Agricultural Trade in Bhutan

Patterns, trends, and economic impact

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Agricultural Trade in Bhutan: Patterns, trends, and economic impact

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"Agricultural and Food Policy Research and Capacity Strengthening"

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ACRONYMS

DAMC	Department of Agricultural Marketing & Co-operatives
BLSS	Bhutan Living Standards Survey
CoRRB	Council for Renewable Natural Resources Research of Bhutan
DoA	Department of Agriculture
DoL	Department of Livestock
FAO	Food and Agricultural Organization
FYP	Five Year Plan
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute
kg	kilogram
MoAF	Ministry of Agriculture & Forests
mt	metric tonnes
NSB	National Statistical Bureau
Nu	Ngultrum
PPD	Policy and Planning Division
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resources
SDC	Swiss Agency for Development Cooperation

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EXECUTIVE SUMMARY

In spite of its remote and land-locked location, Bhutan has been relatively successful as an agricultural exporter. The value of agricultural exports has grown at an annual rate of almost 9% since 2000. Taking advantage of the cooler climate, Bhutan exports oranges, potatoes, vegetables, and apples to India and Bangladesh.

At the same time, agricultural imports have been growing at 10% per year. Rice accounts for more than two-thirds of the value of agricultural imports, which is not surprising given that Bhutan depends on imports for about half of its consumption needs. Wheat, vegetables, fruits, and spices are also imported.

A key question, however, is whether this trade in agricultural products is beneficial to Bhutan in general and to poor farmers and consumers in particular?

From the farmer's perspective, the appeal of growing horticultural crops is clear: the gross returns per hectare are higher than for rice and maize. The returns per hour of labour are less clearly in favor of horticulture because it tends to be more labour intensive than cereal crop production. Given the labour requirements, input costs, and risks, few farmers are able to specialize fully in horticulture but many can produce some fruits and vegetables in addition to their cereal crops. The optimal mix will vary from farmer to farmer depending on skills, ability to finance input costs, tolerance of risk, distance to markets, and other factors.

A broader analysis of the costs and benefits of agricultural trade takes into account the effect of trade on both farmers and consumers. Much of the debate over the impact of trade in agricultural commodities in Bhutan is limited to general statements regarding the advantages and disadvantages of trade. This report contributes to the debate by providing empirical estimates of the gains and losses associated with trade in rice, potatoes, and oranges, as well as some analysis of the distribution of those gains and losses among different groups in Bhutan. We develop simple single-commodity models of the main import and export crops and calibrate them using data on production, consumption, prices, and trade. Along with assumptions about the elasticity (responsiveness) of supply and demand to price changes, these models allow us to estimate the gains and losses associated with trade for farmers, consumers, and the country as a whole.

The results are organized around four common arguments against agricultural trade:

- Argument 1: "It is a waste of foreign exchange to import goods that the country could grow or produce for itself."

The analysis presented here confirms that Bhutan probably could grow enough rice to feed itself, but only at a very high cost. If our assumptions about the supply and demand elasticities of rice are correct, the domestic retail price of rice would have to rise from 30 Nu/kg to about 100 Nu/kg to achieve rice self-sufficiency. In other words, each kilogram of local rice would cost more than three times as much as the imported rice that it replaced. Furthermore, because of the high price required to reach self-sufficiency, rice consumption would decline and consumer would be forced to switch to other staples, including maize, wheat, and other cereals. This analysis

does not examine the effect of rice self-sufficiency on maize markets, but it is likely that higher rice prices would increase the demand for maize, thus increasing maize prices as well. Although rice self-sufficiency would probably not affect the price of wheat, because it is imported, it would increase the volume of wheat imports.

- Argument 2: "Imported products compete with local products, pushing the price down and hurting farmers and other producers in the country."

Again, our analysis confirms part of this claim: rice imports do compete with local rice, they do push down the domestic price of rice, and this does have an adverse effect on farm income. On the other hand, by lowering the domestic price of rice, imports also generate large benefits to rice consumers. In fact, we estimate that rice imports reduce the income of rice farmers by Nu 4.2 billion per year, but this is offset by benefits to consumers of Nu 6.1 billion per year. Thus, the net impact of rice imports is a gain of Nu 1.2 billion per year.

- Argument 3: "When farmers divert land into export crop production, they raise the price of agricultural commodities in the country and contribute to food insecurity by reducing domestic food production."

The analysis presented in this report confirms that exports of potatoes, oranges, apples, and other commodities motivate farmers to expand the area in these crop beyond what it would be without trade. Does this increase food insecurity? Among those growing export crops, the income earned from export crop sales presumably allows them to purchase rice and other staple foods; otherwise they would quickly discontinue export crop production. Among farmers who do not grow export crops, they may be adversely affected by the diversion of land into export crops, but the effect is likely to be negligible for two reasons. First, because rice is an imported crop, any reduction in domestic production would have no effect on the domestic price, which is largely determined by the Indian price and the cost of transporting it to Bhutan. Any shortfall in rice production would be compensated by higher imports. Second, the area under export crops is modest. Only about 13% of the cropped area in Bhutan is allocated to the four main export crops: oranges, potatoes, apples, and cardamom. Applying the percentage of these crops that are actually exported, we estimate that 4.3% of the cropped area in Bhutan is used to produce the exported quantities of these crops.

Finally, only some portion of this land would become available for other crops in the absence of exports because the lower price would increase domestic demand for these crops. If we conservatively estimate that half of the land would become available for other crops, eliminating exports of oranges, potatoes, apples, and cardamom would only free up 2.15% of the crop land in Bhutan. Thus, export crop production displaces very little farm land and is unlikely to have a measurable effect on staple crop prices or availability.

- Argument 4: "World markets are volatile and unreliable, particularly as a source of imported staple foods."

The food crisis of 2007-2008 highlighted the volatility of prices in world markets, particularly in rice markets. Our analysis, however, is a reminder that a policy of self-sufficiency does not eliminate the problem of price volatility; rather it replaces one source of volatility (world markets) with another (domestic production). It is an empirical question whether the volatility associated with world rice markets is greater or less than that associated with variation in domestic rice production. Our analysis indicates that if rice production continues to have the same variability that it did in 2003-2007, the volatility in rice prices could be substantially higher under a policy of rice self-sufficiency. This analysis does not take into account storage and it is not known to what degree this would ameliorate the price volatility, but it is clear that self-sufficiency is not an easy solution to the problem of price volatility.

1. INTRODUCTION

Globalization refers to the increasingly close connections between countries through imports, exports, investment, migration, and cultural exchange. The growth in international trade is an important and sometimes controversial component of globalization. Trade in agricultural commodities is a particularly sensitive issue in developing countries for two reasons. First, a large share of the population, and an even larger share of the poor, is involved in farming. For example, according to the 2007 Bhutan Living Standards Survey, 65% of adults in Bhutan say that farming is their primary occupation and another 14% say it is their secondary occupation (NSB, 2008). To the extent that trade influences agricultural prices and farmers are participating in markets, they will be affected by agricultural trade policy.

Second, food represents a large share of household spending in developing countries, particularly among the poor. For example, food represents almost half of consumption expenditure among Bhutanese consumers in general and 59% among the poor (UNDP, 2004). Thus, agricultural trade policy can substantially affect the purchasing power of poor consumers.

Proponents of trade argue that Bhutan (and other countries) should focus on producing and exporting goods for which they have a comparative advantage, meaning goods that the country can produce at a relatively low cost compared to other countries. They point out that international trade occurs naturally if there are no barriers to trade, suggesting that it is in the interests of producers and consumers to export some products and import others. If it is in the interest of producers and consumers to trade, it must be in the interest of the country as a whole to trade. According to trade proponents, these arguments are as valid for agricultural products as they are for other products.

On the other hand, various arguments have been made against international trade, particularly agricultural trade, both in Bhutan and elsewhere:

- that it is a waste of foreign exchange to import goods that the country could grow or produce for itself;
- that imported products compete with local products, pushing the price down and hurting farmers and other producers in the country;
- that when farmers divert land into export crop production, they raise the price of agricultural commodities in the country and contribute to food insecurity by reducing domestic food production; and
- that world markets are volatile and unreliable, particularly as a source of staple foods.

These concerns have gained strength in light of the dramatic spike in world agricultural prices in 2007-2008 and the global financial crisis which began in the second half of 2008.

1.1 *Objectives*

In order to guide policy makers in designing agricultural trade policies, it is necessary to go beyond the listing of abstract arguments for and against agricultural trade and estimate the actual gains and losses associated with international trade. Furthermore, it is important to go beyond a narrow focus on one group of households, such as farmers, and consider the gains and losses to the whole population, including farmers and consumers. In other words, it is necessary to understand and quantify the trade-offs between the interests of farmers and those of consumers. Development models, policy and programs need to be designed to take into account these compromises.

The objective of this report is to explore the existing data on agricultural trade and estimate the gains and losses associated with this trade. More specifically, the report attempts to address the following questions:

- What are the patterns and trends in the production of export crops and import-competing crops?
- What are the costs and benefits to individual farmers from switching from staple food crops to export crops?
- What are the costs and benefits to Bhutan associated with international trade in selected commodities?
- How do these results shed light on various arguments listed above regarding the effect of agricultural trade on income and food security?

1.2 *Data and methods*

The description of patterns and trend in agricultural production and trade is based largely on secondary statistics from the National Statistical Bureau (NSB), the Department of Agricultural Marketing and Co-operatives (DAMC) of the Ministry of Agriculture & Forests (MoAF), and the Revenue and Customs Authority. In a few cases, we use data from the World Bank and the Food and Agriculture Organization (FAO).

The discussion of the costs and benefits of export crop production to farmers is based on a number of value-chain analyses carried out by the MoAF with support from the FAO.

And the analysis of the aggregate costs and benefits of agricultural trade in selected commodities relies on NSB data on production, trade, and prices. This information is used to estimate standard welfare measures (consumer surplus and producer surplus) with simple one-commodity models. The methods used in this analysis are described in more detail in section 4.1.

2. TRENDS IN THE RENEWABLE NATURAL RESOURCE SECTOR

The renewable natural resource (RNR) sector is composed of agriculture (crop production), livestock, and forestry. However, in this report, we focus on crop production, particularly the main export crops (oranges, potatoes, apples, and cardamom) and the main crops that compete with imports (rice).

2.1 *Role of the RNR sector in the overall economy*

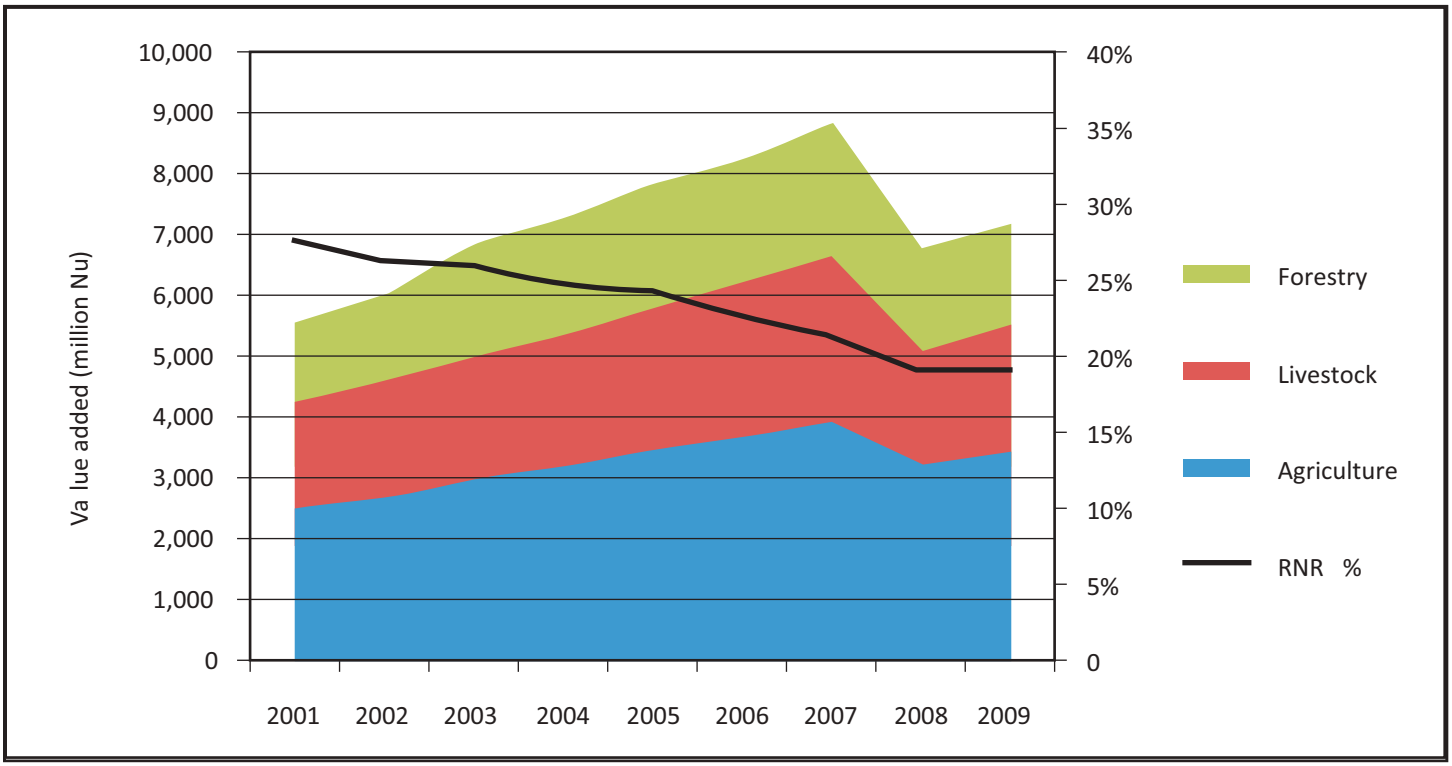
The RNR sector plays an important role in achieving Gross National Happiness. As mentioned above, agriculture is the main or secondary occupation of almost 80% of the adults in Bhutan. Furthermore, the RNR sector supplies the vast majority of the food consumed in the country.

Although a large proportion of the population earns its living from the RNR sector, this sector contributes barely more than one-fifth of the gross domestic product. This disparity reflects the fact that the productivity per person (and therefore income per person) in agriculture is much lower than in other sectors.

The share of the RNR sector in GDP has declined from 28% in 2000 to 19% in 2008 (see Figure 1). This does not imply stagnation in the sector; in fact, the value of output in the RNR sector has increased at 8% per year. However, the rest of the economy has grown even more rapidly, leading to a declining contribution of the RNR sector to the total. The Government's RNR sector strategy has always been a central feature of the Five Year Plans (FYP), especially since the 9th FYP.

Of the RNR sectors, the largest contributor to the country's GDP has always been agriculture, followed by the livestock and forestry sectors. Agriculture accounts for almost half of the total for the RNR sector.

Figure 1. Contribution of Renewable Natural Resource sectors to GDP



Source: NSB, 2009.

Agricultural land in Bhutan covers only 7.8 percent of the country. Available land is under increasing competition with urbanization. Subsistence agriculture is not intensive, using few inputs and obtaining low yields, which exacerbates land scarcity issues. Other constraints to growth include declining farm labour as a result of rural-urban migration, depredation of crops by wildlife, and lack of economic infrastructure.

