for enhancing genetic gains in maize breeding; new developments in production of doubled haploids in maize breeding; maize for fodder/feed, specialty corn, value-addition and processing; stress resilient maize for Asia; socioeconomics and innovative policies for enhanced maize production and impacts; impacts and strategies for adaptation of maize-based cropping systems to the changing climate in Asia; innovations and reforms for improving efficiency of maize marketing; biotechnology for maize improvement; strengthening maize seed systems; country reports from Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, Papua New Guinea, China, Philippines, Thailand, Vietnam, Myanmar, Iran and Turkey; precision-conservation agriculture for enhanced input use efficiency; adapting maize production practices to the changing climate; nutritional enrichment of maize; and enhancing gender equity and social inclusiveness.

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Competitiveness of Maize Production in Pakistan

Hassnain Shah*, Waqar Akhter, Nadeem Akmal and M. Azeem Khan

Social Sciences Research Institute, National Agricultural Research Centre, Islamabad, Pakistan
*Corresponding Author; Email: hassnainshah1@gmail.com

Introduction

Agriculture is a vital sector of Pakistan's economy contributing 21 percent of GDP and employing 43.7 percent of the labor force. Sixty percent of the rural population is directly involved in agriculture to derive their livelihoods (GoP, 2014). Maize is one of the major crops and is ranked third among the cereals after wheat and rice in production and achieves the highest-yield in Pakistan. There is an increasing trend in maize production which mainly comes from productivity enhancement. The contribution of maize to the total value added in agriculture remained at 2.1 percent and to the GDP at 0.4 percent during 2013 to 2014. It was planted at an area of 1.12 million hectares (ha) (65 percent irrigated, and 35 percent rainfed) resulting in a production of 4.53 million tons. Pakistan has already been on the list of the top 30 producers of the world during 2012. The country ranked 31st in area under maize cultivation, 29th in total maize production and 68th in yield among the maize growing countries of the world (FAOSTAT, 2013).

Maize, the highest yielding cereal crop in the world, is of significant importance for countries like Pakistan where demand from a rapidly increasing population has already out-stripped the available food, (Memon et al., 2012, Memon et al., 2011, Ullah et al., 2011, Durrishahwar, 2008) feed and fodder supplies (PARC, 2013). Maize is traditionally a summer crop grown mainly in the two provinces, Khyber Pakhtunkhwa (KPK) and Punjab. The introduction of hybrid maize, particularly planted in the spring season in Punjab, with yields averaging 8–9 tons per hectare (t/ha) has revolutionized maize production (Salam, 2012). Since 1991, maize area, production and yield depicted a positive growth. The growth in production of maize (9.43%) largely came from productivity gains (8.82%) with a very slow growth in area (0.61%) during the last decade (2001-2010). Being a multipurpose crop, maize provides raw material to industry and feed for livestock and poultry production as well. It contributes more than 10 percent of all agricultural production and 15 percent of agricultural employment in the country (Khaliq et al., 2004). It is equally important for subsistence as well as commercial farmers.

The use of maize in Pakistan, for direct human consumption, is declining, but its utilization in the feed and wet milling industry is growing at a much faster pace than anticipated (Tariq and Iqbal, 2010). The major demand for maize comes from the feed sector followed by wet milling (Shah et al., 2014). Demand for maize, largely from the poultry and livestock subsectors, is expected to increase and more can be done to add value to Pakistan's maize crop (USAID 2009). The wet milling of maize produces an array of products, by-products and value addition (GoP, 2014). The growth in poultry and livestock sector, in addition to other industrial uses and human consumption, further triggered the demand which helped the food and feed industry to offer competitive prices to maize growers (SMEDA, 2008). Based on inter- market price data (Shah et al. 2014) reported that maize markets were integrated and price signals were well communicated from the Lahore market located in the maize production hub in Punjab. They also highlighted that the maize trade depicted a fluctuating trend in the past, but since 2008 to 2009, Pakistan has been a net maize exporter. Increase in production coupled with the stability in prices of maize helped to increase the income of the farmers due to the increased adoption of hybrid maize. This also helped to increase maize productivity.

