Can Nepal Attain Self-Sufficiency in Major Crops Production?

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Abstract

Nepal has been pursuing free market trade policies since the 1950s, focusing in agricultural sector, which contributes more than 33 per cent to Gross Domestic Product (GDP) and employs more than 50 per cent of labor force directly and indirectly. India imposed an unofficial quasi-blockade in 2015 and was accused of shipping perishable agricultural goods but cooking gas and gasoline shipment were halted. This resulted in prices of agricultural produces and products to skyrocket. This paper categorically investigates the importance of four major crops, rice, wheat, maize and barley in Nepalese diet and using rice, as a choice crop, investigates what level of increase in yield will be able to offset total imports. Rice followed by maize contributes the most for both, calorie and protein, in Nepalese diet. An ex-post analyses shows that for rice, modest yield increase of 7 per cent (based on CIGAR data) or 14 per cent (based on FAO data) should have offset all the imports. Furthermore, comparative analysis of fertilizer use and price showed that on average Indian counterparts used more fertilizers and received higher prices for rice compared to Nepalese farmers.

Keywords: Agriculture production; import; Nepal; rice production

INTRODUCTION

Nepal, one of the developing nations in Asia, has been pursuing free market trade policies since the 1950s (Skerry *et al.* 1991). The focus of the government has been for more trade in agricultural sector since 1990s and as such Nepal has been importing and exporting goods and services, albeit more to and from its neighbors, India and China, due to geographical constraints (UNDP 2004; FAO 2004; Pyakural *et al.* 2005). As of 2014 Nepal had a negative trade balance, importing more than USD 7 billion worth of goods and services and exporting less than USD 2 billion, the majority of which came from the two neighbors, 61 per cent from India and 15 per cent from China (OEC and MIT 2014). One of the key contributors to the Gross Domestic Product (GDP) of Nepal is the agricultural sector. The agricultural sector contributed more than 33 per cent to the GDP in nominal dollars for 2013/14 fiscal year (GoN 2014). However, agricultural production is not able to meet the domestic demand. Thus, of the imports, direct agricultural imports and goods and services supplementing the agricultural sector, were substantial and in an increasing trend.

For over a decade now, Nepal has not been producing enough of certain agricultural products and produces to fulfil the domestic demand resulting in the country being a net importer of agricultural goods and services. Nepal does produce many commodities enough to meet the domestic

demand. Some of the commodities are even exported due to surplus production. Some of the commodities produced enough to meet domestic demands are cardamom, tea, lentil, ginger, and buckwheat. Nepal relies and is increasingly relying more on Indian imports to fulfil its increasing domestic demand, partly driven by increase in population. According to a leading Nepalese newspaper, as of 2015, imports from India accounted for 27 per cent of fruits and vegetables sold in the largest retail market, Kalimati Fruit and Vegetable Market (Bashyal 2015).

In a free market economy, any country can easily secure agricultural commodities from other sources, by buying them from world market as long as they have purchasing power. Natural resources poor countries like Japan (Mulgan 2013) and Saudi Arabia (Grindle *et al.* 2015) are able to import agricultural products from around the globe to meet their domestic demand. However, in the case of Nepal, this solution is highly unlikely due to Nepal's economic and the geo-political realities/constraints. As a country, Nepal is grappling with many challenges such as its economy not being able to keep up with its neighbors. India, Nepal's south neighbor, had an average GDP growth rate of more than 7 per cent for 2010-2015; China, Nepal's north neighbor, had an average GDP growth rate of more than 8 per cent for the same time period; while, Nepal's average growth rate for the same period was only slightly more than 4 per cent (The world Bank 2017). Furthermore, the country is still in the process of managing its political infrastructure (governance structure at the federal, state and local level, differentiating state and federal government's rights and responsibilities, tax structure at all levels of government, etc). Finally, inflation is increasing at a rate greater than the increase in real household income which is not contributing to increased purchasing power even when the economy is seeing modest growth. As was well covered by the national and international press India imposed an unofficial quasi-blockade of Nepal beginning September of 2015 which was finally resolved mid-2016. During the quasi-blockade India was accused of shipping perishable agricultural goods and produces but cooking gas and gasoline shipment were halted. Because a lot of gasoline and gasoline products are used for agricultural production (in absence of which domestic production declined temporarily) and transportation in the country; the prices of agricultural produces and produces skyrocketed. In the short run, the problem has been resolved however the long-run problem still lingers.

