



**MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF BHUTAN
and
FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS**



COMMODITY CHAIN ANALYSIS : RICE

December 2006

Rice Chain Analysis : A Working Document

By

Mahesh Ghimiray¹
Kencho Wangdi²
Ganesh B Chettri³
Louis Bockel⁴
Meeta Punjabi⁵

¹ Principal Research Officer and Rice Breeder, RNRRC Bajo, CoRRB, MoA

² Research Officer and Agricultural Economist, RNRRC Bajo, CoRRB, MoA

³ Joint Director, Department of Agriculture, MoA, Thimphu

⁴ Policy Analyst, FAO, Rome

⁵ Consultant, FAO, Delhi

TABLE OF CONTENTS

1	INTRODUCTION.....	4
1.1	Criteria for considering the rice chain as pro-poor	4
1.2	Objectives.....	4
1.3	Study Framework and Methodology	5
1.4	Data Collection	6
2	OVERVIEW OF THE RICE COMMODITY CHAIN.....	8
2.1	Supply demand and marketing of rice in Bhutan.....	8
2.2	Emerging Trends	11
2.3	Key issues in the chain.....	12
3	FLOW ANALYSIS FUNCTIONAL ANALYSIS AND TECHNICAL PERFORMANCE AND GAPS.....	14
3.1	Flow Analysis.....	14
3.2	Functional Analysis.....	15
3.3	Commodity Chain Technical Performance and Gaps.....	19
4	MICRO ANALYSIS AT OPERATOR LEVEL	22
4.1	Profile and performance of rice producers	23
4.2	Profile and performance of downstream operators.....	27
5	ECONOMIC AND SOCIAL IMPACT OF THE CHAIN ON ECONOMY.....	30
5.1	Global economic weight and performance of the chain	30
5.2	Global employment and social impact	30
5.3	Food Security Role of the Chain.....	31
6	TOWARDS GROWTH STRATEGY	32
6.1	Enhance and Stabilize Production	32
6.2	Increasing Access to markets and Enhancing employment generation.....	34
6.3	Public Investment and Policy Support Needs	37
6.4	Quantitative Assessment of Growth Scenarios	39
6.5	Potential Achievable Supply Targets	40
7	STRATEGY, INVESTMENTS AND PUBLIC-PRIVATE PARTNERSHIP... 44	44
7.1	Strategic Diagnosis and Log Frame	44
7.2	Investments.....	44
7.3	TOWARDS A PUBLIC-PRIVATE PARTNERSHIP IN ENHANCING COMMODITY CHAIN.....	45
8	CONCLUSIONS AND KEY POLICY RECOMMENDATIONS	46

COMMODITY CHAIN ANALYSIS OF THE RICE CHAIN IN BHUTAN

1 INTRODUCTION

The commodity chain analysis is a major part of the ongoing FAO-Netherlands Partnership Program (FNPP) in Bhutan to address the issues of food security. The objective of the initiative is to conduct a thorough analysis of the commodities that hold promise as potential growth engines for agricultural and rural development. The four commodity chains chosen for this analysis include two cereal chains (rice and maize) and two horticultural chains (potato and oranges). These commodities are analyzed in detail with a pro-poor focus using the Commodity Chain Analysis (CCA) methodology. The results of this analysis will form the basis for the preparation of project and program proposals for further development of selected commodity value chains in the next five year plan. This study focuses on the rice commodity chain. Rice is the most preferred staple food of the Bhutanese people and the food security of the nation depends on rice.

1.1 Criteria for considering the rice chain as pro-poor

Rice production is the livelihood of the vast majority of Bhutanese farmers. Based on the Census of Agriculture, 28,930 households in Bhutan are engaged in rice production (MOA, 2001). Although, rice is not the largest produced cereal in the country, it is the most widely consumed cereal. As domestic production of rice has not been able to meet the demand, imports of this cereal have been increasing in the past few years.

Given that rice is an important source of livelihood, the most important cereal crop from the point of view of food security and is facing competition from cheaper imports, it is important to look closely at the current situation to plan an appropriate strategy for the future.

1.2 Objectives

In the light of this situation, the specific objectives of this study are:

- To develop a thorough understanding of the functioning of the rice chain: understand the different agents and stakeholders in the chain and the functions they perform, get insights into the marketing aspects of the chain with respect to the value added by each agent, understand the constraints and issues at each level (production, marketing, exports, processing).
- Develop a future growth strategy for the commodity based on the understanding of the current situation and emerging trends.

- Prioritize a list of actions and investments required to promote further growth in the value of rice.
- Identify partners (NGOs, government, other stakeholders) to work in collaboration with to achieve the growth objectives.
- Develop a Pro-Poor Commodity Program/Project Proposals/Business Plans for implementation in 10FYP as a followup of this study.

1.3 Study Framework and Methodology

Previous studies on rice production in Bhutan were mostly focused on farm level analysis. CCA is the first study of its kind which analyzes the entire chain from farm level to the consumer. This study has the benefit of an integrated approach that covers the dynamics of production, distribution, price determination and market forces. Through such an approach the nature and characteristics of poverty can be understood and potential areas for upgrading the chain can be identified. It also provides a holistic picture of the rice chain, allowing identification of strengths and weaknesses in the chain for appropriate interventions for improvement.

The CCA methodology is a rigorous approach to understand the various aspects of the chain. The components of the analysis include:

- **Functional analysis** – identifies the agents involved in the rice chain and the functions that they perform. These agents include all the entities involved in the chain, upstream from input suppliers to downstream millers, traders and urban and rural retailers.
- **Flow analysis** – provides insights into the different sub-channels and the flow of the rice through different channels. This gives an idea of how the total production in the country is utilized – home consumption, exchange as gifts, used for feed, and the quantity sold in the domestic and export market.
- **Technical analysis** – provides information on the constraints and technical gaps at all the levels in the chain – inputs supply, production, post-harvest handling, marketing through to processing.
- **Micro analysis at operator level** – provides a detailed description the activity at each level in the chain. This analysis also includes financial analysis of every agent in the chain, giving a clear picture of the costs incurred and revenues generated and hence the profits at each level. For example, in the case of farmers, with this analysis we get information on net returns per acre, the returns per man day of labor etc. These estimates give a clear picture of the income generating capacity per acre for different crops and profitability of the enterprise at the farm level. Similarly, the profitability of all the agents in the chain is estimated including the millers, processors, exports.

The overall efficiency of the chain is gauged by the relative earnings of each agent as compared with their value added. This analysis also forms the basis for understanding the impact of government policies using simulations.

The study also provides information on economic and financial prices and returns. The economic prices and returns account for the home labor as well as home consumption, whereas the financial prices and returns are based only on actual financial transaction, such as money spent on purchasing inputs, and returns from market sales.

Economic and Social Impact of the chain – gives the value of the chain from the perspective of the importance of this sector in the role of the economy. This analysis highlights the total number of households dependent on this chain, employment generated by the chain, the total value generated by the chain, distribution of the value generated among the chain participants, and the degree of vulnerability of the households in this chain.

As is evident, this framework provides a rigorous analysis of the commodity chain from various perspectives and helps to highlight the initiatives and policy issues towards meeting the objectives of the chain.

1.4 Data Collection

Survey areas

The survey covered 6 major rice producing Dzongkhags of Paro, Punakha, Wangdue, Tsirang, Samtse and Sarpang. These Dzongkhags cover the high (1600 – 2600m), medium (700-1600) to low (700 m and below) altitude producing regions. Paro is the only Dzongkhag that falls under high altitude (above 2000 m). Punakha, Wangdue and Tsirang are mid-altitude dzongkhags while the southern Dzongkhags, Samtse and Sarpang fall in the low altitude (below 700 m) zone. Five geogs were selected from each of these Dzongkhags (map below). Data was collected through interviews with 5 households from each geog making a total of 120 households.

Tables 1, 2 and 3 provide details of the survey area and socio-economic characteristics of farmers. The average farm size for the low, medium and high altitudes is 1.49, 1.29 and 2.5 acres respectively.

Table 1: Producers and rice areas in the different altitudes

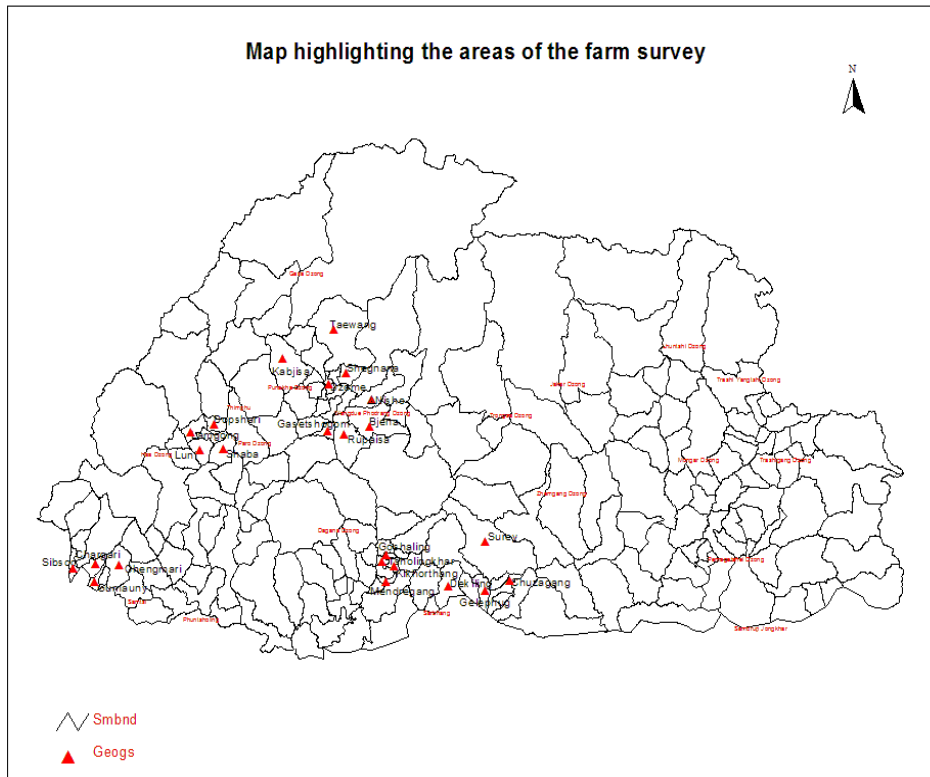
	High altitude (1600 – 2600m)	Med-altitude (700 – 1500m)	Low altitude (below 600m)	Total
No of farmers interviewed	21	60	40	121
Area (acres)	31.87	109.48	132.28	273.63
Average rice area	1.49	1.29	2.50	

Table 2: Respondent's characteristics

Characteristics	Altitude			Average
	High	Medium	Low	
Age	49	48	47	48
Years of education	1.8	3.1	2.7	2.5

Table 3: Household size by age group

Gender and age group	Altitude			Average
	High	Medium	Low	
Male adult (>15 yrs)	2.2	2.0	2.2	2.1
Female adult (> 15 yrs)	2.3	2.5	2.4	2.4
Children (< 15 yrs)	1.7	2.2	2.4	2.1
Total	6.2	6.7	7.0	



Surveys of millers, traders, retailers and exporters were also conducted to get a complete understanding of all the players in the chain. A quick survey of the millers, traders, retailers, and the exporter based in Paro was done. Finally, the consumers in urban areas were also interviewed to get input in the demand of rice and rice products.