Given the scope for export and potential for improving maize economy in terms of product development, there is a need to look at the potential of Pakistan's competitiveness in international markets, However scanty information currently exists. Appleyard (1987) studied the economic efficiency and comparative advantage in agriculture sector of Pakistan by covering regional aspect i.e., Punjab and Sindh provinces of Pakistan including maize. A number of studies on the competitiveness of agricultural commodities had been conducted using the Price Analysis Matrix (PAM) approach. For example, Fang and Beghin (1999) assessed the competitiveness, comparative advantages and protection of maize along with many other crops in China. Huang (2002) analyzed the economic competitiveness of sweet potato and maize in China and Dahmardeh and Faghihzadeh (2008) elucidated economic efficiency by using comparative advantage criteria in different crop production systems such as maize, wheat and barley, along with some horticultural crops in two provinces of Iran.

The current paper intends to provide a better understanding of factors that influence the competitiveness of maize production system in Pakistan and to identify regional efficiency under

import and export scenarios. Based on economic prices, different indicators in the PAM structural model are evaluated to determine if maize production systems in Pakistan are competitive and efficient under import and export scenarios.

Material and methods

The geographic scope of the study was Punjab and KPK provinces of Pakistan. KPK and Punjab are the major maize production regions contributing to 99 percent of the production. The study utilized both primary and secondary data for analysis. The cost of production and marketing data collected from primary sources was obtained through a well-structured questionnaire. Secondary data was collected from different national and international sources to complement the primary data for analysis.

Policy Analysis Matrix (PAM)

The PAM framework was used as method to analyze competitiveness of maize production in Pakistan. PAM has been widely used to compute market-driven and social profitability and competitiveness of crop production systems under different scenarios. The computational framework developed by Monke and Pearson (1989),considers many insights from international trade theory and cost-benefit analysis and measures the competitiveness, economic efficiency or comparative advantage, the degree of government interventions and is also suited for quantitative policy analysis (Nelson and Panggabean, 1991; Khan, 1997; Khan, 2001).

From the data derived from a farm household survey conducted for a maize country study [1] along with secondary data, it is possible to fill-in the elements of the PAM for each activity as presented in Table 1, and to measure the extent of policy effects as well as the inherent economic efficiency or comparative advantage of the maize production system.

The indicator in the first row of the PAM, presented in Table 1, provides a measure of competitiveness (D). It is defined as the difference between observed revenue (A) and costs (B+C). Private profitability demonstrates the competitiveness of the agricultural system, given current technologies, prices for inputs and outputs, and policy interventions or market failures. The second row of the matrix calculates the measure of economic efficiency, comparative advantage through social profitability (H). It is defined as the difference between social revenue (E) and costs (F+G). The PAM framework also provides some quantitative indicators for policy analysis. These measures analyze incentives and disincentives, the degree of protection and dis-protection/ (implicit) taxation to agricultural production in any country resulting from state policies that affect agricultural input and output markets, trade and exchange rate policies, and policies supporting or penalizing non-agricultural sectors compared to the agriculture sector. Some selected indicators for this study are provided below.

[1] Assessment of the maize situation, outlook and investment opportunities to ensure food security in South Asia: Pakistan country report under CRP MAIZE Project (2012)

Table 1. Policy Analysis Matrix (PAM) framework

	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private Prices	A= pd_i	B= $\sum_{j=1}^{k} a_{ij} pd_j$	C= $\sum_{j=k+1}^{n} a_{in} pd_n$	D=A/ (B+C)
Economic Prices	E= pb_i	F= $\sum_{j=1}^{k} a_{ij} pb_j$	G= $\sum_{j=k+1}^{n} a_{in} ps_n$	H=E/ (F+G)
Divergence	I=A-E	J=B- F	K=B- F	L= D- H

Source: Monke and Pearson (1989)

Private profit (Competitiveness) = D=A/ (B+C)
Social profit (Economic Efficiency): H=E/ (F+G);
Output transfer: I=A-E;
Input transfer: J=B- F,
Factor transfer: K=C-G,
Net policy transfer: L= D-H