The livestock sector has grown rapidly in recent years, according to available statistics. The value of livestock production grew at an annual rate of 11% over 2000-2005 and at an annual rate of 29% from 2006-2008. The growth in the demand for animal products is probably a response to rising income in Bhutan. The most important animal products are cheese, butter, and eggs, which account for 81% of the total value. The demand for meat is relatively modest, which may be a reflection of the religious beliefs and sentiments of the Bhutanese people and the social stigma attached to the slaughter of animals.

Forestry sector is important for the rural poor in terms of fodder, fuel wood, and building material. Three-quarters of Bhutan is covered in forests, although this sector contributes the least to GDP amongst the three RNR sectors. Forestry contributes to GDP mainly through the value of timber resources extracted. GDP calculations do not include indirect benefits from standing forests in terms of protection and maintenance of soil and water regimes. Ironically, there is a conflict between maximizing forestry GDP and preserving the environment with its indirect positive effects on downstream water quality and agricultural productivity. This highlights the limitations of GDP as a social objective and the value in using broader concepts of welfare such as Gross National Happiness.

2.2 *Trends in cereal crop production*

Rice is the main staple food in Bhutan. As shown in Table 1, paddy production has increased erratically from 69 thousand tonnes in 2000 to 77 thousand tonnes in 2008. Although rice production has grown at

an average annual rate of 1.5% over 2000-2008, production is volatile and the growth rate varies widely depending on the starting and ending year chosen. For example, over the period 1999-2008 the annual growth rate was 6.6%. According to the 2000 Agricultural Census, paddy is grown by 58% of farm households and in 193 of the 202 geogs. As discussed in more detail below, domestic production of rice has not been able to meet the demand, and rice imports have been in the range of 33-54 thousand tonnes per year. Some rice (5-10 thousand tonnes) is imported by the Food Corporation of Bhutan (FCB) and sold through FCB fair-price shops. However, most of the rice is imported from India by private traders (MoA/FAO, 2006d).

Maize is somewhat less important in the diet of Bhutanese consumers, but by some measures it is at least as important as paddy to Bhutanese farmers. Maize production was similar to paddy production in 1999-2000, but has declined at an average rate of 1.8% per year since 2000. Maize production is now around 67 thousand tonnes. Maize is cultivated in all 20 dzongkhags and in 190 of the 202 geogs, although the volume of maize production is greater in eastern Bhutan. International trade in maize is negligible: net imports are less than 300 tonnes (MoA/FAO, 2006b).

Wheat, barley, buckwheat, millet, and other cereals are also grown in Bhutan, though they account for barely 10% of national cereal production. As discussed below, Bhutan imports around 12 thousand tonnes of wheat and wheat flour.

Table 1. Trends in cereal production (thousand tonnes), 2000-2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth
Paddy	68.6	-	37.9	45.8	54.3	67.6	74.4	74.4	77.3	1.5%
Maize	77.3	-	41.7	49.7	90.6	94.0	71.1	61.8	66.8	-1.8%
Wheat	4.4	-	4.6	4.7	4.2	11.2	9.6	8.9	5.6	3.2%
Other	8.4	-	6.8	6.1	6.3	18.2	13.4	21.7	12.2	4.8%
All cereals	158.7	-	91.0	106.3	155.4	191.0	168.4	166.8	161.9	0.2%

Source : PPD, MoAF.

2.3 *Trends in selected non-cereal crop production*

Due to the hilly and mountainous terrain in much of Bhutan, there is limited scope for increasing the area for cultivation. Slash and burn cultivation is discouraged for environmental reasons. As an alternative, the Royal Government of Bhutan is focusing on diversification into horticulture and other high-value crops. The 10th Five Year Plan (FYP) calls for a 300% increase in horticultural production.

Production of oilseeds, particularly mustard seed, has doubled since 2000, equivalent to an average annual growth of 8% (see Table 2). Local production of vegetable oil competes with large quantities of imported vegetable oil. According to FAO data, vegetable oil imports in 2004 were almost equal in value to rice imports.

The major vegetable crops cultivated are chili, radish, turnip, potatoes, ginger, beans, broccoli, cabbage, and various types of leafy greens. According to MoAF statistics, the volume of vegetable production has grown at an average annual rate of 37% over 2000-2008 (see Table 2).

Potato production is expanding in the high-altitude areas in areas that used to be used for growing buckwheat and wheat. The national average yield of potato is 9.5 tonnes/hectare (RNR Census, 2009). In most parts of the country, potato is grown as a cash crop, serving both the urban market in Bhutan and export markets. The domestic demand for potatoes is rising due to population growth, urbanization, and the growth in the number of hotels and restaurants (MoA/FAO, 2006b). Bhutan produces more than 50 thousand tonnes of potatoes per year. More than one-quarter of this is exported, making potatoes the second-most valuable agricultural export.

Similarly, some of the southern slopes, where people used to practice slash and burn system for growing maize and millets, have been converted to citrus orchards. The main citrus crop grown in Bhutan is the mandarin (*Citrus reticulate* Blanco), locally known as oranges. Oranges are an important source of livelihood, particularly in southern Bhutan. In recent years, orange production has been around 38-43 thousand tonnes (see Table 2). They are also the leading agricultural export in value terms (MoA/FAO, 2006a).

Apple production is considerably smaller (5-10 thousand tonnes per year), and its production is concentrated in the mid-latitudes. Nonetheless, apples are the third most important agricultural export of Bhutan.

Although the production of horticultural crops, spices, and oilseeds have grown at a healthy rate in Bhutan, production of these crops face a number of constraints. Dispersed production and poor infrastructure make it costly to market these products, a particularly important issue for perishable crops. Furthermore, rising labour costs in Bhutan threaten the cost-competitiveness of these crops, particularly the more labour-intensive ones. In addition, there is a shortage of horticultural expertise and specialized marketing infrastructure (MoA/FAO, 2006a).

Table 2. Production of selected non-cereal crops (thousand tonnes), 2000-2007

Commodities	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth
Oil seeds	2.3	NA	3.1	3.7	2.8	6.0	4.6	4.7	4.3	8.1%
Spices	2.5	NA	NA	0.7	7.4	6.7	7.4	7.5	15.2	25.3%
Vegetables	2.2	8.0	NA	6.1	5.2	13.9	10.0	10.2	26.9	36.7%
Potato	35.0	NA	31.5	40.5	47.4	52.2	52.3	53.2	53.0	5.3%
Orange	29.6	NA	37.3	36.3	31.9	47.9	41.9	42.6	38.2	3.2%
Apple	5.1	10.0	7.4	5.7	5.9	10.4	8.6	8.7	5.4	0.7%

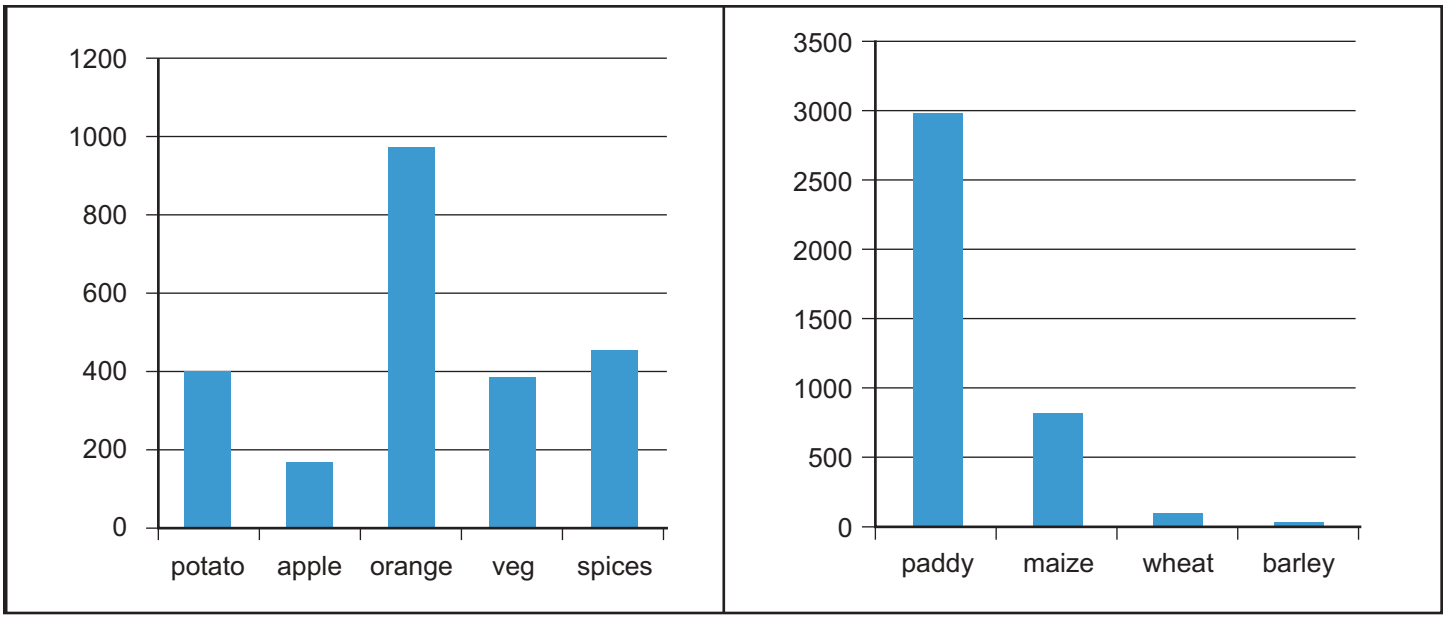
Source : 2000-2007 from the RNR Compendium, PPD, MoAF, Thimphu, Bhutan and 2008 data from the RNR Census 2009.

2.4 *Comparing the value of crop production*

Figure 2 shows the importance of cereal and non-cereal crops in value terms. Among the cereals, it is worth noting that the value of rice production is more than double the value of maize production. Although the volume of maize production is greater, the per-kilogram value of rice is three times greater than that of maize. Data from the RNR Census, 2009 indicate that the average price of rice in 2008 was 39 Nu/kg. With regard to horticulture,

although potato is the most important crop in volume terms, orange is significantly more important in value terms as a result of its higher per-kilogram value.

Figure 2. Value of cereal and horticultural crop production in 2008 (thousand Nu)



Source: RNR Census, 2009.
Note: There is no value of sale from maize in the RNR Census 2009, therefore for the anaylsis, price of maize has been taken as Nu. 12/kg.

The rapid growth in the production of oilseeds, spices, fruits, and vegetables contrasts with the relatively slow growth in cereals production. Part of the explanation is that as consumer income rises, the share of spending allocated to basic staples declines, while the proportion spent on animal products, fruits, vegetables, and processed goods tends to rise. In addition, rising incomes in India and Bangladesh create a demand for Bhutanese horticultural products, such as oranges, potatoes, and apples. The rising demand for these high-value commodities is transmitted to farmers in the form of remunerative prices.

This does not necessarily mean that the prices of horticultural commodities are higher than those of cereals. As shown in Table 3, the price of rice is currently higher than the price of oranges and potatoes. Rather, it means that the rising demand makes these horticultural crops more profitable. The table shows that the returns to land are significantly higher for orange and potatoes than for cereal crops. The picture regarding the returns to labour are less clear. Orange offers the highest returns per hour of labour input, while potatoes offer the lowest. However, in the case of potatoes, it is compensated by higher returns to land and low production cost.

Of course, farmers do not select their crops solely on the basis of the returns to land or labour. They give high priority to meeting a certain proportion of their food needs first by growing maize, paddy, or other cereals for own consumption. For farmers who have enough land and a tolerance for a certain degree of risk, however, the returns to horticulture and other commercial crops are attractive. These factors have contributed to the rapid growth in oilseeds and horticultural crops.

Table 3. Cost benefit analysis of growing cereals as compared to export crops

	Commodities			
	Rice	Maize	Potato	Orange
Retail price in 2007 (Nu/kg)	30.3	9.5	10.5	24.6
Cost of production (Nu/kg)	4.87	6.4	4.8	3.0
Returns to land (Nu/acre)	35,147	7,918	52,766	97,350
Returns to family labour (Nu/day)	163	196	140	256

Source: Retail price from DAMC, MoAF.
Cost of production and returns from MoA/FAO, 2006a, 2006b, 2006c, and 2006d.

2.5 *Trends in livestock production*

Livestock is an integral part in all Bhutanese farming systems. In addition to generating animal products, livestock contribute to crop production through manure and draught power. The large variations in the environmental conditions has led to a range of livestock production systems, ranging from the high-altitude transhumance yak-sheep system to systems where animals are used primarily for draft and manure only.

Cattle are by far the most numerous of the total ruminant population. Improved breeds introduced into the country are Jersey, Brown Swiss and mithun (*Bos frontalis*), but local native cattle account for more than three-quarters of the cattle population, according to the 2006 Agricultural Census.

Livestock products include dairy products, meat, wool and eggs. Over the past 9 years, the production of pork, chicken and mutton has increased by 13-25% per year, whereas the production of beef has declined in volume terms (see Table 4). According to the 2009 RNR Census, butter production has the highest value among the animal products, followed by cheese and eggs. These three animal products account for 75% of the value of livestock production, with milk representing 13% and meat representing 11% of the remaining 25%.

Table 4. Livestock production (thousand tonnes) from 2000 to 2008

Products	2000	2005	2006	2007	2008	Annual growth
Butter	1,316	1,553	1,309	1,394	1,348	0.3%
Cheese	2,173	4,791	6,651	6,164	4,463	9.4%
Beef	1410	548	583	638	776	-7.2%
Pork	187	1,649	536	507	500	13.1%
Chicken	36	55	174	515	190	23.1%
Mutton	21	151	94	239	128	25.3%
Eggs (thousand dozen)	5,718	5,397	6,093	9,630	8,168	4.6%

Source: 2000 & 2005 data from PPD, MoAF & 2006-2008 data from Livestock Statistics, Department of Livestock, MoAF, Thimphu, Bhutan.

3. PATTERNS AND TRENDS IN AGRICULTURAL TRADE

3.1 *Agricultural exports*

This section describes the patterns and trends in agricultural exports. It is divided into three sub-sections, which describe the composition of food and agricultural exports, trends in agricultural exports over the past decade, and the geographic patterns of export crop production in Bhutan.

Composition of food and agricultural exports

Bhutan exports Nu 22.6 billion of goods and services, equivalent to US$ 480 million or €329 million. Exports are expanding rapidly, the average annual growth rate over 2005-2008 being 28%. The main export is electricity, which accounts for about half of the total. Other exports include ferro-silicon, calcium carbide, metal products, cement, and palm oil. Bhutan's main export partner is India, accounting for 95% of the total value, followed by Bangladesh (DRC, 2009).

Food and agricultural exports are worth Nu 1.7 billion (see Table 5). The largest export in this category is oils and fat, primarily refined palm oil. Bhutan imports crude palm oil from Southeast Asia, refines it, and exports the product to India. This trade is based on the differences between tariff rates in Bhutan and India: Bhutanese palm oil refiners can import crude palm oil duty free, while India imposes no tariff on palm oil from Bhutan (as a member of the South Asian Association for Regional Cooperation) but it imposes high tariffs on oil from Southeast Asia. Press reports in 2008 suggested that India would eliminate the import duty on cooking oil, which could endanger the profitability of this trade (Kuensel Online, 2008).

