The Rapid Growth of the Poultry Industry in Asia: Implications for Research and Development

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Introduction

Since 1960, global meat production has increased more than three times, and egg production nearly four times (Speedy, 2003). Globally, the demand for meat is expected to increase by more than 55 percent between 1997 and 2020, and meat production will reach 455 million tons by 2050 (Alexandratos and Bruinsma, 2012). Most of this increase will take place in developing countries. Animal feed is the foundation of livestock production and the catalyst for the structural change in the maize industry from food to feed. Asia will account for half of the increase in global cereal demand, with China alone accounting for 27 percent of this increase (Dixon et al. 2008). Two-thirds of the projected increased demand for meat associated with the livestock revolution will be for pork and poultry meat. In the case of China, the driver is the swine industry. The feed maize demand in China increased by almost 3 percent annually between 2001 and 2011 (Qiu et al., 2014). Accordingly, the area under maize in China increased tremendously and the share of maize area in total sown area increased from nearly 14 percent in 1980 to more than 20 percent in 2010. In India and Bangladesh, the poultry industry is the driver of change. This paper focuses on the growth of the poultry industry.

The production of poultry meat worldwide,increased from 9 million tons in 1960 to 68 million tons in 2000 (Speedy, 2003), and to 105 million tons in 2012 (FAOSTAT, 2012). Market opportunities have emerged in developing countries in response to rising incomes and changing consumer preferences for high-value agricultural products, including poultry. Demand for poultry – primarily chicken which constitutes more than 90 percent of the poultry market – is fueled by the rapidly expanding economy and changing preferences of middle-income consumers (Ravindran, 2013).

One of the fastest growth areas in the poultry industry has been in Asia. The continent now accounts for more than one-quarter of current global poultry production. In Asia, India is one of the leading poultry producers, where the share of poultry in national total meat production has grown from 23 percent in 2004-05 to 51 percent in 2009-10 (GOI 2011). Poultry is low-cost relative to other meat products, and has comparatively wider acceptability as food across regions and religions (Manning and Baines, 2004), particularly important in India where the prevailing Hindu religion limits beef consumption. In India, the share of the population that does not eat any meat because of religious beliefs, as opposed to economic necessity, is small, perhaps as low as 10-20 percent (Landes et al., 2004). Furthermore, the growing middle class is more likely to disregard traditional taboos and religious bias against non-vegetarianism (Rattanani, 2006).

The growth of the poultry sector has spurred the production of poultry feed crops in Asia. The predominant grain used in poultry feeds is maize (or corn, *Zea mays* L.), being widely available as a cheap energy source, easily digestible for poultry and highly palatable. Poultry feed normally contains 60-65 percent maize. Maize is generally the benchmark with which other energy sources are compared. Keeping up with Asia's rapid poultry industry growth, there has been an increase in maize production in the region. In India, for example, while there are multiple uses for maize grain, including human consumption and industrial uses, its use in poultry feed grew from 15 percent of domestic production in the 1990s to more than 50 percent by 2009 (Sethi et al., 2009). Also in Bangladesh the rapid expansion of the poultry industry since 1990 is the main driver of the increase in area under maize and production. Between 1990 and 2013, poultry production increased by around 4.3 percent annually (Miah et al., 2013). Due to favorable growing conditions, and the introduction and widespread adoption of maize hybrids an average yield of almost 7 tons per hectare (t/ha) is currently achieved in Bangladesh, which is the highest productivity realized in Asia (Miah et al., 2013).

The increase in demand for maize as a component of animal feed has huge implications not only for the strategic direction of agricultural research but also for trade experts, land-use planners, epidemiologists and policy-makers. This paper details the exceptional growth of the poultry industry in Asia with a focus on India, analyzes the reasons behind this phenomenon and details the worldwide implications of this poultry revolution.

Methodology

The paper presents a review and synthesis of information from various sources, including published and grey literature. It also builds on commissioned regional consultations in Asia that focus on the current maize situation in the region, likely probability predictions and potential investment opportunities. In addition, it draws on the experience of the authors in relation to maize demands in the region and the implications for research, development and trade.

