12th Asian Maize Conference and Expert Consultation on

Maize for Food, Feed, Nutrition and Environmental Security

30 October – 1 November 2014
Bangkok, Thailand

Extended Summaries

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Organizers

Asia-Pacific Association of Agricultural Research Institutions

International Maize and Wheat Improvement Center

Food and Agriculture Organization of the United Nations

Thailand Department of Agriculture

Correct citation: BM Prasanna, BS Vivek, AR Sadananda, Daniel Jeffers, PH Zaidi, Christian Boeber, Olaf Erenstein, Raman Babu, Sudha K Nair, Bruno Gerard, ML Jat, Natalia Palacios and Kevin Pixley (editors). 2014. Book of Extended Summaries, 12th Asian Maize Conference and Expert Consultation on Maize for Food, Feed, Nutrition and Environmental Security. Bangkok, Thailand, October 30 – November 1, 2014. CIMMYT, Mexico D.F. and APAARI, Bangkok.

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.

Printed in Bangkok, Thailand, October 2014.

Assessment of the Maize Situation, Outlook and Opportunities in Asia

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Introduction

The increasing importance of maize in Asia – the second most important crop after rice – can be attributed to a manifold increase in demand. This is due to its diversified end-uses such as for poultry and cattle-feed, high quality starch and a wide array of industrial derivatives such as dextrose, maltose, ethanol, maize oil, etc., besides different variants of food items such as sweet corn, popcorn, baby corn and other corn-based fast food items. Maize supply and demand, in Asia, played an influential role in the world maize economy (Meng et al., 2006; Hellin and Erenstein, 2007). Though the use of maize for direct human consumption is declining, its utilization in the feed and wet milling industry is increasing at a much faster pace than anticipated (Gianessi and Williams, 2012; Tariq and Iqbal, 2010). Several factors like technological change, higher input usage, better pest management, etc. have contributed to the increase in maize production (Gulati and Dixon, 2008). It is articulated that between now and 2050, the demand for maize in the developing world will double (CIMMYT, 2012), fueled by population growth and changing diets. The rapid adoption of high-yielding hybrid maize led to significant yield improvement in the different agro-ecosystems in Asian countries. The average yield of maize in Asia is about 4.97 tons per hectare (t/ha) (TE 2012) as compared to the world average of 5.2 t/ha. Five countries – Bangladesh, China, India, Indonesia and Pakistan – together produced about 252.42 Mt of maize grain (87.5 percent of the total Asian maize production) from about 48.84 Mha of land area in the TE 2013. The Asian maize sector has seen rapid growth in the recent past. There were radical changes in the sector in terms of technology development and use (particularly of hybrids), technology delivery (expanding role of private sector) and surging demand, mainly from the livestock and poultry sectors (Erenstein, 2010). In the present study, an attempt has been made to assess the maize situation, outlook and opportunities to ensure food security in Asia, with a focus on five major maize growing Asian countries (Bangladesh, China, India, Indonesia and Pakistan).

Data and methodology

The study relies primarily on secondary data compiled from various published sources as well as primary data using focus group discussions (FGDs) with different stakeholders in all five study countries. The compound annual growth rates (CAGR) were estimated by fitting a semi-log trend equation. The Cuddy-Della Valle Index has been used as a measure of instability in area and yield of maize crop. The forecast of maize area, production and yield was done using different models like ARIMA (Bangladesh), China Agricultural Policy Simulation Model (CAPSiM) (China), Artificial Neural Networks model (India) and linear model (Pakistan), depending upon the suitability of the available data. The demand projections for maize have been made for all the countries using suitable demand estimates best fit to the country.

Maize situation in Asia

Area, production and yield

Asia contributes about 31.5 percent of global maize production from about 32.5 percent of the global maize area signifying the importance of Asia in maize production with respect to world scenario. This crop has emerged as the second most important crop after rice in Asia. It is the primary source of feed for the poultry and livestock industry as well as a source of raw material for the manufacturing sector, and is therefore an important source of livelihood and food security for many Asian families. The rapid adoption of high-yielding hybrid maize in Asia has led to significant yield improvement in the favorable rainfed as well as irrigated maize growing areas. The average yield of maize in Asia is about 4.97 t/ha (TE 2013) as compared to the world average of 5.2 (Table 1). Among all the Asian countries, China allocates the largest area (34.61 Mha) for maize cultivation and also harvests the highest maize grain production (205.38 Mt). China's share in world maize area and production is 19.41 percent and 22.19 percent, respectively. India and Indonesia contribute 2.42 percent and 2 percent of maize production in the world, respectively from 5 percent and 2 percent maize area. Contribution to maize production is more than 1 percent each in Philippines, Thailand, Vietnam, Pakistan and Turkey. With regard to yield, Turkey (7.85 t/ha) topped the