2 OVERVIEW OF THE RICE COMMODITY CHAIN

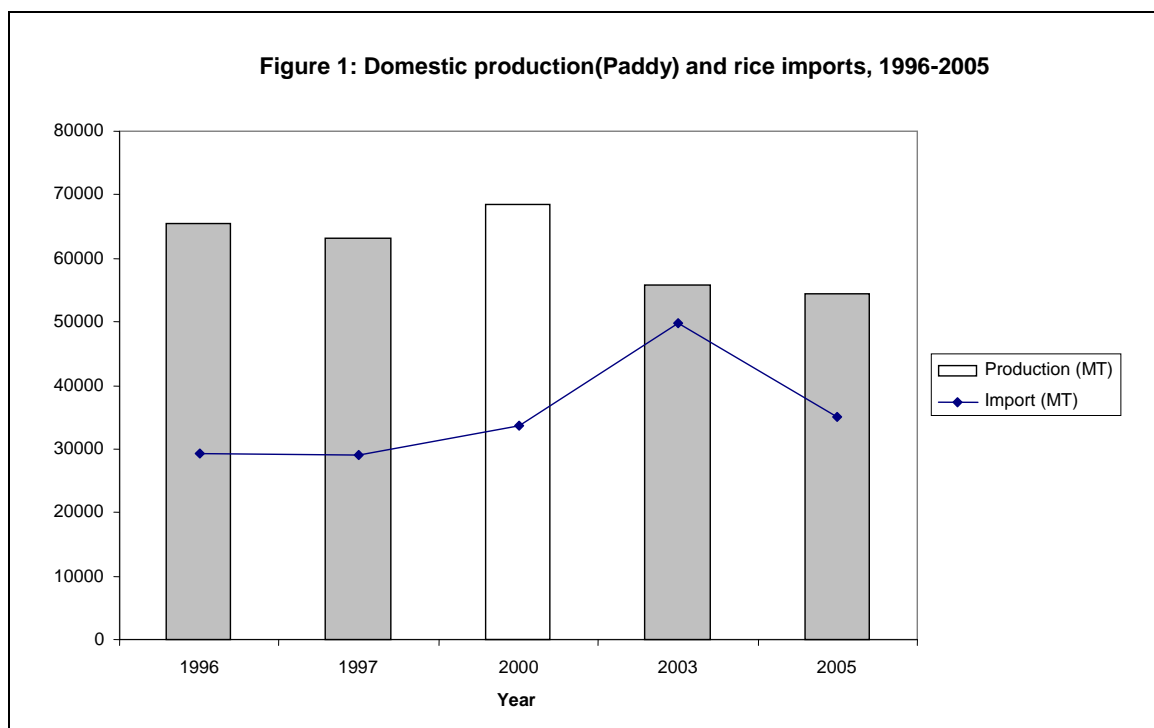
Three aspects of rice chain are discussed in this section – review of the supply demand and marketing situation, some emerging trends based on this analysis and some key issues in the chain which need to be addressed.

2.1 Supply demand and marketing of rice in Bhutan

The production and import analysis is based on secondary data from the Census of Agriculture. Primary data collected from the study survey is used to complement the secondary data to present a comprehensive picture of the current rice situation in Bhutan specifically the domestic demand and marketing situation.

Supply of Rice

The total supply of rice includes the domestic production as well as imports. Figure 1 shows the domestic production of paddy and imports of rice. Over the period 1998, there appears to be a slightly declining trend in production, whereas the imports are increasing. The imports in 2003 were higher than average due to stock piling for security reasons, although not all the imports were actually utilized that year. Based on our survey, the total supply of rice in the country in 2005 was around 67,038 tons (50,000 MT paddy = 33,055 MT rice, excluding 5000 MT of paddy used for seed and feed), whereas the imports of rice was around 30,000 tons. About 49% of rice consumed in the country is produced at



home, whereas 51% was imported.

Rice production has been increasing over the years as a result of the impact of research and extension efforts of the Ministry of Agriculture. Rice producing regions in Bhutan can be categorized as Low, Medium and High altitude producing regions. As shown in Table 4, the total area under rice declined slightly from 2001 to 2004, while the production increased by about 10,000 MT, because of higher yield. The largest area under production is in the medium altitude about 50%, and this region also contributes around the same to percentage share to the total production. However, though the total area under production in the low altitude region is quite high, the contribution of this region is lower than average, while in the case of high altitude region, the production is higher than average. This implies the immense scope to enhance rice production in the country by enhancing productivity in the low altitude region, which has a large share (38% in 2004) of the total rice producing area.

Table 4: Production of Paddy in Different Producing Regions (2004 and 2001)

	Area		Production		Yield	
	2004	2001	2004	2001	2004	2001
Low	17,688	15,996	17,787	12,484	947	830
	(38%)	(33%)	(33%)	(28%)		
Medium	22,797	24,143	28,027	24,189	1,192	950
	(49%)	(51%)	(52%)	(54%)		
High	5,971	6,963	8,395	7,434	1,302	943
	(13%)	(14%)	(15%)	(16%)		
Total	46,585	47,314	54,325	44301	1,166	957

Census Data

Rice Demand

According to the survey results, average rural household consumption of rice is 1632 kg per year. Considering the average rural household size to be 5.7 (CSO, 2000), per capita consumption of rice is computed at 172 kg per year. Per capita rice consumption would even be higher in the urban areas where diversification of staple food base is low. In the urban areas proportion of domestic rice is only about 26% of the total rice consumption (most of this is red rice). About 74% of the rice consumed is imported rice from India. Table 5 shows the percentage share of total rice consumption in the urban areas (CCA Consumer Survey, 2006).

Table 5: Rice consumption in the urban areas by brand, 2006

Rice brand/variety	Percent share
Basmati	20
Bhog rice	16
Ordinary rice (555)	38
Local white	4
Local red	22

Rice products such as *zaw* (puffed rice), *sip* (flattened rice) and *mekhu* (rice chapattis cooked in oil) are also produced and sold by the farmers in the north. While in the south, *chiura* (flattened rice), *siroula* (puffed rice) and *selroti* (round roti cooked in oil) are the main rice products. These are home made products and the quantity traded is low. The consumers survey identified *zaw* and *sip* as the most popular rice products. There is a potential for higher demand from the consumers in the urban areas, if the product quality is enhanced and the availability is more regular (CCA Consumer Survey).

The demand for rice has also been increasing. Most of the rice supply for the urban population, including a high percentage of foreign workers, comes from imported sources, mainly from India.

Rice is also exported from Bhutan to the USA, though the quantity of exports is very small. The only exporter based in Paro reported exporting 100 MT of red rice annually to USA.

Rice marketing

Table 6 presents the average quantity of rice going to the market per household. It is evident that the high altitude region has the highest quantity going to the market. This could be attributed to two factors – first is higher productivity which leaves higher amount as marketable surplus after home consumption. Second factor is the accessibility to markets. Paro serves as an example of a highly accessible Dzongkhag.

Table 6: Average household sale of rice by market and altitude

Place of sale	Altitude		
	Low	Medium	High
Local market	6 kg	17 kg	52 kg
Urban market	57 kg	155 kg	426 kg

Overall, the quantity of rice marketed by the farmers was found to be quite low. One of the reasons for this is that the household consumption of rice is quite high. Due to farm labor shortages, a large proportion of the total production is paid to hired labourers as wage. Barter system that is still prevalent in the villages is another reason for rice not being marketed. Farmers reported bartering rice for meat and other dairy products also.

A major constraint to marketing is the lack of an efficient marketing system. Most of the rice available in the urban stores is imported. This highlights the need for emphasis on developing a marketing system specifically in the mid and high altitude regions as these are the areas with high productivity and hence have more market surplus.

Finally, rice marketing has potential also because the domestically produced rice fetches higher price in the market, where as the imported rice is cheaper. Thus, with marketing facilities, farmers can sell the local rice to fetch a higher price and substitute with imported rice, which also enhances the family income.

2.2 Emerging Trends

Increasing imports

As seen in figure 1 rice imports over the period 1998-2000 was around 30,000 MT per year, which has increased to around 35,000 MT per year in the recent years. The increasing import is also a reflection of the distinct preference for rice relative to other cereals.

Increase in production

The results of rice research in Bhutan have been very promising. With farmers adopting many high yielding varieties, yields have been increasing in many of the rice growing areas. The national rice output has increased by 5000 to 10,000 MT per year which is equivalent to a gross output valued at Nu 60 million to Nu 121 million per year (Shrestha, 2004). However, the high yielding varieties have yet to make inroads into some remote areas where farmers still cultivate their traditional varieties.

Decreasing wetland

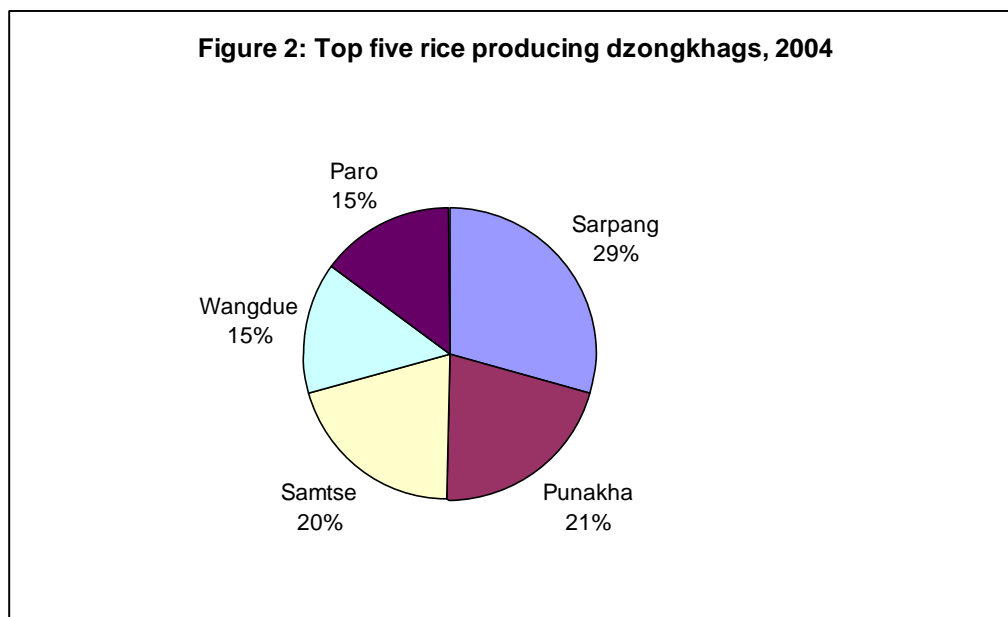
Much as the research has a good impact on rice yield, there are several constraints which hinder production. One of the biggest constraints facing the rural households is the shortage of farm labour. This is particularly so during some critical cropping activities such as transplanting and harvesting. Rural-urban migration is the cause for the dwindling labour force in the agriculture sector. Increase of wetland area from conversion of drylands is rare. In fact, in many of the villages, wetlands have been left fallow. People trying to lease out their wetlands find it difficult to find tenants even when the lease conditions are relaxed in favour of tenants. Crop damage by wild animals also leads to abandonment of farms. As a result, total wetland in the country is decreasing.

2.3 Key issues in the chain

From the above discussion on rice situation in Bhutan, the following key issues emerge, which need a closer look at the operations at all levels in the chain.

Scope for enhancing yields in the low altitude area

Samtse has the highest acreage of land under rice cultivation followed by Sarpang. Total production of rice from Samtse in 2004 was 9,762 tonnes although the yield was the lowest in the country (808 kg/acre). Rice yield in Paro was 1631 kg/acre, which was double that of Samtse. Sarpang's yield was 1278 kg/acre in 2004. There is much scope for enhancing productivity in the low altitude areas. Higher use of inputs coupled with improved management practices in these low altitude areas would have a big impact on the country's total rice production. Figure 2 shows rice area, production and yields in 2004 of some selected dzongkhags.



Impact of Imports

Being a low income and rice deficit developing country, Bhutan depends on India for much of its domestic rice requirement. The government agent responsible for rice import is FCB. Rice imported through this channel is based on a quota agreement with India (Shreshta, 2004). Various studies and documents have assessed the degree of sustainability of the quota imports. However, there is no clear consensus on the issue. A detailed study on the impact of import of Indian rice on domestic rice prices and production is needed to get a clearer and conclusive picture.