Thus, in order to meet its internal agricultural demand, Nepal has to increase aggregate domestic production of agricultural commodities or at the very least production should increase to offset the imports sustainably and reverse the trajectory of the increased trend in imports. This is especially more important as Nepal strives to gain momentum in economic growth.

In an open market economy, as one in Nepal, primary motivating factor for farmers to indulge in agricultural production, which increases aggregate national level production, is to increase in their 'bottom line' or farm level income (which should translate to increased farm level profits). The government of Nepal has been arguably trying to promote and support agricultural production through various means for at least two decades. There have been several government reports (Pyakural *et al.* 2005; Economic survey, 2014, 2013, 2012; FAO 2014) and

papers (Nepal 2015; Grist 2015; Gaudel and Gautam 2016) investigating whether government policies are correct, adequate and sending correct signals to market to increase production. However, the authors of this paper do not know of any research done to see the optimal production level of Nepal and whether that amount is going to be enough to meet its domestic demand. There has also not been any investigation to find out by what levels yields of certain commodities need to increase in order to offset the imports.

In this paper, we do precisely that find out what level of increase in yield needs to be attained to offset total imports. Using rice, as a choice crop, due to its importance in Nepal we analyze three different scenarios- yield increase to India's yield, yield increase by 10 per cent, and required yield to completely offset the imports.

THEORETICAL FRAMEWORK

There are two problems to be solved simultaneously, by the policy makers and the producer. The problem of the policy maker (also often referred as a benevolent dictator in the literature) is to maximize aggregate production level of all grains subject to its constraints on land, fiscal policies, available technologies and infrastructure.

Max P(G);

where

$G = \sum_{n=1}^{4} g_i$; g_1 = rice;

g_2 = wheat; g_3 = maize; g_4 = barley

Subject to

$\sum_{i=1}^{4} l_i + l_o = \beta L$ (1)

$\sum_{s=1}^{4} S_s + So = \theta B$ (2)

where l_1 = land under rice production; l_2 = land under wheat production; l_3 = land under maize production; l_4 = land under barley production; l_o = land under other agricultural products

L = total land available (14.718 million hectares); β = per cent of total land that is arable ; S_1 = subsidies that are (or can) be provided for rice production; l_2 = subsidies that are (or can) be provided for wheat production; l_3 = subsidies that are (or can) be provided for maize production; l_4 = subsidies that are (or can) be provided for barley production; S_o = subsidies that are (or can) be provided for rice production; B = total annual budget of the Nepal

θ = per cent of budget that is being allocated for agricultural subsidies and/or growth

The other problem solved by the producer (a farmer) is maximizing profits subject to budget constraint. The sheer choice of profits based on different cultivation is what determines how much land and what they produce.

Mathematically,

$$\text{Max } \pi_i$$

subject to

$$\sum_{i=1}^{n} W_i X_i = I \quad (3)$$

where W_i are the vector of input costs; X_i are vector of inputs used for production and I is total budget. $\pi_i = P_i Y + S - \sum_{i=1}^{n} W_i X_i$ (4); where Pi is the price per unit of production for a certain cereal/grain (namely for rice or maize or wheat or barley); Y is the total production ; and S is the subsidy received directly and/or indirectly.