table followed by Bangladesh (6.67 t/ha), China (5.93 t/ha) and Pakistan (3.99 t/ha). India (2.49 t/ha) was on the bottom of the table above Nepal (2.38 t/ha) during 2012.

The trends of maize area, production and yield, in the countries under study, have increased significantly in the past three decades (Table 2, Figure 1a, 1b.1c). To meet the exponentially rising demand for maize grain for feed as well as fuel feedstock, the maize area has increased by 140 percent, the largest among all the countries, during last decade. During the same period, the largest jump in maize yield was observed in Pakistan, followed by Bangladesh and Indonesia. However, Bangladesh and China harvest about 6 t/ha, which is higher than the world or Asian average.

Asian nations under study (Bangladesh, China, India, Indonesia and Pakistan) have achieved tremendous progress in maize production. Growth rates of area, production and productivity during last decade was astonishing in Bangladesh and in all the countries under study (Table 3). The highest maize yield was observed in Bangladesh (6.7 t/ha) followed by China (5.5 t/ha) whereas India remained contended with a low yield (around 2.5 t/ha). The growth of area (33.3%) and production (43.0%) was highest in Bangladesh amongst all countries. Yield growth rate in Bangladesh was second highest (7.3%) after Pakistan (9.1%). The growth story of Bangladesh and Pakistan is suggestive of the adoption of modern technology during last decade.

Table 1. Maize production in major maize producing Asian countries, TE 2013.

Asian nations	Maize area (million ha)	% share of maize area in total Asia	Maize production (million tons)	% share of maize production in total Asia	Maize yield (t/ha)
China	34.61	59.64	205.38	71.21	5.93
India	9.00	15.50	22.44	7.78	2.49
Indonesia	3.88	6.69	18.51	6.42	4.77
Philippines	2.57	4.42	7.25	2.51	2.82
Thailand	1.15	1.98	4.99	1.73	4.36
Viet Nam	1.14	1.96	4.94	1.71	4.35
Pakistan	1.12	1.93	4.57	1.58	4.07
Nepal	0.88	1.51	2.08	0.72	2.38
Turkey	0.62	1.08	4.90	1.70	7.85
N. Korea	0.51	0.89	1.94	0.67	3.77
Iran	0.47	0.81	2.56	0.89	5.44
Myanmar	0.43	0.74	1.56	0.54	3.61
Bangladesh	0.23	0.39	1.52	0.53	6.67
Asia	58.03	100.00	288.39	100.00	4.97
World	178.35		925.69		5.19

Source: FAOSTAT

Table 2. Area, production and yield of maize in study countries.

Country	Area (M ha)			Production (Mt)			Yield (t/ha)		
	TE 1992	TE 2002	TE 2012	TE 1992	TE 2002	TE 2012	TE 1992	TE 2002	TE 2012
Bangladesh	negl.	0.02	0.2	negl.	0.1	1.3	1.0	3.6	6.0
China	21.4	24.0	33.7	97.4	114.0	192.9	4.6	4.8	5.7
India	5.9	6.6	8.6	9.0	12.1	21.5	1.5	1.8	2.5
Indonesia	3.2	3.3	4.0	7.0	9.5	18.5	2.2	2.9	4.6
Pakistan	0.9	0.9	1.0	1.2	1.7	3.8	1.4	1.8	3.9
Asia	39.9	42.6	56.3	133.4	157.9	270.9	3.4	3.7	4.8
World	133.9	137.4	170.9	503.1	604.3	870.1	3.8	4.4	5.1

Source: FAOSTAT (http://faostat3.fao.org/faostat-gateway/go/to/download/Q/QC/E)
Note: negl.= negligible (<5 thousand hectares area or<5 thousand tons production)