Scope for increasing exports from Bhutan

The only exporter based in Paro reported exporting 100 MT of red rice annually to USA. The exporter collects paddy from farmers in Paro, Wangdue and

Punakha at a price of Nu. 14 – 16 per kg. The red rice fetches US \$ 2.2 per kg in the US. Other emerging markets for Bhutanese red rice are UK and Germany. Price for red rice in UK and Germany are reported to be US \$ 2.2/kg and US \$ 1.75/kg respectively. Although the demand from USA alone is 200 MT, the domestic supply could not meet the demand because of low production of red rice.

According to the exporter, there is demand for organic rice from the existing markets. However, in the absence of any certification system in place, need of documents and documentation, there is no export of organic rice as such. Routing rice exports through India is not only a hassle but also add up to costs. In view of this, it would really benefit if the planned dry port in Phuentsholing could be taken up soon by the government.

Spread of technologies

To benefit wider section of the farming communities, the government must put greater effort in spreading the available technologies such as high yielding varieties, weedicides, and labor saving farm machines to address labor, shortage. Production has increased tremendously in areas where the adoption rate of these technologies is high. Shrestha (2004) estimated that improved rice varieties are grown by 60% of the households and cover 35% of the rice area. But there are also many areas where technology adoption is very low or non-existent. For example, even in dzongkhags like Wangdue, high yielding varieties are still not adopted by the farmers especially in some remote gewogs. This is also true for almost all the farmers in the southern region.

Upgrading rice processing

Rice is mostly processed using the Indian made “rajah” mill which is metal based resulting in high percentage of broken milled rice. The moisture content of rice further increases the percentage of broken rice. The average milling recovery of the rajah mill is 50 per cent. Acquiring improved rice mills from India or elsewhere can benefit both the miller and farmer. The former will increase the earning with the additional amount of milled rice, while the later gets more from the paddy that are milled by the improved machine. Additional benefits are attributed to increases in capacity and milling recovery.

Enhancing Marketing

The current system of marketing does not encourage farmers to produce for the market. Markets and marketing system must therefore be improved to enhance production. Except for the Sunday markets where the farmer sells his/her product directly to the consumers, there is total lack of any form of organized marketing outlet for domestic sale of agricultural produce. For the producers, the issue not is so much about demand as it is about getting their produce to the market on time.

3 FLOW ANALYSIS FUNCTIONAL ANALYSIS AND TECHNICAL PERFORMANCE AND GAPS

As discussed in section 1, the five components of the CCA – flow analysis, functional analysis, analysis of technical performance, micro analysis of the agents and economic and social impact of the chain. The first three analyses are discussed in this section, while the last two are discussed individually in the next two sections.

3.1 Flow Analysis

Flow analysis provides insights into the different sub-channels and the flow of the rice through different channels. This gives an idea of how the total production in the country is utilized – home consumption, exchange as gifts, used for feed, and the quantity sold in the domestic and export market.

The flow analysis is conducted from the data collected through the CCA survey. The analysis indicates that the total availability of rice in the country in 2005 was 67,033 MT of which 33,055 MT (49%) was domestically produced, while the rest was imported. A very important point in the table is that of the total rice domestically available, ONLY 15% is marketed while the rest is consumed at home. This high figure for household consumption implies the subsistence level of the economy and the crying need to enhance marketing mechanisms in the country.

Table 7: Flow Analysis

100%	67,038	Total Rice in the Country			
49%		33,055	Domestically Produced	55761.74	(Paddy produced)
41%		27,759	Imported by Urban Retailers	(Sold in the urban markets)	
9%		6,224	Imported by FCB	(Sold through FCB Retail)	
		55,762	Domestically Produced Paddy		
			1969	Used for Seed	
			2939	Used for Gift/feed	
			50854	Paddy Supply	
		100%	33055	Domestically available Rice	
		85%		27967	Home Consumed
		1%		409	Sold in the local market
		14%		4480	Sold in the rural market
		0.30%		100	Sold in the Export Market

3.2 Functional Analysis

Functional analysis identifies the agents involved in the rice chain and the functions that they perform. These agents include all the entities involved in the chain, upstream from input suppliers to downstream millers, traders and urban and rural retailers.

Production stage

There are several agents involved at different stages of the chain, performing specific functions. Table 6 provides a summary of the functions of these agents.

Farmer

The farmer is the key agent of the chain who is directly involved in the production of rice. There are an estimated 28,930 rice producers in the country (MOA, 2001). The farmers are largely subsistence, producing very little for the market. Due to mountainous terrain the farms and farmers are scattered, isolated and often far away from motorable roads. The scale of production is thus small and production costs are high.

Commission agent

The commission agent deals with seeds of improved varieties, fertilizers, herbicides and small tools and implements which are essential inputs at the production stage. They are responsible for supplying inputs to the farmers. The government pays a 10% commission of the sale volume of inputs. In most cases the CAs feel that the commission paid is inadequate for the business to be viable. The number of CAs per dzongkhag is also insufficient to cover all the farmers. Currently there are about 60 CAs in the whole country.

Extension agent

The extension agent (EA) provides new information, seeds and technologies and also train farmers on the use of such technologies. There are 201 geogs in the country and each geog is to be served by an EA. However, some EAs look after more than one geog and some geogs are big with geographically isolated villages and households making it difficult for a lone EA to cater to the need of the farmers.

Druk Seed Corporation

The DSC is the sole agency dealing with cereal seeds of new varieties. Once a new variety is identified and released by the research system, the breeder seed is passed on to DSC for multiplication and supply to the farmers. DSC has regional farms and facilities for seed production. It also produces seeds in farmers' fields through a system of registered seed growers. Generally, producing cereal seeds is not a profitable venture for DSC.

Table 8: Main agents and their functions at different stages of the chain

Stage of the Chain	Agent	Function	Output
Input	Commission agent	Inputs supply	
	Extension Agent	Technology and information	Paddy
	Druk Seed Corporation (DSC)	Supply of improved seeds and varieties	
	Researcher	Development of improved technologies	
Production	Farmer	Cultivation of rice	Paddy
	Agricultural Machinery Centre (AMC)	Supply of farm machines, tools and equipment	
Processing	Miller	Provides milling service	Rice
	AMC	Provides milling equipment, spare parts and services	Rice
Marketing	Urban retailer	Imports of rice for selling in urban markets	Rice
	Miller	Selling rice to consumers and retailers	Rice
	Farmer	Selling rice to consumers and sometimes to retailers	Rice
	FCB	Import for rice for selling in FCB outlets in rural and urban markets	
	WFP	Procuring imported rice from domestic brokers for supply to schools (about 2000 – 3000T per year)	
	Exporter	Export of rice, mostly red rice, to US and Europe	

Agricultural Machinery Centre

AMC is involved in farm mechanization through the procurement and supply of farm machines such as power tillers, tractors, reapers, threshers etc. AMC also conducts R & D of small tools and equipment and imparts training to farmers on the use and maintenance of machines.

Till date AMC has supplied 1254 rice mills, 1761 power tillers, 189 power threshers, 88 reapers and 53 transplanters to the farmers. Farmers are aware of the benefits of farm machineries in reducing production cost and also drudgery and the demand for these machines has been increasing. But the farm machineries especially power tillers which are sourced through the Japan government's KR II grant is not enough to meet the demand. AMC, therefore, is exploring other farm machine sources from the neighboring countries, other than Japan.

Research Centers

The role of the scientists at the research centers is to introduce, develop and evaluate new technologies and innovations in agriculture and rice farming. Technologies include new varieties and production practices which are superior to the existing ones in terms of productivity and efficiency. Researchers are based in the RNR Research Centres and their sub-centres.

Processing stage

Miller

There are an estimated 1500 rice millers in Bhutan who mill an average 37.4 MT of paddy a year. The millers are also producers or farmers themselves who set up rice mills as a small business and service in the rural areas. All rice mills are of Indian make and the quality of milled rice is poor. Milling machines are either run on diesel or electricity. Table 7 gives the usage, productivity and other details of rice mills used by farmers.

Agricultural Machinery Center

The involvement of AMC in the processing stage is through the supply of milling machines to the operators. Once a mill is supplied, AMC technicians assist in setting up and trial running the machines. AMC also stocks spare parts and provides services when asked for.

Marketing stage

Urban retailer

An important agent in the marketing chain is the urban retailer who imports rice and ensures rice security of the urban and rural populace. The data on the number of retailers is not available, but based on the survey conducted for the study and the data on rice imports and imports by an average retailer, the total

number of retailers in the country were estimated to be around 1036 (estimated from the study). Together they import about 28000 MT of milled rice annually, which is about 80% of the total import. The bulk of the imported rice is of low to medium quality priced around Nu 12 in the retail market (Table 8). Some high quality rice such as Basmati is also imported and sold to the middle and upper end consumers.

Miller

The miller is also involved in marketing of rice, which is paid in kind as milling charge. In the central and western parts of the country, millers usually collect rice as milling fee at about 1.3 kg (1 drey) of milled rice for every 26 kg paddy milled (20 drey). The collected rice is sold to consumers at the mill site or in the local markets at about Nu 27 per kg (Nu 35 per drey).

Farmer

To some extent, farmers sell rice in the local market when they are in need of cash to buy household essentials and pay for schooling their children. The household survey showed that about 14% of the rice produced in the farm is brought to the market. Individual farmers bring rice to the market using available public transport; there are no associations or cooperatives in marketing. Thimphu is the preferred market because of good price.

Food Corporation of Bhutan

Like urban retailers, FCB too imports rice from India to sell through its retail outlets in both urban and rural areas. The average annual quantity is about 7000 MT which is 20% of the total import. FCB so far is not involved in marketing of local rice. The quality of imported rice and rice brands by FCB and private traders are similar.

World Food Program

As part of the support to school feeding program, WFP procures rice from domestic brokers and supplies to schools around the country. It buys about 2000-3000 MT of rice annually on a competitive bidding basis. The rice it procures is all imported Indian rice because of the much lower price compared to the locally produced rice.

Exporter

The first (started in 1994) and so far the only individual exporting rice from Bhutan is an ex-official of the government now based in Paro. Besides rice, he also exports peaches, cherry, asparagus and strawberry to Thailand and Bangladesh. The main market for red rice has been the USA, but lately other emerging markets are UK and Germany. The total rice exported is about 100 MT annually (Table 9). Local rice is collected from Paro, Wangdue and Punakha @ Nu 14-16 per kg. It is processed and marketed at USD 1.75– 2.5 per kg in the western markets.

3.3 Commodity Chain Technical Performance and Gaps

The analysis of technical performance and gaps helps to understand the technical performance of the chain and identifies the gaps in technical performance, which need to be addressed for effective functioning of the chain. This analysis is conducted for every level in the chain – input, production, processing and marketing. The information provided by this analysis helps to identify the major constraints and issues in the chain that need to be addressed for the growth of the rice sector.

Inputs Stage

Supply of Chemicals and Fertilizers: The most important physical inputs for rice production are seeds, fertilizers, herbicides and irrigation water. Research and extension services, information and technologies are non-physical inputs equally important for higher production. The role of the government in facilitating input access to the producers determines the success of rice farming leading to a higher level of food production and security in the country.

Farmers mostly rely on home-produced organic manures to supply nutrients to the rice crop, which is fine but often not sufficient if a high yielding variety is cultivated. Supplementation through inorganic sources should be done. Green manuring is another simple and cheap method of fertilization and should be promoted in the sub-tropical zone. Low soil fertility is a key factor in the poor rice yields, especially in the low altitude areas.

The survey highlighted a pertinent issue on the access to inputs via the CAs: farmers reported CAs being far away (15%), no information on the availability of inputs and their prices (19%) and not having CAs at all (9%). Again in the southern zone, the CAs are not appointed/present or are not actively functioning. The use of herbicides to control weeds is minimal due to lack of awareness and access. Weeds are known to reduce rice yields substantially if no appropriate control measures are adopted.

Basically, the availability, access and delivery of inputs for rice production need to be vastly improved in most dzongkhags and geogs, and particularly those located in the southern foothills. Such an effort will no doubt pay rich dividends for rice producers as well as consumers.