DATA SOURCES AND DESCRIPTIVE STATISTICS

The office of Disease Prevention and Health Promotion of the United States recommends 1,600 to 2,400 calories per day for adult woman and 2,000 to 3,000 calories for adult men. A weighted average

was calculated in order to estimate the average calories required for an average Nepali citizen assuming the population was evenly distributed based on gender. Using Food and Agricultural Organization (FAO) calculations were done to find the contribution of calories on a daily basis from each of the four major grains consumed from 2002-2013 (Table 1). From table 1, it is evident that rice contributes the most in terms of calories in a Nepalese diet, 37 per cent, followed by Wheat at 17 per cent, Maize at 15 per cent, and Barley less than one per cent. This contribution seems to be fairly consistent overtime suggesting that there has not been any major change in the diet during this time period. Table 1 also suggests that these four cereal crops contribute 70 per cent of caloric needs of an average Nepalese. Remaining 30 per cent, come from potatoes, buckwheat, meat and dairy products, and other sources. The remaining calories not supplemented are deficiencies. Exact breakdown of the two was not possible due to unavailability of data.

Table 1. Contribution of major grains to Nepalese diet on a daily basis.

Year	Barley		Wheat		Rice		Maize		Deficient or other sources	
	Kcal/ Capita/ Day	%	Kcal/ Capita/ Day	%	Kcal/ Capita/ Day	%	Kcal/ Capita/ Day	%	Kcal/ Capita/ Day	%
2002	9	0.40	311	13.82	834	37.07	336	14.93	760	33.78
2003	10	0.44	319	14.18	828	36.80	347	15.42	746	33.16
2004	8	0.36	334	14.84	853	37.91	344	15.29	711	31.60
2005	8	0.36	368	16.36	827	36.76	357	15.87	690	30.67
2006	7	0.31	341	15.16	821	36.49	357	15.87	724	32.18
2007	6	0.27	340	15.11	825	36.67	379	16.84	700	31.11
2008	7	0.31	348	15.47	842	37.42	380	16.89	673	29.91
2009	7	0.31	350	15.56	829	36.84	370	16.44	694	30.84
2010	8	0.36	366	16.27	832	36.98	362	16.09	682	30.31
2011	8	0.36	379	16.84	826	36.71	354	15.73	683	30.36
2012	10	0.44	389	17.29	839	37.29	346	15.38	666	29.60
2013	11	0.49	388	17.24	836	37.16	342	15.20	673	29.91

Protein deficiency can substantially lead to several health problems and perhaps more importantly slow or prohibit full growth of a child. Harvard Medical Institute recommends .8 gm of protein per one kilogram weight. Using FAO data on a daily basis, percentage contribution of protein from these four major cereals on Nepalese diet was estimated (Table 2). It appears that again rice is the leading contributor of protein, contributing almost one-third of the required protein intake. Not surprisingly, as with the caloric contribution wheat (22%), maize (16%) and barley (1%) follow respectively. The long term trend has been the same for the last decade in this case too. Some of the remaining, almost 30 per cent, of required protein intake comes from meat, milk and other dairy products.

Table 2. Protein contribution of major grains to Nepalese diet on a daily basis.

Year	Barley		Wheat		Rice		Maize		Deficient or other sources	
	Grams/ Capita/ Day	Percent-age	Grams/ Capita/ Day	Percent-age	Grams/ Capita/ Day	Percent-age	Grams/ Capita/ Day	Percent-age	Grams/ Capita/ Day	Percent-age
2002	0.30	0.59%	9.12	17.88%	16.58	32.51%	8.23	16.14%	16.77	32.88%
2003	0.32	0.63%	9.31	18.25%	16.47	32.29%	8.49	16.65%	16.41	32.18%
2004	0.27	0.53%	9.84	19.29%	16.96	33.25%	8.42	16.51%	15.51	30.41%
2005	0.27	0.53%	10.81	21.20%	16.44	32.24%	8.74	17.14%	14.74	28.90%
2006	0.23	0.45%	10.02	19.65%	16.32	32.00%	8.73	17.12%	15.70	30.78%
2007	0.21	0.41%	9.97	19.55%	16.40	32.16%	9.28	18.20%	15.14	29.69%
2008	0.23	0.45%	10.19	19.98%	16.75	32.84%	9.29	18.22%	14.54	28.51%
2009	0.22	0.43%	10.32	20.24%	16.48	32.31%	9.05	17.75%	14.93	29.27%
2010	0.24	0.47%	10.76	21.10%	16.55	32.45%	8.85	17.35%	14.60	28.63%
2011	0.26	0.51%	11.13	21.82%	16.43	32.22%	8.66	16.98%	14.52	28.47%
2012	0.30	0.59%	11.43	22.41%	16.69	32.73%	8.39	16.45%	14.19	27.82%
2013	0.30	0.59%	11.41	22.37%	16.62	32.59%	8.31	16.29%	14.36	28.16%