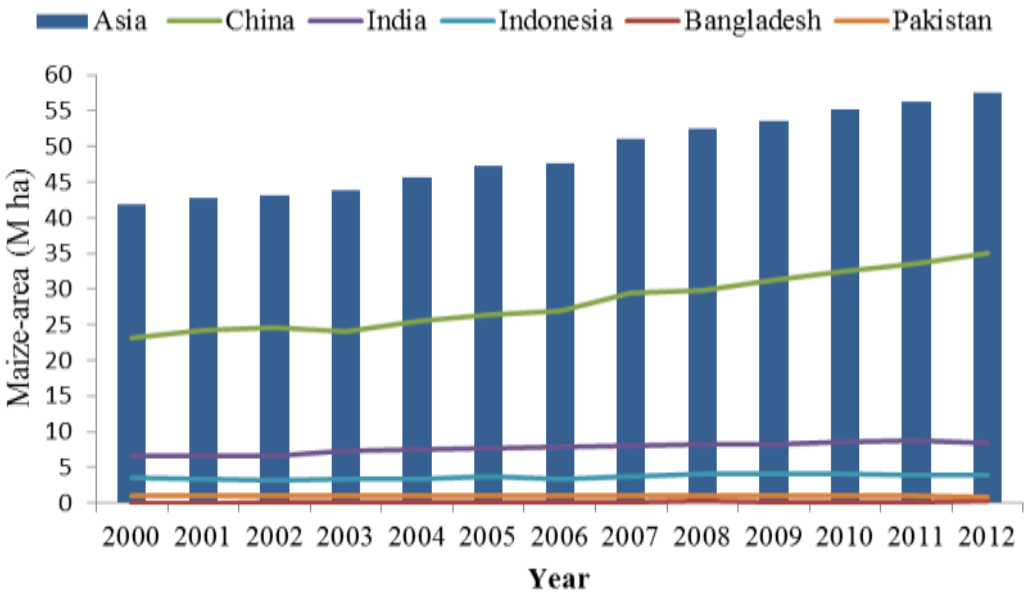


Figure 1a. Trends in maize area in the study countries and in Asia.
Source: FAOSTAT (http://faostat3.fao.org/faostat-gateway/go/to/download/Q/QC/E)

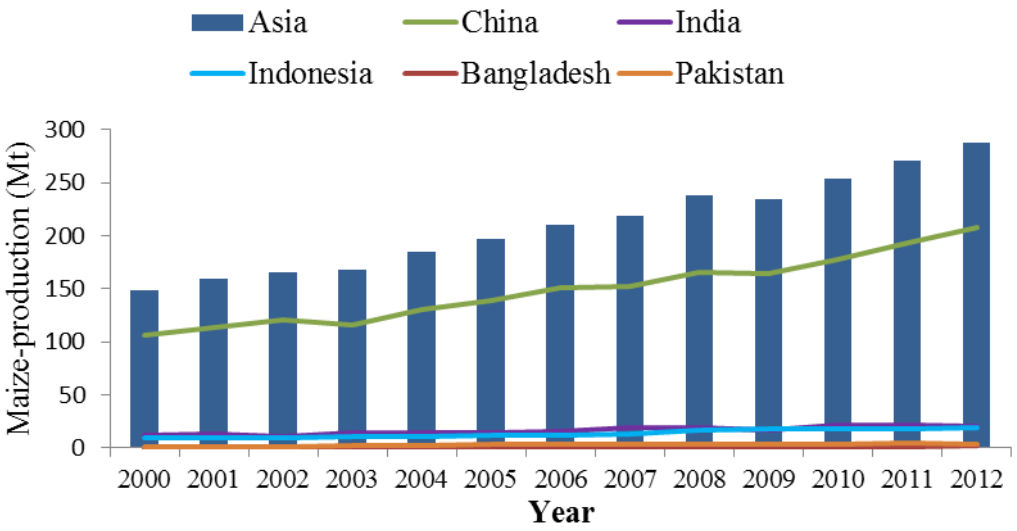


Figure 1b. Trends in maize production in the study countries and in Asia.
Source: FAOSTAT (http://faostat3.fao.org/faostat-gateway/go/to/download/Q/QC/E)