Where:

pd_i = Domestic prices of maize realized by sampled farmers

pb_i = World reference price (Export/ Import unit value) of maize (adjusted for transportation, handling and marketing expenses etc. at farmer market level)

pd_j = Domestic price of the j_{th} tradable input (fuel, fertilizer, pesticide)

pb_j = Adjusted world Reference price of j_{th} tradable input (fuel, fertilizer, pesticide)

pd_n = Market prices of non-tradable inputs n,

ps_n = Shadow price of non-tradable input n

a_{ij} = Quantity of j_{th} inputs required to produce a unit of maize

j=1…k = Directly traded inputs plus the traded elements of non traded inputs used in maize production

n=k+1...n = Primary inputs plus non-traded elements of non-traded inputs obtained after decomposing the non-traded items into non-tradable.

Nominal Protection Coefficient (NPC)

The nominal protection coefficient (NPC) corresponds to the unit domestic price (DP) and the foreign price ratio (PP), with both prices expressed in national currency. If NPC is greater than 1, then the policies related to the considered sector are protecting the producers (implicit subsidy). NPCO is expressed as:

$$NPCO = \frac{pd_i}{pb_i} \qquad (1)\ (2)$$

Effective Protection Coefficient (EPC)

The effective protection coefficient (EPC) expresses the importance of the private value added (PVA) compared to the social or economic value added. An EPC greater than one means that the producers generate a value added higher than under the optimal situation. In this case producers are economically efficient because of the positive protection and incentives, while values less than one indicate that producers are dis-protected (implicitly) taxed through policy interventions on value addition.

$$EPC = \frac{pd_i - \sum_{j=1}^{k} a_{ij}\, pd_j}{pb_i - \sum_{j=1}^{k} a_{ij}\, pb_j} \qquad (3)$$

Domestic Resource Cost (DRC) Ratio

The domestic resources cost (DRC) indicates the relationship between the opportunity cost of the domestic resources and the social value added per unit of commodity. If DRC is lower than one, then the country has a comparative advantage for the considered product. The lower this coefficient is, the higher the comparative advantage. Beyond the calculation of protection and comparative advantage coefficients, the PAM allows to undertake policy simulations according to possible scenarios. The method of calculating the DRC ratio in the PAM framework is given as:

$$DRC = \frac{\sum_{j=k+1}^{n} a_{in}\, ps_n}{pb_i - \sum_{j=1}^{k} a_{ij}\, pb_j} \qquad (4)$$

PCR ratio used to evaluate competitiveness at farm level. PCR is the ratio of factor costs (C) to value added in private prices (A-B). The system is competitive if the PCR is less than 1. Using the PAM framework the PCR can be expressed as:

$$PCR = \frac{\sum_{j=k+1}^{n} a_{in}\, pd_n}{pd_j - \sum_{j=1}^{k} a_{ij}\, pd_j} \qquad (5)$$

Results and discussion

Competitiveness and economic efficiency of maize production under import scenario

Based on cross-sectional cost of production data along with supportive secondary data, two PAM's were constructed on a regional basis for maize production of Pakistan under the import and export scenarios. Maize is a traded commodity and Pakistan remained a net importer until 2007 to 2008 after this period, it became a net exporter. To fulfill the objective of measuring economic efficiency in maize production, social profitability was measured under the import scenario. The results of the PAM model as given in Table 2 show that both maize producing provinces are competitive in maize -level given the current level of technologies, prices of inputs, output and current policy and market conditions. The results reveal that social profit is positive in Pakistan which indicates that the resources used in the production of maize were used in a cost-effective manner. Hence,

expansion of maize production at the current level of technology, prices of inputs and outputs, in Pakistan, has economic advantages. It would be beneficial to the country to promote maize as import-substitute crop in the regions under analysis. A negative divergence between private- and social- profit in Punjab and overall in Pakistan implies that the net effect of policy intervention leads to a reduction in profitability at farm level. A removal of policy distortion would increase profitability at farm level which would provide additional incentives to expand maize production as import substitute crop.