OBJECTIVE OF THE PAPER

Table 1 and 2 show the importance of these four crops for Nepal from a dietary perspective; however, Nepal is not self-sufficient when it comes to production of these four crops. Table 3 shows the relative import of these four major crops using data from FAO till 2013. Table 3 shows that Nepal imports barley the most followed by rice, maize and wheat when calculated relative to the annual production of the country. The cardinal ranking is the same when measured relative to domestic supply defined as aggregate production and imports less export. This means that the proportionate exports and imports of all the major cereal crops is essentially the same. In other words, Nepal is neither importing nor exporting any more of one cereal crop than other as a percentage of production.

Table 3. Import as a percentage of total domestic production and domestic supply

Year	Barley (Ton per Ha)		Wheat (Ton per Ha)		Rice (Ton per Ha)		Maize (M ton per Ha)	
	Production	Supply	Production	Supply	Production	Supply	Production	Supply
2002	16%	14%	1%	1%	1%	1%	0%	0%
2003	25%	21%	2%	2%	2%	2%	1%	1%
2004	16%	14%	2%	2%	1%	1%	1%	1%
2005	24%	19%	0%	0%	2%	2%	1%	1%
2006	18%	16%	2%	2%	6%	6%	1%	1%
2007	7%	7%	0%	0%	10%	8%	3%	3%
2008	21%	18%	1%	1%	3%	3%	2%	2%
2009	52%	34%	1%	1%	4%	3%	2%	2%
2010	50%	33%	1%	1%	4%	3%	8%	7%
2011	40%	29%	2%	2%	6%	5%	9%	9%
2012	49%	33%	1%	1%	12%	13%	2%	2%
2013	59%	37%	7%	6%	14%	13%	10%	10%

ANALYSIS, RESULTS AND CONCLUSION

Consistent with the theoretical framework laid in the previous section, a farmer is motivated by the profit earning potential of these crops. While the data on production costs were not available to calculate farm level profits for each enterprise a proxy measure, nominal price received by farmers of Nepal and India, was used to assess the relative profitability. The reason being most of the trade in agriculture (and for that matter other aspects) of Nepal occurs with India so the relative prices received by the producers should help analyze profitability at farm level. Table 4 shows the nominal and real (inflation adjusted using GDP deflator) price received by a Nepalese producer relative to Indian producer.

Table 4. Nominal & real price Nepalese producer receives as a percentage of price an Indian producer receives

Year	Barley		Wheat		Rice		Maize	
	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
2002	*	*	91%	88%	96%	94%	118%	115%
2003	*	*	87%	86%	92%	91%	120%	119%
2004	*	*	93%	91%	68%	66%	112%	110%
2005	*	*	88%	88%	74%	75%	109%	110%
2006	*	*	84%	85%	58%	59%	82%	83%
2007	*	*	85%	86%	49%	49%	89%	90%
2008	97%	100%	89%	91%	47%	48%	97%	99%

In table 4 a percentage greater (smaller) than 100 implies that a Nepali producer is receiving more (less) than his/her counterpart in India. Since, Nepal imports majority of goods and services from India and purchasing power parity is mostly measured accurately by the real price (which in return translates to real profits to buy other goods and services) the interpretation of table 4 will mostly focus on the real prices. For the most recent data available year, 2008, barley and maize producers were receiving almost the same price as their Indian counterparts.