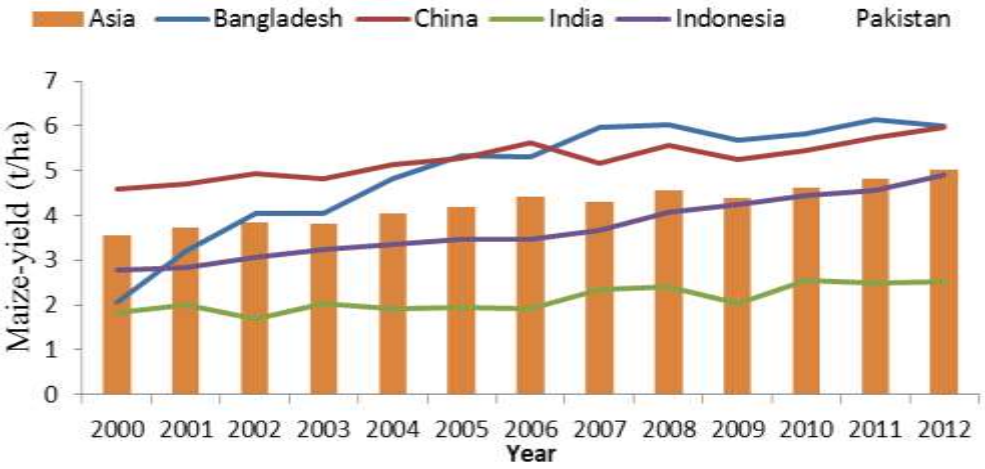


Figure 1c. Trends in the maize yield in the study countries and in Asia.
Source: Author's calculation

Table 3. Production performance of maize in Asian countries

Countries	Area		Production		Yield	
	TE 2010-11 ('000 ha)	CGR, % (2000-2011)	TE 2010-11 ('000 t)	CGR, % (2000-2011)	TE 2010-11 (t/ ha)	CGR, % (2000-2011)
Bangladesh	201.0	33.3	1,353.0	43.0	6.7	7.3
China	32,408.3	3.5	178,000.0	5.4	5.5	1.8
India*	8,367.0	2.9	19,393.6	5.8	2.3	2.8
Indonesia	4,052.3	2.9	17,866.9	7.7	4.4	4.6
Pakistan	987.1	0.7	3520.5	9.8	3.6	9.1

Source: Author's calculation: *Kumar et.al. (2013)

Technology status

As the marginalisation of landholding is increasing in all the countries under study, the number of small and marginal farmers is also growing. The small size of cultivated land per farm and fragmented plots are recorded to be important constraints in mechanization of maize cultivation (Fleisher and Liu, 1992). The average area under maize cultivation is increasing slowly in these countries. A strong positive relationship exists between farm size and adoption of large fixed cost technologies (Binswanger, 1978; Byerlee, 1992). Thus, technology adoption is also slow in study countries. Fastest adoption is observed in hybrid seed technology that ranges between 35 percent to almost 100 percent in different countries (Table 4). Other maize technologies are also adopted by farmers in different magnitude as farmers maximize the expected utility subject to their landholding size and other constraints related to credit, labour, market, etc. (Feder et al., 1985). Infrastructural variables such as irrigation, access to fertilizers, markets and roads, and population density, explain the variations in adoption of modern maize varieties. Similarly, availability of timely, cost-effective and adequate credit to the farmers is one of the most important factors for the adoption of modern technologies in maize cultivation (Jansen et al., 1990).

Maize production in Bangladesh, China, India, Indonesia and Pakistan, contributed more than 87 percent to the total maize production in Asia during TE 2002 to TE 2012. There is not much change in the production contributions of these five countries to the total production in Asia at different periods, except minor increases that accrued in Bangladesh and Indonesia during the past decade (Figure 2).

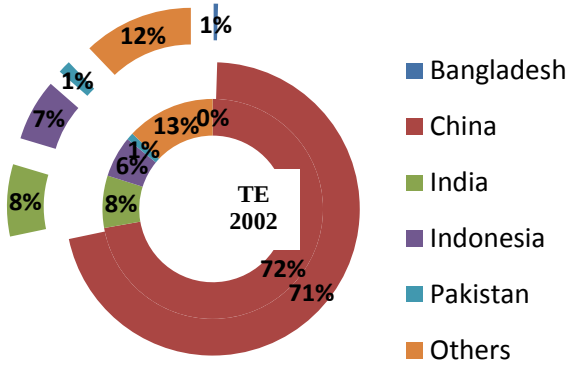


Figure 2. Share of maize production of the countries in Asia in TE 2002 and TE 2012.