As shown in Table 5, Bhutan also earns significant revenue from the export of fruit juice and other beverages to India. The other beverages consist mainly of non-alcoholic sweetened drinks. Cordyseps exports have grown dramatically. In 2005, trade statistics did not even record their existence, but in 2008 exports were Nu 118 million. Cordyceps are exported to Hong Kong and, to a lesser extent, China and Singapore. Among the agricultural commodities, the most important exports are oranges, potatoes, and apples.

Table 5. Summary of food and agricultural exports

	2005	2007
Potatoes	120	120
Oranges	240	246
Apples	80	60
Cordyceps	0	118
Juice	99	149
Other beverages	255	120
Oils & fat	225	607
Other	268	316
Total	1288	1737

Source: Department of Revenue & Customs, Ministry of Finance, Thimphu, Bhutan, Statistical publication of 2006 and 2009.

Trends in agricultural exports

Turning our attention to trends in the export of agricultural commodities, the volume of exports are shown in Table 6. Bhutan exports 30-50 thousand tonnes of agricultural products per year. Of this, oranges and potatoes account for a large majority of the volume. Apple exports have increased dramatically over the period 2000 to 2008, rising at an average rate of 16% per year. Annual growth in orange and potato exports is lower (8% and 4%, respectively), but still respectable. The volume of vegetable exports, consisting mainly of cabbage, peas, carrots, and turnips, has declined by about 8% per year over 2000-2008. The volume of spice exports has also declined by about 5% per year over this period.

Table 6. Volume of agricultural exports (metric tonnes), 2000-2008

Products	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth
Apples	1,470	3,355	3,304	4,842	3,123	5,264	5,389	3,211	4,947	16.4%
Oranges	11,301	18,202	18,280	14,524	19,574	19,274	16,391	17,093	20,346	7.6%
Potatoes	11,356	20,539	14,180	17,911	17,662	17,542	13,730	14,397	14,954	3.5%
Vegetables	4,192	2,791	418	225	962	697	340	2,164	2,221	-7.6%
Spices	1,090	1,095	1,293	1,038	1,153	1,335	1,086	436	736	-4.8%
Total	29,587	46,057	37,527	46,537	42,562	49,091	37,039	37,301	43,205	4.8%

Source: Department of Agricultural Marketing & Co-operatives, MoAF.
Note: These figures have been compiled by DAMC from the Trade Statistical Yearbook.

The value of agricultural exports (shown in Table 7 and Figure 3) has ranged from as low as Nu 16 million to as high as Nu.246 million in recent years. The average growth rate in the value of agricultural exports over 2000-2008 has been 9%, although most of this growth occurred between 2000 and 2001. Oranges are the most valuable agricultural export, worth around Nu 246 million. The value of orange exports has increased at 11% per year over 2000-2008. This is almost twice the growth rate in the volume of orange exports, indicating that the average value per ton has increased significantly over time. The bulk of the orange exports are sold to Bangladesh, with India accounting for almost all the remainder.

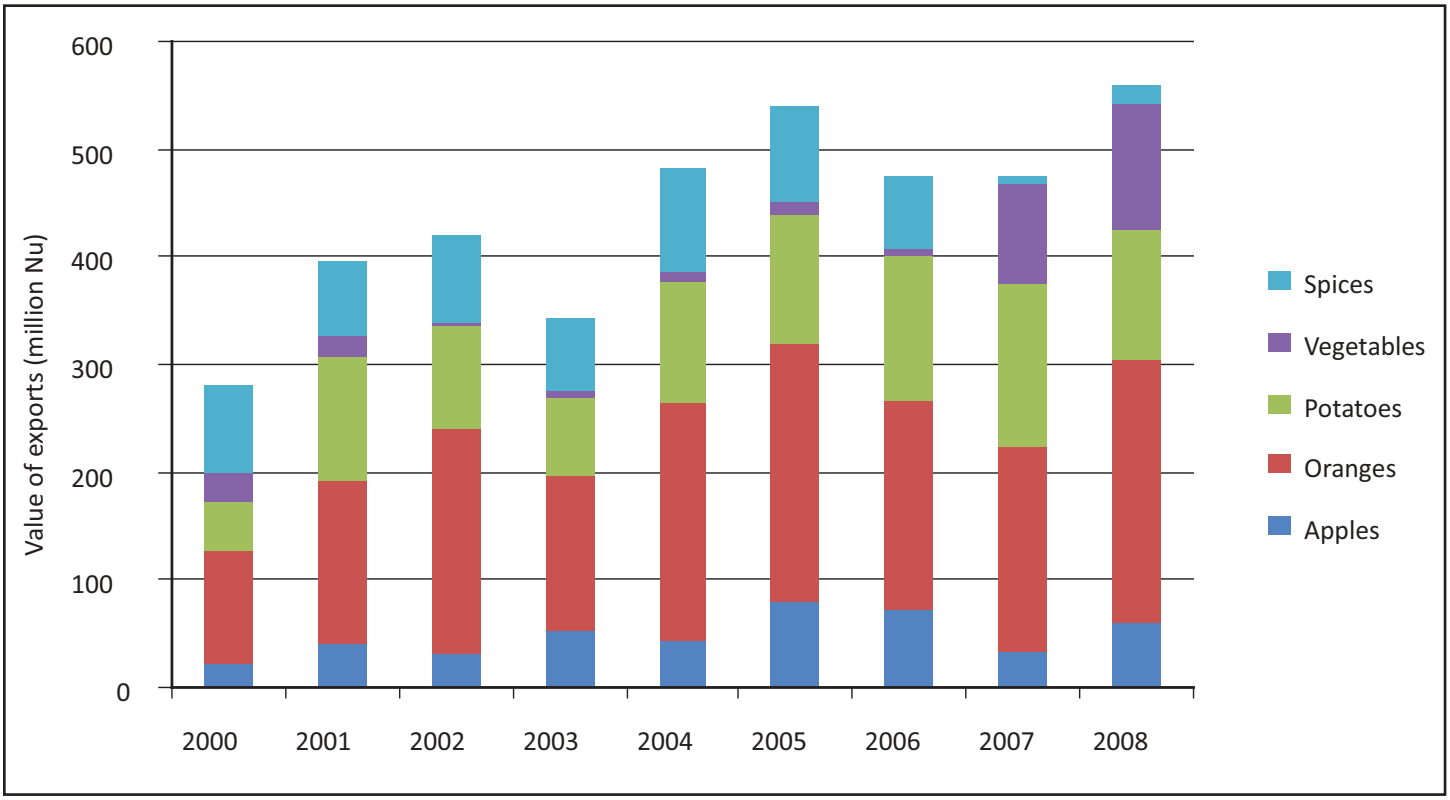
Table 7. Value of agricultural exports (Nu Million), 2000-2008

Products	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth
Apples	22	41	32	53	44	80	71	33	60	13.3%
Oranges	105	152	207	143	220	240	195	191	246	11.2%
Potatoes	47	115	97	72	113	120	136	150	120	12.4%
Vegetables	26	19	3	9	9	12	6	94	116	20.8%
Spices	82	69	82	66	96	87	67	7	17	-18.0%
Total	286	402	425	411	486	587	476	475	559	8.8%

Source: Department of Agricultural Marketing & Co-operatives, MoAF.
Note: These figures have been compiled by DAMC from the Trade Statistical Yearbook.

Potatoes are the second-most valuable agricultural exports, earning over Nu 119 million in recent years. The value of potato exports has grown at an average rate of 12% per year, a rate that also suggests that the unit value of potato exports has risen significantly over this period. India is the main market for potatoes from Bhutan. The larger potatoes are sold as table potatoes, while the small ones are sold as seed.

Figure 3. Value of agricultural exports (million Nu)



Source: Department of Agricultural Marketing & Co-operatives, Ministry of Agriculture & Forests.

Vegetables tied for third place in terms of the value of agricultural exports, earning about Nu 116 million per year. Apples stands next earning about Nu 60 million per year. Until 2006, spices accounted for just 3% of the volume of agricultural exports but 14% of the value of agricultural exports. This scenario has changed recently with the production and export of spices declining. The main decline occurred between 2007 and 2008. The main spices exported by Bhutan are cardamom, ginger, and dried powdered chilies. Cardamom represents the bulk of export value of spices, though its exports have declined since 2004 due to disease.

Estimates of the share of production that is exported are presented in Table 8. In recent years, over half of the apples output of Bhutan have been exported, the share being 91% in 2008. In the case of oranges and potatoes, between one-third and one-half of production is exported[1]. The export share for potatoes has declined from 32% in 2000 to 28% in 2008, as a result of growth in production but stagnant export volumes with competition from the low priced potatoes of India. In the case of spices and vegetables, exports represent only a small share (less than 8%) of total production.

[1] A recent study stated that 80% of orange production is exported, but the production and export figures in the cited table are consistent with the lower percentages given here (MoA/FAO, 2006).

Table 8. Share of production that is exported over 2000-2008

Commodities	2000	2001	2002	2003	2004	2005	2006	2007	2008
Apples	29%	34%	45%	85%	53%	51%	63%	37%	91%
Oranges	38%	NA	49%	40%	61%	40%	39%	40%	53%
Potatoes	32%	NA	45%	44%	37%	34%	26%	27%	28%
Vegetables	191%	35%	NA	4%	19%	5%	3%	21%	8%
Spices	44%	NA	NA	148%	16%	20%	15%	6%	5%

Source: Production estimates from PPD (AgCensus 2000, RNR Sample Surveys & RNR Census 2009) and export estimates from the DAMC, MoAF.

Geographic patterns in agricultural exports

One of the concerns about agricultural exports crops is that they may displace the production of staple food crops and endanger food security. For this reason, it is worth examining the area allocated to export crop production. In particular, data from the 2009 RNR Census are used to examine the percentage of crop land allocated to the four main agricultural exports: oranges, potatoes, apples, and cardamom. Crop land is defined as the area used for the production of annual crops and tree crops[2].

At the national level, the Census data suggest that 4.5% of the crop land is allocated to orange production, 6% to potato production, 1% to apples production, and 2% to cardamom production. Thus, 13% of the all crop land is used for the production of the four main export crops (see Table 9).

At the dzongkhags level, the share of land allocated to these four export crops varies widely. Orange production accounts for more than 14% of the crop land in the Pemagatshel, 10% in Zhemgang and more than 7% Sarpang, Chhukha, and Dagana, but most dzongkhags have little or no orange production. All five of the dzongkhags with widespread orange production lie on or near the southern border, where the lower altitude provides the sub-tropical climate needed for orange production (see Table 9 and Figure 4).

Potato production represents almost 29% of the crop area in Bumthang, almost 17% in Wangdue, and 10-14% in Thimphu, Ha, and Paro. Given the cooler climate required for potato production, it is not surprising that these dzongkhags are mostly located in the north.

Apple orchards account for more than 23% of the crop area in Thimphu and 12% in Paro. These two dzongkhags represent more than 80% of apple production in Bhutan. In all the other dzongkhags, apple orchards represent less than 4% of the crop area (see Table 9).

Cardamom production is concentrated in Samtse and Chukha. The dzongkhag with the largest proportion of crop land in cardamom is Samtse (10%) followed by Ha (7.3%). Chhukha and Dagana each have 3-5% of the crop land allocated to cardamom production. Most of the other dzongkhags report very little or no cardamom production.

The four export crops account for the largest share of crop land in Thimphu (37%) and Bumthang (31%), followed by Paro, Ha, and Pemagatshel (20-23%). In Ha and Bumthang, the high percentages are largely due to the effect of potatoes, while in Pemagatschel it is mainly orange production. Thimphu and Paro have high shares in export crops due to the combined effects of potato and apple production. At the other end of the spectrum, Punakha, Trongsa, and Lheuntse have the smallest share of crop area in these export crops, less than 7% (see Table 9).

[2] The RNR Census 2009 collected information on the total number of fruit trees and the number of bearing trees, but not the area. We have estimated the area allocated to orange and apple production based the total number of trees and the assumption of 112 trees per acre.

Table 9. Share of crop area allocated to the four main export crops, 2008

	Percentage of total crop area				
Dzongkhag	Orange	Potato	Apple	Cardamom	Total
Thimphu	0.0	13.9	23.4	0.0	37.3
Paro	0.0	10.8	12.0	0.0	22.9
Ha	0.5	11.7	3.5	7.1	22.8
Chhukha	8.0	6.4	0.3	4.2	19.0
Samtse	3.1	1.4	0.0	10.3	14.8
Punakha	2.0	1.6	0.0	0.0	3.6
Gasa	0.0	7.6	0.2	0.0	7.8
Wangdue	0.6	16.7	0.1	0.0	17.4
Tsirang	6.7	2.8	0.0	0.3	9.9
Dagana	7.5	2.0	0.0	2.8	12.3
Bumthang	0.0	28.7	2.0	0.0	30.7
Trongsa	0.6	3.8	0.0	0.3	4.7
Zhemgang	10.0	3.2	0.0	0.1	13.2
Sarpang	8.0	1.5	0.0	0.4	9.9
Lhuentse	0.6	6.2	0.0	0.0	6.8
Mongar	1.1	6.4	0.0	0.0	7.6
Trashigang	0.6	9.0	0.0	0.0	9.7
Trashiyangtse	0.8	7.1	0.0	0.1	8.0
Pemagatshel	14.5	5.5	0.0	0.1	20.2
Samdrup Jongkhar	5.8	3.0	0.0	0.3	9.0
Total	4.5	5.7	0.9	2.0	13.0

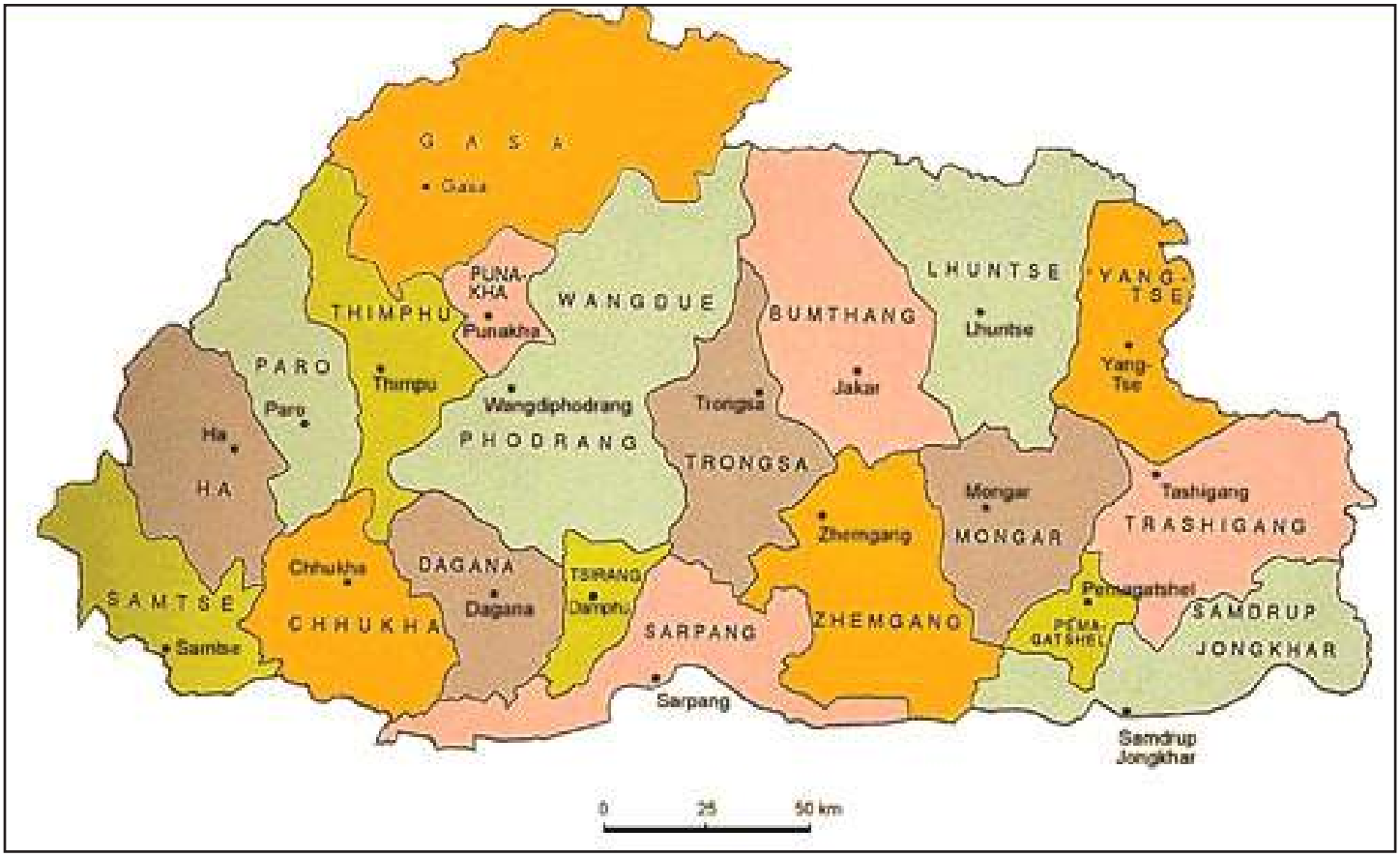
Source: Analysis of data from the RNR Census 2009, PPD, MoAF, Thimphu, Bhutan.

