

Rice Production in Asia: Key to Global Food Security

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Abstract Rice is the staple food for over half of the global population. About 90% of the global rice is produced and consumed in Asia. Hence, rice production in Asia is the key for global food security. The growth in rice production with stability has been a matter of concern to achieve food security, especially in developing countries. In this backdrop, the present paper attempts to study the area and production growth rates of major rice growing countries of Asia. Also, the export growth rates were estimated and the contribution of major rice growing countries of Asia to Global food security was quantified for the period between 1994 and 2013. The trends from the year 1964 for area and production were analyzed. For exports, the trends have been analysed from the year 1984. The results revealed that there was a rapid increase in production of rice during 2004–2013 mainly because of increase in area and also because of increased investment in agriculture. The growth rate of exports has declined and stood at 4.01% during 2004–2012. This is mainly because of 2008 rice crisis that has provided impetus to expanded rice production in several rice importing countries. The study suggests that, for expansion of international trade, the governments will need to adopt measures that reduce supply chain loss, improve supply response time, reduce the market costs and post harvest loss.

Keywords Asia · Rice · Food security · Exports

Introduction

Food security is the major goal of governments across the world for development and poverty elimination. The World Food Summit of 1996 defined food security as existing “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”. Rice plays a major role in global food security, as it is the staple food for over the half of the world’s population. Asia is the centre of the global food security with more than half of the world’s population and one-thirds of global hungry and poor [1]. The words for food and rice, or for rice and agriculture, are the same, in many Asian countries implying the fact that rice is a staple food for many in Asian countries.

Eleven countries of Asia contribute about 87% to the total global rice production. The export of eight of these countries constitutes about 35% of the global rice export. The global food security is highly impacted by the rice production in Asia in general and India and China in particular. The two giant economies of Asia viz., China and India together account for 37% of the world’s population and 49% of the world’s rice production. There is a wide spread concern at the population growth and the agricultural production needed to sustain it without environmental degradation [2]. The increasing scarcity of land and water resources, environmental degradation, and loss of biodiversity had begun to limit the expansion of food production in both developed and developing countries [3]. As the population and income of people is rising, the demand for food is increasing and meeting the food requirements of the growing population for global food security poses a huge challenge. Growing prosperity is accompanied by human diets that will claim more natural resources per capita. This reality, combined with growing populations, may raise the

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global demand for food crops two- to four-folds within two generations [4]. Food insecurity is facing mounting supply-side and demand-side pressures (Fig. 1). Demand from consumers in rapidly growing economies will increase with the increasing per capita income; and population continues to grow, resulting in an enormous pressure on the food system. On the supply side, there are challenges due to increasingly scarce natural resources in some regions, as well as declining rates of yield growth for some commodities and the climate change impacts. Hence the present study was undertaken with the objectives to (1) study area and production growth rates and trends of major rice growing countries of Asia, (2) estimate export growth rates and trends, (3) compare the contribution of major rice growing countries of Asia to Global food security, and (4) suggest policy options/suitable strategies to enhance the production for global food security.

Material and Methods

The study was conducted to estimate the area, production and export trends of rice from Asia for the past fifty years. The compound annual growth rates were calculated by using the following formula.

$$\text{CAGR}(t_0, t_n) = \left[\frac{V(t_n)}{V(t_0)} \right]^{1/t_n - t_0}$$

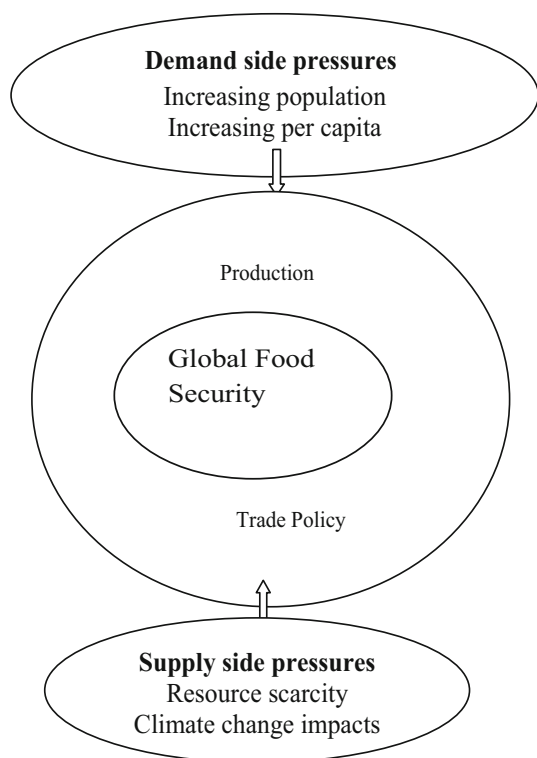


Fig. 1 Factors involved in Global Food Security

where CAGR = Compound Annual Growth Rate expressed as percentage, t_n = End Value, t_0 = Start Value, and $t_n - t_0$ = number of years.