Seed Replacement: The seed replacement ratio is low as farmers prefer to use their own seeds year after year, which affects production. Awareness and availability of seeds of improved rice varieties is also low, leading to a low adoption rate. More assertive extension and promotion of new varieties, possibly through free promotional programs, would remedy the situation.

Irrigation: Irrigation water is a core input in rice cultivation, but the problem of inadequate water affects a large proportion of rice growers. During the field survey, 46% of the respondents (n =120) reported inadequacy of irrigation water as their foremost constraint. The problem is graver in the southern low altitude foothills where irrigation infrastructures are lacking or defunct. The zone however has 18,000 acres (37% of the total rice area) of rice fields with yield less than 1 t/acre. Rice cultivation is dependent on monsoon rains which are highly erratic. The zone offers a huge potential for increased production if all inputs can be assured. There is a need to also strengthen research activities for the zone to make more technologies available to the users.

Production Stage

Cultivation methods: Farmers use traditional practices and methods of rice cultivation which result in sub-optimal management regimes and lead to low production. This is in fact typical of any subsistence farming – the challenge now is to go past such a stage to become more commercialized and specialized, exploiting the environmental and agro-ecological potentials of a given agro-economic zone.

Labor Shortage: There is an extremely high use of labour (more than 200 person days per ha) in rice cultivation, and farm labour in Bhutan is scarce and costly (Nu 100 per day with 2-3 meals provided). Scarcity stems from a small population and competing opportunities such as working off-farm, children enrolling in schools and monastic institutions, migration to urban centres etc. In such a scenario, reducing the labour requirement in rice cultivation, possibly through newer practices and increased use of farm machines, is called for.

Farming Equipment: Farming tools and implements are still largely traditional with very low use efficiency. For instance, the local plough, wooden plough shear and sickles which lack serration are inefficient; simple modifications to such implements can lead to greater efficacy and span. AMC can lead in this area. Farm mechanization, to the extent possible, needs to be accelerated. Options for machinery ownership by groups can be explored to ensure availability, instead of individual ownership.

Crop loss due to wild animals: Crop loss to wild animals such as elephants, wild boar, deer and monkeys is substantial and any prevention of such losses adds to the total production. It is often times beyond the means of a farmer to offset crop losses, except for crop guarding which still results in losses of yield and productive time of the farmer. Wild animals are a menace to farmers at the national level and much is talked about even in the National Assembly and outside it, but nothing concrete has been done so far.

Land Ownership: Ownership of land is an issue in relation to increasing productivity. From the survey, over 17% of the households have leased in or

leased out land. Land owners often restrict the use of crops and new varieties, productivity and optimization of land resource thus suffer. It becomes difficult for extension and development workers to promote new technologies and increase productivity.

Post Harvest and Processing

Harvesting and post harvest issues: Farmers usually harvest rice much later than the recommended stage when 85% of the upper portions of panicles turn straw colored, due to community belief of finding an auspicious date to commence harvesting. This results in pre-harvest and post-harvest losses in the field through grain shattering, particularly with the local varieties. Duba et al (1995) reported about 5% yield loss from shattering in Paro, Wangdue and Punakha valleys. Transportation loss from the field to heaps near the house accounts for another 2%. Clearly, rice breeding program should consider improvement of the shattering trait of the local varieties.

Rice Milling and Marketing: Rice milling is done using entirely Indian made machines which are pretty crude. It results in a lot of grain breakage, reducing substantially the head rice and total milling recovery. AMC needs to explore better and newer machines to improve the quality of milled rice.

The rice mills are owned by individual farmers and operated sub-optimally. The survey recorded an average 282 hours of operation in a year. This translates to only about 35 days of operation in a year. The lack of use of the machines leads only to wastage and abrasion. There is a need to improve the use efficiency of farm machines. In high rice producing pockets and regions, the government can provide support to private investment in setting up larger milling machines with provision of grading and bagging rice. Such rice can then be brought to the urban areas in a much more organized way. The mills can also serve as a collection center for traders.

Processed Products: The rice by-products such as *zaw* (puffed rice), *sip* (flattened rice) and *mekhu* (chapatti-like, cooked in oil) are home processed in small scale, mostly consumed at home and some brought to the local market (5 % farmers selling *zaw/sip* from the survey) mostly from Punakha. The by-products are available mostly on weekly local markets and only a few shops in urban centers stock them. Processing is labour-intensive and all done manually. Mechanization in processing *zaw* and *sip* will be a real boon for farmers, as *tengma* (roasted and flattened maize) machines have for maize farmers. These processing machines can create opportunities for micro enterprises. AMC should explore the possibilities of processing machines.

Marketing

Rice production in Bhutan is for home consumption. The census data for 2001 reported 1% of rice being marketed. However, based on our farmer survey as shown in the flow analysis, about 15% goes to the market. The census data is for 2001, and there has probably been an increase in marketing since then. The selling price of locally produced rice averages Nu 24 per kg, which is higher than the best quality (Basmati) imported Indian rice that sells at Nu 20 per kg. Urban retailers do not stock local rice so there is no regular supply for consumers as farmers bring their rice only to the weekly markets. The argument that rice import depresses domestic production thus does not seem to hold water.

There is no sizeable marketable rice volume from a single household or producer as land holdings are small. What is required is some sort of mechanism to pool together the small surpluses from individual households and bring to the market. We need entrepreneurs, middlemen, brokers and traders to get involved. This may not be a lucrative business to start with, and government has to provide some form of incentives or subsidies.

The proposal of setting up large scale milling and bagging centers fits well with the idea of getting the small surpluses out of the villages and production pockets. In the course of time, farmers will be induced to produce more for the market if reasonable price and door/farm gate collection could be assured. A possible marketing option is the link between FCB and Millers, millers provide rice to FCB for selling.

The above initiatives could grow bigger and lead to formation of farmers' associations and co-operatives for rice production and marketing, which is in fact a cherished goal of the Ministry of Agriculture. The government, however, must invest in development of infrastructures, farm roads, transportation facilities etc.

Although limited so far, the export of rice to the west is a lucrative and successful venture and there are distinct possibilities of further expansion. There is a need to develop marketing linkages for exports in other countries. This will enable farmers to sell their produce at a higher price and get a higher value for it. Government or research agencies have to invest in developing linkages. Increased exports would enable farmers to get a higher price for their produce and substitute for lower priced imported rice.

4 MICRO ANALYSIS AT OPERATOR LEVEL

As mentioned in the data section, data was collected from every operator in the chain – producers, millers, urban retailers, exporters and the FCB. Data collected at each level included the size of operations, costs, revenues, labor (family and hired). This helped to arrive at the financial and economic returns to each operator. The economic returns include the value of home consumption as well

as payment for household labor, whereas the financial returns account only for the market transactions.

After arriving at a detailed account of the individual operator, these values were aggregated to the total number of operators at each level. When available, national estimates of the number of operators at each level were used. Where the data was not available the number of operators was estimated from the study. For example, the total number of farmers is taken to be the same as the number of farmers provided in the Census (2001). This number might have changed over time, but there is not likely to be a very significant change. Also, the production figures arrived at using this method was quiet close to the production in the previous year.

In the case of downstream operators, 25 millers were interviewed, which gave an idea average quantity milled by each miller. Since the size of the mills used in the country are same, the average quantity processed by each miller was also not likely to differ significantly. Using the data for the total paddy produced in this country and the average quantity processed by each miller, we arrived at the number of millers in the country. This figure was crosschecked by the total milling machines provided by the AMC. The two numbers were very close. The estimates for the number of the other operators were also arrived at in a similar manner. These aggregates gave a complete picture of the aggregate returns and costs at each level in the chain.

4.1 Profile and performance of rice producers

Production and Utilization

Table 9 : Survey Results for Production

	Farm Size	Yield	Prod/Farm	Aggregate Production
Low	7,233 2.5	755	1888	13651
Medium	19094 1.3	1412	1821	34778
High	2604 1.5	1890	2816	7332
Total	28930 1.6	1197	1927	55762

Table 9 shows the profile of the producers based on the CCA survey. The surveys were conducted in all the producing regions – low, medium and high, which help to estimate the average farm size and yields and hence the production in these regions. The number of farms in each of these regions is

based on the Census 2001 data. Using this information we arrived at the total production in each producing region.

The average farm size in the low, medium and high altitudes is 2.5 acres, 1.3 acres and 1.5 acres respectively, still the total production per farm is the lowest in this region. This is because the yield in the low regions was 755 kg/acre which is about half the yield in the medium altitude regions. Thus, there is immense scope for enhancing the production in the country by enhancing the yield in the low altitude region.

Table 10: Average utilization of Paddy in different producing regions

Paddy Uses	Low altitude		Mid-altitude		High altitude	
	Avg.qty (kg)	Agg. qty (tons)	Avg. qty (kg)	Aggre. qty (tons)	Ave. qty (kg)	Aggre. qty (tons)
Seeds	50.00	362	78.54	1500	41	107
Home consumed	1636	11831	1382	26391	1845	4804
Gifts- Feed	104	752	96	1831	137	356
Sales in Paddy	98	707	265	5057	793	2065
Sales in equiv rice	64	459	172	3287	516	1343

The use of rice within a household is given in Table 10. Of the total production, the maximum amount is self-consumed, averaging about 1600 kg per household. Other uses include keeping seeds for planting in the following season and rice given as gifts. As seen in the flow analysis as well, the total rice sold in the market is 5089 tons, which is only about 15% of the domestic rice production.

Cost of Production

Table 11 shows the cost of production in the three producing regions. The cost of rice production is in per farm basis. While comparing the cost of production across regions it is important to keep in mind that the average farm size for the low, medium and high altitude is different. The total farm cost is divided by the average farm size in each category to arrive at the **Farm cost per acre** which makes it easy to compare the farm cost of production across regions. Farm cost of production and the total production cost including the cost of paddy processing are specified below.

The farm cost per acre is highest in the high altitude regions. This is because of the high use of fertilizers and plant protection chemicals. There is some use of chemicals and fertilizers in the mid altitude producing regions, where as in the low altitude regions the use of chemicals and fertilizers is negligible while the cost of labor and labor meals accounts for 96% of the farm cost. This analysis highlights two key points, first is the need for enhancing the supply of chemicals and fertilizers in the low altitude areas and the need to propagate labor saving technologies.

Table 11 : Production cost of rice producers

Cost items	Low altitude (2.5 acre)		Mid-altitude (1.3 acre)		High altitude (1.5 acre)	
	Nu	%	Nu	%	Nu	%
Fertilizer	0	0%	180	3%	326	4%
Plant protection chemical	0	0%	239	4%	929	12%
Small equipment	190	2%	202	4%	242	3%
Manure	221	2%	1134	20%	1739	22%
Hired labor	4750	43%	2038	36%	2664	34%
Meals provided to hired labour	5700	52%	1835	33%	1918	25%
Total Farm Cost	10861	100%	5628	100%	7818	100%
Farm Cost Per Acre	4344		3752		6013	
Rice processing	1461		1388		2223	
Total cost for Rice Production	12322		7016		10041	

Financial Analysis

The financial analysis accounts only for the market transactions and does not include house hold consumption or labor. Only the hard cash actually spent and earned is included in this analysis. Hence we account for the money spent on inputs and given out as wages and meals, and the income earned from actually selling the rice in the market. Table 12 shows the gross profits and cash income per household labor day (equivalent to cash wages earned) for each of the three growing regions. The cash income for both the low and the mid altitudes is negative, which is quiet obvious, because these groups spend money on purchasing inputs but sell only a very small amount of their produce in the market. Hence their cash income is negative. Only the high altitude farmers who sell a sizeable amount of their rice in the market actually make money from it. It is important to remember that this group also has the highest cost of production per acre, yet they are making returns even in financial terms.