The long term trend seems to be dismal for all crop producers. In 2002 the differences were marginal for wheat and rice and in fact maize producers were receiving more than Indian counterparts. However, this trend seems to reverse drastically from 2004. There seems to essentially be a regime shift in the prices received by Nepalese producers and Indian producers. There are two plausible explanations for this -1) the price in Nepalese market was heavily regulated and were not let to flow freely upwards towards the international price or 2) while the Indian government heavily subsided its producers Nepal just did not have any policies in place to support its producers hence irrespective of global market prices Indian producers started receiving significantly higher prices than their Nepalese counterparts. Considering no significant regulatory changes were made in Nepal and India did start supporting agriculture forcefully and sustainably the second explanation is much more likely for the price difference.

Table 4 shows that Nepalese producers have not been supported or at the very least supported as Indian producers. This definitely cannot help Nepal attain self-sustaining level of production of these crops. The case for rice is particularly dismal and even worrisome so further analysis will be done for the specific crop in the later sections.

The government policies can be directed towards giving direct subsidies, or help in subsiding inputs (fertilizers, pesticides, etc.), and technology to increase yield. If yields are increased significantly they can compensate the loss in profits at farm level by offsetting less per unit price by increasing the quantity. So, a comparative analysis of yield was done for the same crops (Table 5).

An interesting finding from table 5 is that at the start of the time period, 2002, average Nepalese rice and maize producers produced more than their Indian counterparts. However, ever since for all the crops Indian producers have a comparative advantage in producing. At least for rice and maize, this could partly be, as a result of lack of government subsidies in inputs compared to India. It is noteworthy that there could be various other factors such as but not limited to use of improved seeds, better farming practices, new productive land being into production, technology use, and irrigation by Indian producers.

In summary, whatever the causes, Indian producers seem to have better average yield than Nepalese producers and the difference seems to be substantial for barley and wheat, moderate for maize and nominal for rice. Table 4 and 5 also prove that rice is a staple food with very inelastic demand as well as supply considering that even when prices received by Nepalese producers is almost half of their Indian counterparts; productivity in rice production does not seem to lag too far behind the Indian producers relative to other crops.

Table 5. Comparative yield of four major cereal crops for India and Nepal

Year	Barley (Ton per Ha)			Wheat (Ton per Ha)			Rice (Ton per Ha)			Maize (M ton per Ha)		
	Nepal	India	Diff. yield (Nepal minus India)	Nepal	India	Diff. yield (Nepal minus India)	Nepal	India	Diff. yield (Nepal minus India)	Nepal	India	Diff. yield (Nepal minus India)
2002	111.07	216.00	-104.93	188.59	276.21	-87.62	2.68	2.62	0.06	182.91	168.07	14.84
2003	115.08	200.60	-85.52	200.92	261.00	-60.08	2.68	3.12	-0.44	187.65	204.05	-16.40
2004	111.66	197.50	-85.84	208.73	271.32	-62.59	2.86	2.98	-0.12	190.59	190.73	-0.14
2005	111.02	195.80	-84.78	213.44	260.16	-46.72	2.78	3.15	-0.37	201.91	193.85	8.06
2006	105.94	193.78	-87.84	207.45	261.88	-54.43	2.72	3.18	-0.46	203.82	191.25	12.57
2007	106.44	205.82	-99.38	215.63	270.79	-55.16	2.56	3.29	-0.73	209.09	233.52	-24.43
2009	89.96	239.35	-149.39	193.38	290.71	-97.33	2.91	3.24	-0.33	220.54	202.38	18.16
2010	103.71	217.17	-113.46	212.89	283.95	-71.06	2.72	3.36	-0.64	211.86	254.01	-42.15
2011	106.25	235.74	-129.49	227.47	298.86	-71.39	2.98	3.59	-0.61	228.14	247.84	-19.70
2012	124.54	210.39	-85.85	241.23	317.75	-76.52	3.31	3.69	-0.38	250.11	255.57	-5.46
2013	114.14	221.52	-107.38	229.02	315.38	-86.36	3.17	3.62	-0.45	235.28	245.16	-9.88

ANALYSIS OF RICE

Rice is a staple food for Nepalese. As stated earlier the demand and supply for rice seem to be inelastic. When resources are scarce, and policy makers have to choose crop by crop on being self-reliant, the first strategic choice for policy makers most likely will be rice. So in this section an in-depth analysis of rice production and required levels of yield and/or new land to be bought into agricultural production is done.