The time series of data on area, production and exports of rice in Asia and World have been compiled from data obtained from IRRI Stat [5]. The period from which the trends have been analysed begins from the year 1964 for area and production. For exports, the trends have been analysed from the year 1984. The contribution of Bangladesh, Cambodia, China, India, Indonesia, Myanmar, Japan, Pakistan, Philippines, Thailand and Vietnam to Global food security has been compared for the period between 1994 and 2013.

Results and Discussion

The key variables which influence global food security beyond 2050 are presented in Table 1. For the world as a whole the pressures on agriculture to produce more food for the growing population will increase beyond 2050. The global agricultural production would need to grow at 0.4 % per year from 2050 to 2080, i.e. less than half the growth rate projected for the period 2005/2007–2050 [6].

Rice production in Asia determines the future trend of the global rice production. Asia contributed 92–89% of the total world rice area in the year 1964 and 2013, respectively (Table 2). In Asia, rice area has increased rapidly during 1964–1973 and moderately during 1974–1983. This was mainly because of the promotion of Green Revolution technology in many Asian countries during this period. More lands have been brought under rice due to Green Revolution. The area has stagnated during 1984–2003. Since the mid 2000s and heightened after the food price spikes, there has been renewed interest in agricultural investment and there are calls for the next Green Revolution [7] and hence, the area under rice in Asia has increased very rapidly during 2004–2013.

The rice production in Asia has increased rapidly during 1964–1983 due to the Green Revolution and this increasing trend has contributed to the region's increased rice production during the period. The rice production has moderately increased during 1984–1993 and 1994–2003 which was mainly because of the stagnant rice area during the period. The late Green Revolution period (1980–2000) differed from the early Green Revolution (1960–1980) period, in part because the prices to farmers were declining; production growth was lower in all regions of Asia. [8]. This implies that it was more difficult to improve modern rice yields after the green revolution. The deceleration of rice production in Asia has been attributed to water scarcity, indiscriminate addition and inefficient use of inputs such as inorganic

Table 1 Influence of Global Key variables on food security beyond 2050 *Source:* Alexandratos and Bruinsma [6]

	2005/2007	2050	2080	2100
Population (million)—UN 2008 revision	6592	9150	9414	9202
Population (million)—UN 2010 revision	6584	9306	9969	10,125
kcal/person/day	2772	3070	3200	
Cereals, food (kg/capita)	158	160	161	
Cereals, all uses (kg/capita)	314	330	339	
Cereals, production (million tonnes)	2068	3009	3182	
Cereal yields (tonnes/ha; rice paddy)	3.32	4.30	4.83	
Arable land area (million ha)	1592	1661	1630	

Table 2 Study of area growth rates and trends of rice in Asia and world *Source:* Author's calculations

S. no.	Year	Asia	Decadal growth rate	World	Decadal growth rate	% of Asia's rice area to the world rice area
1	1964	114.95		125.06		91.92
2	1973	124.34	0.88	136.57	0.98	91.05
3	1974	124.33		136.89		90.83
4	1983	128.92	0.40	142.83	0.47	90.27
5	1984	129.49		144.24		89.78
6	1993	131.23	0.15	146.49	0.17	89.58
7	1994	131.38		147.28		89.20
8	2003	132.77	0.12	148.54	0.09	89.38
9	2004	133.66		150.58		88.76
10	2013	146.94	1.06	165.16	1.03	88.97

Table 3 Study of production growth rates and trends of paddy in Asia *Source:* Author's calculations

Year	Asia's production (million tons)	Growth rate (%)	World production (million tons)	Growth rate (%)	% of Asia's production to the world
1964	242.17	2.69	331.97	2.73	92.1
1973	307.6		334.93		91.84
1974	302.82	3.56	262.93	3.39	91.22
1983	414.84		448.02		92.59
1984	427.80	1.45	465.34	1.48	91.93
1993	486.89		531.00		91.69
1994	491.68	0.90	538.92	0.95	91.23
2003	532.85		586.70		90.82
2004	547.75	2.28	607.58	2.23	90.15
2013	671.02		740.90		90.57

fertilizers and pesticides, and policy issues and the reliance on a narrower genetic material base with impacts on variability [9–11]. There was a rapid increase in production of rice during 2004–2013 (Table 3) mainly because of increase in area and also because of increased investment in agriculture. Since more than 90% of the world's rice is produced

in Asia, there is a similar trend with respect to rice production at the global level.

The decadal export growth rate of paddy in Asia and world for the period 1984–2012 are presented in Table 4. The export growth rate was 2.67% in 1984–1993. China and India have emerged as important exporters in 1990s.