The geog-level patterns of export crop production are presented in the form of maps rather than tables. The share of crop land in orange production is shown in Figure 5. The darkest shade indicates geogs with more than 10% of the crop area in orange production. The geogs with the largest share of crop land in oranges are Chokhorling (Pemagatshel) and Nglangla and Goshing (both in Zhemgang), with more than 20% of the crop land devoted to orange production. Among the other geogs with more than 10% of the land in oranges, most are in Zhemgang, Pemagatshel, Dagana, Chhukha, and Sarpang, which are on or near the southern border. Most of the geogs in the center and north of the country have less than 1% of crop land in oranges, as indicated by the lightest shade in the map. Thirty-two geogs reported not having any orange bearing trees in their geogs.

The pattern of potato production is quite different, as shown in Figure 6. Potato production is found primarily in the northern half of the country, particularly in the northeast, north central, and the east. The geogs with the highest share of crop land in potatoes are Phobki (Wangdue), Chapcha (Chukha), Gangte (Wangdue), and Ura (Bumthang), each with more than 40% of the area in potatoes. Almost all geogs report at least some potato production.

Apple production is concentrated in Thimphu and Paro, as shown in Figure 7. The geogs with the highest share of crop land in apple production are Chang (Thimphu), Mewang (Thimphu), and Dopshari (Paro), with more than 20%. Sixty-seven geogs reported not having any apple bearing trees in their geogs.

Figure 4. Map of Dzongkhags in Bhutan



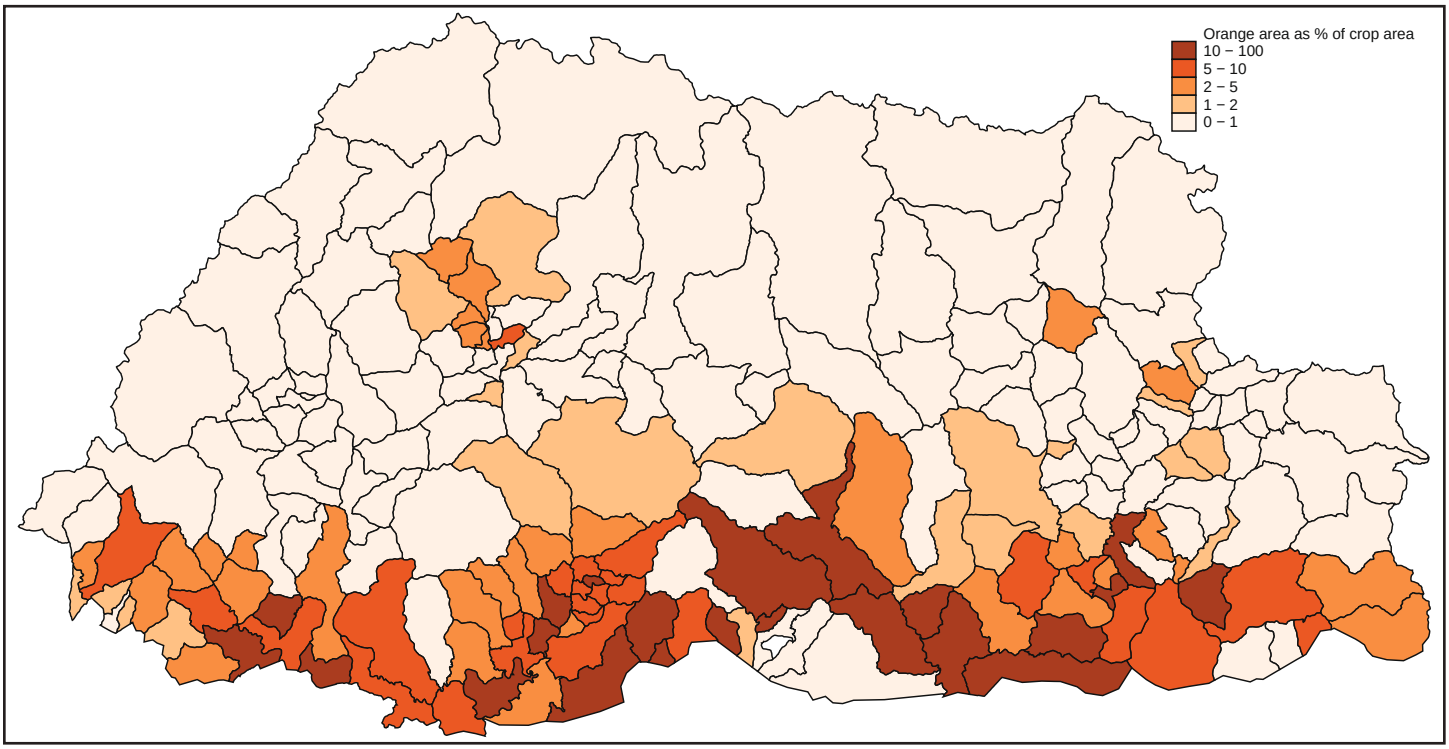
Source: RGB, 2009.

As shown in Figure 8, most of the cardamom production is concentrated in the southwest of Bhutan. The geogs with the highest proportion of crop land in cardamom are Bangra and Tendruk in Samtse and Sangbay in Ha, all of which allocated more than 20% of the area to cardamom production. The other geogs with some allocation of land in cardamom production are situated in Chukha, Samtse, Dagana and Sarpang dzongkhags. Ninety-five geogs reported producing no cardamom at all.

The proportion of farm land allocated to all four export crops is shown in Figure 9. In this map, the scale has changed so that the darkest shade of grey now refers to geogs with more than 40% of the crop area in the four export crops. Geogs falling into this category are Chang and Mewang (Thimphu), Phobji and Gangte (Wandue), Chapcha (Chukha), Bangra (Samtse), and Ura (Bumthang). The two geogs in Thimphu are on the list because of the large proportion of crop land allocated to apple production, while Bangra (Samtse) is dominated by cardamom production. The other four are on the list because of the large share of land planted with potatoes.

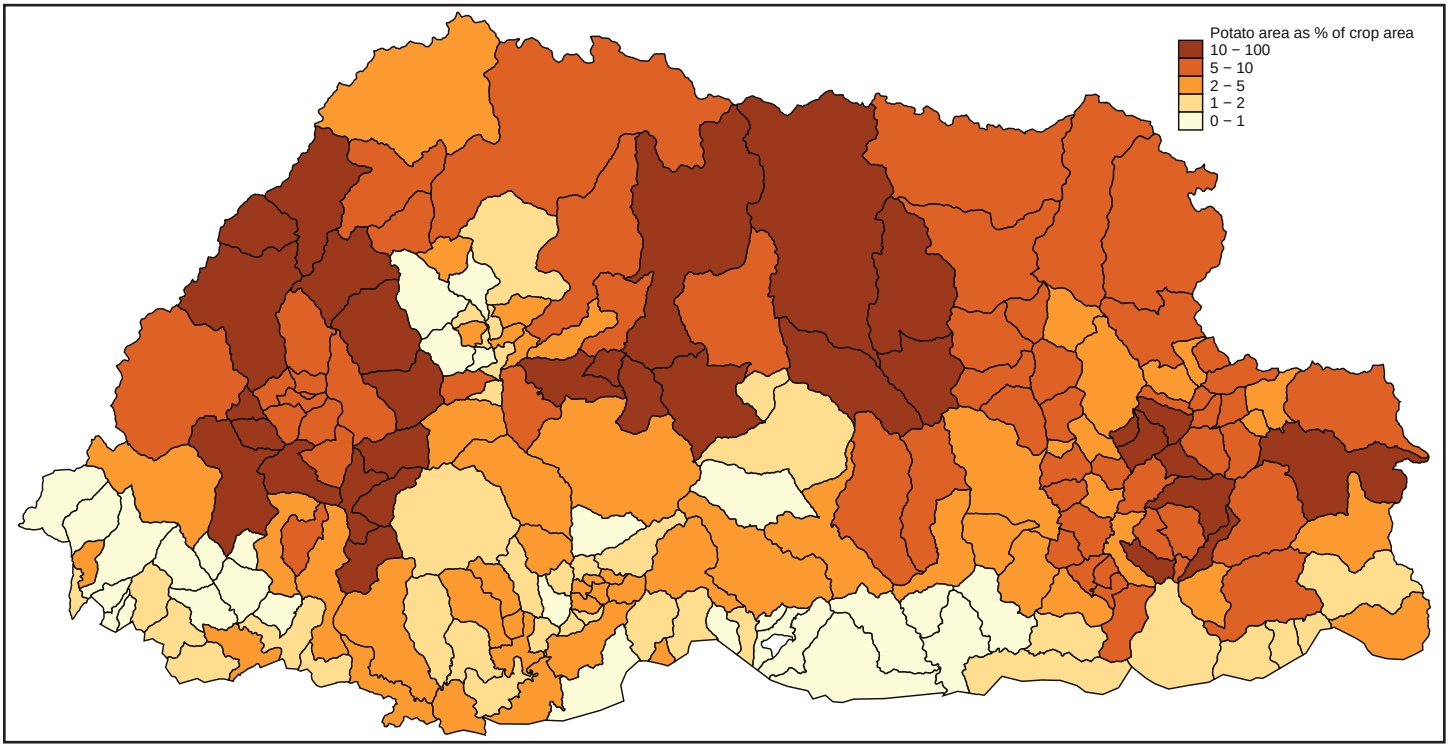
In another 34 geogs, the share of these four export crops in total crop area ranges between 20% and 39%. At the other extreme, more than half (108) of the geogs have less than 10% of the crop area in export crops. As can be seen in Figure 9, the central west region and the east seem to have a relatively low share of land in export crops, but in general Bhutan does not have a specific area that is specialized in export crop production; rather production of different export crops is scattered throughout the country.

Figure 5. Map of the share of crop land in orange production



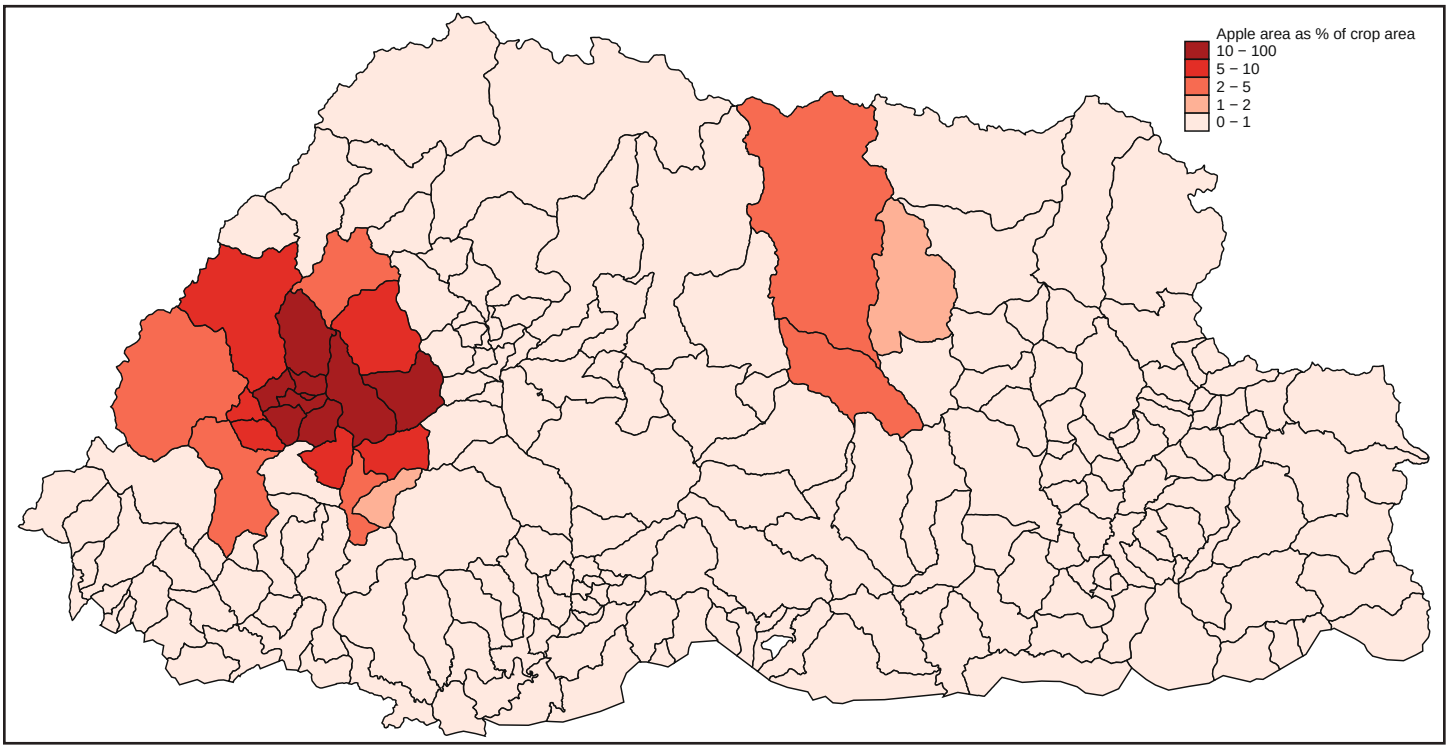
Source: Analysis of data from the RNR Census 2009.