On the other hand, the prevailing price structure discriminates against growing this crop as shown by negative transfers. A negative transfer in the total revenue column indicates that the producers are receiving less than the import parity price for maize in Punjab and Pakistan. The value of output (revenues) transfer was negative for both regions. Considering the two cost columns i.e. tradable factor and domestic factor, a negative transfer in the domestic factors represents a positive transfer to the producers of the commodity as this contributes to an increase in profit. A negative transfer in profit indicates output dis-protection (implicit) taxation that producers earning less than they would earn if distortion were not present in output market. Private profitability level is high in Punjab as compared to KPK showing the high-competitiveness in the maize production in Punjab.

Table 2. Policy Analysis Matrix of maize production in Pakistan at import parity

Area		Revenue	Tradable factor	Domestic factors	Profit
		(PKR/Hectare)			
Punjab	Private prices	159,312	64,516	64,713	30,083
	Economic prices	359,075	52,610	103,040	203,426
	Divergence	-199,764	11,906	-38,327	-173,343
KPK	Private prices	98,250	31,364	5,1876	15,010
	Economic prices	202,757	23,343	70,793	108,622
	Divergence	-104,508	8,021	-18,917	-93,611
Pakistan	Private prices	131,577	52,643	58,400	20,534
	Economic prices	282,182	49,860	85,832	146,491
	Divergence	-150,605	2,784	-27,431	-125,957

Source: Survey data 2012

Ratio indicators under import scenario

Policy analysis and economic efficiency in domestic resource use or comparative advantage indicators as given in Table 3, indicate that under the import scenario, maize producers are not protected or producers have been implicitly taxed as indicated by a NPC less than 1 in Punjab and KPK and overall Pakistan. These results suggest the existence of substantial output revenue transfer from farmers to other stakeholders of economy/ other value chain actors. The EPC ratios were 0.31, 0.37 and 0.34 for Punjab, KPK and overall Pakistan respectively. The values lower than one confirm that policies in the input market for maize production constrains the industry. Overall, the protection co-efficients showed that the transfers of output and tradable inputs were significant. Output transfer from farmers to the overall economy was much higher than the input transfer from the economy to farmers as indicated by higher values of NPCs than of EPCs. The value of the DRC, as an indicator for economic efficiency or comparative advantage, is less than one in Punjab (0.34), in KPK (0.39) and overall for Pakistan (0.37). It demonstrates that domestic production of maize is efficient and internationally competitive and maize is an import substitution crop. These numbers imply that the value addition of the existing system could afford the domestic factor costs. Based on this result, it can be argued that producing maize domestically was more efficient in the use of scarce resources in comparison to importing it. That the DRC ratio is lower in Punjab indicates that farmers used domestic resources more efficiently in Punjab as compared to KPK. Overall, the expansion of maize production in Punjab as an import substitute is highly-economic efficient in domestic resource use and for saving foreign exchange. The results demonstrate that the opportunity cost of using domestic resources is smaller than the net foreign exchange saved by substituting for imports of maize grain. These results also indicate that maize production is likely to expand in the future as import substitute crop. Competitiveness at the farm-level is further validated by Private Cost Ratio that remains below one. This suggests the ability of maize production to create value for the growers. Punjab has maintained more competitiveness as compared to KPK. In conclusion, maize production as an import substitute should be expanded as it is found to be privately and socially profitable.