Table 4. Technology status in countries under study

Countries	Seed spread		Fertilizer	Irrigation	Harvesting and threshing
	Hybrid	OPV			
Bangladesh	~100%	-	Less than RD*	Need based subject to availability	Increasingly use power operated maize thresher
China	>95%	<5%	More than RD	More than ½ of the maize area is under irrigated conditions	Mechanized harvesting and thresher
India	~40%	~60%	Less than RD	24% maize area is irrigated, rest is rainfed	Mechanized thresher introduced recently otherwise hand-made sheller
Indonesia	50-65%	35-50%	More than RD in irrigated conditions Less than RD in rainfed conditions	~89% is in irrigated conditions	
Pakistan	Spring 100% Autumn 21%	0% 79%	< RD	Spring maize irrigated, otherwise rainfed	Manual harvesting and maize sheller is used

Source**:** Authors' study during project period
*RD = Recommended dose

Economics of maize cultivation

Maize has been a profitable crop for farmers in the study region. However, profitability depends on the price of output as well as cost of cultivation, i.e. price of inputs used. Although maize is relatively less labor-demanding crop than its competing crops like paddy, the share of labour cost in total cost of cultivation has been substantial in these countries. Bangladesh, India and Pakistan still depend more on human labor. Keeping in view the difference in cultural and agronomic differences, the cost of maize cultivation varied from about USD 307/ha in India to USD 2197/ha in China. Similarly, net profit from maize cultivation ranged between USD 160/ha in Pakistan to USD 1300/ha in Indonesia (Table 5).

Table 5. Economics of maize cultivation in study region

Country	Bangladesh[1]	China[2]	India[3]	Indonesia[4]	Pakistan[5]
Cost of cultivation (USD/ha)	1014- 1242	2197	307- 866	412-487	560- 1282
Cost of production (USD/ton)	130- 180	297	142- 254	73- 97	201- 250
Net profit (USD/ha)	200-460	470	(-96)- 544	742- 1323	105- 391

Source: Country Reports

1. Year 2009; 2. Year 2012; 3. Year 2010-11; 4. Year 2011-12; 5. Year 2011-12: Exchange rate: 1USD = 78 BDT = 6.31 Yuan = 53.39 INR = 9365 IDR = 93.39 PKR: http://www.x-rates.com

Improved hybrid seed cost is the second important component after labor in maize cultivation. Both public and private sectors are actively engaged in research and development as well as distribution of improved maize varieties and hybrids. However, due to aggressive marketing strategies and region-specific focus, private seed sectors are more dominant in hybrid maize seed sector. More so, five to six multinational seed companies control about three-fourths of hybrid maize seed market in Asian countries.

Demand drivers of maize

There are four drivers of maize demand in Asian countries. First of all, feed demand of maize due to high economic growth and rapid urbanization. This led to increased demand for non-vegetarian food such as poultry, livestock and fish. Maize is the major ingredient in feed of these animals. Therefore, increased demand for feed qualifies as the most important demand driver of maize in all the countries under study (Table 6). Second, the per capita food consumption of maize by rural and urban residents in different countries is different but has positive effect on maize demand. Third, the maize demand for industrial use also continues to grow at different magnitude in different countries. Maize starch is widely used in different industries: paper-making, textile, food-processing, pharmaceutical and medicine, building materials and casting. It is also used in the deep-refining industries as a raw material to produce modified starch, ethanol, sweetener, organic acid, antibiotic substances and amino acids. Considerations of maize stalk as silage production (in Pakistan), export (for India), ethanol production (for China), etc. are other considerations for increased maize demand.