Table 12 : Financial Returns to Producers

Inputs/outputs	Average household (Nu.)		
	Low altitude	Mid-altitude	High altitude
Sales	1,347	3,753	11,634
Intermediate Inputs	2,277	4,086	5,928
Other Costs	10,450	3,873	4,583
Gross Profit	-11,380	-4,206	1,123
Cash Income/HH labor day	-142	-48	21

The economic analysis of rice production is given in Table 13. This analysis values the amount of rice consumed at home as well as the wages of the household labor. Thus in this analysis, the value of sales includes the amount of rice sold in the market as well as the rice consumed at home. Also, Income section includes the income earned from the farming enterprise as well as income earned from working on the own farm.

Table 13: Economic Returns to Producers

	Low altitude		Mid-altitude		High altitude	
	Ave. Household (Nu.)	%	Ave. Household (Nu.)	%	Ave. Household (Nu.)	%
Sales	18,271	100%	24,738	100%	38,287	100%
Intermediate Input	2,277	12%	4,086	17%	5,928	15%
Value Added	15,994	88%	20,652	83%	32,359	85%
Income	5,544	35%	16,779	81%	27,776	86%
Hired Labour	10,450	65%	3,873	19%	4,583	14%
Returns to family labour (per day)	69		190		521	

The economic analysis of medium rice producers presents a slightly better picture in terms of family incomes. The returns to family labor per day is around 69 Nu per day, which is close to wage per day from working outside the farm in the low altitude zone. This reflects that by working on his own farm, he gets about as much as he would get from working off farm. This returns per day is higher in the mid and high altitude zones. Thus, though in financial terms the

farmer may actually be making losses, but in economic terms he is justified in continuing to work on his farm. However, the plight of the farmers in the low altitude regions can be enhanced by investing in increasing the productivity in this region.

4.2 Profile and performance of downstream operators

This section presents the profile and performance of the other operators – millers, urban retailer, exports. The profile gives a detail of their activities, the cost analysis helps to calculate the costs incurred in their operations and finally the financial analysis is presented. At the farm level, both the financial and economic analyses are conducted because household consumption and household labor is a big part of the household economy. However, at most other levels in the chain, both the analyses will give same results because household consumption and labor are not a big part of the analyses. Thus in such cases, it is sufficient to present the financial analysis.

Rice millers

Table 14: Usage and other details of rice mill

Item	Amount
Total millers (no)	1358
Paddy milled per year (kg)	37,441
Milling charge (Nu/kg)	0.84
Income per year (Nu)	31,549
Processing ratio (rice-husk)	0.65
Productivity of mill (kg/hr)	100
Machine use per year (hr)	282
Cost of mill (Nu)	19,000
Av life span (year)	12
Maintenance cost (Nu/year)	3500
Depreciation (Nu/year)	1583

The details of the rice milling activity shows that the average quantity of paddy milled per year is about 37 tons. The total costs per year amounts to Nu 16,559, of which 72% (Nu 11,981) is spent on diesel. Other costs are maintenance and electricity usage of Nu 3500 (21%) and hired labour of Nu 1076 (7%) (Table 14).

The financial analysis of rice millers is presented in Table 15. The analysis shows a value added of Nu 16,068 which is 51% of the total sales (Nu 31,549). The intermediate inputs are worth Nu 15,481 or 49% of the sales. The gross profit or income of a rice miller averages Nu 14,990 per year (93%) and the hired labour is low at Nu 1078 (7%). The returns to family labour is Nu 180 per day.

Table 15: Financial analysis of rice miller

Cost Items	Value (Nu.)	Per cent
Sales	31,549	100%
Intermediate inputs	15,481	49%
Value Added	16,068	51%
Income (gross profit)	14,990	93%
Cost of Hired Labour	1,078	7%
Returns to family labour (Nu/day)	180	

Urban retailers

The aggregate activity profile of urban retailers is shown in table 16. This includes the total quantity of rice imported and sold and the costs incurred in carrying out the operations. Together, the retailers in Bhutan imported 27,759 MT of milled rice, which is worth Nu 322,775 (Table 17).

The average purchase and selling price of the various varieties of rice are shown in Table 16. The local price is still sold at the highest price in Bhutan, implying the preference for local rice over imported rice.

Table 16: Prices and volumes of rice marketed by urban retailers

Item	Amount
Total rice imported per year (MT)	27,759
Local rice sold per year (MT)	2,164
Purchase price of high quality rice- Basmati (Nu/kg)	17.25
Purchase price of low quality rice- 551 (Nu/kg)	9.75
Purchase price of local rice (Nu/kg)	22.25
Selling price of high quality rice- Basmati (Nu/kg)	20.00
Selling price of low quality rice- 551 (Nu/kg)	12.25
Selling price of local rice (Nu/kg)	24.00
Total costs incurred for transport, marketing, labor (Nu/MT)	1431

Table 17: Cost analysis of urban retailers

Cost items	Nu.	Per cent
Imported rice	322,775	83%
Transportation	19,117	5%
Maintenance/ electricity/tel	560	0%
Rents	19,200	5%
Others	2,678	1%
Hired labour	10,511	3%
Taxes	12,000	3%
Total costs	386841	100%

The total costs amount to Nu 386,841 per year, of which 83% is the cost of imported rice, with transport and rents taking up 5% each and hired labour and taxes 3% each (Table 17).

The analysis of financial returns of urban retailers (Table 18) shows a high return to family labour per day of Nu 860. The value of total sales is Nu 469,344 annually. The gross profit (or income) is Nu 34,401. The value added is low at 12% of the sales.

Table 18: Financial returns of urban retailers

	Value (Nu.)
Sales	469,344
Intermediate Inputs	412,432
Other costs	22,511
<i>Gross profit</i>	<i>34,401</i>
Family Cash Income (Nu./day)	860

Exporter

The exporter of red rice from Bhutan is based in Bondey, Paro. Annually, he exports about 100 MT of milled rice to the USA, Germany and UK. The biggest market is the USA. The annual sales are worth Nu 9.90 million (Table 18) and his value addition is worth Nu. 5.30 million or 53% of the total sales. The intermediate inputs are 47% of the sales. The annual income is over Nu 4.67 million.

Table 19: Prices, costs incurred and volume of rice exported from Bhutan.

Item	Amount
Total rice exported per year (MT)	100
Purchase price from farmers (Nu/kg)	22.54
Selling price (Nu/kg)	99.00
Total costs incurred (Nu/kg)	45.00
Transport cost Paro - P/Ling (Nu/MT)	300
Transport P/Ling to Kolkata (Nu/MT)	4000
Ocean fare CIF (Nu/MT)	7500
Packing material (Nu/MT)	1000
Drying cost (Nu/MT)	807
Winnowing/sorting (Nu/MT)	5000
Collection cost from the farm (Nu/MT)	2240
Milling cost (Nu/MT)	800

The financial analysis in Table 20 shows that the gross profit of the exporter is over Nu 4.67 million. The family cash income per day is Nu 23,351.

Table 20: Financial Analysis

	Value (Nu.)
Sales	9,924,248
Intermediate Inputs	4,669,655
Other costs	584,450
<i>Gross profit</i>	4,670,142
Family Cash Income (Nu./day)	23351

5 ECONOMIC AND SOCIAL IMPACT OF THE CHAIN ON ECONOMY

5.1 Global economic weight and performance of the chain

Table 21: Distribution of value added and Pro-poor impact

	Million Nhu	US\$ Million	Distribution of Value Added
Gross product	1,302	28.93	
Added Value	670	14.89	100%
Salaries/Wages	174	3.88	26%
Farmers income	444	9.87	66%
micro-enterprise income	49	1.10	7%
Exporter	5	0.10	1%
State	15	0.33	2%

The economic and social impact aggregates the information generated in the previous section to understand the dynamics of the chain as a whole. Table 21 shows overall impact of the chain. The total value generated by the chain is 1302 million Nu (approx US\$ 29 million). Of the total value added a large part 92% is retained by the farmers as income and as wages earned by working on the rice farm. About 7% goes to micro enterprise which includes the rice millers and urban retailers. One percent of the value added goes to the exporter, which is a rather high percentage, given that there is only one exporter in the country. Finally, the state also benefits from importing rice and selling it in the country. This result specifically highlights the pro-poor orientation of the chain. Further, this distribution of value added reflects that any efforts to upgrade the chain will result in larger gains accruing at the farm level. Also, efforts to encourage group marketing and exports by farmers will also enable the farmers to capitalize on potential returns from exports.

5.2 Global employment and social impact

The 2004 Poverty Assessment Report estimated that about 32% of the Bhutanese population lives below the poverty line of Nu 740 per capita per

month. Rice and maize are the two most important food crops in Bhutan, accounting for over 80% of cereal production. Food self-sufficiency is closely associated with rice sufficiency. Poverty and food insecurity in Bhutan is largely a rural phenomenon with a rural poverty incidence of 38% (VAM, 2005). Region-wise, the east is considered to be the poorest, followed by central, southern and western regions. Dzongkhag-wise, the most vulnerable districts are Zhemgang, Pemagatshel, Wangdue, Mongar, Trashiyangtse and Gasa (VAM, 2005). The most vulnerable geogs (blocks) in different parts of the country are those which are far-flung and inaccessible.

Based on our estimates, the rice sector, the aggregated labour mobilized is over 3932 thousand man days per year. Assuming 150 days of employment per year, this translates to about 26,218 equivalent employments (Table 20). The total number of micro-enterprise in this sector are 31,325 which includes the number of farmers, millers, and urban retailers. Thus interventions to enhance incomes in the rice sector will have an impact on a large number of small farms and house households. This refers to the pro-poor criteria of the chain, where an intervention is likely to benefit a large number of poor households.

Table 22: Employment generation by the rice sector.

	Aggregated '000 MD	MD/ year /employment	equiv employments	employ/ micro-ent	Number of micro- enterpr
Labor mobilized	3,932.66	150	26,218	0.84	31,325.00

5.3 Food Security Role of the Chain

Rice is the second largest cereal consumed in the country after maize. Maize consumption is limited to the areas in which it is grown. In coming years rice is likely to become the largest consumed cereal because of increasing preference for rice, increasing urbanization, and diversification from maize to other high value crops. Thus, rice is the most important crop from the food security and sufficiency perspective. Rice and food are almost synonymous in the Bhutanese context, and food security is often equated with rice availability at the household and national level.

About 85% of the rice produced domestically is used at home with about 15% is going to the market. This reflects that rice cultivation is an important activity for the rural households for food security. The urban dwellers and consumers mainly depend on imported rice. The main importing agents are the urban retailers (80 % of imports).

Currently about 50% of the rice consumed in the country is imported. With increasing demand in future, the share of imports in the total consumption will increase if specific steps to meet the higher consumption with higher domestic production are not initiated. Based on the analysis discussed in the previous

sections, the growth strategy presents some concrete steps that can be undertaken for the growth of the rice chain.

6 TOWARDS GROWTH STRATEGY

The growth strategy is developed along the four axis of the Bhutan National Food Security Plan: i) Enhance and Stabilize Production, ii) increase access to markets, iii) generating employment opportunities and iv) minimizing the risks to production. The analysis conducted in the previous section, the functional and flow analysis as well as the analysis of technical performance and gaps have given insights into the issues and constraints in production and marketing (including issues and processing) of rice. The information from this analysis is used to develop the growth strategy.

The strategy emphasizes different actions for different production areas. In the low altitude region where the productivity is low, the strategy emphasizes enhancing productivity. It does not make sense to invest in marketing in the low production areas, where the marketing surplus is low. The emphasis in the medium and high altitude regions is on enhancing processing and marketing to provide a further impetus to production. Summary of the growth strategy is presented in Table 23.

6.1 Enhance and Stabilize Production

Promote adoption of improved technologies

The 'environmental potential' or the natural conditions for rice production is maximum in the temperate high-altitude zone because of the cooler temperatures at grain filling and ripening stage, relative freedom from insects, pests and diseases (except for rice blast), solar radiation and a combination of other factors favoring high grain yields. The medium altitude zone also has great potential for higher yields. Owing to high pest pressures and inherent low quality of soils, the low altitude foothills offer relatively low potential for rice production. However, even a slight increase in yield per unit area will lead to substantial increase in the total production due to the vast rice area.