Figure 6. Map of the share of crop land in potato production



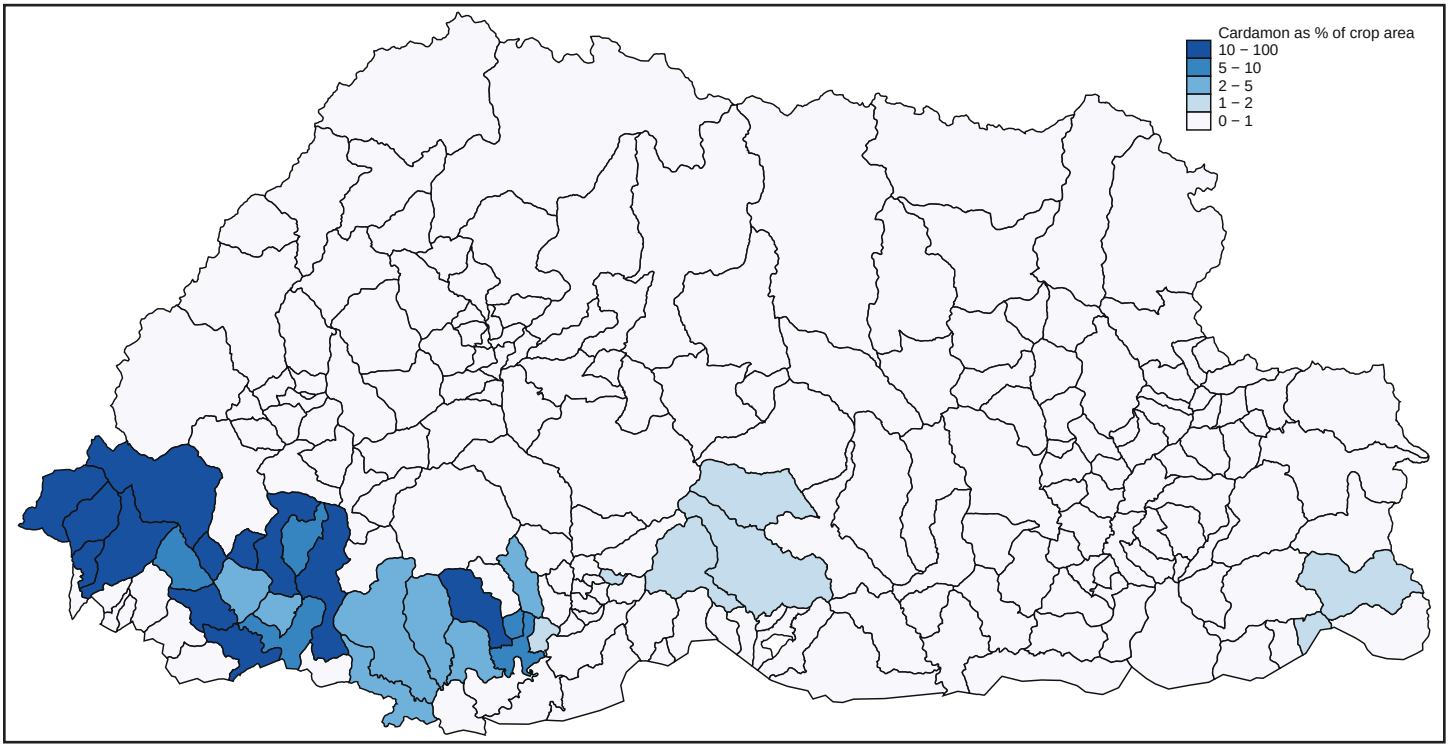
Source: Analysis of data from the RNR Census 2009.

Figure 7. Map of the share of crop land in apple production



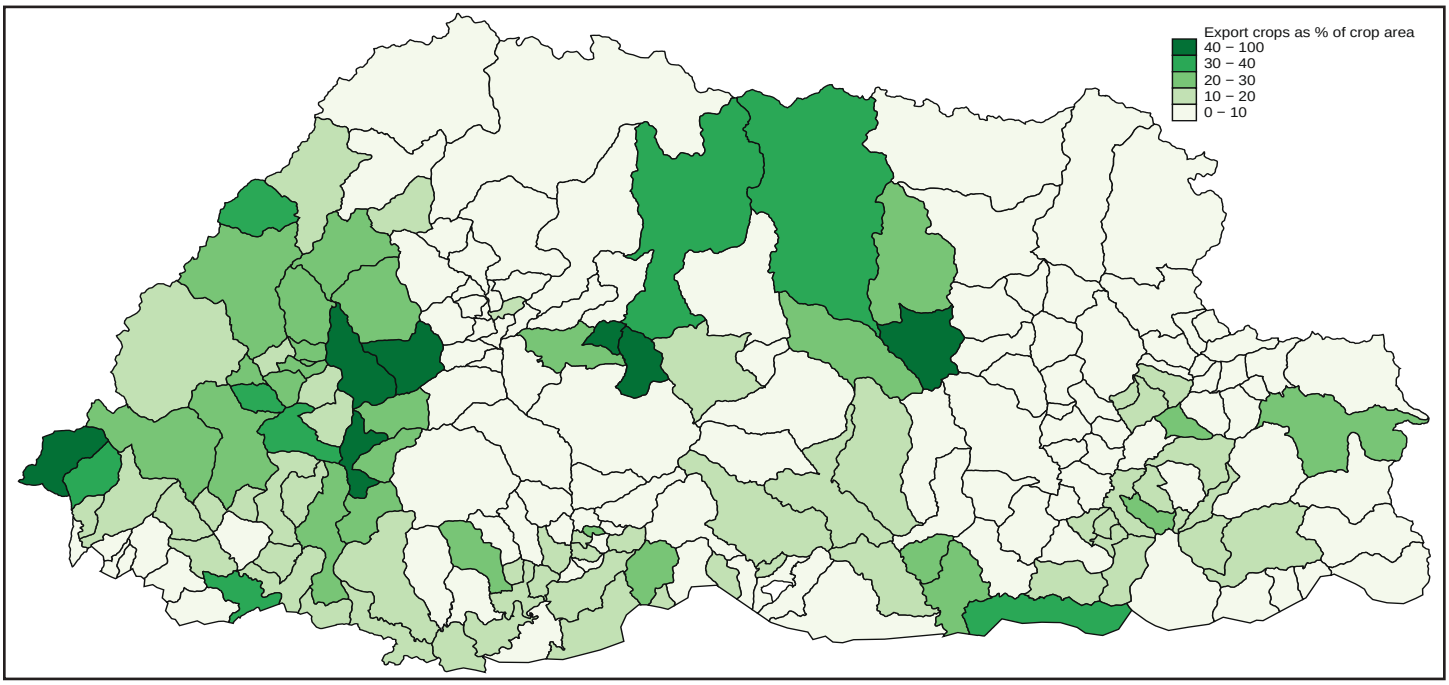
Source: Analysis of data from the RNR Census 2009.

Figure 8. Map of the share of crop land in cardamom production



Source: Analysis of data from the RNR Census 2009.

Figure 9. Map of the share of crop land in the four main export crops



Source : Analysis of data from RNR Census 2009.

3.2 *Agricultural imports*

This section describes the patterns and trends in agricultural imports. It is divided into two sub-sections: the composition of food and agricultural imports and the trends in agricultural imports.

Composition of food and agricultural imports

The value of total imports is Nu 23.5 billion, equivalent to €342 million or US$500 million. Imports are growing but in recent years, they have grown more slowly than exports, so that the trade deficit in 2008 is less than 4% of exports. The main imported items are fuel and lubricants, vehicles, rice, minerals, and crude palm oil. Bhutan's main import partner is India, which supplies 74% of the total, followed by Japan, Singapore, and China (DRC, 2009).

Food and agricultural imports were Nu 3.85 billion in 2008, up from Nu 2.5 billion in 2005 (see Table 10). The largest import items in this category is cooking oil and fats, which includes cooking oil for local consumption and imports of crude palm oil to be refined and re-exported to India. The second-largest item is rice, which is imported from India, both by the Food Corporation of India (FCB) and by private traders. The third-largest import in this category is beverages, which consists mainly of beer and other alcoholic beverages. Other important food and agricultural imports are meat, powdered milk, sugar, fruits and vegetables, and cheese.

Focusing now on agricultural commodities, over 2000-2008, the volume of imports has ranged from 27 thousand metric tonnes to almost 94 thousand tonnes (see Table 11). In 2008, Bhutan imported 65 thousand tonnes of agricultural commodities, of which rice accounted for 52 thousand tonnes. In normal years, 6-7 thousand tonnes of rice are imported by the Food Corporation of Bhutan (FCB), for distribution in its network of fair price shops. The bulk of rice imports, however, are carried out by private importers who sell to wholesalers and retailers in Bhutan (MoA/FAO, 2006d). Given that paddy production in 2008 was 77 thousand tonnes, equivalent to about 50 thousand tonnes of milled rice, the self-sufficiency ratio (the proportion of Bhutan's rice consumption that comes from local production) in 2008 stands at 50% in 2008.

Table 10. Summary of food and agricultural imports

	2005	2008
	(million Nu)	
Rice	420	694
Wheat	77	21
Other cereals	26	40
Fruits & vegetables	123	180
Meat	181	266
Butter	34	39
Cheese	45	104
Powdered milk	150	236
Other animal products	94	47
Cooking oil & fats	322	966
Sugar	191	186
Beverages	410	382
Other prepared food	442	688
Total	2,514	3,850

Source: DRC, 2006 and 2009.

Bhutan also imports about 8 thousand tonnes of vegetables, primarily tomatoes, onions/shallots, cabbage, and fresh chilies. It is interesting to note that cabbage is one of the more important vegetable imports, as well as being the largest vegetable export. Over the last five years, cabbage imports have increased to over 1000 tonnes, while exports have declined to barely 200 tonnes. The simultaneous import and export of cabbage and other vegetables is related to seasonal patterns, in which Bhutan exports during its harvest season and imports during the off-season.

Trends in agricultural imports

Table 11 also shows that agricultural imports have been growing rapidly over the last decade. Imports of fruits, vegetables, and spices have increased by 8%-14% per year, while rice imports have grown by 6% per year.

Table 11. Volume of agricultural imports (metric tonnes), 2000-2008

Products	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth (%)
Rice	33,691	37,443	39,123	54,926	-	45,224	52,113	46,526	52,163	6%
Wheat	8,904	11,331	18,999	31,402	17,459	10,801	10,366	8,656	-	0%
Fruit	952	1,201	1,115	1,923	1,789	2,147	2,180	2,035	2,791	14%
Vegetables	4,733	6,519	7,046	5,868	7,860	8,189	8,344	8,383	8,852	8%
Spices	157	222	255	223	267	308	272	298	301	8%
Total	48,437	56,716	66,538	94,342	27,375	66,669	73,275	65,899	65,834	4%

Source: Data compiled from the Statistical Yearbooks by DAMC, MoAF, Thimphu, Bhutan

The value of major agricultural imports in 2008 was Nu 826 million, implying that agricultural export revenue (Nu 559 million) covers about two-thirds of the cost of agricultural imports. Rice typically accounts for about 70% of the value of agricultural imports, though this rose to more than 80% in 2008 because of the spike in global

food prices. Although rice is by far the largest agricultural import, fruits and vegetables/spices are the most rapidly expanding imports in this sector, growing at about 8-14% per year over the period 2000-2008 (see Table 12 and Figure 10). Overall, the value of agricultural exports is expanding at about 9% per year, whereas the value of agricultural imports is growing at 10% per year (compare Table 7 and Table 12).

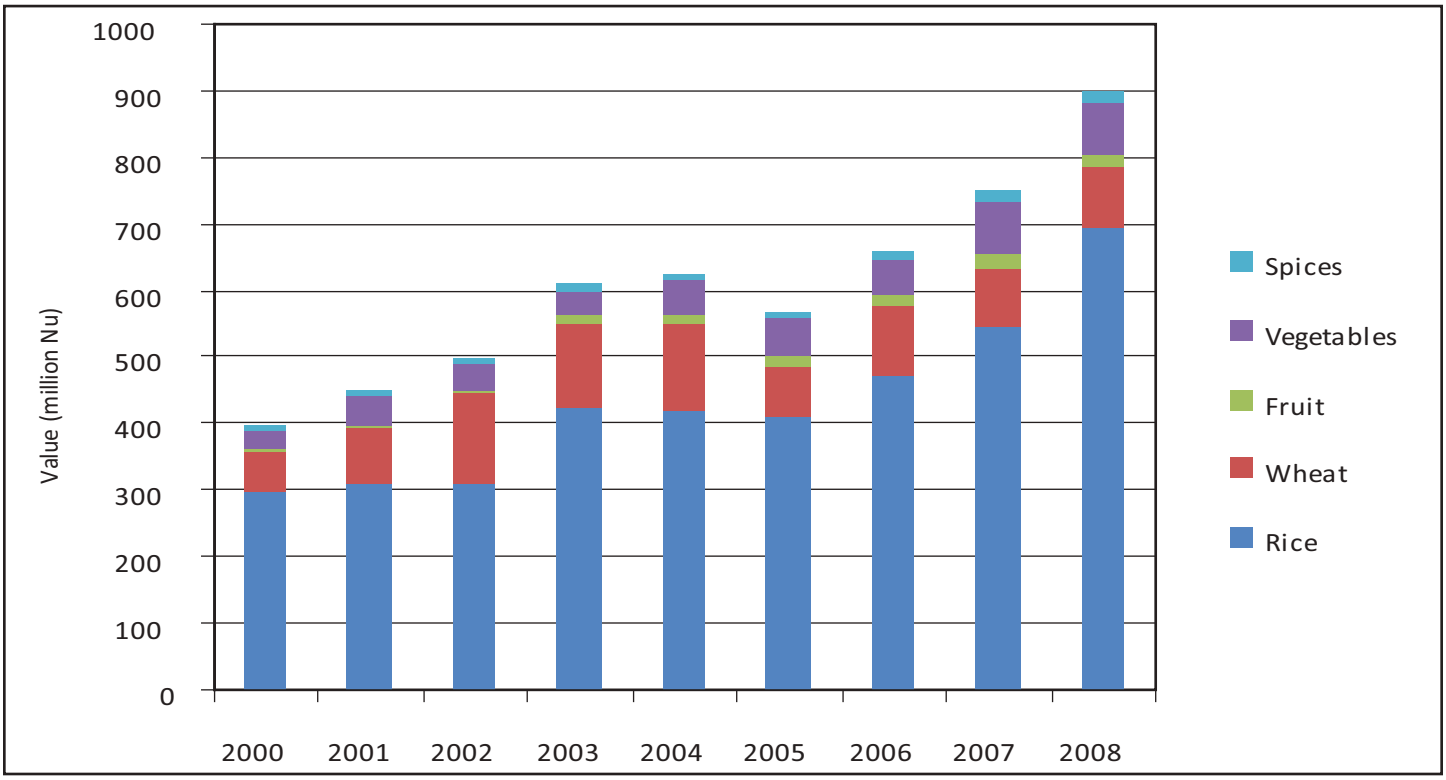
Table 12. Value of agricultural imports (million Nu), 2000-2008

Products	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual growth
Rice	296.0	308.9	311.1	424.6	-	409.6	472.0	544.6	693.7	11%
Wheat	60.8	82.5	132.4	124.1	134.4	77.0	103.3	90.4	-	6%
Fruit	6.3	7.4	7.2	12.7	12.7	16.1	16.4	21.4	20.2	16%
Vegetables	25.6	41.1	38.6	37.9	49.9	54.6	55.7	78.6	77.1	15%
Spices	8.1	9.5	9.9	9.9	12.3	11.6	12.9	15.7	16.3	9%
Total	396.8	449.4	499.2	609.2	209.3	569.0	660.3	750.7	826.9	10%

Source: Data compiled from the Statistical Yearbooks by DAMC, MoAF, Thimphu, Bhutan

As shown in Table 10, meat and animal products are an important component of food and agricultural imports in Bhutan. The volumes of imported meat and animal products is shown below in Table 13. Over the period 2002-2007, imports of beef, pork, and fish have more than doubled, probably reflecting the growing demand associated with rising income. In contrast, imports of chicken, mutton, and eggs appear to be somewhat stable. Milk imports grew slowly over 2002-2005, but increased dramatically in 2006-2007.