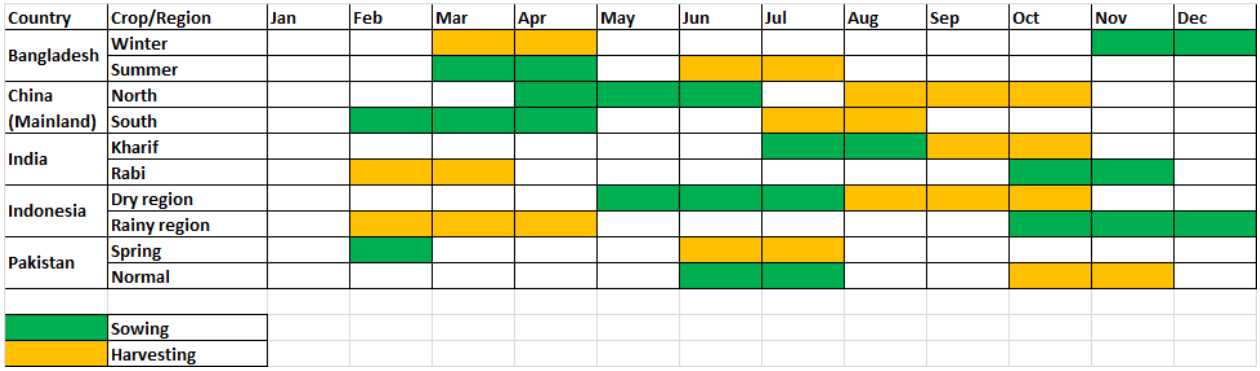
Table 6. Drivers of maize demand

Countries	**Feed Industry (Poultry, livestock and fish feed)**	**Other industry (Starch and other industrial usages)**	**Food (human consumption-raw or processed)**	**Others (Specified)**
Bangladesh	****	**	*	-
China	****	**	*	** (Ethanol)
India	****	**	*	*(Exports)
Indonesia	****	*	***	-
Pakistan	***	**	**	*(Silage production)

Source: Authors' analysis

Maize crop calendars in Asia

General maize crop calendar in the study region is depicted in Figure 3. Maize in Asia is harvested throughout the year except in the months of December, January and May. These months have extreme climates. However, in Bangladesh and Indonesia, crop sowing starts in November. Accordingly, arrival of maize grain output starts in late February (winter maize) in India and Indonesia and peaks out in October in almost all the countries.



Source: AMIS 2012 & FAO

Figure 3. Maize crop calendar in study countries

Maize imports and exports

The Asian region is importing as well as exporting maize. Moreover, the trade scenario of maize has dramatically changed in the recent years. The imports in Asia are due to very high demand for this crop in Bangladesh, China and Indonesia. China, once a net exporter has become a net importer. Its imports are 51 million tons in 2012, which is expected to grow despite a major emphasis on maize production within countries (Table 7). Maize demand in Indonesia for all food, feed and industrial purpose is the major reason for imports. Total imports to Indonesia are 1.6 Mt. Even though inflected with low crop productivity, India and Pakistan are thenet exporters of maize in Asian countries. During 2012, their exports were 4.3 and 0.4 million tons, respectively. There is a consistent increase in maize exports from both the countries, which is expected in the future also.

The major destination for Indian maize is within the Asian region only, which gives it comparative advantage from the rest of the world. Total exports in Asia, are comparatively low as compared to exports. This is due to the fact that demand for maize is increasing at a very fast pace. It is also important to note that almost 50 percent of global maize trade is destined to Asia only, showing the huge potential of maize exports in this region.

Outlook on maize production

To understand the outlook of maize production in study countries, the short- to medium-term forecasts of maize area and yield were estimated using time-series data (Table 8). The area and yield of maize in Bangladesh were forecasted on the basis of previous 25-year time series data using ARIMA model. The forecasts suggested that the total maize production in Bangladesh is expected to be 3.5 Mt by 2020. In China, the Chinese Agricultural Policy Simulation and Projection Model (CAPSiM) was used for outlook on production. The maize production in China would increase from 177.3 Mt in 2010 to 220.6 Mt in 2020. The forecasts resulting from artificial neural networks method for India revealed that if the past trend continues, total maize production is expected to add more than 6 Mt in 2020 from the 2012 level of production. Applying growth analysis for estimating forecasts for maize production for Indonesia, it is estimated to be about 27 Mt in 2020. While in the case of Pakistan, the total maize production is estimated to increase from 4.24 Mt to 6.87 Mt during the same period.