Poultry industry and the maize sector

Growth of the poultry industry

The poultry-meat and egg industry in Asia is growing, especially in India. India is now the third-largest egg producer and fifth-largest poultry-meat producer in the world (Mitra and Bose, 2005). By 2003, India was producing 1.6 million tons of poultry-meat. This figure had risen to 2.0 million tons by 2006 (Hellin and Erenstein, 2009) and now stands at 2.2 million tons per annum (www.dahd.nic.in). By 2030, poultry-meat production is expected to reach 3.0 million tons (Joshi and Kumar, 2012). The per capita consumption of meat in India is expected to further increase from its current level of 3.1 kilograms (kg) to up to 18 kg by 2050, with 12.5 kg of it being poultry meat (Alexandratos and Bruinsma, 2012).

Meanwhile, between 1980/81 and 1998/99, annual egg production in India increased from 10 billion to 29 billion (Ramaswami, 2006) and has continued its rapid growth ever since. Egg production in India is likely to surge from the current level of about 66 billion to 95 billion by 2015 at a compound annual growth rate of 8 percent. Joshi and Kumar (2012) forecast Indian egg supply to reach around 124 billion numbers by 2030. For Bangladesh, poultry production is expected to increase from 170 million birds in 2000 to more than 233 million birds by 2020 (Miah et al., 2013). Currently maize production in Bangladesh is not sufficient to meet the demand, caused by the poultry but also fish feed industry; therefore maize is imported, mainly from India (Miah et al., 2013).

To ensure quality and consistent supply of perishable inputs and outputs, the poultry industry in India has rapidly evolved toward more vertical coordination, allowing retailers to standardize quality, improve bargaining power and achieve economies of scale. Currently, there are about 60,000 poultry farms in India under modern intensive systems of management. While there is still some backyard poultry farming, it is relatively unorganized, economically less significant and small-scale (Conroy et al., 2005). Growth in the poultry sector has been engineered and dominated by the large-scale commercial private sector, which controls roughly 80 percent of total Indian poultry production (Joshi et al., 2003) concentrated in the southern states of Andhra Pradesh and Karnataka.

Feed is the most important input for poultry production, accounting for 55 to 64 percent of variable costs in India (Landes et al., 2004). The sustained availability of low-priced, high-quality feeds is critical if poultry production is to remain competitive and to continue to grow to meet consumer demand for eggs and meat. The maize and poultry sectors are closely interlinked. Up to the late 1980s, maize was predominantly (70 percent) consumed directly as food, with the remaining 30 percent going to feed and industrial use in about equal proportions (Singh and Pal, 1992). Since the 1990s, there has been an increase in the quantity of maize used as feed, whereas non-feed use (including food and industrial use) has remained relatively static. Over 50 percent of maize production in India is destined for the poultry industry (Chaudhary et al., 2012). Growth in the industry is fueling investment in maize cultivation and processing in India (e.g. Business Today, 2014). For both broiler and layer rations, maize accounts for most of the energy in the feed ration, soybean meal provides most of the protein. Broiler rations, on average, contain 64 percent maize and 20 percent soybean cake, while layer rations contain 42 percent maize and 16 percent soybean cake.

Maize in Asia

Asia is an important maize-producing region (see Table 1) and there is a close link between the growth of the poultry industry and maize availability (Figure 1). For example, in China, total maize area increased to 35 million ha in 2012, with a total production of around 206 million tons, up from 114 million tons in 2001 (Qiu et al., 2014).

Table 1. Maize area, production, yield and food supply across countries in Asia

Country	Annual average area (million ha) 2011/12-2013/14	Annual average production (million MT) 2011/12-13/14	Annual average yield (MT/ ha) 2011/12-13/14	Area CAGR (%) 2004/5-2013/14	Production CAGR (%) 2004/5-2013/14	Yield CAGR (%) 2004/5-2013/14	Average food supply quantity (kg/ capita/ yr) 2009-2011	Food supply CAGR (%) 2002-2011
Bangladesh*	0.28	1.9	6.88	22.96	27.72	4.20	0.70	16.65
Cambodia	0.20	0.87	4.39	12.20	15.32	2.78	11.53	2.27
China	34.96	205.63	5.88	4.03	5.91	1.81	7.27	0.94
India	9.07	22.74	2.51	2.66	6.11	3.36	6.27	2.68
Indonesia	3.08	8.82	2.86	-0.62	2.64	3.28	33.33	2.14
Nepal	0.91	2.14	2.36	0.92	4.09	3.13	46.43	0.71
Pakistan	1.12	4.78	4.25	1.68	6.64	4.88	12.67	8.43
Philippines	2.57	7.31	2.85	0.83	4.55	3.70	26.40	14.41
Thailand	1.07	4.60	4.30	-0.08	1.70	1.78	10.07	6.24
Vietnam	1.14	4.88	4.29	1.31	3.67	2.32	11.33	3.03