Figure 10. Value of agricultural imports (million Nu)



Source: DAMC, MoAF, Thimphu, Bhutan.
Note: Rice import data for 2004 and wheat import data for 2008 were not available and are interpolated.

Table 13. Imports of meat and other animal products, 2002 - 2006

Items	2002/03	2003/04	2004/05	2005/06	2006/07
Beef (mt)	1,547	1,210	1,104	2,690	3,671
Pork (mt)	639	503	1,050	1,733	1,352
Chicken (mt)	560	602	683	526	562
Mutton (mt)	13	8	15	18	35
Dry Fish (mt)	550	787	955	978	1,136
Fresh Fish (mt)	301	308	426	535	621
Eggs (thousand cartonnes)	234	216	195	118	126
Milk (thousand litres)	152	153	91	234	1,657

Source: BAFRA, cited in PPD, 2009.

4. ECONOMIC IMPACT OF AGRICULTURAL TRADE

This section attempts to contribute to the debate regarding trade in food commodities by moving beyond general statements of the advantages and disadvantages, and instead estimating the economic benefits and costs of agricultural trade to Bhutan. The analysis also provides a rough distributional analysis, showing the impact on farmers and consumers separately.

4.1 *Methods and data*

How can we measure the costs and benefits of agricultural trade to Bhutan? The *static* gains and losses from trade are those calculated from the gains and losses to producers and consumers of the traded good. These static gains and losses from trade are easily calculated using standard economic methods, based on the estimated change in price due to trade and the volumes produced and consumed. In addition, there are *dynamic* gains and losses from trade, which take into account changes over time as a result of trade. For example, what is the effect of trade on investment and adoption of technology, which will affect economic growth rates? And what is the effect of trade on the volatility of prices over time? Although measuring the dynamic gains from trade is beyond the scope of this report, we discuss the effect of rice trade on the volatility of rice prices.

The static gains from agricultural trade are measured in two steps. First, we determine the effect of trade on the prices of agricultural commodities, focusing on those that are most widely imported and exported. Second, we measure the effect of those price changes on the welfare of producers and consumers. Each step is discussed below.

4.2 *Effect of agricultural trade on prices*

It is clear that agricultural imports tend to reduce the domestic price of a commodity, while agricultural exports tend to increase the domestic price. If not, there would be no commercial incentive to carry out international trade in these commodities. In order to measure the impact of trade, we need to estimate how much trade reduces the price of imported goods and increases the price of exported goods. For example, how much higher would rice prices be if imports were eliminated? And how far would potato prices fall if potato exports were ended?

Higher rice prices would encourage farmers to expand rice area and to cultivate more intensively, thus expanding output. Likewise, higher rice prices would cause consumers to reduce rice consumption, switching to maize and other staple foods. At some price, called the *autarky price,* production and consumption would be equal and Bhutan would become self-sufficient in rice.

Similarly, oranges, potatoes, and apples are the most important agricultural exports. In the absence of exports, the price of these commodities would fall, increasing consumption and reducing production until the point where they were equal.

In mathematical terms, we can describe the supply function as follows:

$$\log(S) = \alpha_s + \beta_s \log(P)$$

where S is the quantity supplied, P is the price, β_s is the price elasticity of supply, and α_s is the constant. The elasticity of supply is a measure of the responsiveness of production to changes in the price. For example, if the supply elasticity of a crop is 0.5, this means that a 1% increase in price will lead to a 0.5% increase in production, if other factors remain constant.

The demand function can be described as follows:

$$\log(D) = \alpha_d + \beta_d \log(P)$$

where D is the quantity demanded, P is the price, β_d is the price elasticity of demand, and α_d is a constant. The price elasticity of demand is a measure of the responsiveness of consumption to changes in the price. For example, if the price elasticity of demand is -2.0, this means that a 1% increase in the price will result in a 2% reduction in consumption.

The autarky price (P_a) can be calculated by setting supply equal to demand and solving for P:

$$\alpha_s + \beta_s \ln(P_a) = \alpha_d + \beta_d \ln(P_a)$$
$$\ln(P_a) = (\alpha_d - \alpha_s)/(\beta_s - \beta_d)$$
$$P_a = \exp[(\alpha_d - \alpha_s)/(\beta_s - \beta_d)]$$

The elasticities of supply and demand are drawn from other studies. Minten and Dukpa (2010) use data from the 2007 Bhutan Living Standards Survey to estimate the price elasticity of demand for rice at -0.3. This is a plausible estimate since we expect the demand for a staple food such as rice to be relatively inelastic (close to zero). a relatively low elasticity, as one would expFor example, PPD (2009) estimates that the price elasticity of the demand for rice is about -0.30, for fruit -0.52, and for vegetables 0.37. Here, we use this estimate for the demand elasticity of rice. However, the price elasticity for individual fruits and vegetables is likely to be much higher because each has many substitutes. The price elasticity of potato demand has been estimated at -0.6 in Thailand (Konjing et al, 1989) and at -0.6 to -0.8 in Indonesia. In this study, we adopt a price elasticity of demand for potatoes of -0.7. Orange demand is likely to be even more elastic given the number of other fruits that it competes with, so we adopt an elasticity of -1.0.

With regard to supply, a number of studies have estimated that the supply elasticity of rice in South Asia is in the range of 0.2 to 0.5 (Mushtaq, 2000; Khan and Iqbal, 1991). Based on this, we adopt an elasticity of rice supply of 0.3. We adopt a potato supply elasticity of 0.2, based on an estimate from Bulgaria (Mishek et al, n.d.) and the fact that Fuglie (1995) adopts this figure as the most plausible supply elasticity for potatoes in Tunisia. Orange production is probably also quite inelastic given the fact that it is a tree crop, so we assume a supply elasticity of 0.2.

Table 14. Supply and demand elasticities used in the analysis

Commodity	Price elasticity of demand	Price elasticity of supply
Rice	-0.3	0.3
Potatoes	-0.7	0.2
Oranges	-1.0	0.2

4.3 *Effect of price changes on consumer and producer welfare*

The static impact of a change in price of a product can be divided up into the impact on producers, consumers, and the government. The impact of a price change on consumers is the amount of money needed to compensate it for a price change, leaving it just as well off as before. For most purposes, this can be approximated using the change in consumer surplus, defined as follows:

$$\text{Welfare impact on consumers} \cong \text{change in consumer surplus} \cong (P_0 - P_1)\,(D_1 + D_2)/2$$

where P_0 is the original price
P_1 is the price after the change
D_0 is the original level of consumption
D_1 is the level of consumption after the change

The first term is the negative of the price change (so an increase in price is a negative number). The second term is the average level of demand (consumption) before and after the price change. This expression suggests that the adverse impact of higher prices will be larger if 1) the price change is large, 2) the original quantity consumed is large, and 3) the demand is not very sensitive to price increases, so D_1 is not much smaller than D_0.

The impact of a price change on producers is measured by the change in producer surplus, defined as follows:

$$\text{Welfare impact on producers} = \text{change in producer surplus} \cong (P_1 - P_0)\,(S_1 + S_2)/2$$

where P_0 is the original price
P_1 is the price after the change
S_0 is the original level of production
S_1 is the level of production after the price change

The first term is the price change (so an increase in price is positive). The second terms is the average level of supply (production) before and after the price change. Thus, the benefits of higher prices to farmers will be greater if 1) the price change is large, 2) the original quantity produced is large, and 3) the supply is sensitive to price increases, so that S_1 is much larger than S_0.

The net impact of a price change is therefore the sum of the change in producer surplus and the change in consumer surplus. A given price change has opposite welfare effects on producers and consumers. For example, an increase in prices benefits farmers but hurts consumers, while a decrease in price has the opposite effect. Therefore, the net impact depends on which of the two is larger.

In summary, the impact of trade in selected agricultural commodities on the Bhutanese economy can be measured in two steps. First, a simple model of supply and demand for each of the main traded agricultural commodities is used to estimate the change in the domestic price associated with eliminating trade. Second, we

calculate the producer and consumer surplus associated with this price change. The sum of producer and consumer surplus gives us an estimate of the net impact of the elimination of trade in that on the Bhutanese economy.

4.4 *Results*

This section uses the methods and data described above to estimate the impact of agricultural trade on Bhutan. The analysis focuses on three commodities: rice, the dominant agricultural import, and potatoes and oranges, the two most important agricultural exports.

Rice – Gains from trade

Rice is by far the most important agricultural import. Over 2002-07, the value of rice imports exceeded the combined import value of cooking oil, sugar, salt, and wheat products. In 2006, Bhutan produced 74 thousand tonnes of paddy, equivalent to 49 thousand tonnes of milled rice. Rice imports that year were 52 thousand tonnes, implying a self-sufficiency ratio of about 49%. Total availability of milled rice for consumption, seed, and other uses is therefore about 101 thousand tonnes. According to the National Statistical Bureau (NSB), the average retail price of rice in 2007 was 30 Nu/kg.

Based on a supply elasticity of 0.3 and a price elasticity of demand of -0.3, we estimate that in the absence of rice imports, the domestic price of rice would be more than three times as high, 101 Nu/kg. At that price, domestic production would eventually rise to 70 thousand tonnes of milled rice, while rice consumption would decline to that level (see Figure 11).

Our analysis confirms that rice farmers are hurt by rice imports. By comparing producer surplus with and without rice imports, we estimate that imports reduce the income of Bhutanese farmers by Nu 4.2 billion per year (US$ 94 million). Most of this lost income is due to the lower domestic price of rice when there is trade, but in addition the lower price causes a reduction in rice output (see Table 15).

On the other hand, the lower prices imply significant benefits for rice consumers. The benefits to Bhutanese consumers associated with rice imports is about Nu 6.1 billion per year (US$ 135 million). Rice imports reduce the price consumers pay to about one-third of the autarky price and allow rice consumption to increase almost 50% above what they would be in the absence of trade. The reason that the consumer gains are bigger than the producer losses is that rice consumption is larger than rice production. Thus, the overall static benefit to the Bhutanese economy from allowing international trade in rice is Nu 1.8 billion per year (US$ 41 million).

Rice – Volatility in prices

However, producers and consumers are not only interested in the average price, but also the volatility of prices. Because consumers are risk averse, they may prefer a higher, more stable price than a lower, more volatile one. The risks associated with depending on world markets for supplies of a staple food were highlighted by the spike in international food prices that occurred in 2007-2008. The price of 5% broken Thai white rice rose from an average of US$ 330/tonne in 2007 to over US$ 1000/tonne in April and May 2008, before falling to US$ 550/tonne at the end of 2008. This price spike raises the question whether Bhutan (and other rice importers) might be better off insulating itself from world markets by pursuing rice self-sufficiency. However, rice self-sufficiency would not eliminate price fluctuations; rather it replaces the volatility of world markets with volatility associated with variation in domestic rice production. The key question is whether the price volatility due to weather-

Figure 11. Supply and demand diagram for rice in Bhutan

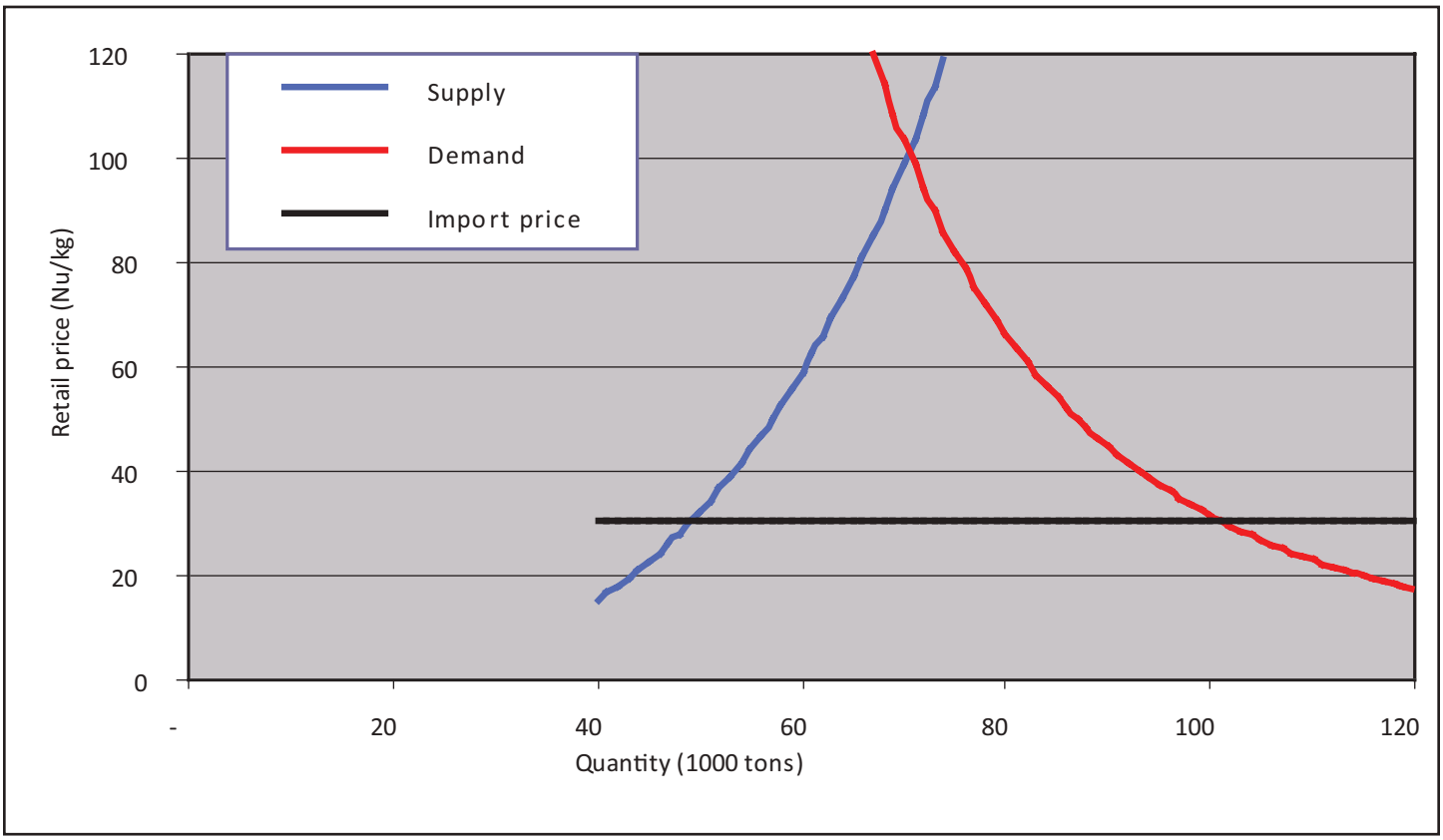


Table 15. Gains from trade in rice

Results	Base scenario 2007	No trade scenario	Percent change
Production (tonnes)	49,091	70,485	44%
Consumption (tonnes)	101,204	70,485	-30%
Exports (tonnes)	-52,113	0	-100%
Price (Nu./kg)	30	101	234%
Annual gains from trade			
Impact on consumers (million Nu)		6,085	
Impact on rice growers (million Nu)		-4,238	
Net gain (million Nu)		1,847	

related variation in domestic rice production would be greater or less than the price volatility associated with importing rice from world markets.