Outlook on demand

Islam et al, (2010) used the AIDS projected requirement of maize at 0.698 Mt by 2020, in Bangladesh, with income elasticities considered to be constant during 2000-2020 (2.0 for eggs and 1.23 for meat). Whereas under declining elasticities during two decades i.e. declining of 1.67 for eggs and 1.14 for meat during 2000-2010 and, those of 1.14 for eggs and 0.83 for meat during 2010-2020, the estimated demand also decreased to 0.657 Mt by 2020. Rural consumption data from the Food Management & Research Support Project (FMRSP) and urban consumption data from the Household Income and Expenditure Survey (HIES), 2000 were used for these estimates.

Accompanying the high economic growth and rapid urbanization, the per capita consumption of meat, eggs and dairy products are poised to grow further in China. The demand for maize is expected to rise by 35.4 percent for feed, drop by 31.5 percent for food and rise by 41.1 percent for industrial uses. The maize demand in China is expected to grow sharply from 182 Mt to 239 Mt during 2010 to 2020, with an annual growth rate of 2.7 per cent. To meet the rising demand of maize, the country has to depend on imports to the extent of 18.2 Mt in 2020 leading the importer of maize.

Table 7. Maize imports and exports in Asia and study countries

		Maize imports ('000 t)					Maize exports ('000 t)					
Year	Asia	Bangla-desh	China	India	Indonesia	Pakistan	Asia	Bangla-desh	China	India	Indonesia	Pakistan
2001	38,858.8	0.00	36.11	3.9	1,035.8	0.0	6,822.0	0.0	5,998.0	109.9	90.5	0.0
2002	40,675.9	228.5	6.32	0.6	1,154.1	0.0	11,989.9	0.0	11,673.5	89.6	16.3	0.0
2003	43,063.4	167.2	0.12	0.3	1,345.5	39.8	16,936.2	0.0	16,399. 5	206. 9	33.7	0.2
2004	40,445.3	95.2	2.37	0.8	1,088.9	5.3	4,798.1	0.0	2,318.2	1,298.7	32.7	0.1
2005	41,158.8	167.5	3.98	1.4	185.6	28.2	9,402.6	0.0	8,611.0	433.4	54.0	0.0
2006	42,311.4	212.8	65.22	1.8	1,775.3	6.7	4,445.3	0.1	3,070.5	633.9	28.1	0.5
2007	40,851.8	194.2	35.20	5.1	701.9	8.2	7,045.4	0.0	4,916.4	1,494.8	101.7	0.9
2008	39,053.3	60.4	49.17	5.8	286.5	150.9	5,493.2	10.5	252.5	4,197.3	107.0	69.0
2009	39,250.6	533.7	83.58	9.6	338.8	28.7	4,616.1	0.4	129.5	2,694.6	62.6	234.4
2010	50,179.9	531.2	1,572.39	18.5	1,527.5	9.0	3,946.9	0.0	127.3	1,841.0	41.9	10.5
2011	45,615.2	529.3	1,752.83	12.3	3,207.7	13.1	6,529.0	0.0	136.0	3,952.1	12.7	249.4
2012	51,154.4	187.4	5,206.75	2.4	1,693.0	17.7	5,434.2	1.4	257.3	4,271.7	34.9	365.2

Source: UNCOMTRADE data

Table 8. Maize production outlook in study countries

Country	Production 2010 (million tons)	Production estimates 2020 (million tons)	Model used
Bangladesh	1.4	3.5	ARIMA
China	177.2	220.6	CAPSiM
India	22.2	28.5	ANN
Indonesia	16.0	27.1	CAGR
Pakistan	4.2	6.9	CAGR

Using India's current population growth rate of 1.41 percent, the annual growth of maize demand for non-vegetarian commodities (poultry products, fish and prawns, goats and sheep meat and others) and expenditure elasticities were computed. Demand estimation using per-capita GDP growth in three scenarios – Low growth scenario (4%) (LGS), Medium growth scenario (6%) (MGS) and High growth scenario (8%) (HGS) – were estimated. Total domestic demand estimate for maize would increase to 21.36, 24.45 and 26.77 Mt by 2020 under LGS, MGS and HGS respectively, from 17.52 Mt in 2011. Major demand would come from the poultry sector, 64%, 63% and 65% under three scenarios respectively, unless any structural changes in industrial sector or dairy sector take center stage.