Using mainly the improved varieties as a vehicle of reaching higher production, substantial yield gains are achievable. A combination of improved varieties with better management of soils, weeds and insect pests and diseases will result in further yield gains. There are already a number of improved rice technologies available for different rice zones, for instance, 15 high yielding varieties, accompanied by improved package of practices for management of seedlings, weeds, nutrient, diseases etc. Traditional rice varieties are highly adapted to local conditions and possess excellent culinary characteristics but have limited genetic yield potential. A switch from the traditional to improved varieties has the

potential of higher production at minimal costs. Similarly, any supplementation of inorganic nutrients to the traditional practice of using organic manures will greatly increase rice production.

From a technical standpoint, continuous breeding and variety development using local rice germplasm for specific needs in different AEZs will be essential. Increased use of mineral/inorganic fertilisers in conjunction with the organic sources (green manures in the foothills) will increase and sustain rice productivity. Assuring irrigation water in major rice growing areas through major expansion and rehabilitation of defunct schemes will pay dividends in terms of increased rice production. From policy viewpoint, the Ministry of Agriculture needs to convince the government for a higher level of subsidies for rice farmers and put in place support mechanisms favoring production through farm mechanization, processing and marketing. Farm mechanisation should be supported to minimize the cost of production through labour saving and to make rice farming more appealing to the youth. Building farm roads and power tiller roads will increase access to inputs and markets for rice farmers. Formation of farmers' groups and associations for collective and efficient production and marketing needs to be supported.

Ensure availability of inputs in all producing regions

The most important physical inputs for rice production are seeds, fertilizers, herbicides and irrigation water. Research and extension services, information and technologies are non-physical inputs equally important for higher production. Lack of inputs availability came out as an important issue in hindering production in all producing regions. Infact, this was a issue not only for the rice crop but also for all the crops for which CCA analysis was conducted – maize, potato and mandarin. The availability, access and delivery of inputs for rice production need to be vastly improved in most dzongkhags and geogs, and particularly those located in the southern foothills. The input supply system of the Commission Agents is apparently not adequate to ensure availability of inputs at the farm level. A closer look at the input supply system is required to ensure availability of inputs at the farm level, which in turn will lead to higher productivity.

Another aspect of input supply is farming tools and implements. Farming tools and implements are still largely traditional with very low use efficiency. For instance, the local plough, wooden plough shear and sickles which lack serration are inefficient; simple modifications to such implements can lead to greater efficacy and span. AMC can lead in this area. Farm mechanization, to the extent possible, needs to be accelerated. Rather than owning individually, the farm machines can be provided to a community or group, with facilitation of the geog centres, for more efficient use.

Promote labor saving devices and mechanisms

Rice production is highly labor intensive using more than 200 person days per ha in rice cultivation. Farm labour in Bhutan is scarce and costly (Nu 100 per day with 2-3 meals provided). To start off with, scarcity of labor arises from a small population. Furthermore there are competing opportunities such as working off-farm, children enrolling in schools and monastic institutions, migration to urban centres etc. Labor shortage results first in high cost of labor and secondly leads to land being left fallow and hence reducing the area under rice cultivation. In such a scenario, reducing the labour requirement in rice cultivation, through newer practices and increased use of farm machines, is called for. Due to farm labor shortages, a large proportion of the total production is paid to hired labourers as wage. Barter system that is still prevalent in the villages is another reason for rice not being marketed. Farmers reported bartering rice for meat and other dairy products also.

Reduce the impact of wild animals

Crop loss to wild animals such as elephants, wild boar, deer and monkeys is substantial and any prevention of such losses adds to the total production. It is often times beyond the means of a farmer to offset crop losses, except for crop guarding which still results in losses of yield and productive time of the farmer. Wild animals are a menace to farmers at the national level and much is talked about even in the National Assembly and outside it, but nothing concrete has been done so far.

The government is responsible for overall rural development and welfare of the people. Plans, programs and policies of different ministries and agencies impinge on the livelihood of the rural people; the government should ensure harmony amongst agencies for a balanced and sustainable development. A case of increasing imbalance is felt with the current environment and conservation policy of the government in protecting wildlife whilst farmers fall prey to crop depredation by these wild animals, threatening their very livelihoods. Rational resource allocation at the national level is another sacred responsibility of the government.

6.2 Increasing Access to markets and Enhancing employment generation

The issues of marketing, processing and employment generation are closely associated and are discussed jointly in this section. It has come out strongly in the above discussion that marketing of rice is a very crucial issue. Currently only about 15% of rice domestically produced is marketed, which comes mostly from high and mid-altitude zones, whereas marketing from low altitude zones is almost negligible. There is no internal flow of rice from areas of high production to non-rice and deficit dzongkhags. Rice trade is dominated by a few urban retailers who

deal with imported rice from India. Trade in local rice is not at all organized, hence there is no real incentive for the farmers to produce rice for the market.

The Ministry of Agriculture realizes this bottleneck and as a part of the triple strategy of production, access and marketing (PAM), the earlier insignificant marketing unit of the Planning and Policy Division is now upgraded to the Agricultural Marketing Services (AMS) with added people and resources. AMS is likely to become a full-fledged department in the future. It is expected that rice marketing will receive the required support from AMS.

For collective marketing, which is obviously more efficient than individuals bringing their produce to the market, there is a need to support producers to form appropriate groups, association and co-operatives. Such groups are also essential for rice production at a commercial scale. The Cooperative Acts of 2000 provides the legal basis for such formations. A number of initiatives are already underway in this regard, however more focused efforts are necessary for rice marketing.

There is a real need to involve FCB in rice marketing in a much more meaningful role than their present engagement. FCB already has a wide network in the rural areas, with retail shops and godowns. FCB can be actively involved in the domestic procurement of local rice from strategic collection centers around the country. The rice can then be sold through the FCB shops or to the urban retailers.

Mechanized processing of rice by-products will also help marketing, by way of making by-products available in urban markets in large quantity as well as quality.

As far as rice export is concerned, the involvement of the government seems minimal and the exporter based in Paro is doing well. However the exporter would like the involvement of the government in setting up certification system in the country as such a prerequisite is increasingly demanded by the importers. Setting up an inland dry port will also reduce the hassles and costs of marketing rice in the future.

Table 23: Growth Strategy for Rice Chain

National food security strategy axis	Rice strategic areas of intervention	Specific Activities for Supporting Rice Chain	Specific support policies
Increase and stabilize domestic food production	Promote adoption of improved technologies (with focus on low altitude areas)	<ul style="list-style-type: none"> • Research and adaptation of superior varieties • Production management including nutrient and pest management, and other production technologies 	<ul style="list-style-type: none"> • Ensure adequate fund and manpower resources for agriculture

6.3 Public Investment and Policy Support Needs

Enhance Production

Although there are a number of rice technologies available for use, they are not fully utilized. There is also a need to more effectively integrate the various components of rice technologies to suit different agroecological and socioeconomic domains (Shrestha, 2004). The agriculture extension needs to carry out more aggressive promotion and utilization of improved rice technologies for visible impacts.

The national research for rice (and other crops) is carried out in four major research centres (RNRRCs) and a few of their sub-centres. Given the diversity of rice agro-ecological conditions the present stations are inadequate to cover the needs and specificity of local environments. Hence there is a need to open up more sub-stations in key locations and also strengthen the existing ones with human and other resources.

Particularly for the low elevation southern belt, there is an urgent need to relocate additional research resources because of the large rice area and the potential to contribute to the national production. Presently, there is only one research assistant based at Bhur looking after the research needs of the entire belt. The possibility of opening sub-stations at Samtse and Samdrupjongkhar also needs to be looked at.

Enhance Involvement of Private Operators

One of the frequently cited problems during the survey related to inputs supply was about the commission agent (CA) not present in the locality, being far away, or not actively dispensing inputs. The CAs play a critical role in the development of agriculture through the provision of needed inputs and information, but the present number of CAs (one per dzongkhag in most cases or 3-4 in some dzongkhags) is not adequate to cover the needs of the rice farmers. Ideally, one CA per geog would make inputs more accessible but the viability of such a suggestion needs to be studied.

More private operators in the rice chain should be encouraged. The recent opening of the sale of tools and implements by private operators, restricted to AMC earlier, is a good initiative. Private operators can also get into the supply of herbicides, fertilizers, seeds etc bringing in much needed competition and improvement in quality. Sufficient regulatory regimes need to be in place, of course.

In a similar way, private entrepreneurs should be supported to set up large milling units with facilities for grading and packaging of rice in the major rice belts on a commercial scale. Such units would also serve as collection centres and induce rice production beyond the present household and subsistence levels.

There is also a need to involve private operators in the processing of rice by-products such as *zaw* and *sip* with possible mechanization. Currently, the production is limited to small amounts for household consumption and local markets due to high labour requirement. AMC may look into the possibility of mechanizing the production of *zaw* and *sip*.

Enhance Marketing in the Rice Chain

The marketing aspect of the rice chain is weak and under-developed. There is no internal flow of rice from areas of high production to non-rice and deficit dzongkhags. Rice trade is dominated by a few urban retailers who deal with imported rice from India. Trade in local rice is not organized – most of the domestic rice is sold in Sunday markets. Hence there is no real incentive for the farmers to produce rice for the market. The Ministry of Agriculture realizes this bottleneck and as a part of the triple strategy of production, access and marketing (PAM), the earlier insignificant marketing unit of the Planning and Policy Division is now upgraded to the Agricultural Marketing Services (AMS) with added people and resources. AMS is likely to become a full-fledged department in the future. It is expected that rice marketing will receive the required support from AMS.

For collective marketing, which is obviously more efficient than individuals bringing their produce to the market, there is a need to support producers to form appropriate groups, association and co-operatives. Such groups are also essential for rice production at a commercial scale. The Cooperative Act of 2000 provides the legal basis for such formations. A number of initiatives are already underway in this regard, however more focused efforts are necessary for rice marketing.

There is potential to involve FCB in rice marketing in a much more meaningful role than their present engagement. FCB already has a wide network in the rural areas, with retail shops and godowns. FCB can be actively involved in the domestic procurement of local rice from strategic collection centers around the country. The rice can then be sold through the FCB shops or to the urban retailers.

Mechanized processing of rice by-products will also help marketing, by way of making by-products available in urban markets in large quantity as well as quality.

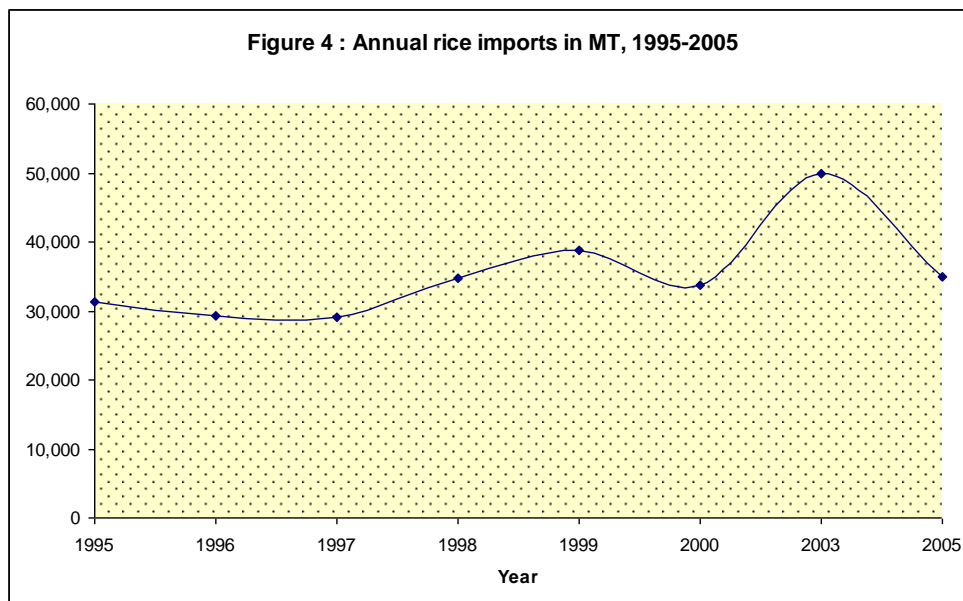
As far as rice export is concerned, the involvement of the government seems minimal and the exporter based in Paro is doing well. However the exporter would like the involvement of the government in setting up certification system in the country as such a prerequisite is increasingly demanded by the importers. Setting up an inland dry port will also reduce the hassles and costs of marketing rice in the future.