In this analysis we use two measures of volatility:

- The coefficient of variation (CV) in annual prices is defined as the standard deviation of prices divided by the mean price. In other words:

$$CV = 100(\sigma/\mu)$$

where $\sigma = (1/N) \Sigma (P_t - \mu)^2$
$\mu = (1/N) \Sigma P_t$,
P_t is the annual price in year t, and
N is the number of years of data.

- The average percentage change in annual prices is defined as:

$$(100/(N-1)) \Sigma (P_t - P_{t-1})/P_{t-1}$$

where P_t is the annual price in year t and
N is the number of years of data.

The coefficient of variation is a standard measure of relative volatility, but it lacks a simple intuitive interpretation. The average percentage change is less commonly used but more easily understood.

One measure of the volatility in prices with rice imports is simply the historical volatility in rice prices in Bhutan. Over 2003-2007, the CV of annual average retail prices has been 14%, with an average annual change of 10%. Another measure is to look at wholesale prices in Kolkata and Patna, major urban centers in India near the Bhutanese border. As shown in Table 16, the CV of Indian wholesale prices is somewhat higher (17% and 19%) but the average percentage change is quite low (7% and 9%). However, it could be argued that these do not represent rice price volatility under free trade because of policies by the Indian government to stabilize rice prices, including the procurement and distribution activities of the Food Corporation of India.

Better measures of the volatility of rice prices on the world market are the prices of Thai A1 Super broken rice and Thai 100% B Second grade rice, widely used as benchmark rice prices in international markets. Over 1990-2007, the CV for these prices was 21% and 19%, respectively, indicating a level of volatility somewhat higher than wholesale rice prices in Kolkata and roughly similar to that in Patna. However, if we include the year 2008, the CV of both Thai prices increases substantially (39% and 37%, respectively). In addition, the average percentage change from one year to the next is 18% and 17% respectively.

How volatile would the domestic price of rice in Bhutan be if the country maintained a policy of rice self-sufficiency? According to NSB production statistics over 2003-2007, the coefficient of variation (CV) in rice production in Bhutan is 20%. Since part of this is related to a trend over time due to population growth, we calculate the coefficient of variation after removing the effect of population growth trend, yielding a CV of 19%. The average level of milled rice production under self-sufficiency (70 thousand tonnes) and the degree of variability defined by the CV of 19% allow us to generate 100 years of simulated rice production data. The retail price in Bhutan for each year can be estimated from the production in each year. The demand curve is:

$$\ln(Q_d) = \alpha_d + \beta_d \ln(P)$$

Table 16. Measures of rice price volatility under trade and self-sufficiency

	Time period	Mean	Coefficient of variation	Average percentage change
Actual volatility with trade				
Retail price in Bhutan	2003-2007	26 Nu/kg	14%	10%
Kolkata wholesale price	2002-2008	959 R/q	17%	7%
Patna wholesale price	2002-2008	915 R/q	19%	9%
Thai A1 Super broken	1990-2007	193 $/t	21%	14%
Thai A1 Super broken	1990-2008	210 $/t	39%	18%
Thai 100% B Second grade	1990-2007	273 $/t	19%	11%
Thai 100% B Second grade	1990-2008	296 $/t	37%	17%
Estimated volatility without trade				
Retail price in Bhutan		101 Nu/kg	77%	85%

which can be rearranged as:

$$P = \exp[(\ln(Q_d) - \alpha_d)/\beta_d]$$

Since self-sufficiency implies that rice supply and demand are equal, we can rewrite this as:

$$P = \exp[(\ln(Q_s) - \alpha_d)/\beta_d]$$

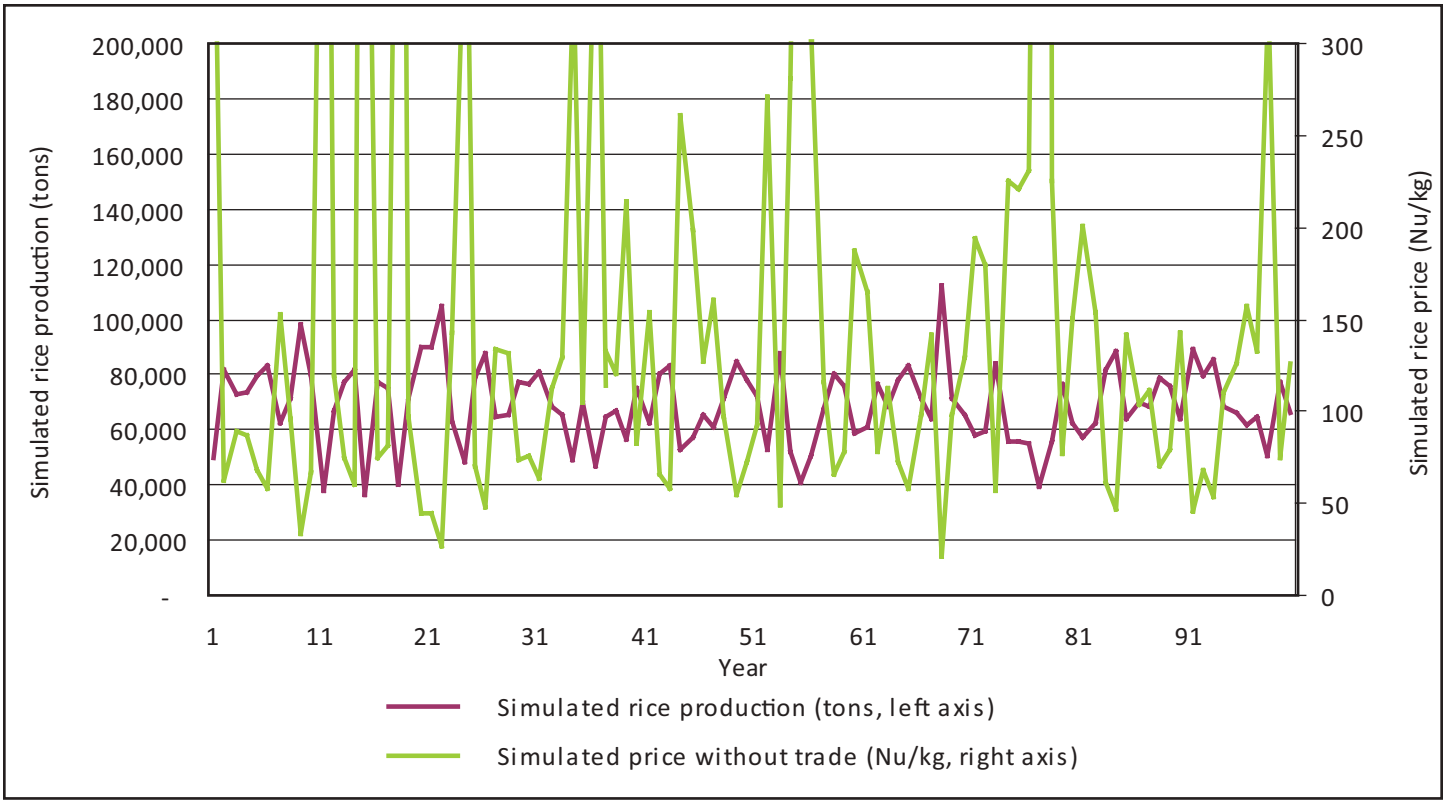
This gives us an equation describing the market price without trade in terms of the quantity supplied (Qs) and the demand parameters (α_d and $\beta_{d'}$).

The result of this simulation analysis is shown in Figure 12, which graphically illustrates the high volatility of rice prices under a policy of self-sufficiency. Prices are more volatile than production because of the price inelasticity of rice demand, assumed to be -0.3 in this analysis. In other words, because rice demand is not very sensitive to the rice price, it takes a large change in prices to adapt to a small change in rice production. As shown in Table 16, the coefficient of variation in rice prices under self-sufficiency is 77%, far higher than the volatility of rice prices in the world market. Furthermore, the average percentage change in prices from one year to the next is 85%, far higher than the corresponding figure for Thai prices, Indian prices, or current Bhutan retail prices.

This analysis assumes that rice prices are determined only by production in the same year, implying that there is no inter-annual storage. In practice, households and traders would have an incentive to store rice after the good harvests and use stocks during the bad years. This, combined with likely operations by the Food Corporation of Bhutan, would smooth rice prices over time. The degree to which storage could smooth this price volatility depends on how well it is managed, how much funding is available, the cost of storage, and other factors, but this analysis is outside the scope of this report.

In summary, rice self-sufficiency would insulate Bhutan from volatile world markets, but it would introduce a new source of price volatility: variation in domestic rice production. This analysis shows that, in the absence of storage, rice price volatility would be much greater under a policy of self-sufficiency than with the current policy of relying on rice imports. Rice storage would smooth prices to some degree, but it is clear that a policy of rice self-sufficiency would not solve, and might well exacerbate, the problem of volatility in domestic rice prices.

Figure 12. Simulated volatility in rice production and rice prices under self-sufficiency



Oranges – Gains from trade

In 2006, Bhutan produced 42 thousand tonnes of oranges. Of these, about 16 thousand tonnes, or 39% were exported. The value of exports was Nu 195 million, making oranges the most important agricultural export in Bhutan. Based on these figures, the volume available for domestic consumption in 2006 was 26 thousand tonnes. The average retail price of oranges is 25 Nu/kg, according to the NSB.

Our analysis indicates that, in the absence of orange exports, the domestic retail price would be 17 Nu/kg, 34% below the current price. The gain to producers from the higher prices and output associated with exports is Nu 341 million per year (US$ 7.6 million). The gains to producers exceed the value of exports because the higher price benefits all orange farmers, including those who are not exporting their output. The cost to consumers is Nu 271 million per year (US$ 6.0 million). The net effect on the Bhutanese economy of orange exports is a gain of Nu 69 million per year, equivalent to US$ 1.5 million (see Figure 13 and Table 17).

Figure 13. Supply and demand diagram for oranges in Bhutan

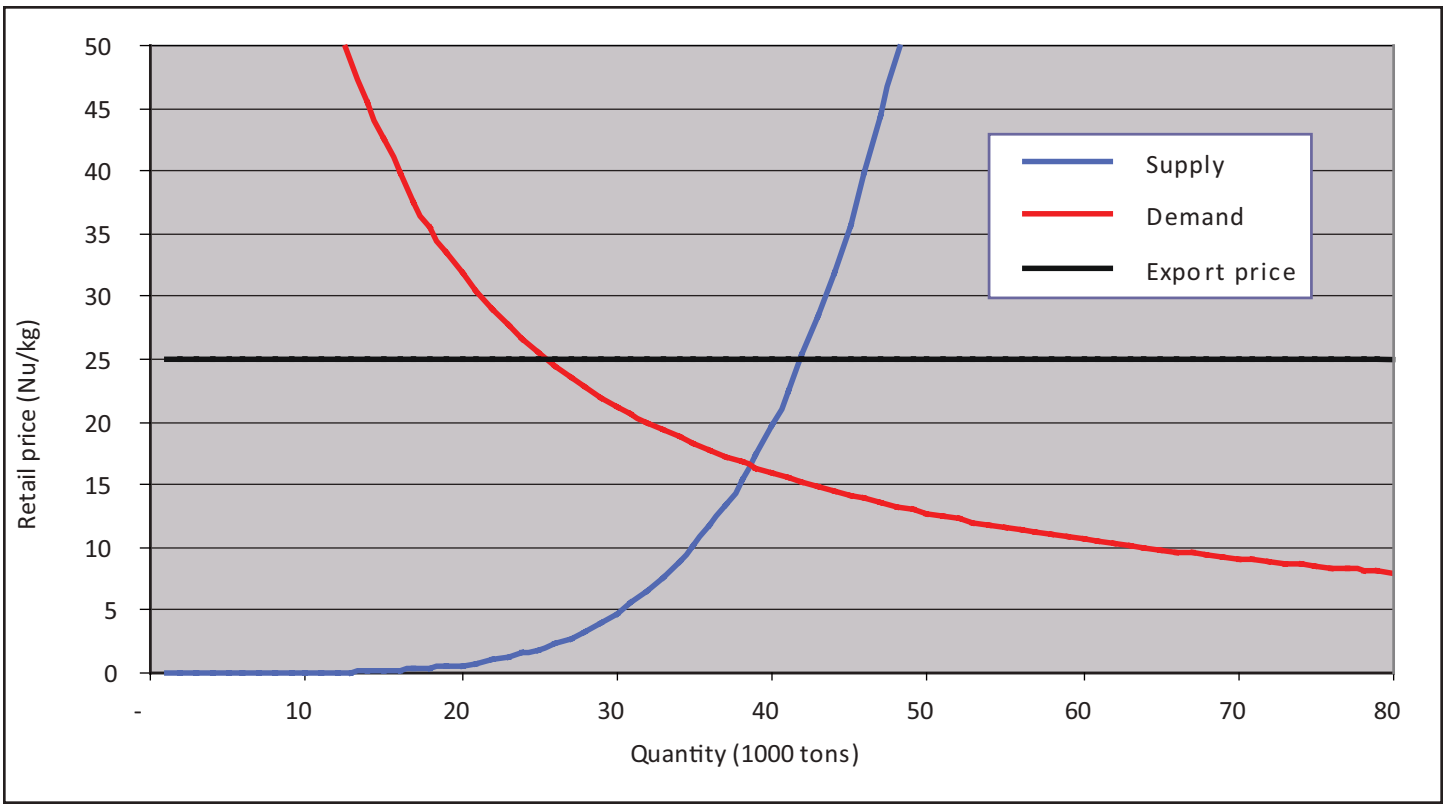


Table 17. Gains from trade in oranges

Results	Base scenario 2007	No trade scenario	Percent change
Production (tonnes)	41,900	38,574	-8%
Consumption (tonnes)	25,510	38,574	51%
Exports (tonnes)	16,390	0	-100%
Price (Nu/kg)	25	17	-34%
Gains from trade in oranges			
Impact on consumers (million Nu)		-271.30	
Impact on orange growers (million Nu)		340.68	
Net gain (million Nu)		69.39	