Table 4 Export growth rates of rice in Asia *Source:* Author's calculations

Year	Asia export Qty (million tons)	Growth rate (%)	World export Qty (million tons)	Growth rate (%)	% of Asia's exports to the world
1984	8.69		12.69		68.48
1993	11.02	2.67	16.74	3.23	65.80
1994	11.67		17.84		65.44
2003	20.77	6.61	27.83	1.52	74.63
2004	22.08		28.86		76.52
2012	30.24	4.01	39.78	12.92	76.03

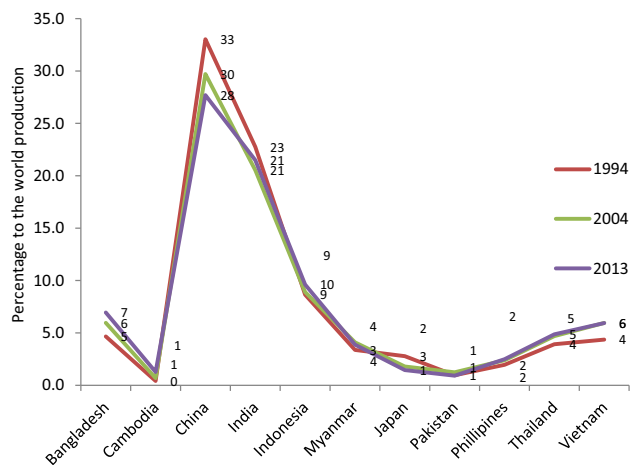
Although the vast majority of rice production in the world's two largest countries is consumed domestically, both have proved able to export large quantities. India was the world's second largest exporter (behind only Thailand) in 1996 and 1998, exporting more than 5 million tons in 1998. China exported more than 3.5 million tons in 1998. The apparent willingness of these countries to supply world markets lends added stability in times of crisis [12].

The emergence of China and India as major exporters has resulted in highest export growth rate of 6.61% in 1994–2003. In 1998, owing to poor crops in a number of importing countries, the presence of Thailand and Vietnam as commercially oriented rice exporters was a major factor in stabilizing the world market in 1998. Indian rice exports approached 5 million tons. In 1998, Vietnamese Government imposed temporary control on rice exports in order to maintain the security of domestic supplies.

The growth rate of exports has declined and stood at 4.01% for the year 2004–2012. This is mainly because of 2008 rice crisis that has provided impetus to expanded rice production in several rice importing countries like West Africa, as these countries sought to increase rice self-sufficiency rather than relying as heavily as they have had in the past on international trade to meet their food security goals [13]. West Africa procures half of its rice needs through imports and accounts for about 20% of the world's rice exports. Asia (particularly Thailand, Vietnam, Pakistan, and India) is the major source of these imports [14].

India is the leading exporter of rice in the world. It has exported 3.7 million tons of basmati rice worth Rs. 27,597 crores and 8.27 million tons of non-basmati rice worth Rs. 20,428 crores during 2014–2015. There has been a tremendous increase in export of both basmati and non-basmati rice from India during the period 1995–96 to 2014–2015. The total quantity of total rice exports have increased by about 144% during the last two decades [15].

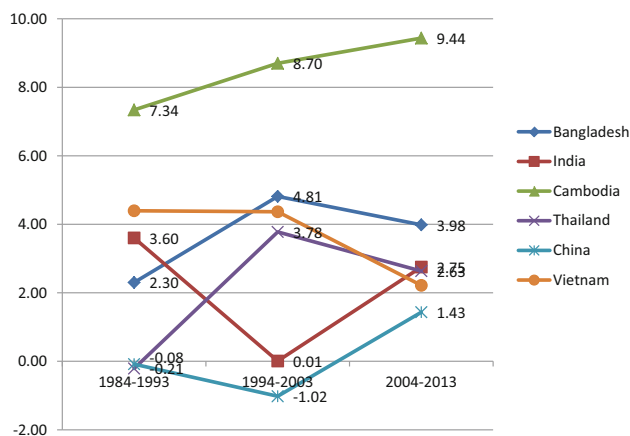
In 2013, the top eleven producers in Asia were China (28%), India (22%), Indonesia (10%), Bangladesh (7%), Vietnam (6%), Thailand (5%), Myanmar (4%), Philippines (2.5%), Japan (1.5%), Cambodia (1.3%) and Pakistan (1%)

**Fig. 2** Contribution of major rice growing countries of Asia to Global food security *Source:* Author's calculations

(Fig. 2). China with a population of 1.4 billion is the most populous country in the world. The 2015 Global Food Security Index ranked 109 countries on the basis of food affordability, availability, and quality and safety. China ranked 42 on this index [16]. Rice production in China has significant implications for global food security. The contribution of China to world rice production ranged from 28 to 33% in the year 1994 and 2003 respectively. The rapidly rising costs of production, pressure on rice area from competing crops, and water shortages are likely to make imported rice an attractive option for Chinese traders. In addition, the demand for different types of rice such as sticky rice from Vietnam, jasmine rice from Thailand, and long-grain rice from Pakistan is growing as Chinese consumers diversify their consumption habit with rising income [17]. Hence the demand for Chinese rice imports will grow in the future. China, India, Indonesia, Bangladesh, Thailand and Vietnam will continue to be major players in global food security due to their share in the world rice production. In India, the importance of rice as an export commodity gained prominence after liberalization with more emphasis on quality and mode of production for international trade [18].