Sources: Computed based on United States Department of Agriculture (USDA) online database (production data) and FAOSTATonline database (food supply data).
MT = Metric tons, CAGR = Compound Annual Growth Rate
Note: * Data on maize production and area not available from USDA data base, therefore information here refer to Miah et al. (2013); area, production and yield are given for the period 2010/11-2012/13 and the CAGRs for area, production and yield, for the period: 2003/4-2012/13 respectively

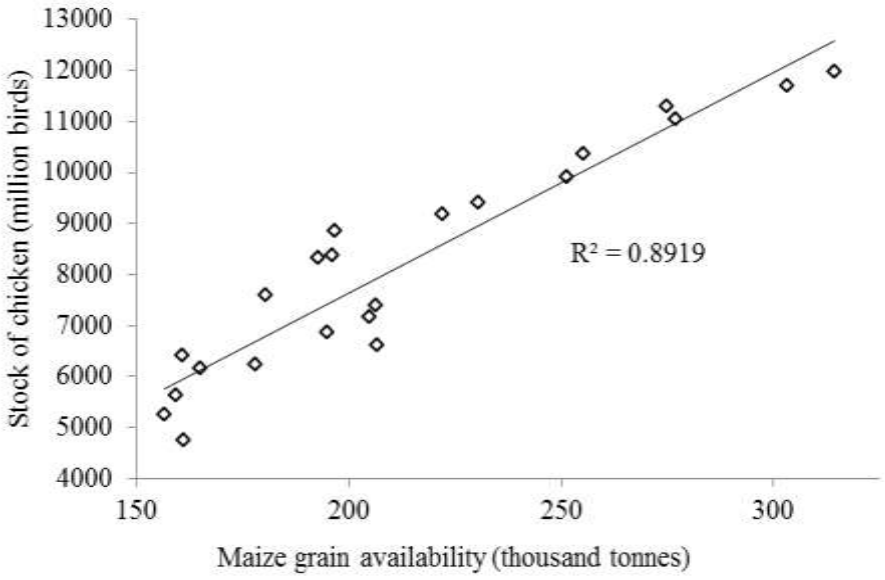

Figure 1. Correlation between chicken production and maize availability in Asia, 1990-2011.

Maize was introduced into India by the Portuguese in the 16th century (Singh et al., 2003) and is now the third most important grain crop after rice and wheat. There are now more than 12 million maize growers in India and the sector contributes 2 percent to the total value of output from all the agricultural crops in the country. Maize is grown in India in a wide range of production environments, from the temperate hill zones to semi-arid desert margins and in all three seasons – monsoon *(Kharif)*, winter *(Rabi)* and *spring*. Despite low yields, the Indian maize sector has grown considerably during the last 40 years and is likely to continue to do so as demand increases (Narayanan et al., 2008). Maize yields have nearly doubled since 1962. Yield increase was the main source of maize production growth during the 1980s and 1990s, but productivity has been relatively stagnant since the turn of the century. From 2007-2011, maize production in India registered an annual growth of 6.4 percent, the highest amongst all food crops in the country. Over

the last decade, maize output in India in total has grown by 56 percent (Business Today, 2014).

India is currently the sixth-largest maize producer in the world, contributing about 2 percent to the global maize production of approximately 855 million tons in 2012-13. Total maize production in India, is expected to grow continuously from the current level of 22 million tons to 28 to 44 million tons by 2020, owing largely to demand from the poultry industry (Narayanan et al., 2008). Maize productivity in India, however, remains low with average maize yields of 2.5 t/ha (Dass, 2013) compared to a global average of 5.5 t/ha (Business Today, 2014). Kumar et al. (2013) argue that the national level yield figure underestimates the current yield levels, which might already be higher due to the fast spread of hybrid maize production in non-traditional growing maize areas, e.g. Tamil Nadu, and maize cultivation in "new seasons," e.g. *Rabi* maize in Bihar or spring maize in Punjab or Uttar Pradesh.