Potatoes – Gains from trade

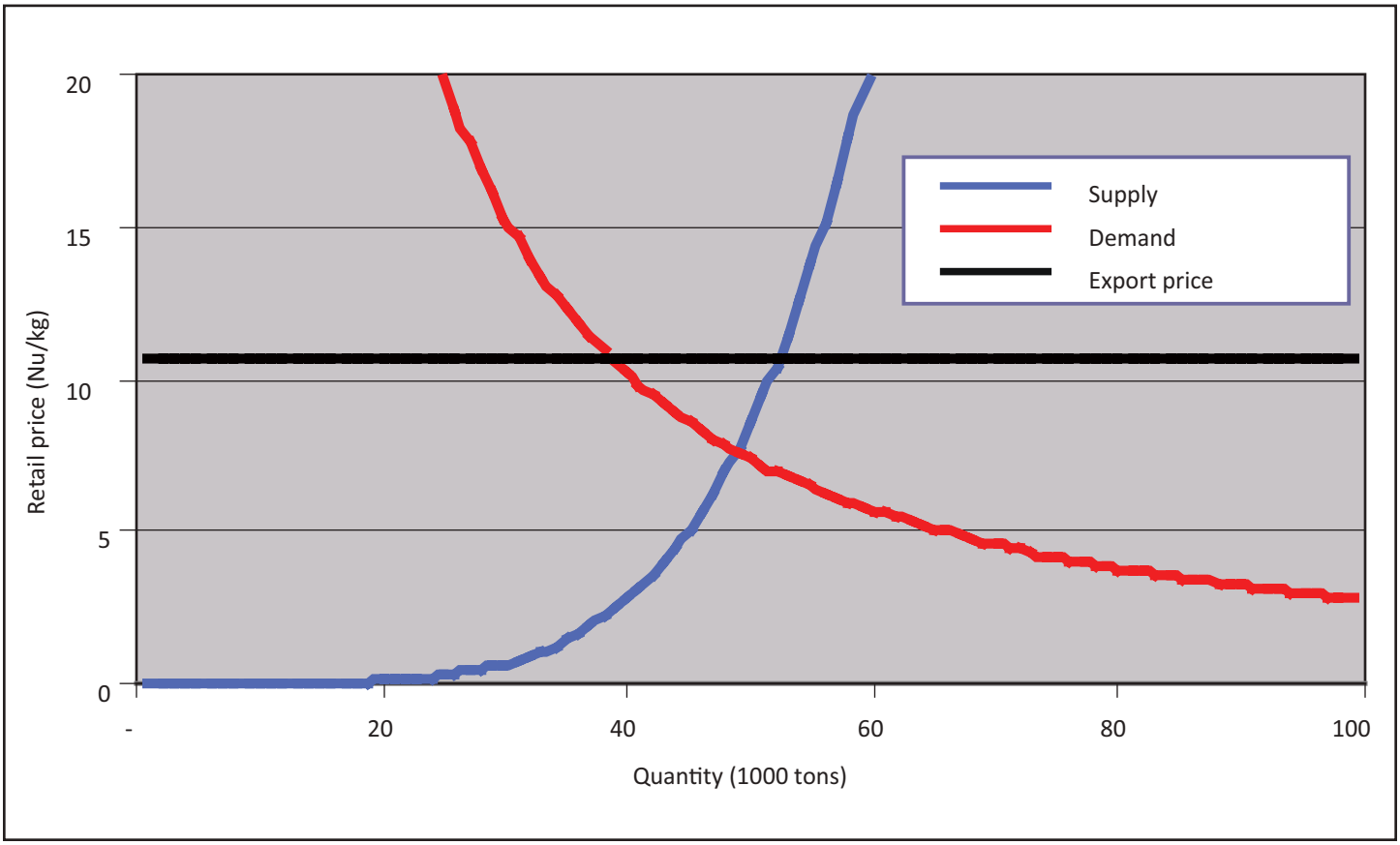
Potatoes are the second-most important agricultural export from Bhutan after oranges. In 2006, Bhutan exported 13.7 thousand tonnes of potatoes[3], or 26% of potato production in Bhutan. The value of exports was Nu 136 million.

The retail price of potatoes is 11 Nu/kg on average. If Bhutan did not export potatoes, the domestic price would be lower. Based on the single-commodity model for potatoes, the retail price of potatoes would fall from 11 Nu/kg to 8 Nu/kg. Production would decline from 52 thousand tonnes to 49 thousand tonnes, a relatively small decrease because of the inelastic supply (0.2). At the same time, domestic consumption of potatoes would expand from less than 39 thousand tonnes to 49 thousand tonnes. The larger response of consumers to the price change is related to the fact that the price elasticity of demand is larger (in absolute terms) than the supply elasticity (see Figure 14).

What are the gains and losses associated with potato exports? Because exports raise the domestic price of potatoes, potato growers benefit. More specifically, potato exports generate Nu 155 million per year (US$ 3.4 million) in benefits for potato farmers.

In contrast, potato consumers lose as a result of the higher price of potatoes. According to this analysis, consumers lose Nu 134 million per year (US$ 3.0 million) compared to the situation without potato exports. The net impact of potato exports on farmers and consumers is Nu 21 million per year (US$ 467 thousand) (see Table 18).

Figure 14. Supply and demand diagram for potatoes in Bhutan



[3] Sales of potatoes through the auction system were about 24 thousand tonnes, but this includes Bhutanese institutional buyers, so actual exports are less than this.

Table 18. Gains from trade in potatoes

Results	Base scenario 2007	No trade scenario	Percent change
Production (tonnes)	52,300	48,878	-7%
Consumption (tonnes)	38,570	48,878	27%
Exports (tonnes)	13,730	0	-100%
Price (Nu/kg)	10.7	7.6	-29%
Gains from trade in potatoes			
Impact on consumers (million Nu)		-134.30	
Impact on potato growers (million Nu)		155.39	
Net gain (million Nu)		21.09	

4.5 *Discussion of gains from trade*

The analysis above depends on a number of assumptions which need to be examined. First, the analysis is based on supply and demand elasticities that are plausible but subject to some uncertainty. The table below provides an analysis of the sensitivity of the estimates of net gains from rice trade to different assumptions about the elasticities of demand and supply of rice. In each case, we use elasticity estimates that are higher and lower than our base assumption made above.

Table 19. Sensitivity of net gains from rice trade to alternative supply and demand elasticities

	Price elasticity of rice demand = -0.1	Price elasticity of rice demand = -0.3	Price elasticity of rice demand = -0.5
Supply elasticity of rice = 0.1	Nu 28.6 billion	Nu 4.0 billion	Nu 1.8 billion
Supply elasticity of rice = 0.3	Nu 4.0 billion	Nu 1.8 billion	Nu 1.2 billion
Supply elasticity of rice = 0.5	Nu 1.8 billion	Nu 1.2 billion	Nu 0.8 billion

These results suggest that impact of rice trade on the Bhutanese economy is positive regardless of the elasticity estimates, but the magnitude of the gains varies from Nu 0.8 billion to Nu 28.6 billion. The net gains from trade are greatest when both the supply of rice and the demand for rice are relatively inelastic to changes in price. In this case, the autarky price would be quite high, implying larger net gains from trade.

Second, the analysis above assumes perfect substitution in consumption between local and traded versions of the product. In fact, local and traded versions of agricultural commodities are generally imperfect substitutes. For example, Bhutanese rice sells at a premium over most imported rice, implying that it is preferred by consumers. In addition, exported potatoes and oranges may be of a higher quality than those sold on the local market. However, taking into account the imperfect substitution of local and traded versions of agricultural commodities would result in *larger* gains to trade. To understand why, we can take the extreme case in which imported rice and local rice are not substitutes at all. This would mean that imported rice would offer benefits to consumers without affecting the market for local rice, that is, without harming farmers by lowering the local price of rice. In this case, the net gain from rice imports would simply be the change in consumer surplus, Nu 6.1 billion, instead of the net gains of Nu 1.8 billion shown in Table 15.

Similarly, if there were little or no substitution in production between local and exported potatoes, then Bhutan could expand production of potatoes for export with little effect on the output of potatoes for domestic

consumption. Thus, potato exports would generate benefits for farmers without harming consumers by raising the price of local potatoes. The same logic applies to other export crops. This implies that our estimates of the gains from trade are lower limits, and that imperfect substitution between local and traded version would increase the net gains from trade.

Third, the analysis ignores the distinction between retail prices and producer prices. We use average retail prices even though the prices farmers receive are significantly less than retail prices. The estimates of consumer surplus are unaffected by this simplifying assumption, but the estimates of producer surplus are larger than the actual gains (or losses) to farmers. In fact, since marketing margins account for the difference between producer and retail prices, we can say that our estimates of producer surplus include the gains and losses to farmers plus the gains and losses to traders that market this commodity. The overall net gains from agricultural trade are unaffected, but the distribution of gains and losses is somewhat more complex than described above.

Fourth, as discussed above, this analysis measures only the static gains from agricultural trade. Other than the analysis of rice price volatility, it does not include the dynamic effect of trade on innovation and investment. Most studies of the effects of trade suggest that the dynamic effects of trade are positive. For example, an open trade policy allows the importation of new seeds varieties, new tools and machinery, and new types of fertilizer which may stimulate agricultural productivity. Furthermore, agricultural exports may stimulate local and foreign direct investment in agricultural production and marketing, which in turn bring new technology and skills to farmers, allowing them to access high-income markets in other countries. It is difficult to quantify the size of these benefits, but studies in other countries suggest that the dynamic gains from trade often exceed the size of the static gains from trade.

5. SUMMARY AND CONCLUSIONS

Agricultural production in Bhutan is dominated by cereals, mainly rice and maize, and horticulture. Rice is the most important staple food in the diet of Bhutanese consumers, as well as being the most important agricultural commodity in value terms. However, the total value of horticultural production surpasses the value of cereal production. Local rice production covers only half of Bhutan's consumption requirements, the remainder being supplied with imported rice from India. Bhutan also imports smaller quantities of wheat and wheat products, but is self-sufficient in maize. Oranges, potatoes, and apples are the main agricultural export items. Production and traded volumes are fairly volatile, but horticultural production and exports appear to be growing.

From the farmer's perspective, the appeal of growing horticultural crops is clear: the gross returns per hectare are higher than for rice and maize. The returns per hour of labour are less clearly in favor of horticulture because they tend to be more labour intensive than cereal crop. Given the labour requirements, cost, and risks associated with horticultural production, very few farmers are able to specialize fully in horticulture but many can produce some fruits and vegetables in addition to their cereal crops. The optimal mix will vary from farmer to farmer depending on skills, ability to finance input costs, tolerance of risk, distance to markets, and other factors.

A broader analysis of the costs and benefits of agricultural trade should take into account the effect of trade on both farmers and consumers. Much of the debate over the impact of trade in agricultural commodities in Bhutan is limited to general statements regarding the advantages and disadvantages of trade. This report contributes to the debate by providing empirical estimates of the gains and losses associated with trade in rice, potatoes, and oranges, as well as a limited analysis of the distribution of those gains and losses among different

groups in Bhutan. The results of this analysis allow us to evaluate the four arguments against agricultural trade listed at the beginning of this report.

- Argument 1: "It is a waste of foreign exchange to import goods that the country could grow or produce for itself."

The analysis presented here confirms that Bhutan probably could grow enough rice to feed itself, but only at a very high cost. If our assumptions about the supply and demand elasticities of rice are correct, the domestic retail price of rice would have to rise from 30 Nu/kg to about 101 Nu/kg to achieve rice self-sufficiency. In other words, each kilogram of local rice would cost 3.3 times as much as the imported rice that it replaced. Furthermore, because of the high price required to reach self-sufficiency, rice consumption would decline and consumer would be forced to switch to other staples, including maize, wheat, and other cereals. This analysis does not examine the effect of rice self-sufficiency on maize markets, but it is likely that higher rice prices would increase the demand for maize, thus increasing maize prices as well. Although rice self-sufficiency would probably not affect the price of wheat, because it is imported, it would increase the volume of wheat imports.

- Argument 2: "Imported products compete with local products, pushing the price down and hurting farmers and other producers in the country."

Again, our analysis confirms part of this claim: rice imports do compete with local rice, they do push down the domestic price of rice, and this does have an adverse effect on farm income. On the other hand, the analysis also highlights the fact that this is an incomplete picture of the overall impact on Bhutanese people. By lowering the domestic price of rice, imports also generate large benefits to rice consumers. In fact, according to our estimates, the benefits to consumers from rice imports (Nu 6.1 billion) significantly outweigh the costs to farmers (Nu 4.2 billion). This is because the impact is roughly equal to the price change multiplied by the volume bought or sold, and consumers buy more rice than farmers sell.

- Argument 3: "When farmers divert land into export crop production, they raise the price of agricultural commodities in the country and contribute to food insecurity by reducing domestic food production."

The analysis presented in this report confirms that exports of potatoes, oranges, apples, and other commodities motivate farmers to expand the acreage in these crop beyond what it would be without trade. Does this increase food insecurity? It is useful to distinguish between farmers growing export crops and other farmers. Among those growing export crops, the income earned from export crop sales presumably allows them to purchase rice and other staple foods; otherwise they would quickly discontinue export crop production. Among farmers who do not grow export crops, they may be adversely affected by the diversion of land into export crops, but the effect is likely to be negligible for two reasons. First, because rice is an imported crop, any reduction in domestic production would have no effect on the domestic price, which is largely determined by the Indian price and the cost of transporting it to Bhutan. Any shortfall in rice production would be compensated by higher imports. Second, the area under export crops is modest. Only about 13% of the cropped area in Bhutan is allocated to the four main export crops: oranges, potatoes, apples, and cardamom. In Table 8, we estimated the share of each crop exported. Over 2006-08, the average share exported was 64% of apple production, 44% of orange production, 27% of potato production, and 9% of spice production (see Table 8). Applying these percentages to the area under each crop, we estimate that 4.3% of the cropped area in Bhutan is used to produce the exported quantities of these crops. Finally, only some portion of this land would become available for other crops in the absence of exports because the lower price would increase domestic demand for these crops (see Figure 13). If we conservatively estimate that half of the land would become available for other crops, eliminating exports

of oranges, potatoes, apples, and cardamom would only free up 2.15% of the crop land in Bhutan. Thus, export crop production displaces very little farm land and is unlikely to have a measurable effect on staple crop prices or availability. .

- Argument 4: “World markets are volatile and unreliable, particularly as a source of imported staple foods.”

The experience of 2007-2008 highlights the volatility of prices in world markets, particularly in rice markets. The analysis presented here, however, is a reminder that a policy of self-sufficiency does not eliminate the problem of price volatility, rather it replaces one source of volatility (world markets) with another (domestic production). It is an empirical question whether the volatility associated with world rice markets is greater or less than that associated with variation in domestic rice production. Our analysis indicates that if rice production continues to have the same variability that it did in 2003-2007, the volatility in rice prices could be substantially higher under a policy of rice self-sufficiency. This analysis does not take into account storage and it is not known to what degree this would ameliorate the price volatility, but it is clear that self-sufficiency is not an easy solution to the problem of price volatility.

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