In Indonesia, maize share for feed industry increased sharply to 43.2 percent in 1999, whereas that for the household consumption dropped to a level below 10 percent. Indonesia imported 1.6 Mt of maize in 2010 which further increased to 3.2 Mt in 2013. Overall demand increase is expected to be very high. Due to government push the maize demand is expected increase significantly.

Population growth in Pakistan (1.7%) has profound impact on the maize consumption and demand. The maize demand for non-vegetarian commodities as feed was estimated using expenditure elasticities and the per-capita GDP growth scenarios *viz.* LGS (2%), MGS (4%) and HGS (6%). The total domestic demand for maize will increase to 4.398 under LGS, 5.075 under MGS and 5.724 under HGS Mt by 2020 from current demand of 3.042 Mt during 2010. The major demand under LGS (2.696 Mt), MGS (3.143 Mt) and HGS (3.660 Mt) will come from feed for poultry and livestock. The trend of direct maize consumption as food will decrease. The industrial uses of maize are expected to increase by 90, 133 and 158 percent from present level of 0.530 Mt respectively under three scenarios.

Emerging opportunities in maize sector

Opportunities for investment in the maize sector, in Bangladesh, are visible from strong demand of maize from poultry feed industries and the new establishment of starch manufacturing plants. To cater to these industries, expansion of areas under cultivation along with promoting maize-based cropping patterns and systems including relay farming, introduction of mechanization, hybrid seed

production program, improved post-harvest management practices need a lot of both financial and research inputs for creating opportunities in terms of profitability and employment generation. In China, investment is required to cater vast geographical area and expansion of maize area for cultivation, through subsidiiese for maize grain and input policies favoring farmers. Due to globalization in the maize marketing sector, demand for maize for feed, food and industrial uses, coupled with growing population, creates an atmosphere of investment in China. Improvement of yields in India, where maize can be suitably included for diversification, has large scope for investment in maize. Besides, large and growing middle income population provides a big consumption base for maize-derived food-direct or indirect. Possible expansion of egg-based nutrition enrichment of mid-day meal scheme across the states will add to scope of increase in investment in maize sector in India. All these are very conducive for high investment. Nearly 40-45 percent of maize area still under non-hybrid provides ample scope for investment in this sector, building strong partnership among R&D organizations in public, private and international arena and leading to better livelihood and employment enhancement in the maize sector.

Strong domestic demand in Indonesia, for maize, would attract investment in the maize sector. Maize, which is used as one of main feed raw materials, has high potential yield improvement through application of hybrid varieties, strong domestic demand of feed and opportunity for export. Since only half of Indonesian production of corn coming from Indonesia, it provides opportunity to invest in maize crop improvement. Increasing population resulting in high demand from domestic and international market for food and maize based feed for growing livestock and poultry industry, rapid growth in industry, development of an array of maize-based food products, value addition with export potential, emerging demand and markets for silage and green cobs are envisaged as high returns to investment attracting private investment.

Conclusion

Maize is the second most important crop in Asia. China is the biggest maize producer and consumer of maize in Asia. Maize is the second most important crop in China and the demand for its domestic consumption is very high; therefore China is the biggest importer of maize in Asia. There is a very huge investment opportunity in China for maize R&D and its expansion to reduce the import dependency of such an important crop. In India, maize is the third most important crop after wheat and rice. However, India followed China in terms of maize production and consumption. It is a net exporter of maize. Increased domestic consumption, coupled with export prospects, place India in a unique place to catalyse investment in maize R&D. Indonesia followed India in production and consumption, with the third-highest area and production levels in Asia. Demand for maize in Indonesia is again, very high; it cannot produce the required quantity, therefore, it imports maize as was the case of China. Bangladesh is the first, in terms of growth rate in area and production of maize, but the total size of the production is comparatively, very low. However, the increasing demand for poultry and livestock products keeps maize demand, in Bangladesh, very high which is met though imports. Therefore, investing in R&D and extension of maize area and production would be a better option for Bangladesh. In Pakistan, maize area and production has also shown an increasing trend. Present demand of maize is being met though domestic production and surplus is exported. Under the increasing demand for maize in feed and processing industry in Pakistan and relatively higher cost of production, higher investment in maize R&D is required along the whole maize value chain for export of value added maize products to increase competitiveness. There is a lot of scope of investment in maize sector in these Asian countries. Governments of these countries need to focus on this aspect along with having a regional cooperation both in R&D, expansion and trade.

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