A comparative analysis of several aspects of rice production for India and Nepal was done (Table 6). There are many important findings from Table 6. First, as a percentage of arable land Nepal uses significantly more land in rice production compared to India. While India uses less than one third of its arable land for agricultural production Nepal uses twice as much (two- thirds) of its arable land in relative comparison. Secondly, there seems to have been a regime shift since 2002 in rice yield for the two countries. Nepal's yield was greater than India's yield by slightly more than 2 per cent in 2002; however, ever since Nepal's yield has been lower than India's. For 2013 India's yield was 14 per cent more than that of Nepal's, with the highest of almost 30 per cent in 2007. In summary, yield for both countries have been increasing for the most part at an increasing rate; however, this rate of increase has been smaller for Nepal compared to India. This could be partly explained by a significantly higher use of fertilizer by Indian producers. Indian producers on average have always used more fertilizer than their Nepalese counterparts which could be as a result of more subsidies received by Indian producers.

The cumulative effect of price and quantity effect is that Nepalese producers making significantly lower revenues and profits. Price effect (reduction in received price) could be compensated by increased yield which would return in higher total revenue per hectare and concurrently more profits. However, in rice production the combined effect of lower received price and lower yield shows that an average Nepalese receives significantly lower profit than an Indian producer.

Table 6. Descriptive statistics related to rice production in India and Nepal

Year	Percent of arable land in rice production		Yield (Tonne per Hactre)			Imports (1,000 Tonnes)		Per Capita Domestic Consumption (kg/per year)		Fertilizer usage (NPK per 1000 t)	
	Nepal	India	Nepal	India	Difference (Nepal minus India)	Nepal	India	Nepal	India	Nepal	India
2002	66%	26%	2.68	2.62	0.06	18.36	0.87	112.26	73.65	16.68	100.33
2003	67%	27%	2.68	3.12	-0.44	54.76	0.34	111.93	73.19	5.06	105.18
2004	68%	26%	2.86	2.98	-0.12	32.10	0.00	115.97	74.97	8.03	115.27
2005	68%	27%	2.78	3.15	-0.37	50.14	0.26	112.76	76.70	3.57	127.61
2006	69%	28%	2.72	3.18	-0.46	157.04	0.16	114.32	75.78	5.64	136.40

2007	64%	28%	2.56	3.29	-0.73	226.26	0.14	113.34	76.26	1.61	142.84
2008	70%	29%	2.78	3.25	-0.47	92.40	0.08	110.46	77.05	1.36	153.35
2009	71%	27%	2.91	3.24	-0.33	102.94	0.07	116.32	76.06	19.17	167.46
2010	68%	27%	2.72	3.36	-0.64	98.16	0.10	114.66	76.58	25.08	179.10
2011	69%	28%	2.98	3.59	-0.61	161.10	1.09	115.75	76.39	34.66	177.32
2012	72%	27%	3.31	3.69	-0.38	367.31	0.54	121.67	74.99	44.07	164.78
2013	67%	28%	3.17	3.62	-0.45	325.46	1.32	119.19	74.13	57.73	157.52

Nepal has seen a continuous and increased import of rice since 2002. There has been a dramatic increase in the imports during this time period primarily driven by population growth as the per capita consumption has not gone up substantially. The imports have increased from 18 thousand tonnes in 2002 to more than 325 thousand tonnes in 2013.