In 2012-13 India exported around 4.3 million tons of maize, while import is negligible in quantity (Kumar et al., 2013). The export of maize was also found to have increased drastically after 1995 (FAOSTAT, 2014). Under the recent National Food Security Act 2013, the Government of India seeks to guarantee cheap grains to 67 percent of the population, which gives little scope for a shift of area under rice and wheat to maize. Due to this and the continuous growth in the demand of maize as a feed grain, India might become a net importer of maize by 2018-2020 (Munro, 2014; KPMG, 2013). According to the demand and production scenarios outlined by Kumar et al. (2013) India would remain a net exporter of maize till 2020, given that the share of hybrids would increase significantly from its current level of around 57 percent of the total maize area.

Maize production has particularly taken off as a new cash crop in the states of southern India, where it is grown for commercial purposes and is used by nearby vertically integrated poultry companies. More than three-fourths of the area under production of maize is contributed by Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and Tamil Nadu. Maize is often grown in rotation with wheat in traditional areas and with chickpeas in non-traditional areas (Joshi et al., 2005). Andhra Pradesh and Karnataka are non-traditional maize-growing states in southern India. In these states maize is increasingly grown as a sole crop during *Kharif* or replacing the second rice (*Rabi*) crop in the traditional rice-rice rotation system (Satyanarayana et al., 2013).

Implications for research and development

The growth of the poultry industry in Asia and particularly in India, has wide-ranging implications for maize researchers, private (input and output) sector personnel, trade experts, policy-makers and also epidemiologists.

Feeding the burgeoning poultry industry

Maize is set to remain the preferred energy source for poultry. Substitution of existing crops provides an opportunity for increasing maize area, but considering the need of grain production for human consumption to fulfill the aims of the National Food Security Act 2013, the opportunities for this might be limited in India. However, in India maize continues to spread to new areas and is replacing barley, sorghum and pearl millet as a feed and fodder crop. Substitution is largely driven by the relative profitability of commercial maize cultivation, aided by the high productivity of hybrids and the increased demand for maize.

With average maize yields in India well below the world average, there is enormous potential for increased use of higher-yielding hybrids. There are, hence, opportunities for the private- and public-sectors in plant breeding and seed sales. India liberalized seed laws in the late 1980s and, since then, private investment in maize research has grown. Private seed companies have captured a significant share of the market, especially in southern India (Pal et al., 1998). At present, there are five multinational and more than 400 domestic seed companies engaged in maize seed production in the country.

The availability of low-priced, high-quality feeds is critical if poultry production is to remain competitive and continue to grow to meet the demand for animal protein. Protein is one of the major limiting ingredients in the poultry feed mixture. In recent years, the supplementation of feeds with commercially produced and relatively cheap synthetic amino acids has become common in developing countries. Currently, the limiting amino acids in poultry diets – methionine, lysine, threonine and tryptophan – are added to poultry feed. Amino acid supplements now play a very important role in improving protein utilization in animal feeding. However, development and distribution of bio-fortified maize – Quality Protein Maize (QPM) and High Methionine Maize (HMM), containing enhanced levels of limiting amino acids – might hold significant economic potential.

In 1963, scientists at Purdue University discovered a mutant maize variety with double the normal levels of lysine, together with elevated levels of tryptophan. The variety was named *opaque-2*. There were, however, several drawbacks to *opaque-2*, not least that yields were relatively low. Scientists at the

International Maize and Wheat Improvement Center (CIMMYT) sought to maintain its nutritional quality while also making it higher yielding. The improved *Opaque-2* varieties were renamed Quality Protein Maize, or QPM. Quality protein maize and regular maize differ in protein quality. The proportion of lysine and tryptophan is higher in QPM (approximately 75 percent for lysine and 83 percent for tryptophan). However, the content of protein and other nutrients varies with different QPM germplasm used (Lopez-Pereira, 1993). Furthermore, one of the challenges of breeding and growing QPM is that a recessive gene controls its high lysine levels. Maize is an open-pollinated crop and, hence, this gene can be easily lost through cross-pollination.