Table 3. Competitiveness and economic efficiency indicators of maize in Pakistan at import parity

Region	(Indicators)			
	NPC	EPC	DRC	PCR
Punjab	0.44	0.31	0.34	0.68
KPK	0.48	0.37	0.39	0.78
Pakistan	0.47	0.34	0.37	0.74

Source: Survey data 2012

Competitiveness and economic efficiency of maize production under the export scenario

The economic efficiency of resource-use in maize production, in Punjab and KPK, has been evaluated by calculating social profitability at export parity prices. Under the export scenario, maize production in Punjab earns positive social profits. However, the system has marginal economic efficiency in domestic resource use and is less efficient than the production as an import substitute crop. This suggests that, overall, Pakistan does have comparative advantage under the existing technologies and market conditions for inputs and output prices of maize. The analysis revealed clearly that production of maize was socially profitable in Punjab, KPK and overall in Pakistan. Punjab and KPK secure comparative advantage with a moderate positive social profit in maize cultivation under the export scenario. Overall, the maize production system utilizes scarce resources at margin, producing at social revenue that exceeded social costs of export. The results for the competitiveness under the export scenario are presented in Table 4. Thus, the expansion of maize production in Punjab and KPK for export promotion is marginally cost effective and it is only viable with increased productivity and better export prices of maize.

Table 4. Policy Analysis Matrix of maize in Pakistan at export parity

Area		Revenue	Tradable factor	Domestic factors	Profit
	(PKR/Hectare)				
Punjab	Private prices	159,312	64,516	64,713	30,083
	Economic prices	180,398	52,610	82,364	45,425
	Divergence	-21,087	11,906	-17,651	-15,342
KPK	Private prices	98,250	31,364	51,876	15,010
	Economic prices	99,109	23,343	59,591	16,175
	Divergence	-859	8,021	-7,715	-1,165
Pakistan	Private prices	131,577	52,643	58,400	20,534
	Economic prices	138,556	49,860	70,393	18,303
	Divergence	-6,979	2,784	-11,993	2,230

Source: Survey data 2012

Analysis of ratio indicators under export scenario

Pakistan has been regular exporter of maize since 2008-09 but with small quantities of maize. Social profitability in producing and exporting maize was judged by DRC ratio that computes the value of domestic primary and non-tradable resources to earn a unit of foreign exchange through production and export of maize grain. Economic efficiency and policy analysis indicators were evaluated under the export scenario by estimating Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC) and Domestic Resource Cost (DRC). Overall, the NPC remained close to 1 under the export scenario at the national-level and in KPK. This implies that domestic producers are receiving prices near to export parity. The lower value of 0.88 in Punjab (< 1) shows a higher potential for exports from Punjab. The results of EPC were in line with those of NPC. However, the lower value of the EPC implies higher-level of dis-protection (implicit) taxation. DRC ratio remained less than one (0.64) in Punjab, which shows that the system depicts a higher efficiency in domestic-resource-use compared to KPK and overall Pakistan. DRC ratio remained also less than one (0.79) in KPK and overall Pakistan showed marginal efficiency in the domestic-resource-use. The results are presented in Table 5. Overall, the maize production in Punjab, for export, remained socially profitable; however, unless maize productivity and export prices improve, maize exports may not be encouraged.

Table 5. Competitiveness and economic efficiency indicators of maize in Pakistan at export parity

Region	(Indicators)			
	NPC	EPC	DRC	PCR
Punjab	0.88	0.74	0.64	0.68
KPK	0.99	0.88	0.79	0.78
Pakistan	0.95	0.89	0.79	0.74

Source: Survey data 2012

Conclusions

The study sheds light on both import and export scenarios under the prevailing production practices at the farm-level and enlightens the future perspective of Pakistan's maize economy. The positive private profitability indicates that the maize production system in general, is competitive and that farmers are making some financial gains. The private profitability calculations show the competitiveness of the maize production system at the regional-level under current technologies used by farmers (given output prices, input costs and policy distortions). The comparative competitiveness by region, is captured and the findings indicate that Punjab remained better-off than the KPK in terms of competitiveness. From the national perspective, maize production, as an import-substitute crop, generates positive social income for the economy by using domestic resources. Therefore, there is economic efficiency in domestic resource use. This efficiency is higher as an import substitute crop as compared to the scenario under which maize would be exported. However, under export promotion there is a need to enhance productivity for economic efficiency in the use of domestic resources. Therefore, further development in product development and value addition is recommended for targeting the higher gains by focusing on the development of maize sectors as import substitute crop. The marginal competitiveness as export commodity could be increased through the export of value-added maize products along with targeting the high end markets.

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