Table 5 Trends in Paddy production (million tons) of major rice growing countries, 1984–2013 *Source:* Author's calculations

S. no.	Country/year	1984	1994	2004	2013
1	Bangladesh	21.93	25.12	36.24	51.50
2	Cambodia	1.26	2.22	4.17	9.39
3	China	181.10	177.99	180.52	205.21
4	India	87.55	122.64	124.70	159.20
5	Indonesia	38.14	46.64	54.09	71.28
6	Myanmar	14.26	18.20	24.94	28.77
7	Pakistan	4.97	5.17	7.54	6.80
8	Philippines	7.83	10.54	14.50	18.44
9	Thailand	19.90	21.11	28.54	36.06
10	Vietnam	15.51	23.53	36.15	44.04

**Fig. 3** Production Growth Rates of major rice growing countries of Asia *Source:* Author's calculations

The trends in paddy production of major rice growing countries of the Asia for the period 1984–2013 are presented in Table 5. There was a tremendous increase in paddy production in Vietnam (184%), Myanmar (102%) and Indonesia (87.1%) during the period 1984–2013. In India and Thailand the paddy production has increased by about 82% during the period 1984–2013. In Cambodia, the paddy production had increased by 7.45 times during 1984–2013, whereas in Bangladesh and Philippines, the increase in paddy production was 2.36 times. In Pakistan, the increase was 1.37 times for the same period.

The production growth rates of major rice growing countries of Asia have been presented in Fig. 3. Cambodia showed an upward trend in production growth rate from 7.34 to 9.44 during 1984–1993, 1994–2003 and 2004–2013, due to the Cambodian government's intent on expanding its production and export capacity and becoming a major rice export nation. In India, the production growth rate was 3.6 during 1984–1993 and was lowered during 1994–2003. The main reasons for the lower growth rate during 1994–2003 were due to the fact that the year

1994 was a flood year with All India Summer Monsoon Rainfall (AISMR) in excess of one standard deviation above the mean (i.e., anomaly exceeding +10%) and the year 2002 was a drought year with AISMR less than one standard deviation below the mean (i.e., anomaly below -10%). China has implemented a series of programs to promote rice productivity and it imposes trade restrictions and policies aimed at raising farmers' income while managing the food demand of its growing population. Since 2004, China has begun to subsidize and remove taxes on agriculture and China could achieve a growth rate of 1.43 during 2004–2013. To encourage production, the Chinese government introduced a machinery subsidy, which is monetary assistance granted by the government to a farmer for buying agricultural machinery. Farmers are offered a 30% discount on agricultural machinery purchased, with a maximum subsidy ranging from \$7720 to \$30,879 per item (50,000–200,000 yuan). These subsidies target grain producers [19].

Conclusion

Asia has been playing a leading role in ensuring food security of the world. The global food security is highly dependent on the rice production in Asia as evident from the contribution of this region to the global rice production, which is generally 90.6%. Therefore, sustainable rice production in Asia is crucial for the global food security.

Asia is the major producer and consumer of rice in the world and is likely to maintain rice surplus in the future. Yield growth is expected to remain modest in the next few decades as high-yield varieties continue to face high input costs and low consumer prices. Growth in rice area is expected to continue to slow, as the risk of crop diseases discourages multiple cropping and new investments in irrigation infrastructure do not expand beyond earlier levels. World rice consumption continues to rise but at a

reduced pace. Asia is the major supply source for this global consumption growth. Shifts in supply and demand in Asia affect global rice prices. Asian countries like India, Thailand and Vietnam are likely to remain a dominant force in world rice trade. It is important to consider the rice production and consumption of these countries in projections of the world rice market and of global food security. Any fluctuations in rice production and changes in rice trade policies can have outsized effects on international price. For expansion of international trade, the governments will need to adopt measures that reduce supply chain losses, improve supply response time, reduce the market costs and post harvest losses. High food prices have a disproportionate impact on the global food security. Hence, efforts in research and extension should be made to break the trend of stagnant yield and closing yield gaps to increase rice production for ensuring the global food security.

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Compliance with Ethical Standards

Conflict of interest The author has no conflict of interest to declare.

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