6.4 Quantitative Assessment of Growth Scenarios

The above section defines the growth strategy. However, in making investments in this sector, it is important to have quantitative estimates of the level of growth required and also see the impact of this growth strategy on different players in the chain. Thus, this section answers two critical sections: What is the extent of growth required? What is the impact of growth strategy on chain participants – including, farmers, micro processors, etc. Of course, the growth strategy is very wide and it is not possible to measure the impact of all these changes, but we present here the impact of some of the key aspects of the chain.

Future Demand Evolution

To evolve a growth strategy we need some estimates about the future demand for rice. The total milled rice consumed in the country in 2005 was 67,038 MT. The current domestic production fulfilled 49% of this total and the rest was imported. The demand for rice can only be expected to rise in the future because of the growing population at around 2.5% per annum, rural-urban migration and rapid urbanization, higher preference for rice than maize, the only other cereal crop in the country, and an increase in income from the sale of cash crops and off-farm employment. The emergence of non-farming population and the rapid growth of the urban population at around 10% will contribute to an increase in rice demand over the next 15-20 years (MoA, 2000). Assuming these rates of growth and considering the per capita consumption of rice at 172 kg as estimated from our data, the projected demand for rice in 2015 is 80,000 MT. To what extent can we achieve this? To what extent will imports grow with increasing demand?



6.5 Potential Achievable Supply Targets

The rice production in the country in 2005 was 33,055 MT against the total consumption of 67,038 MT. In 2004, rice was cultivated on an area of 46,585 acres (Agri Stats, 2004). The land registration records, however, showed the total rice area in 2004 to be 69,414 acres. The difference in the acreage can be partly explained by the fact that many rice fields in different parts of the country remained uncultivated owing to several reasons, including shortage of farm labour, crop predation by wild animals and lack of irrigation. Over the years, the total rice area has been decreasing but the rice yields per unit area have increased. The top five rice producing dzongkhags are Samtse, Sarpang, Punakha, Wangdue and Paro. The national average yield of rice is 1.35 t/acre. Paro has the highest average yield (1.63 t/acre), followed by Punakha, Wangdue, Trashigang, Trashiyangtse and Thimphu. The southern districts of Samtse, Samdrupjongkhar and Sarpang, although with large area, have low average yields, largely due to problems of soil fertility and pest problems.

Technically, there is ample scope to raise the current level of rice productivity and total production in the country. Table 21 provides a summary of the present and projected rice production by zones. Assuming a modest increase of the rice yield from 1.35 t/acre to 1.70 t/acre, an additional 19,840 MT of rice could be produced.

Thus, in 10 years, the demand will be about 80,000 MT, where as the supply will be about 33,000 + 19,840 = 52,840 MT. The balance which will be covered by imports will be around 27,160 MT (about 34 % of demand). Thus, to enhance self sufficiency in food grains it is necessary to achieve the increase in production.

Table 24: Current and projected rice production in Bhutan (CCA survey)

Production zone	Area (acres)	Current Production (MT)	Current Yield (t/acre)	Potential yield t/ac	Additional production (MT)
High altitude	3880	7332	1.89	2.00	428
Mid altitude	24631	34778	1.41	1.80	9558
Low altitude	18081	13651	0.75	1.30	9854
Total	46592	55761	1.35	1.70	19,840

The analysis conducted above can be used to conduct simulations and see the impact of this higher production at the farm level and different levels in the chain. We present here two scenarios for the growth of the rice sector. **Scenario 1** focuses only on enhancing yield by increasing input supply. **Scenario 2** focuses on enhancing rice production by enhancing input supply as well as bringing more area under rice cultivation. This captures the impact of bringing fallow land under rice cultivation. The results of these two scenarios are presented here which shows the impact of these changes on the rice chain. These two scenarios are

demonstrated here only as an example. Other possible scenarios can be explored using the analysis in a similar manner.

Rice growth scenario 1

Scenario 1 assumptions:

- For high and mid altitude rice zones: Increase in fertilizer use by 30%
- For low altitude, increase in fertilizer and herbicide use by 15%

Growth **Scenario 1** assumes an increase of fertilizer use by 30% in the high and mid altitude zones and 15% increase in fertilizer and herbicide use in the low altitude rice zone. The impact of this change is summarized in table 25 and 26. Table 25 presents the key parameters -- rice area, production, productivity, for the current period and Scenario 1 along with the percentage change from current situation to Scenario 1. Table 26 presents the distribution of value added in the current and scenario 1 situation along with the percentage changes.

The average yield, household production and the total rice production will increase by 34%. The cost of production will decrease by 22%, while raising the returns to family labour by 57%. The average cost of producing a kg of milled rice declines from Nu 13.41 to 10.48 because of higher productivity per acre. In the current situation, the farm labor productivity per day is 15.3 kg which increases to 20.4 kg. Finally, the returns to family labor increases from Nu 180 per day to 283.

Table 25: Current rice area, production and productivity

<i>Parameters</i>	<i>Current Situation</i>	<i>Scenario 1</i>	<i>% Change</i>
Total paddy production (tons)	55,762	74,538	34%
Rice area (acre)	46,592	46,592	0%
Average yield (Kg/acre)	1,197	1,600	34%
Average production (kg/household)	1,927	2,576	34%
Eco productivity per acre (Nu/acre)	27,946	39,973	43%
Farm labour productivity (kg/day)	15.3	20.4	33%
Paddy production cost (Nu/kg)	7.95	6.09	-23%
Rice production cost (Nu/kg)	13.41	10.48	-22%
Average Eco. Profit (Nu/farm)	14960	23458	57%
Returns to all labour (Nu/day)	163	230	41%
Returns to family labour (Nu/day)	180	283	57%

At the national level, the gross product from rice farming is Nu 1315 million which is equivalent to USD 29 million. The gross product will increase by 43% to Nu 1862 million. Likewise, the farmers' income will be raised by 56%, however, the largest benefit will accrue to the micro-entrepreneurs with an increase of 326%. The micro enterprise in this case include the millers, urban retailers and exporter.

Table 26: Value added distribution of rice enterprise (Current Situation and Scenario 1)

Parameters	Million (Nu)		Million (USD)		Value added distribution		% Change
	Current	Scenario1	Current	Scenario 1	Current	Scenario 1	
Gross product	1,315	1,862	29	41			43%
Added Value	683	1,119	15	25	100%	100%	64%
Wages	174	203	4	5	26%	18%	17%
Farmers income	443	690	10	15	65%	62%	56%
Micro-enterprise income	49	210	1	5	10%	19%	326%
State	15	15	0	0	1%	1%	0%

Rice growth scenario 2

Assumptions:

- For high and mid altitude rice zones: Increase in fertilizer use by 20%
- For low altitude, increase in fertilizer and herbicide use by 10%
- For low altitude, increase in area by 20% by cultivating fallowed wetlands

In the growth scenario 2, the assumptions are: for high and mid altitude rice zones, an increase in fertilizer use by 20%; for low altitudes, an increase in fertilizer and herbicide use by 10% and an increase in cultivated area by 20% by using fallowed wetlands. Many wetlands are left fallow due to lack of assured irrigation and farm labour. So the increase in cultivated rice area would entail investments in irrigation for the low altitude zone.

The simulation outcomes of the rice scenario 2 are presented in Tables 27 and 28. The results for the two scenarios are not very significantly different. The major difference is that in scenario 1 all the increase in production is due to higher yield, where as in scenario 2 the increase in production is achieved by bringing in a larger area under rice production as well as by increasing yield. This is shown in the yield difference which is 34% in scenario 1 and 22% in scenario 2.

Table 27: Growth projections: Scenario 2

Parameters	Current Situation	Scenario 2	% change
Total paddy production (tons)	55,762	73,467	32%
Rice area (acre)	46,592	50,208	8%
Average yield (Kg/acre)	1,197	1,463	22%
Average production (kg/household)	1,927	2,539	32%
Eco productivity per acre (Nu/acre)	27,946	36,086	29%
Farm labour productivity (kg/day)	15.3	18.8	23%
Paddy production cost (Nu/kg)	7.95	6.43	-19%
Rice prod. cost (Nu/kg)	13.41	11.00	-18%
Average Eco. Profit (Nu/farm)	14960	22218	49%
Returns to all labour (Nu/day)	163	209	28%
Returns to family labour (Nu/day)	180	255	42%

The value added will increase by 58% and the gross product by 39%. The micro-enterprise income will be augmented by 295%. Similarly, the income of rice farmers will be boosted by 48%.

Table 28: Value added distribution of rice enterprise (Current Situation and Scenario 2)

Parameters	Million (Nu)		Million (USD)		Value added distribution		% Change
	Current	Scenario 2	Current	Scenario 2	Current	Scenario 2	
Gross product	1,315	1,812	29	40			39%
Added Value	683	1,080	15	24	100%	100%	58%
Wages	174	216	4	5	26%	20%	24%
Farmers income	443	654	10	15	65%	61%	48%
Micro-enterprise income	49	195	1	4	10%	18%	295%
State	15	15	0	0	1%	1%	0%

7 STRATEGY, INVESTMENTS AND PUBLIC-PRIVATE PARTNERSHIP

7.1 Strategic Diagnosis and Log Frame

The strategies for rice growth can be categorized as short term, medium term and long term.

Program/activities	Time frame
Long term	
• Strengthen rice research capability (staff, facilities, outreach centres) for the low-altitude zone	5-6 years
• Rice variety development	6-9 years
• Develop irrigation canals	5-6 years
• Put in place enabling policies for rice (subsidies, inputs etc)	
• Develop links with international markets, especially for red rice	5-6 years
• Build farm roads, power tiller tracks	5-10 years
Medium term	
• Variety introduction and evaluation	3-4 years
• Development of production technologies (nutrient, pests, processing)	2-4 years
• Farm mechanization – suitable machineries, tools, equipment	2-5 years
• Develop internal marketing mechanisms and facilities	2-3 years
Short term	
• Appoint commission agents to improve inputs supply and delivery	1-2 years
• Appoint more research staff (in Bhur, Darla/Samtse) to cover the low altitude rice zone	1-2 years

7.2 Investments

(See Investment Plan as an Annex to this document)

7.3 TOWARDS A PUBLIC-PRIVATE PARTNERSHIP IN ENHANCING COMMODITY CHAIN

Many stakeholders are involved and are important for proper functioning of the rice commodity chain. Their participation and genuine contribution for improvement of the functioning of the chain through various measures including policy changes are vital. The government has a facilitative role in bringing together the stakeholders and provide interactive forums from time to time.

The FCB is involved in the import of rice and its domestic marketing. It does not have an apparent role in the production and marketing of local Bhutanese rice so far. Such a role however is crucial to boost local rice production, through establishment of collection centres and linking with large scale rice mills.

The government is responsible for overall rural development and welfare of the people. Plans, programs and policies of different ministries and agencies impinge on the livelihood of the rural people; the government should ensure harmony amongst agencies for a balanced and sustainable development. A case of increasing imbalance is felt with the current environment and conservation policy of the government in protecting wildlife whilst farmers fall prey to crop depredation by these wild animals, threatening their very livelihoods. Rational resource allocation at the national level is another sacred responsibility of the government.

The role of the MoA is to develop or attune policies with changing times and emerging needs to ensure a favorable policy regime for the growth of agriculture and rice sector. Another important area of intervention is the study, allocation of adequate resources and application of relevant subsidies to foster agriculture. The present level of subsidy, which is mainly on transport and commission paid to CAs, is too little and spread thinly for any noticeable impact.