Any QPM entering the maize-poultry value chain would also have to be kept separate from non-QPM maize. When maize is marketed in India the harvest from different fields and different farmers usually gets mixed during drying, cleaning and packaging at the local grain market. So, even if maize hybrids would have the "QPM trait," farmers might not be able to achieve a price premium for this grain, as it cannot be distinguished from other grains. Separating a largely invisible trait, such as QPM, adds to the costs of the product as it moves along a chain.

While QPM contains higher levels of lysine and tryptophan, the methionine content is only slightly higher than in regular maize. Research has shown that increasing dietary methionine content in feed substantially increases the weight of broiler chicks (Mack et al., 2010, Panda et al., 2010). Methionine intake also enhances egg output and feather growth. Synthetic methionine, however, is often costlier than other synthetic amino acids and plant breeders have started developing maize rich in methionine. Examining the potential of innovative value chains to capture the quality attributes of feed ingredients from farmers to poultry firms is one of the areas of research that is capturing the attention of the private and public sector.

Changing structure of poultry markets

Poultry meat constitutes approximately 25 percent of the meat production in India (Mitra and Bose, 2005). Unlike many other countries, only about 2 to 3 percent of the total poultry meat produced in India is sold as processed meat, reflecting consumers' preference for live chicken and also inadequate processing and storage infrastructure, such as refrigerated transport. This is beginning to change. With India experiencing an economic boom and as greater foreign direct investment is permitted, many large international retailers are expected to open food outlets to cater to an increasingly affluent population. This is likely to lead to an increased demand for processed meat. Furthermore, increased ownership of durables, such as cars and refrigerators, also facilitate the shift from daily purchases from neighborhood stores to weekly/fortnightly shopping in supermarkets.

The growth of the poultry industry in Asia has led to a decline in North American and European producers' share of the global poultry market. Stiff competition from countries such as India can be expected in the future. Poultry from India already has a significant market share in the Middle East and captured some of these markets following the outbreak of avian bird flu in Southeast Asia in 2003/2004. India's export of poultry products has increased from about 517,000 tons in 2010-11 to 578,000 tons in 2012-13. This has implications for countries such as the United States, the leading exporter of poultry meat. Furthermore, India has also become a net exporter of maize in recent years albeit not yet on a scale comparable with the United States.

The threat of disease

The rapid growth of the poultry industry in India and other Asian countries has raised the threat of disease pandemics. Currently there are two avian influenza virus infections that have appeared in domestic poultry and which have caused high human fatality rates, especially in a number of Asian countries: highly pathogenic avian influenza H5N1 (with infected countries widely distributed internationally) and avian influenza H7N9 (confined to China).

Both H5N1 and H7N9 have pandemic potential but are currently not contagious among people in their current forms. However, although the international community through its animal health agencies (the World Organization for Animal Health and the Food and Agriculture Organization of the United Nations, or FAO) have developed comprehensive guidelines for the detection and control of animal influenzas, there is little prospect that the H5N1 and H7N9 infections will be eradicated in affected countries, or that new strains of influenza will be prevented in the rapidly growing poultry industry.

Outbreaks of avian influenza virus infections can have detrimental impacts on the poultry industry. Bangladesh, for example, experienced Highly Pathogenic Avian Influenza outbreaks during 2007 and 2008. A total of 547 commercial and 42 backyard flocks were culled with over 1.6 million birds being destroyed. As a result, demand for maize from the feed industry decreased from 3.0 million tons to 2.0-2.2 million tons (Chakma and Rushton 2008).

Conclusions

The growth of the poultry industry in Asia, and particularly in India, has wide-ranging implications for maize research and development (R&D), including the need to feed the burgeoning poultry industry, the changing structure of poultry markets and the threat of disease. The Asian maize production sector is expanding and changing rapidly in response to the growth in the livestock sector. Although policy-makers tend to have neglected the maize crop as a food crop in the region, compared to other major cereals, its surging commercial production has resulted in some progress being made in reducing the degree of distortions in maize market. Meanwhile, maize value chains are growing more sophisticated with the transformation of poultry industries in India and elsewhere in the region (as well as e.g. swine in China). Maize offers the potential of contributing to the agriculture sector and national economy growth, while simultaneously reducing the prevalence of poverty among Asian maize producers. The achievement of this potential depends on the creation of an appropriate institutional and policy environment – a weighty challenge that confronts national policy-makers.

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