In order to achieve self-sufficiency in rice consumption aggregate production needs to increase to offset the imports. There are three ways to achieve increased aggregate production at national level- i) bring more land into agricultural production; ii) increase yield and iii) combination of both increase in yield and more land bought into agricultural production. In case of Nepal, most of the arable land that is not in production is forest which has its own natural, economic and eco system services benefits. Furthermore, since Nepal lags significantly behind on productivity compared to India now, when that was not the case in 2002, it is important to focus on increasing yield. So, an analysis was done to see how much yield increase would be needed in order to offset the imports completely. Data available from FAO and CIGAR vary slightly on these imports.

Analysis was done for three scenarios –i) reduction in import if Nepal's yield equaled India's yield; ii) Nepal's yield increase by 10 per cent for the given year and iii) required yield increase in per cent to completely offset imports.

Mathematically scenario i would be,

Percenatge decrease in Imports =

$$= \frac{\left\{\left(\alpha_t^N \times \Omega_t^I\right) - \left(\alpha_t^N \times \Omega_t^N\right)\right\} - \tau_t^N}{\tau_t^N} \qquad (5)$$

where, N and I stand for Nepal and Import respectively; t represents a given year ; α is total area with rice plantation ; Ω is yield and τ is total imports.

For scenarios ii would be changed to increase in current yield by 10 per cent. Mathematically, equation iii will be

Percenatge increase required to offset all Imports =

$$\frac{Required\ yeild}{Current\ yeild} \times 100 \qquad (6)$$

Required yeild =

$$= \frac{(\alpha_t^N \times \Omega_t^N) + \tau_t^N}{\alpha_t^N} \qquad (7)$$

Results from table 7 show that if Nepal's yield was as high as India's yield there would be no necessity to import any rice

from India according to CIGAR data for all the years. Even if FAO data was to be used for analysis only last two years, 2012 and 2013, would require a modest import. It is noteworthy that the high negative percentages suggest that production would exceed demand and Nepal would be able to *export* rather than import. Modest increase of 10 per cent yield would virtually eliminate all imports for all the years irrespective of the data used. Finally, Nepal only needs to attain a modest growth in yield, 7 per cent based on CIGAR data and 14 per cent based on FAO data, to completely offset the imports.

Table 7. Reduction in import of rice for various scenarios as a percentage of total imports, 2002-2013

Year	Yield equal to India		Yield increase by 10 %		% Increase in yield required to offset net imports	
	CIGAR	FAO	CIGAR	FAO	CIGAR	FAO
2002	*	*	*	*	0%	1%
2003	-1154%	-680%	-669%	-3.75	1%	2%
2004	-496%	-256%	-1303%	-7.49	1%	1%
2005	-1030%	-568%	-747%	-4.02	1%	2%
2006	-357%	-184%	-172%	-0.68	4%	6%
2007	-366%	-187%	-65%	-0.01	6%	10%
2008	-696%	-439%	-374%	-2.19	2%	3%
2009	-403%	-217%	-344%	-1.79	2%	4%
2010	-871%	-501%	-316%	-1.56	2%	4%
2011	-466%	-260%	-176%	-0.76	4%	6%
2012	-58%	8%	-37%	0.19	7%	12%
2013	-96%	1%	-38%	0.30	7%	14%

**Nepal had higher yield than India; Negative numbers imply increase in production would be more than enough to offset the import (i.e surplus); surplus expressed as a percentage of that year's import; Positive numbers imply increase in production would not be to offset the import and Nepal would still need to import the given per cent of that year's actual import.*

POLICY IMPLICATIONS

As stated in the introduction section, it is important for Nepal to be self-sufficient in major crop production due to economic and socio political realities. Findings of this study suggest self-sufficiency in rice production is attainable with correct policies in place. Major policy recommendations would be to increase research in rice; introduce the varieties with higher yield and subsidize fertilizers as Nepal's farmers are using significantly less fertilizers compared to their counterparts in Nepal. Furthermore, even though this research did not analyze the aspect of bringing new land into rice production, introduction of new land into rice production would also help attain self-sufficiency goals.

ACKNOWLEDGEMENT

Authors of this paper would like to thank an anonymous reviewer who provided critical feedback on the content, gave some insights which have been incorporated in the paper and took time to thoroughly provide feedback on all aspects of the paper.

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