CORRB oversees RNR research and administers the research centres in the country. There are currently four main research centres and a few sub-centres which carry out research on rice. Among the centres, RNRRC Bajo has the responsibility for overall coordination and supervision of rice research. CoRRB is also responsible for resource allocations for research.

The research centres consider rice as an important commodity and research is accorded a higher priority relative to other crops. All the centres have facilities and trained staff to conduct rice research. However, the research allocation for the low altitude region, now based at Bhur, needs to be doubled to cater to the needs of a vast rice growing population and area grown to rice. Other rice environments such as the humid subtropical zone (600-1400 m) also require more research attention.

Among other responsibilities, the Department of Agriculture looks after the construction and maintenance of irrigation infrastructure in the country. Due to limitations on manpower and funds, the desired level of investment in irrigation has not been possible. In the future there is a need to explore investment possibility, particularly in the low altitude rice belt. The Department is also tasked with the construction of farm roads to improve market access in the rural areas. The agricultural extension network of the districts is technically overseen from the Department, while the Dzongkhag provides finances and administration. Such an arrangement often leads to a lapse of responsibility and passing of blame from one to another.

Supply of farm machineries, tools and equipment for improving farming efficiency is the primary role of AMC. So far it has supplied 1761 power tillers, 189 power threshers, 88 reapers, 53 transplanters and 1254 rice mills besides small hand tools and equipment. The demand especially for power tillers outstrips its capacity to supply, dependent as AMC is on the grants from Japan. There is a need to explore other sources of farm machineries which are suitable for our farmers in terms of technical performance and price.

DSC is a semi-government organization dealing with the supply of seeds and planting materials. It has dual, often opposing, mandates of becoming financially sustainable while at the same time fulfilling the social role of providing seeds and planting materials to the farmers at reasonable costs. This leads to a dilution of efforts in both the fronts and there are complaints of shortfalls of seeds and seedlings, both in quantity and quality. The mandates of DSC need to be clarified and separated, and a workable system of seeds supply reinstated urgently.

Donor groups have played a crucial role in the development of agriculture in Bhutan. Specifically to rice research and development, the IDRC in technical collaboration with IRRI has supported the country in improving the rice productivity and production and in building human capacity for research. Such collaboration and support have to continue in newer and emerging areas such as market development and linkages.

8 CONCLUSIONS AND KEY POLICY RECOMMENDATIONS

Rice plays a crucial role in food security of the Bhutanese people. In recent years, the imports are increasing. With future rise in population and increasing urbanization combined along with increasing preference for rice as a staple food, the imports in future are likely to increase. This situation has severe implications for food security and sufficiency in the country. Further, rice is largely a subsistence crop with only 15% of the domestic production going to the market. The rice marketing and processing are in a very primitive stage and it is crucial to invest in upgrading and modernizing the chain to meet the internal demand and enhance competitiveness vis-à-vis the imports. A detailed understanding of the

rice production system and the various actors involved is necessary for improvement and modernization of the rice enterprise. The present analysis of the rice chain, the first of its kind, is therefore timely and appropriate. The study covered 6 major rice growing dzongkhags and 24 geogs in the high, mid and low-altitude zones.

The present rice production in the country is estimated to be 33, 055 MT against the domestic supply of 67, 038 MT. Cultivated rice area in the country is 46,585 acres, which has been on a decline over the years. Major rice producing dzongkhags are Samtse, Sarpang, Punakha, Wangdue and Paro. The national average yield of rice is 1.16 t/acre, with Paro having the highest average yield of 1.63 t/acre. The low altitude districts of Samtse, Samdrupjongkhar and Sarpang, have large area but low average yields due to problems of soil fertility and pests. Technically, there is a scope to raise the current level of rice productivity and total production in the country.

The different agents or stakeholders in the chain include the farmers, commission agents, extension agents, researchers, DSC, AMC, FCB, WFP, millers, exporters and urban retailers. The rice farmers are largely subsistence and not directly linked with the market. The CAs supply inputs such as seeds, fertilizers and herbicides to the farmers, on a commission basis which requires revision. The current coverage and number of CAs is inadequate for inputs distribution. The research and extension staff provide new technologies and train farmers on their use. Large scale seed supply of a newly released variety is the responsibility of DSC, while AMC is involved in farm mechanization. The scope for further mechanization exists, which is expected to lower the cost of production. There are an estimated 1500 rice millers in the country, but the quality of milled rice is poor with a high percentage of broken grains. The urban retailers import about 28,000 MT of milled rice annually, which is 80% of the total import. FCB imports the remaining rice and retails through its rural and urban outlets. About 100 MT of Bhutanese red rice is exported to the west annually.

There are several gaps and weaknesses in the production, processing and marketing of rice. The low seed replacement ratio and use of modern varieties affects production. Farmers mostly rely on organic manures to supply nutrients to the rice crop, which is not sufficient for raising production. Low soil fertility is a key factor in poor rice yields of the low altitude areas. Irrigation water is a core input in rice cultivation, but the problem of inadequate water affects a large proportion of rice growers. The problem is more serious in the southern low altitude foothills where irrigation infrastructures are lacking or defunct. Access to inputs via the CAs is still a problem area because of the insufficient number of CAs and their inappropriate location in the dzongkhags.

Farmers use traditional practices and methods of rice cultivation which result in sub-optimal management regimes and lead to low production. There is an extremely high use of labour in rice cultivation, and farm labour in Bhutan is

scarce and costly. Farming tools and implements are still largely traditional with low use efficiency. Farm mechanization is limited, restricted by the availability of affordable machines and the natural terrain itself. Ownership of land is an issue in relation to increasing productivity. Land owners often restrict the use of new crops and varieties, leading to low productivity and resource utilization. Crop loss to wild animals such as elephants, wild boar, deer and monkeys is substantial, and farmers are left with limited options like crop guarding.

There is substantial (up to 5%) pre-harvest and post-harvest loss in the field through grain shattering, particularly with the local varieties. The presently used rice milling machines are pretty crude resulting in a lot of grain breakage and low head and total rice recovery. The mills are owned by individual farmers and operated sub-optimally. The rice by-products such as *zaw*, *sip* and *mekhu* are home processed in small scale, mostly consumed at home and only about 5% brought to the local market. Processing is labour-intensive and all done manually.

Marketing of rice is quite limited with less than 15% of the harvest going to the market. Although the selling price of locally produced rice is higher (Nu 24 per kg) than the best quality imported Indian rice (Nu 20 per kg), urban retailers do not stock local rice due to limited and erratic supply and also low profit margin. Farmers bring their rice mostly to the weekly markets. The export of Bhutanese rice to the west is seemingly lucrative and there are possibilities of further expansion.

On the positive side, the rice research and development program has been successful in increasing production and food security in the country. In terms of available technologies, there are 15 improved rice varieties accompanied by improved packages of production. About 35% of the rice area is grown to modern varieties. Improved rice varieties and component technologies have increased national rice output by 5,000-10,000 MT per year, which is equivalent to Nu 60 to 121 million per year.

However, it is apparent that an important rice ecosystem in the low altitude region which covers 37% of the total rice area has so far been neglected by research and development. Resource allocation for this belt has not been commensurate with the large area and potential for contributing to the national rice production.

Key policy recommendations

There are several agencies of MoA involved in rice research and development but the efforts have been largely piecemeal, with different agencies working in isolation. There is a need to develop a comprehensive and national program on rice with the involvement of all the major stakeholders (research, extension, inputs suppliers, producers, retailers, millers, exporter etc) to improve the national output of rice. Rice production areas and pockets need to be identified

and their potential maximized. The program should have appropriate coordination amongst agencies, clear output goals and adequate resources.

So far the interventions for rice development have been limited to providing improved technologies to the producers with the expectation that this will lead to additional production. This has not happened to the desired level. None or little support has been provided in the area of processing and marketing. Rather than 'pushing' farmers to produce more, 'pulling' them through suitable support in processing and market linkages will be more effective. Mechanisms to link additional production to the markets are necessary. Internal markets have to be organized and developed for greater rice trading and flow from production to consumption areas.

The MoA's Triple Gem approach of production, access and marketing (PAM) has to be translated into practical terms with matching investments in farm roads, processing and trading facilities, and market linkages. MoA must garner additional resources to do this. To boost production, investments in irrigation infrastructure and improvement in the delivery of production inputs (seeds, fertilizers, weedicides etc) are required. Farm mechanization is another area that can bring about benefits through lower costs and greater production.

The low altitude rice zone, despite having 37% share of the rice area, has not contributed significantly to the increase in production due to low yields. The region has been neglected in terms of research, extension, supply of inputs and farm machines etc. With suitable technologies, research on special varieties for this area, the region can substantially contribute to the national food supply and reduce dependence on imports. Allocation of additional resources should be prioritized for the region.

As a policy intervention, provision of a higher level of subsidy for agriculture in general and rice in particular is strongly advocated. It is generally accepted that the current level of subsidy is too less and thinly spread to make any impact. It is recommended that the MoA commission a review of the present policy on subsidy and propose suitable alternatives on a priority basis.

To exploit the advantages of a niche product like red rice, there is a need to support the producers through better technologies and inputs. The exporters could be supported by exploring new markets and establishing linkages. The possibility of having a certification system in place for organic products also needs to be studied.

References

- DoA. 2004. Agriculture statistics. Department of Agriculture, Ministry of Agriculture. Thimphu.
- Duba S, Ghimiray M, Dorji Y. 1995. Rice post harvest management systems in Paro and Wangdue-Punakha valleys. RNRRC Bajo Technical Papers Series No. 2. Wangdue.
- MoA-WFP. 2005. Vulnerability analysis and mapping. Policy and Planning Division, Ministry of Agriculture. Thimphu.
- PPD. 2000. RNR statistics. Planning and Policy Division, Ministry of Agriculture. Thimphu.
- Shrestha S. 2004. An economic impact assessment of the rice research program in Bhutan. International Rice Research Institute, Los Banos, Philippines.

Table 29: Program Budget Summary

Sub-program/Project/Component	Estimated Budget (Nu. m)			Funding Source	Funding Type	Remarks
	Recurrent	Capital	Total			
1. Post production and marketing	1.5	4.5	6.0	Donors, RGoB		To be sourced
Key activities						
<ul style="list-style-type: none"> • Purchase of advanced milling machines from India and supply through AMC • Subsidy to set up micro-enterprise for rice milling, packaging and marketing. (Farmer group is a prerequisite for this to ensure the volumes for processing) • Facilitation to support farmer groups by extension agents for post-harvest management, collection and marketing • Encourage group certification by farmers through a process of GCS (Group Certification System) to encourage exports 						
2. Crop Production and Management	1.5	5.0	6.5			
<ul style="list-style-type: none"> - Research and adaptation of varieties <ul style="list-style-type: none"> • Production management including nutrient and pest management, and other production technologies suitable to this region • Enhancing irrigation facilities to Bring rain-fed rice areas under irrigation • Immediate need to mobilize skilled researchers in this region to further area based research • Promote mechanization at farm level by encouraging use of small farm equipments such as harvesters, threshers, powertiller • Relax laws preventing culling of wild-life pests and inform the public and the officials in the field accordingly. 						

Sub-program/Project/Component	Estimated Budget (Nu. m)			Funding Source	Funding Type	Remarks
	Recurrent	Capital	Total			
<ul style="list-style-type: none"> Insurance for protection against natural disasters 						
3. Infrastructures and Inputs Supply <ul style="list-style-type: none"> Irrigation canals Farm roads Increasing the number of Commission Agents to meet the input requirement by the farmers (higher incentives to CAs working in rural areas) 	3.0	14.0	17.0			
4. HRD		11.0	11.0			
Component 1: Long term training	-					
Component 2: Short trainings	-					
Component 3: Others (TA, workshops)	-					
Total	6.00	34.50	40.50			